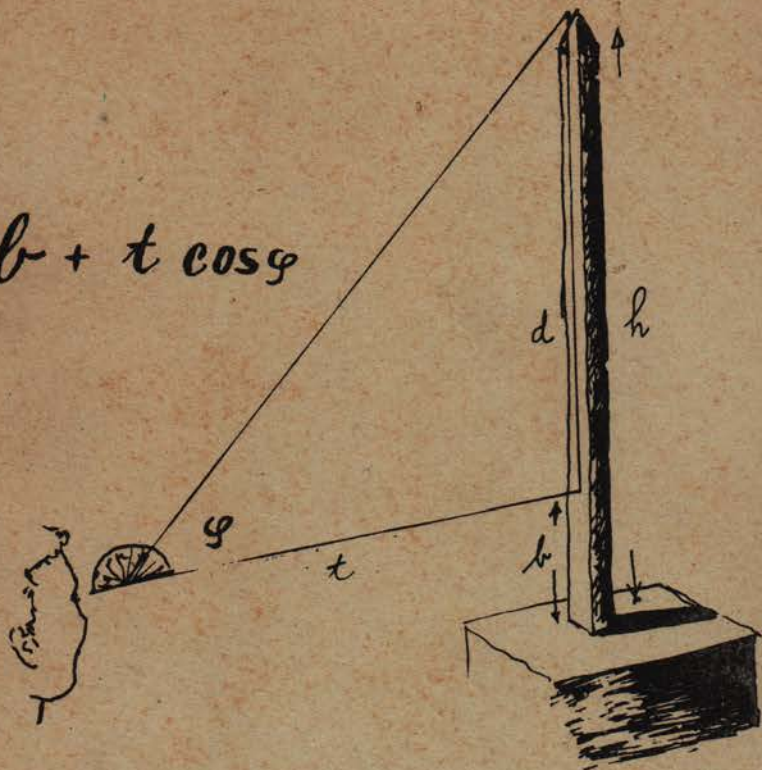


86 h
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XISAAB

$$h = b + t \cos \varphi$$



FASALKA KOWAAD

DUGSIGA SARE

XISAAB

FASALKA KOOWAAD

1

DUGSIGA SARE

WASAARADDA WAXBARASHADA IYO BARBAARINTA
XAFIISKA MANAAHIJTA

H O R D H A C

Buugaagta Xisaabta dugsiyada Sare oo ah afar isdabayaan ah waxaan filayaa in ay si habboon u fuliyaan fikradaha xisaabta ee ardayda dugsiyada Sare u baahan yihiin.

Buugaagtu, sal ahaan, waa kuwii hore loogu isticmaali jirey dugsiyadeenna sare ee loogu qoray af-ingiriisiga, hase ahaatee cutubyada intooda badan waa la ballaadhiyay, cutubyo dhowr ahna waa lagu kordhiyay.

Cutubyada buug kasta waxay u kala horreeyaan iday Manhajka xisaabta dugsiyada sare ay ugu kala horreeyaan. Haddaba, bare kasta waxa u bannaan in uu u kala horreysiyo sida uu isagu door bido. Bareyaalka xisaabta ee dhigi doona buugaggan waxa laga codsanayaa in ay si toos ah ula xidhiidhaan Xafiiska manaahijta, oo ay u sheegaan dhaliilka buugaagta iyo sidii loo hagaajin lahaa, haddii ay jiraan dhaliillo.

Buuggan oo ah kii ugu horreeyay buugagga aan soo sheegnay oo loogu talagalay Fasalka Koowaad ee dugsiyada Sare wuxu ka kooban yahay siddeed Cutub: Aljebre, Joome-teri, Tirignoometeri, Garaaf, Qiime sugan, Ururro, Dhardhaarada tirooyinka maangalka ah iyo Sahan. Cutubka aljebuhu waxa uu u badan yahay naqtiinka aljebraadii lagu soo dhigtay dugsiga Dhexe; ka joometerigu waa bilowga joometeriga Yuklidh, waana la yara fidiyay marka loo eego intii buuggii hore ku qornaan jirtay. Tirignoometeriga aad ayaa loo balaadshay, wuxuuna ku dhisan yahay fikradda fansaarro goobo. Cutubyada dhardhaarada tirooyinka maangalka ah iyo sahan way cusub yihiin. Cutubyada intooda kale wax isbeddel ah oo weyni kuma dhicin.

Buugaagtan waxa tarjumay, habeeyayna Guddidii buug-oraalka xisaabta dugsiyada Sare. Guddidu waxa uu ka koobnaa Jaalle Cusmaan Aadan (Badawi), Xansan Daahir Obsiye, Maxamed Cabdulle Biriir, Xuseen Maxamed Xaaj Omar (Xa-

naan), Maxamad Cali Muuse (Cali Dheere), Maxamad Saciid Samantar, Maxamad Cabdiraxmaan Yuusuf (Carrabey), Ibraahim Aw Aadan, Muuse Cabdi Cilmi iyo Cali Maxamed Xirsi (Cali Aar). Waxa isku dubbariday Jaalle Biriir, Obsiye iyo Xanaan. Sawirrada buugagga waxa sameeyey Cabdiraxmaan Cali Maxamad, Maxamad Cabdalla Cali, Maxamad Xirsi Faarax, Axmad Maxamad Cali iyo Cabdullaahi Rayaale Wacays. Dhammaantoodna way mahadsan yihiin.

Waxa iyana aqoonsi leh kooxdii ugu horreysay ardayda xisaabta ee Kulliyada Waxbarashada Lafoole, oo ahaa qoraayaashii buugagga oo ugu horreyn ku soo baxay afka ingiriisiga. Waxay ahaayeen Jaalle Bashiir Faarax Kaahiye, Xasan Daahir Obsiye, Cabdiraxmaan X. Cabdalla Saciid, Cali Iid Ibraahim, Xuseen Maxamad X. Cumar, Axmad Geedi Maxamuud, Muuse Cabdi Cilmi, Axmad Saciid Diiriye iyo Cawil Cali Cabdi. Mahad gaar ah waxa leh Borofesar Cabdikariim Cashuur oo abaabulay buug-qoraalka ugu horreeyay iyo Maxamad Cilmi Bulaale oo saxay iskuna dubbariday buugaagtaas.

Waxa kale oo mahad naga mudan Wakaaladda Madbaccadda Qaranka.

Maamulaha Xafiiska Manaahijta
Bashiir Faarax Kaahiye

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**Buuggan lama daabacan karo lamana guurin karo iyadoo
aan Wasaaradda Waxbarashada iyo Barbaarinta laga helin
oggolaansho.**

**Waxaa lagu daabacay Madbacadda Qaranka
Xamar — 1976**

Cutub Koowaad

ALJEBRA

Isku-Dhufashada iyo Qaybinta Tibxaalayaasha:

Tibaaxaha tirsiiimada ah, doorsoomayaasha, wadaraha, tarannada, farqiyada iyo wixii qayb ah oo doorsoomayaal leh, sida:

$$8, 3b, yx, + ys, 3m, \frac{x - 5}{y} \text{ waxaa lagu magacaabaa}$$

tibaax Algebra. Tibaaxaha caynkaas ah jibbaarro waa lagu isticmaali karaa, waxaanay u qaataan jibbaarrada sida tirooyinku u qaataan. Tusaale ahaan, 6^4 waxay tahay $6 \times 6 \times 6 \times 6$. Jibbaarka 4 wuxuu muujinayaa in salka 6 loo isticmaalay isir 4 jeer. Guud ahaan, haddii «n» u taagan tahay abyoone togan, «m» ina tahay tiro maangal ah, markaa, n isir tarankood oo mid waliba «m» yahay waa m^n . Waxaana loo akhriyaa «m ku jibbaaran n»,. Salku waa «m» jibbaarkuna waa n.

Waxaa hoos lagu tusaaliyey jibbaarrada m qaarkood:

Jibbaarka kowaad $m^1 = m$

Jibbaarka labaad $m^2 = m \times m$ (labajibbaarka m)

Jibbaarka saddex $m^3 = m \times m \times m$ (saddexjibbaarka m)

Tibaax kasta oo u dhexaysa summadda isugeynta iyo ta kala goynta waxaa la yiraa **tibix**. Imminka $3x^2 + 5xy - \frac{2}{x}$

waxay ka kooban tahay saddexda tibxood ee ah $3x^2, 5xy, \text{ iyo}$

$$-\frac{2}{x}$$

Haltibix: waa tiro, doorsoome iyo kuwaa

tarankood, sida $4, x, 5x^2, 6xy$, mid waliba waa haltibix. Laakiin — oo kale haltibix maaha sababtoo ah doorsoome waa inaanu hoos marin. Haltibixyada $2, 3, 4, — —$ xa la yiraa way isu eg yihiin. Sidoo kale $x^2, 3x^2, — 7x^2$ hal tibixyo isu eg.

Haltibixa heerkiisu waa wadarta jibbaarradiisa oo idil. Tusaale, heerka $5xy^3$ waa 4. Heerka $6x^2y^2$ waa 4. Haltibix kasta oo tira ahina eber mooyaane heerkiisu waa eber. Haltibixa eber ma laha heer.

Weheliye waa haltibixa intiisa tirada ah. $16xy^2$ weheliyihisu waa 16 waana u isir, sidoo kale, $— x^2$, weheliyuhu waa $— 1$.

Tibxaale waa haltibix ama haltibixyo wadartood. Heerkiisu waa haltibixyadiisa ka u heer weyn heerkiisa. Bil metel $3x + 5x^2y^4 - 2x^3 + 4$ heerkiisu waa heerka $5x^2y^4$ waana 6. Tibxaale wuxuu yeelan karaa hadba inta doorsoome ee loo baahan yahay. Metelan $x^2 - 2x + 2$ waa tibxaale x halka $2ab - a^3$ uu ka yahay tibxaale a iyo b.

Marka tibxaale aanu lahayn tibxo isu eg isla markaana tibxihiisu u ratiban yihiin horstimo dhinmaysa sida:

$x^4 + 8x^3 - 5x^2 + x$ wuxuu u qoran yahay sida u fudud.

Layli:

Tibaaxaha soo socda u kala sooc, haltibix, laba-tibix ama saddex-tibix, sheegna heerka mid kasta.

- b) 5
- t) $x^2 + 5y - 2$
- j) $3xy^2$
- x) 6×7
- kh) $5 - 3^2$
- d) 0
- r) $y^2 - 2x^2y$
- s) $5x^2y^2 + 2y^2 + 6x^5y^2$
- sh) $10y^{2+} + 2x^2$

Tibxaalayaashan u qor sida u fudud:

- dh) $d^2 + 4 - 3d$

- c) $x^8d^8 + 12d^2 + x^2d^2$
 g) $5d + 2d^2 + 3d^3 - 5$
 q) $15y^4 + 8y^3 + 3y^2 - 3y$
 f) $d^2x - x^2$
 k) $x^3 + 4xn + 3x^2m^2n + a^3$

Fududaynta Tibaaxaha:

Astaamaha ururka tirooyinka maangalka ah waa lagu tali karaa tibxaalayaasha, siiba marka la fududayn rabo. Tibaaxi hadday leedahay tibxo isu eg fududaynteeda waxaa fuliya astaamaha isu geynta iyo isku dhufashada ee dhardharrada hormogelinta, isweydaarka iyo kala dhigga.

Tusaale I Fududee:

$$(m^3 - 2m + 3m^2 + 7) + (m^2 - m + 5)$$

Furfuris:

$$\begin{aligned} & (m^3 - 2m + 3m^2 + 7) + (m^2 - m + 5) \\ = & m^3 - 2m + 3m^2 + 7 + m^2 - m + 5 \\ = & m^3 + 3m^2 + m^2 - 2m - m + 7 + 5 \\ = & m^3 + m^2(3 + 1) + (-2 - 1)m + (7 + 5) \\ = & m^3 + 4m^2 - 3m + 12 \end{aligned}$$

Tusaale II Fududee:

$$(3x^2 + 2x + 1) - (8x^2 - 6x + 7)$$

Furfuris:

$$\begin{aligned} & (3x^2 + 2x + 1) - (8x^2 - 6x + 7) \\ = & 3x^2 + 2x + 1 - 8x^2 + 6x - 7 \\ = & 3x^2 - 8x^2 + 2x + 6x + 1 - 7 \\ = & (3 - 8)x^2 + (2 + 6)x + (1 - 7) \\ = & -5x^2 + 8x - 6 \end{aligned}$$

Tibxaalayaal wadartood ama faraqood sida u fudud ee u dhiganta marka la rabo, weheliyeyaasha tibxaha isu eg ayaa la isu'geeyaa ama la kala gooyaa.

Tusaale:

- 1) $5x^3 + 3x^3 = (5 + 3)x^3 = 8x^3$
- 2) $3x^2y - 2x^2y = (3 - 2)x^2y = 1 \cdot x^2y = x^2y$

Layli:

Raadi tibxaale fudud oo u dhigma mid kasta oo soo socda:

- 1) $\left(\frac{1}{3} + \frac{1}{7}\right) 42$
- 2) $(10 + 14) \div (-2) + 3$
- 3) $(49 - 1) \div (1 + 7)$
- 4) $(49 - 1) \div (1 - 7)$
- 5) $50\left(\frac{1}{5} + \frac{1}{2}\right)$
- 6) $5 - 2(3r + 4) + r$
- 7) $9x + (5r + 2) - (3r + 8)$
- 8) $2a - (7a + 3) + (5a + 6)$
- 9) $8(a + b) - 6(a + b) + 2a^2b^2$
- 10) $(5x^3 + 7x^2 - 3x + 1) + (3x^3 + 5x - 18 - 4x^2)$
- 11) $(b^3 - 2b^2 + 3b + 4) - (b^2 - 4b^3 + 2b - 1)$
- 12) $(2a^4 + 3a^3 + 2 - 5a^2) + (3a^2 + 4a^3 - 8a^4 - 3)$
- 13) $(m^2 - 7m^3 - m - 3) - (10m^3 + m + 2 - m^2)$
- 14) $(2x^3 + 7x^2y^2 + 10xy^3) + (9x^2y^2 - 3x^2y)$
- 15) $(3c^2d + 2cd + 5d^3) + (ad^3 - 7c^2d - 2cd)$
- 16) $3[a + 5(a + 2)] - 8$
- 17) $21 - 2[8k + 4(3 - k - 1)]$
- 18) $x(3x + 4) + 2(x^2 - 7x + 6) - 3x(1 - 5x)$
- 19) $4(5 - 2y - y^2) - y(y + 6) + 2y(7 - 8y)$

Tibaaxaha jibbaarka abyan leh:

Xeerarka jibbaarradu leeyihiin ee aynu aritmetigga ku soo aragnay aan is xusuusino:

- 1) $8^2 \times 8^3 = 8^{2+3} = 8^5$
- 2) $(2a)^4 = 2^4 \times a^4$
- 3) $(7^2)^3 = 7^{2 \times 3} = 7^6$
- 4) $\frac{6^7}{6^3} = 6^{7-3} = 6^4$

$$5) \frac{4^3}{4^7} = \frac{1}{4^{7-3}} = \frac{1}{4^4}$$

$$6) \left(\frac{a}{2} \right)^4 = \frac{a^4}{2^4}$$

Xeerarkan, tibaaxaha aljebraaduna way ku shaqeeyaan. Sidaa awgeed ayntu u qorro sida soo socota: ka soo qaad in x iyo y ay u joogaan tirooyin maangal ah, m iyo n ay yihiin abyoonayaal togan. Markaas:

$$1) x^m \times x^n = x^{m+n}$$

$$2) (xy)^m = x^m y^m$$

$$3) (x^m)^n = x^{m \times n}$$

$$4) \frac{x^m}{x^n} = x^{m-n} \text{ Haddii } x \neq 0$$

$$5) \left(\frac{x}{y} \right)^m = \frac{x^m}{y^m}, y \neq 0$$

Imminka waynu istimcaali karaa 1 — 3 oy raacsan yihiin astooyinka hormagelinta iyo kala hormarinta ee isku dhufashada.

Tusaale:

$$1) (3xy^2)(-5x^3y^3) = 3 \times (-5)(x \cdot x^3)(y^2 \cdot y^3) = -15x^4y^5$$

$$2) (-6x)^3 = (-6)^3 \cdot x^3 = -216x^3$$

$$3) (2t^2g^4)^4 = 2^4 t^8 g^{16}$$

Markaynu fududayn rabno haltibixyo qaybohood waxaynu la kaashan xeerarka 4 — 6.

Tusaale:

$$1) \frac{24x^2y^2}{8x^2y^2} = \frac{24}{8} \times \frac{x^2}{x^2} \times \frac{y^2}{y^2} = 3 \times 1 \times 1 = 3$$

$$2) \frac{7d^7c^3}{49d^5c^5} = \frac{7}{49} \times \frac{d^7}{d^5} \times \frac{c^3}{c^5} = \frac{1 \times d^2}{7} \times \frac{1}{c^2} = \frac{d^2}{7c^2}$$

haddii $d \neq 0$, $C \neq 0$

$$3) \left(\frac{2a}{b^3} \right)^3 = \frac{(2a)^3}{(b^3)^3} = \frac{2^3a^3}{b^9} = \frac{8a^3}{b^9} \text{ haddii } b \neq 0$$

Waxaynu naqaan in:

$$\frac{10^3}{10^3} = 1, \text{ waxayna sidaa u noqotay,}$$

$$\frac{10^3}{10^3} = \frac{10 \times 10 \times 10}{10 \times 10 \times 10} = 1, \text{ hase yeeshee haddii}$$

Xeerka 4aad lagu dabiqi lahaa jajabkaa waxaynu heleynaa

$$\frac{10^3}{10^3} = 10^{3-3} = 10^0 = 1$$

Markaa, way habboon tahay in $10^0 = 1$. Guud ahaan

$$x^c = 1, \text{ } x \neq 0.$$

Fiiri 0^0 : micno ma leh.

Hadda tixgeli jajabkan:

$$\frac{10^4}{10^7} = \frac{10 \times 10 \times 10 \times 10}{10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10} =$$

$$\frac{1}{10 \times 10 \times 10} = \frac{1}{10^3}$$

Haddii aynu xeerka laad la kaashanno, $10^{-1} \times 10^{-1} \times 10^{-1}$

Taasina waxay tilmaamaysaa in aynnu qorro $10^{-3} = \frac{1}{10^3}$

Qeexda guud waa: $x^{-n} = \frac{1}{x^n}$ haddii «n tahay abyoone togan,»

«b»na ay tahay tiro maangal ah oo aan eber ahayn. Labadaa arimood ee gaarka ah qeexahoodu waxay inaga kaalmayn ti-baaxaha jibbaarrada taban leh:

Sida:

$$1) \quad a^{-2} \times a^{-3} = \frac{1}{a^2} \times \frac{1}{a^3} = \frac{1}{a^{2+3}} = \frac{1}{a^5}$$

$$2) \quad \frac{x^{-4}}{x^{-6}} = \frac{1}{x^4} \times \frac{1}{x^{4+(-6)}} = \frac{1}{x^{-2}} = x^2$$

$$3) \quad \frac{1}{y^{-4}} = y^4$$

$$4) \quad \left(\frac{1}{d}\right)^{-1} = \frac{1^{-1}}{d^{-1}} = \frac{1}{d^{-1}} = d$$

$$5) \quad 5^{-1} + t^{-1} = \frac{1}{5} + \frac{1}{t}$$

Layli:

Raadi tarannada iyo qaybaha sheegan:

$$1) \quad x^2 \cdot x^5 \cdot x^4$$

2) $\frac{y^5}{y^3}$

3) $3^x \cdot 3^y$

5) $x^5 \cdot x^6$

5) $\frac{g^5}{g^2}$

6) $(-35)^5$

7) $(x^3)^3$

8) $\left[\begin{array}{c} 1 \\ - \\ r^2 \end{array} \right]^4$

9) $(-5a^2)^2$

10) $(-a)^4$

Raadi tarannada iyo qaybaha. Ka soo qaad doorsocme kas-ta oo hoose in aanu eber ahayn.

1) $4x^3 \cdot 6x^2$

2) $7t^3 \cdot 3t^3$

3) $(-3xy)(-4x)(5y^3)$

4) $(-2m^2)^3(3mx^2)^2$

5) $(-5^2ab)(-3ab^2)$

6) $(5ab)(-6^2ab)^2$

7) $(12rst^2)(-3r^2st^2)$

8) $(2rs^2t^3)^2(-3r^2s^3)^2$

9) $\frac{64^3x^2b}{4xb}$

10) $\frac{(12t^2y)^2}{18ty}$

$$11) \frac{14r^4s^3}{5rs}$$

$$12) \frac{(-2x^2y)^3}{(6x^2y^2)^2}$$

$$13) \frac{28mn^2}{-7m^3n}$$

$$14) \frac{(3ab^2)^3}{-18a^2b}$$

$$15) \frac{(4r^2s)^3}{4r^2s}$$

Fududee tibaaxahan mid walba:

$$1) (-3b)^3 (6b^2) - (2b^4) (5b)$$

$$2) (-3d^2) (-2cd^2) + (3d) (cd) (-5c)$$

$$3) (7x) (-3x) + (2x^2)^2 - (3x) (2x)^3 + \frac{(5x^4)^2}{x^3}, x \neq 0$$

$$4) (2x)^2 (-3x) - \frac{9(x^3 + y^3)^2}{9(x^3 + y^3)} + (-5y)^2 y, x \neq -y$$

Layli (Akhris):

Mid walba oo hoose u dhig astiro ama jibbaar doorsoome (doorsoome $\neq 0$).

$$1) (a - b)^0$$

$$2) 2^m \times 2^n$$

$$3) \frac{x^{-6}}{x^{-2}}$$

4) $8^{-6} \times 8^8$

5) $u^x \times u^{-x}$

6) $6^n \times 6^0$

7) $(y^2)^{-4}$

8) $\frac{1}{t^0 + 1}$

9) $\left(\frac{1}{b}\right)^{-1}$

10) $a^{6m} \div a^{4m}$

11) $(5^{-2} t^{-2})^{-2}$

12) $\left(\frac{1}{u^5}\right)^{-2}$

Keen mid walba sansaan u dhiganta oo aan lahayn jibba-
arro taban.

1) $\frac{2^{-1} a^{-1}}{3a^2b^{-1}}$

2) $\frac{3^{-1} u^{-1} y^2}{24 u^{-4}}$

3) $\frac{x^{-2}y^3}{xy^{-2}}$

4) $\frac{a^{-5} b^{-3}}{a b^{-4}}$

5) $\frac{3m + 2n}{2^2m^2n^{-1}}$

$$6) \frac{5^{-1} \times m^{-1} \times n}{5m^{-2} n^{-3}}$$

Isku dhufashada Tibxaalayaasha:

Taranta laba tibxaale ama in ka badanba waxaynu fali karaa iyadoo aynu la kaashanayno astaamaha kala-dhigga, hormogelinta, kala hormarinta iyo xeerarkii jibbaarrada. Metelan taranta

$$2x^2 (4x^2 + 2x - 5) = 2x^2 \cdot 4x^2 + 2x^2 \cdot 2x + 2x^2 \cdot (-5)$$

kala dhig isku dhufashada ee isgeynt.

$$= 2 \times 4x^2 \times x^2 + 2 \times 2x^2 \times x + 2 \times (-5) x^2 \quad \text{Kala hormarinta iyo hormogelinta isku dhufashada.}$$

$$= 8x^4 + 4x^3 - 10x^2 \text{ isku dhufashada iyo xeerka laad ee jibbaarrada.}$$

Tusaale:

U qor sida u fudud:

$$\begin{aligned} & (3x + 3) (2x^2 + x - 5) \\ &= 3x (2x^2 + x - 5) + 3 (2x^2 + x - 5) \\ &= 6x^3 + 3x^2 - 15x + 6x^2 + 3x - 15 \\ &= 6x^3 + 9x^2 - 12x - 15 \end{aligned}$$

Sida tusaalaha sare ka muuqata, laba tibxaale tarankoodu waa tibxaalaha ka soo baxa marka tibix kasta ee ka hore lagu dhufto ka kale, dabeedna haltibixiyada isu eg la isu geeyo.

Tusale:

$$\begin{aligned} (9y - 8) (4y + 5) &= 36y^2 + 45y - 32y - 40 \\ &= 36y^2 + (45 - 32) y - 40 \\ &= 36y^2 + 13y - 40 \end{aligned}$$

$$\text{Waa sidan: } (9y - 8) \overset{3}{\underbrace{\overset{4}{\underbrace{\quad}}}} \overset{4}{\underbrace{\quad}} \overset{2}{\underbrace{\quad}} \overset{1}{\underbrace{\quad}} (4y - 5)$$

Tibxaalaha hore tibixdiisa hore ka kale tibxihiisa ku

wada dhufo. Tibixda labaada sidoo kale ugu dhufo. Sidaa ku wad. Markaad dhammayso isu gee inta isu eg

Arrimo Gaar ahaaneed:

I — Marka la rabo laba-tibxaale labajibbaarkiis.

Sida $(a + b)^2$; habku waxa weeye:

- 1) Tibixda hore laba jibbaar
- 2) Labada tibixood tarankooda labanlaab.
- 3) Tibixda danbena laba jibbaar.
- 4) Isu gee jideeyooyinka 1, 2 iyo 3.
 $(a + b)^2 = a^2 + 2ab + b^2$

II — $(a + b)$, $(a - b)$; labatibixaalayaashan labadooda tibxood ee hore waa isku mid labada danbena waa iska soo horjeedaan.

Tarankoodu markaa waa:

$$\begin{aligned}(a + b)(a - b) &= a \times a + a(-b) + ba + b(-b) \\ &= a^2 - ab + ba - b^2 \\ &= a^2 + a(-b + b) - b^2 \\ &= a^2 + a \times 0 - b^2 \\ &= a^2 - b^2\end{aligned}$$

$$\text{Sidoo kale } (8t^2 + 5)(8t^2 - 5) = 64t^4 - 25$$

Layli (Akhris):

Taran kasta ka dhig tibxaale u yaal sansaan fudud.

- 1) $(x + 1)(x + 3)$
- 2) $(4y + 3)(3y - x)$
- 3) $(a + 6b)(a - 2c)$
- 4) $(n - 1)(n - 2)$
- 5) $(1 - 3y)(1 + 3y)$
- 6) $(n - 1)(n - 2)$
- 7) $(a + 4)(a - 1)$
- 8) $(t - 3)(t + 2)$
- 9) $(x + 5)(x - 5)$
- 10) $(2a + 1)(2a - 1)$

- 11) $(n - 7)(n + 7)$
- 12) $(x + 2y)(x + 3y)$
- 13) $(5 - 3t)(5 - 4t)$
- 14) $(a - 6b)(a + 2b)$
- 15) $(3 - 2n)(3 + 2n)$
- 16) $(3a - 2b)(3a + 2b)$
- 17) $(7ab + 1)(7ab - 1)$
- 18) $(3a - 2b)^2$
- 19) $(2a + 5)^2$
- 20) $(3a - 7)(2a + 5)$

Qaybinta Tibxaalayaasha.

Astaanta kala-dhigga waa lagu isticmaali karaa tibxaale iyo haltibix qaybtood; oo ah jajabyo wadartood, tibxaale ama tibxaale iyo jajabyo.

Tusaale:

$$1) \frac{9x^3 + 12x^2 - 6x}{3x^4} = \frac{9x^3}{3x^4} + \frac{12x^2}{3x^4} - \frac{6x}{3x^4} = \frac{3}{x} + \frac{4}{x^2} - \frac{2}{x^3}$$

$$2) \frac{y - 5y^2 + y^3}{y} = -\frac{5y^2}{y} + \frac{y^3}{y} + \frac{y}{y} = 1 - 5y + y^2$$

$$3) \frac{18x^4 + 3x^2 - x - 2}{6x^2} = \frac{18x^4}{6x^2} + \frac{3x^2}{6x^2} - \frac{x}{6x^2} - \frac{2}{6x^2}$$

$$= 3x^2 + \frac{1}{2} - \frac{1}{6x} - \frac{1}{3x^2}$$

Xagga aritmetigga waxaynu isticmaallaa qaybinta dheer;
 marka $\frac{162}{13}$ oo kale la rabo.

$$\begin{array}{r}
 12 \qquad \qquad \qquad 6 \\
 \text{t.a. } 13 \overline{)162} \quad \text{jawaabtu waa } 12 \text{ ---} \\
 \underline{130} \qquad \qquad \qquad 13 \\
 32 \\
 \underline{26} \\
 6
 \end{array}$$

Qaybinta tibaaxaha aljabraduna waa sidoo kale t. a. qayb-
 $\frac{x^2 - x + 8}{x + 2}$ waxaa u dhiganta tibaaxda ah $x - 3 + \frac{4}{x+2}$

$$\begin{array}{r}
 x - 3 \\
 \underline{x + 2 \overline{)x^2 - x + 8}} \\
 x^2 + 2x \\
 \underline{ - 3x + 8} \\
 - 3x - 6 \\
 \underline{ + 4}
 \end{array}$$

O g o w :

$x^2 - x + 8$ waa la qaybshaha, qaybtu waa $x - 3$, ha-
 raaguna waa 14. Raac hubsiimadan:

$$\begin{aligned}
 x^2 - x + 8 &= (x - 3)(x + 2) + 14 \\
 &= (x^2 - x - 6) + 14 \\
 &= x^2 - x + 8
 \end{aligned}$$

Qaybinta tibxaalayaasha, sida kor ku tusan, la qaybsha-
 ha iyo qaybshuhuba waxay u yaallaan horsanaan doorsooma-
 na heerkiisu dhinmayo. Qaybintu waxay go'daa marka he-
 erka haltibixa haraaga ahi ka yaraado ka qaybshaha ama ha-
 raaguba eber noqdo.

Fiiri tusaalahan hoose; sida heerka tibxaha loo safayo
 meelaha qaarkoodna weheliye 0 ah loo isticmaalayo.

Tusaale:

$$2d^3 - t^3 - td^2 \text{ u qaybi } 2d^2 + td + t^2 \\ d - t$$

$$\begin{array}{r} 2d^2 + td + t^2 \overline{) 2d^3 - td^2 - 0.t^2d - t^3} \\ \underline{2d^3 + td^2 + t^2d} \\ - 2td^2 - t^2d - t^3 \\ \underline{- 2td^2 - t^2d - t^3} \\ 0 \quad 0 \quad 0 \end{array}$$

$$: \frac{2d^3 - td^2 - t^3}{2d^2 + td + t^2} = d - t$$

Hubsiiimo:

$$\begin{aligned} 2d^3 - td^2 - t^3 &= (d - t)(2d^2 + td + t^2) \\ &= (2d^3 + td^2 + dt^2) - (2dt^2 + t^2d + t^3) \\ &= (2d^3 + td^2 + dt^2 - 2dt^2 - t^2d - t^3) \\ &= 2d^3 - td^2 - t^3 \end{aligned}$$

Layli:

Samee qaybinta xusan.

$$1) \frac{21a^4 - 14a^3 + 7a^2}{7a}$$

$$2) \frac{25x^3 + 15x^2 - 30x}{5x}$$

$$3) \frac{16x^3y - 24x^2y^2 - 64xy^3}{-8xy}$$

$$4) \frac{15x^2 - x - 6}{5x + 3}$$

$$5) \frac{36a^4 + 18a^3b - 24a^2b^2}{-6a^2}$$

$$6) \frac{6x^2 + 2x - 28}{3x + 7}$$

$$7) \frac{-15x^3 + 30x^2 + 5}{5x^3}$$

$$8) \frac{-12a^3 - 9a^2 + 3a}{3a^2}$$

$$9) \frac{x^2 - 6}{x + 3}$$

$$10) \frac{x^2 - 4}{x - 1}$$

$$11) \frac{12x^2 - 4xy - y^2}{2x - y}$$

$$12) \frac{8a^3 - 22a^2 - 5a + 12}{4a + 3}$$

$$13) \frac{4^2 + a^2}{4 + a}$$

$$14) \frac{9 - u - u^3}{3 + u}$$

$$15) \frac{3 + 2t - 2t^3}{1 - t}$$

$$16) \frac{w^4 + 4w^3 + 10w^2 + 12w + 9}{w^2 + 2w + 3}$$

$$17) \frac{r^4 - 4r^3 + 2r^2 + 4r + 1}{r^2 + 2r + 3}$$

$$18) \frac{9 - 4y^2 - 12y^3 - 4y^4}{3 - 2y - y^2}$$

Isrin:

Marka tiro ku kale loo qaybsho oo a haraa jirin, qaybshuhu sida la yiraahdo waa u isir la-qaybshaha, isaguna waa dhufsanaa qaybshaha.

Tusaale:

$30 \div 6 = 5$; 6 waa 30 isirkeed, 30 na waa dhufsanaha 6 iyo 5. Isirrada kale ee 30 leedahay waa 1, 2, 3, 15, 10, 30. Tirooyin kale oo qaybiya isirrada 2, 3, 5 ma jiraan 1 iyo laftiisa mooyaane. Kuwaas oo kale waxaa lagu magacaabaa isirro Mutuxan.

Si habsan oo loo raadsho abyoone togan isirradiisa dhammaan mutuxan yaa hoos ku sheegan.

Waxa la raadinayaa 252 isirradeeda mutuxan oo idil.

$$2 \overline{) 252}$$

$$2 \overline{) 126}$$

$$3 \overline{) 63}$$

$$3 \overline{) 21} \quad 252 = 2 \times 2 \times 3 \times 3 \times 7 = 2^2 \times 3^2 \times 7$$

$$7 \overline{) 7}$$

$$\overline{) 1}$$

Helista isirrada abyooneyaal waxay ina siin karaan abyoonaasha isir weynaha ay wadaagaan (i.w.w.) iyo weliha dhufsana yaraha ay wadaagaan (dh, y, w).

Tusaale:

Raadi i. w. w. iyo dh. y. w 42 iyo 252

$$252 = 2^2 \times 3^2 \times 7$$

$$42 = 2 \times 3 \times 7$$

1) Si loo soo saaro i.w.w. waxaan qaadannaa isirrada mutuxan ee ugu jibbaar yaryar ee ka dhexeeya laba-daba, dabeedna waa la isku dhuftaa.
i.w.w. 42 iyo 252 waa $2 \times 3 \times 7 = 42$

2) Dh. y. w. tirooyin waa taranka isirrada ugu jibb weyn ee ugu yaraan tirooyinka mid ku jira.

Hadda dh. y. w. 42 iyo 252 waa $2^2 \times 3^2 \times 7 = 252$

Tibaax haltbix ah oo weheliyeheedu abyoone yahay marka la isirinayo waxa la raadshaa haltibixyo caynkaas ah oo tarankocdu yahay haltibixaa hore.

Tusaale:

Soo saar i.w.w. iyo dh. y. w. ee $51yx^3w$ iyo $34y^2x^2$.

Raadinta i.w.w.

1) Raadi i.w.w. weheliyeyaasha
 $51 = 3 \times 17$; $34 = 2 \times 17$
: i.w.w. weheliyeyaashu = 17

Is garab dhig jibbaarrada doorsoome walba ee isir u ah labada tibixleba, dabeed qaado doorsoomaha ugu jibbaar yar.

Is garab dhig y iyo y^2 qaado y
Is garab dhig x^2 iyo x^3 qaado x^2
: i.w.w. = $17 \times y \times x^2 = 17xy^2$

Raadinta dh. y. w.

1) Raadi dh. y. w weheliyaashu
 $51 = 3 \times 17$; $34 = 2 \times 17$
: dh.y.w = $2 \times 3 \times 17 = 102$

2) Is garab dhig jibbaarrada doorsoome walba ee isir u ah tibixleyaasha, dabeedna qaado doorsoomaha ugu jibbaar weyn.

Is garab dhig y iyo y^2 qaado y^2
Is garab dhig x^3 iyo x^2 qaado x^3
: dh. y. w = $102 \times y^2 \times x^3 \times w = 102y^2x^3w$

Layli:

B. Ku isiri abyoone kasta ururka mutuxanayaasha.

1) 156

- 2) 343
- 3) 630
- 4) 128
- 5) 67
- 6) 5096
- 7) 53
- 8) 2475

T. Raadi (b) i.w.w. (t) dh. y. w. tibixleyaasha soo socda:

- 1) 125,75
- 2) - 90,225
- 3) 576, - 336
- 4) $2x^2y, 10xy^3$
- 5) $4rs^2, - 6r^3s$
- 6) $- 3a^2b^2, 12ab^4$
- 7) $- 15r^2w^3, - 80t^3w^2$
- 8) $1, 4x^2y, s^2$
- 9) $3x, 5y, 4w$
- 10) $51xyw, - 34x^2w^3$

Isirinta Tibxaalayaasha.

Tibxaale isirintiisu waa tabta tibxaale loogu qorayo saansaan ah taran tibxaalayaal.

Imminka isirinta tibxaalaha $25x^2 + 15x$ waxaynu ia kaashan astaanta kala dhigga, $25x^2 + 15x = 5x(5x + 3)$. Haltetibixyada tibxaalahan, haltibixa isir weynaha ahi waa $5x$, ka asoo ahaa i.w.w. tibxaha tibxaaluhu.

Tallaabada u horraysa isirinta tibxaale waa marka tibxaalaha laga dhigo taranka haltibixa isir weynaha ay wadaagaan ah iyo tibxaale haltibixa isir weyne u ah uu 1 yahay.

Tusmadan hoose ayaa kuu muujin karta sida tibxaalayaashaas oo kale loo isiriyo.

Tibxaalaha la helay

isirrada

saansaan isiran

$$\begin{aligned} 10y^2 - 5y^3 \\ 5x^4 + 2x^2 \\ 3t^2 + 18t + 27 \end{aligned}$$

$$\begin{aligned} 5y^2, 2 - y \\ x^2, 5x + 2 \\ 3t^2 + 6t + 9 \end{aligned}$$

$$\begin{aligned} 5y^2(2 - y) \\ x^2(5x + 2) \\ 3(t^2 + 6t + 9) \end{aligned}$$

Sansaano taran oo gaar ah barashadoodu waxay inaga caawisaa labatibxaalayaal iyo saddex-tibxaalayaal isirrintood kuwaas oo haltibixa isir weynahoodu yahay 1.

I. $a^2 - b^2 = (a + b)(a - b)$ laba labajibbaar faraqood

Tusaale:

- 1) $y^2 - 36 = y^2 - 6^2 = (y + 6)(y - 6)$
- 2) $9x^2 - 81y^2 = 9(x^2 - 9y^2) = 9(x + 3y)(x - 3y)$
- 3) $t^4 - 1 = (t^2)^2 - 1 =$
 $= (t^2 + 1)(t^2 - 1)$
 $= (t^2 + 1)(t + 1)(t - 1)$

II. b) $a^2 + 2ab + b^2 = (a + b)^2$ laba tibxaale labajibbaran

t) $a^2 - 2ab + b^2 = (a - b)^2$

Tusaale:

- 1) $x^2 + 6x + 9 = x^2 + 2 \times 3x + 3^2 = (x + 3)^2$
 - 2) $25t^2 - 40t + 16 = (5t)^2 - 2 \times 5t \times 4 + 4^2 = (5t - 4)^2$
- III. b) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
- t) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

Tusaale:

- 1) $m^3 - 1 = (m - 1)(m^2 + m + 1)$
- 2) $(45)^3 + 27 = (45)^3 + (3)^3$
 $= (45 + 3)(45^2 - 3 \times 45 + 3^2)$

Waxa kaloo la isticmaali karaa astaamaha isugeynta ee hormogelinta iyo kala hormarinta. Kuwaas oo suuragelinaya dib u tixidda tibxaha tibxaalaha si ay isirradu u muuqdaan.

Tusaale:

$$\begin{aligned}
 & 3xy - 20uw - 15xu + 4yw = \\
 & = (3xy - 15xu) + (4yw - 20uw) \\
 & = 3x(y - 5u) + 4w(y - 5u) \\
 & = (3x + 4w)(y - 5u)
 \end{aligned}$$

Tusaale:

$$\begin{aligned}y^2 - 6y + 9 - s^2 &= (y^2 - 6y + 9) - s^2 \\ &= (y - 3)^2 - s^2 \\ &= (y - 3 + s)(y - 3 - s)\end{aligned}$$

Layli:

Tibxaalayaashan sheeg mid walba isirradiisa.

- B.
- 1) $4^2 - 8$
 - 2) $x^2 - 4a$
 - 3) $ax^2 + 3ax^2$
 - 4) $ax + 6x$
 - 5) $3a + 3b$
 - 6) $m^2y + n^2y$
 - 7) $4a^2 - 1$
 - 8) $9a^2 - 4$
 - 9) $25 - b^2$
 - 10) $1 - 16b^2$
 - 11) $x^2 + 6x + 9$
 - 12) $x^2 + 10x + 25$
 - 13) $y^2 - 16y + 64$
 - 14) $4a^2 + 4a + 1$
 - 15) $25x^2 - 20x + 4$

T. Isiri kuwan mid walba:

- I.
- 1) $2x - 18$
 - 2) $3y^2 - 48$
 - 3) $a^4 - 16$
 - 4) $a^4 - 625$
 - 5) $5a^2 - 3a + 45$
 - 6) $ax - 6x + ay - 6y$
 - 7) $2ax + 3 + x + 6a$
 - 8) $343 - 1000s^3$
 - 9) $729 - 8y^3$
 - 10) $8x^3 + 1$
 - 11) $64x^3 - 1$
 - 12) $m^3 + n^3$
 - 13) $3x^2 + 84x + 588$
 - 14) $2x^2 - 64x + 512$

- II. 1) $1 - 8n^6$
 2) $1 + 125m^6$
 3) $a^3 - a^2b - a + b$
 4) $x^3 + y^3w^6$
 5) $x^6 + 125$
 6) $(x - 1)^2 - y^2$
 7) $216 - s^2$
 8) $49 - 12(2 - b) + (2 - b)^2$
 9) $y^2 + 2y + 1 - 9t^2$
 10) $x^2 - y^2 + 4y - 4x$

- III. 1) $1x^{2a} - 1$
 2) $1 - y^{2n}$
 3) $t^{2k} - 2t^k + 1$
 4) $i^{2m} + 6r^m + 9$
 5) $(x - 2y)^3 - (x - 2y)^5$
 6) $(a - b)^5 + 4(6 - a)^3$
 7) $(t - 1)^6 + (1 - t)^2$
 8) $(5 - 2)^2 - (5 - 2)^2$

Isirrinta tibxaalayaasha saableyda ah ee sansaankoodu yahay $ax^2 + bx + c$; a , b iyo c waa tirooyin maangal ah $\neq 0$, aan raacno hilinka tusaalahan hoose sheegayo.

Tusaale:

Isir $x^2 - 8x + 12$

- 1) Tibxaalahani sidiisaba wuxuu ka dhashay laba laba-tibxaale oo laysku dhuftay; haddaba, labada tibxocd ee hore waa in tarankoodu yahay x^2 .
- 2) Taranka madoorsoomeyaashuna waa 12, isla markaana waa in wadartoodu le'eg tahay weheliyaha tibixda dhexe $- 8$ (eeg labaduba waa taban yihiin) Cugashooyinka abyani waa $- 1$ iyo $- 12$, $- 3$ iyo $- 2$ ama $- 2$ iyo $- 6$. Inta siyaabood ee ka suuragasha:

Isirrada suuragalka ah

Tibixda toosan ee ku aaddan

$(x - 1) (x - 12)$

$- 12x - x = 13x$

$(x - 3) (x - 4)$

$- 4x - 3x = 7x$

$(x - 2) (x - 6)$

$- 6x - 2x = 8x$

- 3) Tibixda toosan ee tibxaalaheennu waa — $8x$ waxa-ana keenta sida u danbeysa tixidda sare.

$$: x^2 - 8x + 12 = (x - 2)(x - 6).$$

Tibxaalaha aan loo dhigi karin taran tibxaalayaal, ee aan la isirin karin waxa la yiraahdaa waa mutuxan yahay, mar walba haltibixa isir weynihiisu waa 1.

i.w.w. iyo dh. y. w. ee Tibxaalayaasha:

Tibxaalayaal isir wadaagoodu waa tibaax midood walba isir u ah. Dhufsane wadaagooduna waa tibaax tibxaalayaashu isiiriro u ahaan karaan.

Urur kastoo tibxaallayaal ah, helista i.w.w. iyo dh. y. w., horta dhammaystir tibxaalayaasha isirintooda dabadeedna raac tallaabooyinka tusaalahan hoose sheegayso.

Tusaale:

Raadi i. w.w. iyo dh. y. w. $9y^3 - 9y^2 - 18y$ iyo $6y^4 - 24y^3 - 24y^2$.
 $9y^3 - 9y^2 - 18y = 9y(y^2 - y - 2) = 9y(y + 1)(y - 2)$
 $6y^4 - 24y^3 - 24y^2 = 6y^2(y^2 - 4y + 4) = 6y^2(y - 2)^2$

Helista i.w.w.

- 1) Hel i.w.w. madoorsoomayaasha weheliyaasha ahi.
 $9 = 3^2$ $6 = 2 \cdot 3$ i.w.w. = 3
- 2) Is garab dhig tibxaha jibbaarán ee labada tibxaalaba isirrada u ah, dabeedna qaado ta jibbaarkeedu u yar yahay:

Is garabdhig y iyo y^2 qaado y
 Is garabdhig $(y - 2)$ iyo $(y - 2)^2$ qaado $(y - 2)$
 $: i.w.w. = 3y(y - 2).$

Helista dh. y. w.

- 1) Hel dh. y. w. madoorsoomayaasha weheliyaasha
 $9 = 3^2$ $6 = 2 \cdot 3$: dh.y.w $2 \cdot 3^2 = 18$
- 2) Is garab dhig jibbaaraha tibxaalayaasha mutuxan ee isir u ah labada tixaale midkooduun dabeedna qaado doorsoomaha jibbaarkiisu u weyn yahay.

Isgarabdhig y iyo y^2 qaado y^2

Isgarabdhig $(y - 2)$ iyo $(y - 2)^2$ qaado $(y - 2)^2$ welib; qaado $(y + 1)$

$$: \text{dh.y.w.} = 18y^2 (y - 2)^2 (y + 1)$$

Layli:

Si dhammaystiran u isiri mid walba kuwan, doorsooma yaasna jibbaarrada ahi waxay u joogaan abyoonayaal togan.

- B. 1) $n^2 + 5n + 6$
2) $x^2 - 4x + 3$
3) $x^2 + 6x + 5$
4) $n^2 - 11n + 24$
5) $m^2 + 3ms - 45^2$
6) $y^2 + 4y - 12$
7) $y^2 - y - 30$
8) $t^2 + 2t - 80$
9) $t^2 - 14t - 72$
10) $6 - x - x^2$
11) $12x^2 - 8x - 15$
12) $12y + 2y - 9$
13) $18y^2 - 21y - 9$
14) $n^2 - 9nr - 360r^2$
15) $m^2 - 35mn + 300n^2$
16) $m^2 + 2mn - 360n^2$
17) $n^2 + 23nr - 420r^2$
18) $6x^2 + 30x - 900$
19) $8x^2 - 24x - 1440$
20) $4 - 125 - 9s^2$
- B. 1) $x^2 - 3x^2 - 40$
2) $x^{2a} - 3x^a + 2$
3) $y^3 - y^4 + 45$
4) $16x^2 - 2$
5) $3y - 81y^4$
6) $x^4 + x^3 + x^2$
7) $w^4 + 4w^2$
8) $3t^{4m} - 10t^{2m} + 3$
9) $y^{6n} - 5y^{3n}t^6$
10) $(3x - 1)^2 - 3(3x - 1) - 10$
11) $10(r + 5)^2 + 11(r + 5) + 3$

- 12) $x^4 - (4x - 5)^2$
 13) $(y^2 + y - 2)^2 - (y^2 - y - 6)^2$

Raadi (b) i. w. w. (t) dh. y. w. ee tibxaalayaashan soo scoda:

- 1) x ; x^2 ; $-x^3$
 2) $2 - x$; $2x - 4$
 3) $2s - 25$; $25 + 10$
 4) $2t + 6$; $t + 3$
 5) $y^2 - 81$; $2y + 18$
 6) $-r$; r^4 ; r^2
 7) $48y^2 (yn + 2)$; $(y - 3)^3$; $32y^2 (y - 3)$
 8) $-35t^3$; $25t (t - 1) (t + 5)$
 9) y ; $3y^3$; $6y - 6y^3$
 10) $-21t^2$; $14t^4$; $2t - 2t^3$
 11) $6x^2 - 6x$; $4x^3 - 24x + 20$
 12) $10w^2 + 30w$; $-5w^2 - 35w - 60$
 13) $r^3 - 1$; $r - r^3$
 14) $s^2 - 36$; $6 + s$; $6 - s$
 15) $k^3 + 3k$; $-9k^2 - 4$; $2 - 3k$
 16) $a + 19$; $(a - 1)^2$; $a^2 - 1$

Isle'egyada Toosan iyo Furfuridooda:

Isle'eg waa weedh sheegaysa in laba wax is le'eg yihiin. Isle'eg kasta haddii labadiisa dhinac wax isku mid ah ama is le'eg lagu daro, ama laga gooyo, lagu dhufto, ama loo qaybiyo, mar walba natiijadu waa isle'eg.

Marka isle'eg la furfurayo waxa badiba la yeelaa, tibxaha doorsoomayaasha leh ayaa xagga bidixda la dhigaa, kuwa madoorsoomayaasha ahna xagga midigta.

Tusaale:

Furfur isle'egta, $7x - 5 = 4x + 13$

Furfuris: $7x - 5 = 4x + 13$ Astaanta u geynta ee isle'egta

$$\begin{array}{r}
 7x - 5 + 5 = 4x + 13 + 5 \\
 7x = 4x + 18 \\
 7x - 4x = 4x - 4x + 18 \\
 3x = 18 \\
 \frac{1 \times 3x}{3} = \frac{1 \times 18}{3} \\
 x = 6
 \end{array}$$

Astaanta u geynta ee isle'eg
 Xisaabfalka isugeynta
 Astaanta u geynta ee isle'gta
 Xisaabfalka isugeynta
 Xisaabfalka isku dhufashada

Hubsiiimo:

Haddii

$$\begin{array}{l}
 x = 6 ; 7x - 5 = 7 \times 6 - 5 = 42 - 5 = 37 \\
 4x + 13 = 4 \times 6 + 13 = 24 + 13 = 37 \\
 : 7x - 5 = 4x + 13 \text{ marka } x = 6
 \end{array}$$

Haddaan dib u eegno tusaalaha sare, marka tibxaha loo rarayo dhinaca ay ku habboon yihiin, waxa lagu darayaa ama laga goynayaa tibix le'eg laakiin ka soo horjeedda. Sanga-abta aan ka soo qaadno, tibixda la rarayo summaddeeda beddel dabeed rar.

Tusaale:

$$\text{Furfur isle'egta } 12m - 7 = 5m + 21$$

Furfuris: 5m u rar bidixda

$$\begin{array}{l}
 12m - 7 - 5m = 21 \\
 7 \text{ u rar midigta;} \\
 12m - 5m = 21 + 7 \\
 7m = 28
 \end{array}$$

$$\begin{array}{r}
 7m \quad 28 \\
 \hline
 7 \quad 7 \\
 m = 4
 \end{array}$$

Hubsii mo:

Haddii

$$m = 4 \quad 12m - 7 = 12 \times 4 - 7 = 48 - 7 = 41$$

$$5m + 21 = 5 \times 4 + 21 = 20 + 21 = 41$$

∴ Furfuristu waa $m = 4$

Layli:

Furfur isle'eg kasta adoo raacaya tallaabooyinka tusaalayaasha sare. Hubsiiimada mid walba dhig.

1) $3x = 2x + 5$

$$1x$$

2) $\frac{\quad}{3} = 5$

3) $16 = 3x + 4$

4) $4y - 5 = 9$

5) $5y - 4 = 9 + 3y$

$$2x$$

6) $\frac{\quad}{3} = 12$

7) $7x + 5 = 4x + 17$

8) $12 + 3x = 5x$

$$5d$$

9) $\frac{\quad}{6} = 30$

$$6$$

10) $8 = 5x - 7$

11) $5y - 4 = 9 - 2y$

12) $12m - 7 = 5m + 24$

13) $5a = 3a + 8$

14) $4b = 18 - 2b$

15) $6x + 5 = 29$

Furfur isle'egyadan; hubi furfurista:

1) $5x = 2x + 12$

2) $7b - 35 = 0$

3) $8y - 21 = 5y$

4) $18 - x = 2x$

5) $5 = 36 - 3a - 16$

6) $2 - 3x = 5 - 4x$

- 7) $6 + 9x = 5x + 30$
- 8) $5 - 3a = 23 - 6a$
- 9) $8s + 9 = 15 + 4s + 8$
- 10) $5x = 6x + 21 - 8x$
- 11) $4k - 3 - 7k = 9 - 6k$
- 12) $4x - 7 + 5x = 8 + 3x + 9$
- 13) $3a - 20 = 12 - 2a + 3$
- 14) $7x + 7 = 4x + 19 - x$
- 15) $1 = 37 - 5x - 11$
- 16) $31 - 2x = 2x + 7$
- 17) $6w + 9 - 2w = 21 - 5w + 33$
- 18) $3m = 8m + 16 - 10m$
- 19) $12 - 4x - 5 = -7x$
- 20) $4y + 7 = 9y + 22 - 10y$
- 21) $11 - m - 8 = 29 - 4m$
- 22) $7a - 3 + 6a - 8 = 69 + 9 + 2a$
- 23) $2 - 5x + 7 = 2x + 39 - 13x$
- 24) $11x - 20 = 3x - 15$
- 25) $9 + 5g = 16 - 2g - 7$

Isle'egyada layliga sare, furfuristu waxay mar walba soo baxaysey tiro. Tiradaasina mar walba xaraf bay ku magacawnayd. Tusaalooyinka soo socda waxaynu ka baran doonnaa xeelado aan mashaakilka nolosheenna ku furfuri karro.

Si aad u furfurtid laylis kasta marka hore akhri; markaad fahamto, waxa la raadinayo xaraf ka soo qaad, adoo xarafkaa adeegsanaya, hawraarta ama hawraaraha u tarjim xiriir sum-mado ah. Ugu danbayn, waa inaad heshaa isle'eg furfuriste-
edu ku siinayso wixii la rabay.

Tusaale: 1

Tiro ayaa 5 lagu dhuftay, dabeedna 13 lagu daray, markaa waxaa soo baxay 48. Raadi tiradii?

Furfuris:

Ka soo qaad in x tahay tiradii la rabay.

«x baa 5 lagu dhuftay oo lagu daray 13, markaa waxa soo baxay 48».

Hawraartu summad ahaan waa $5x + 13 = 48$.

Furfur isle'egta :

$$5x + 13 = 48$$

$$5x = 35$$

$$x = 7$$

: tiradii la rabay waa 7.

Hubin $7 \times 5 + 13 = 48$.

Tusaale 2:

Jaamac iyo Cali baa 61 shilin u qaybsaday si Jaamac 9 shilin u dheeraado Cali, immisaa midba haystaa?

Furfuris:

Ka soo qaad in Jaamac x shilin haysto. Markaa, Cali wuxuu haystaa $(x - 9)$ shilin. Labadooda lacagtood waa isku 61 shilin.

$$x + (x - 9) = 61 \quad \text{Isle'egtan baa soo baxday.}$$

$$2x - 9 = 61$$

$$2x = 61 + 9$$

$$2x = 70$$

$$x = 35$$

∴ Jaamac 35 shilin buu haystaa.

Cali oo 9 shilin ka wax yari wuxu markaa haystaa $35 - 9 = 26$ shilin.

Hubi:

$$35 + 26 = 61$$

Layli:

Laylisyadan mid walba u raadi jawaab adoo marka hore isle'eg u samaynaya dabeedna furfuraya:

- 1) Raadi tirada marka la labanlaabo, 7na lagu daro soo baxda 25.
- 2) Wadarta tiro iyo saddexlaabkeed waa 24. Waa maxay tiradaasi?
- 3) Raadi tirada haddii 4 lagu dhufto 29 dheeraata 7.

- 4) Cali 5 shilin buu ka lacag yar yahay Cumar, lacagta labadu haystaan waa 23. Immisaa midba haysataa?
- 5) Laydi baa dheererkiisu saddex jeer ka weyn yahay, ballaciisa. Wareegiisuna waa 32. Soo saar dheerkiisa iyo ballaarkiisa.
- 6) Raadi saddexda tiro-tirsiimo ee isku xigga ee wadartoodu 84 tahay.
- 7) Tiraa haddii la saddexlaabo iyo haddii 26 lagu daro isku mid soo baxda. Waa maxay tiradaasi?
- 8) Raadi tirada inta ay 25 ka weyn tahay iyo inta ay 93 ka yar tahay is le'eg yihiin?
- 9) Nin baa muddo baaskiil ku xawaareynayey $8\frac{1}{3}$ km/s dabeedna 2 saacadood oo lug ah yaa xawaarihiisu $3\frac{1}{4}$ km/s ahaa. Gebi ahaan wuxuu jaray 31 kii-lomitir. Waa maxay muddada uu baaskiilka watey?
- 10) Nin baa baabuur duug ah qadar lacag ah siistay. Intii uu siistay shaneedkeed buu haddana baabuurkii ku hagaajey. Haddii waxa ka baxay 102 gini tahay, immisuu baabuurka siistay?

ISLE'EGYADA WADAJIRA

U fiirso isle'egyada $2x + y = 7$ iyo $3x + 2y = 12$. Laba doorsoome baa ka dhexeeya. Markaa qiimaha x iyo y waa inay raalli geliyaan labada isle'egba.

Imminka $x = 2$ iyo $y = 3$ waa qiimayaasha labada isle'egba raalli gelinaya. Labadan isle'eg oo kale waxaa la yiraa isle'egyo wadajira. Badiba laba dariiqo baa loo furfuraa isle'egyada wadajira (i) dariiqada ku beddelka (ii) dariiqadda ka-bixinta.

I — Furfuridda ku beddelka:

Tusaale:

Furfur isle'egta $2x + y = 3$, $3x - 2y = 8$

(i) $2x + y = 3$

(ii) $3x - 2y = 8$

(iii) $y = 3 - 2x$

Qiimaha y ee tallaabada u danbaysa ku beddel ka (ii) halka y taalloba.

$$3x - 2(3 - 2x) = 8$$

$$3x - 6 + 4x = 8$$

$$7x = 14 \quad x = 2$$

$$4 + y = 3$$

$$\therefore 2 \times 2 + y = 3$$

$$4 + y = 3$$

$$y = 3 - 4$$

$$y = -1$$

Hubsiiimo:

$x = 2$, $y = -1$ ku beddel (i) iyo (ii)

$$2x + y = 3 ; 4 - 1 = 3$$

$$3x - 2y = 8 ; 6 + 2 = 8$$

II — Furfuridda ka bixinta:

Isticmaalka dariiqadan ayaa aad uga hawl yar ta hore, sababtoo ah waxaanay keenayn jajabyo qallafsan.

Tusaale:

Furfur isle'egta

$$2h - 3k = 7 ; 4h + 5k = 3$$

i) $2h - 3k = 7$

ii) $4h + 5k = 3$

iii) Ku dhufo 2 ; $4h - 6k = 14$

$$\text{Ka goo ii) } 4h - 6k = 14$$

$$4h + 5k = 3$$

$$- 11k = 11$$

$$\therefore k = -1$$

$$\text{ka i) Ku beddel } -1 \text{ halka } k; 2h - 3(-1) = 7$$

$$2h + 3 = 7$$

$$2h = 4$$

$$\therefore h = 4$$

Hubsiiimo:

$$2h - 3k = 2 \times 4 - 3(-1) = 4 + 3 = 7$$

$$4h + 5k = 4 \times 4 + 5(-1) = 8 - 5 = 3$$

Layli:

B. Isle'egyadan mar x ku soo saar y marna y ku soo saar x.

$$1) x + 2y = 3$$

$$2) x - y = 6$$

$$3) x - 2y = 3$$

$$4) 5x + y = 2$$

$$5) 2x - 4y = 3$$

$$6) 6x + 3y = 1$$

$$7) 3x + 5y = 2$$

$$8) 4x - 7y = 5$$

T. Ku furfur habka ku beddelka:

$$1) y = x + 1$$

$$x + y = 3$$

$$2) y = 2x + 4$$

$$3x + y = 11$$

$$3) x + y = 4$$

$$2x - y = 5$$

$$4) y - 2x = 1$$

$$3x - 4y = 1$$

$$5) 3x + 2y = 1$$

$$4x - y = 6$$

$$6) 5x + 2y = 2$$

$$2x + 3y = -8$$

I. Furfur:

- 1) $2x + y = 5$
 $x - y = 1$
- 2) $x + 2y = 7$
 $3x + 2y = 9$
- 3) $3a - 2b = 2$
 $3a + 4b = 14$
- 4) $3x - 2y = 10$
 $2x + 3y = -10$
- 5) $2r + 5s = 4$
 $7r + 4s = 14$
- 6) $4u - w = 3$
 $2u + 3w = 19$
- 7) $5x + y = 0$
 $3x - 2y = 13$
- 8) $4x = 5y + 5$
 $2x = 3y + 2$
- 9) $2h - 5k = 8$
 $3h - 7k = 11$
- 10) $4b = t + 7$
 $3b + 4t = -7$
- 11) $4x + 2y + 8 = 0$
 $6x = 2y - 27$
- 12) $4e + 3f = 4$
 $2e = 5f + 15$
- 13) $8f + 4g = 7$
 $6f - 8g = 41$
- 14) $5u + 10w = 28$
 $15u = 20w - 121$

Waxaynu soo aragnay in laba isle'eg loo baahan yahay marka laba dahsoome la raadiyo. Sidoo kale marka laylis la furfuri rabo, waa in la ogyahay laba summadood oo mid waliba isle'eg ku jiri karo.

Tusaale:

Raadi laba tiro oo ta hore labanlaabkeeda marka lagu daro ta dambe wadartu 21 tahay. Ta dambe labanlaabkeed marka lagu daro ta horena wadartu 27 tahay.

- 1) Ka soo qaad in labada ta hore x tahay, ta dambena y.
- 2) Labanlaabka ta hore oo lagu daray ta dambe waa 21;
 $2x + y = 21$ (i)
- 3) Ta dambe labanlaabkeed oo ta hore lagu daray waa 27;
 $2y + x = 27$ (ii)
- 4) (i) iyo (ii) wadajir u furfur; $2x + y = 21$ ku dhufo 2.
 $x + 2y = 27$ ka goo (i)

$$4x + 2y = 42$$

$$x + 2y = 27$$

$$3x = 15$$

$$x = 5$$

$$x = 5 \text{ ku beddel ka (i) ; } 10 + y = 21$$

$$y = 11$$

∴ Labadii tiro waa 5 iyo 11.

Hubsiiimo:

$$2 \times 5 + 11 = 10 + 11 = 21$$

$$5 + 2 \times 11 = 5 + 22 = 27$$

Tusaale:

Haddii labanlaabka da'da Jaamac 31 sanno dheer tahay ta Cusmaan, isla markaana wadarta da'da Cusmaan iyo labanlaabka ta Jaamac ay tahay 49. Raadi mid walba da'diisa?

Furfuris:

Ka soo qaad da'da Jaamac x sanno, ta Cusmaan y sanno, labanlaabka da'da Jaamac waa 2x. Haddii ay 31 dheer tahay y, markaa:

$$2x = y + 31 \quad (i)$$

$$\text{Isla markaa } 2x + y = 49 \quad (ii)$$

Isle'egyada (i) iyo (ii) aan wada jir u furfurno:

$$\begin{array}{rcl} \text{Isu gee } 2x - y & = & 31 \quad (i) \\ 2x + y & = & 49 \quad (ii) \end{array}$$

$$\begin{array}{rcl} \hline 4x & = & 80 \\ x & = & 20 \end{array}$$

$$\begin{array}{rcl} \text{Ku beddel ka (ii) } 2 \times 20 + y & = & 49 \\ & & y = 9 \end{array}$$

: Jaamac waa 20 jir, Cismaanna waa 9 jir.

Hubsiiimo:

$$\begin{array}{l} 2 \times 20 - 9 = 40 - 9 = 31 \\ 2 \times 20 + 9 = 40 + 9 = 49 \end{array}$$

- 1) Raadi laba tiro oo saddexlaabka ta hore marka ta kale labanlaakeeda lagu daro tahay 30 Ta hore labanlaabkeedoo ta dambe lagu darayna tahay 17.
- 2) Cabdi 8 sanno buu Jaamac ka weyn yahay. Labadooduna waa isku 25 sanno. Midba da'diisa soo saar.
- 3) Nin baa 32 jir ahaa markuu inankiisa curad dhashay. Imminkana da'doodu waa isku 56. Midba waa immisa jir?
- 4) Haddii doornii 16 km/saac u socon karto xagga webigu u socdo, 11 km/saac xagga webigu ka soo socdo. Soo saar xawaaraha doonta marka biyuhu taagan yihiin.
- 5) Tiro saddexlaabkeed ayaa le'eg tu kale waaxdeed. Afarlaabkeeda oo 12 lagu darayna waxay le'eg tahay ta kale saddexlaabkeeda. Waa maxay labada tiro?
- 6) Laba xaglood oo isku sidkan ayaa mid cabbirkeedu 6° ka yar yahay ta kale saddexlaabkeed. Soo saar mid walba cabbirkeeda.
- 7) Qolbaa 29 arday oo gabdhiyo wiilalba lihi ku jiraan. Tirada gabdhuhu mid bay ka yar tahay ta wiilasha badhkeed oo 3 lagu dhuftay. Immisaa gabdho ah? Immisaase wiilal ah?

- 8) Geeddi 3 rodol buu Caraale ka culus yahay. Labadooda culays oo laysu geeeyey Aw Yuusuf baa 16 rodol ka culus. Aw Yuusuf waa 213 rodol. Soc saar culayska Geeddi iyo ka Carraale.
- 9) Huuriga Jimcaale xawaarihiisu waa xawaaraha biyaha Juba oo 4 lagu dhuftay. Socdaal 15 km ah hadduu sare u raaco biyaha, dibna meeshii ugu soo noqdo 4 saac bay ku qaadan Jimcaale. Raadi xawaaraha biyaha.
- 10) Tiro laba god ah baa ta tobnaad 2 dheer tahay ta kowaad labanlaabkeeda. Haddii horsiimada khaanadaha lays weydaarsho tirada akhrisantaa 5 bay dheer tahay wadarta godadka oo 3 lagu dhuftay. Soo saar tirada labada god.
- 11) Abyoone togan oo laba god ah, ta kowaadku 1 bay dheer tahay ta tobnaadka oo 3 lagu dhuftay. Tirada akhrisantaa marka godadka la isku beddelo waa wadarta godadka oo 8 lagu dhuftay. Raadi abyoonahaa.
- 12) Tiro laba god ah, wadarta godadku waa 6. Haddii godadka laysku beddelo, tirada cusub ee akhrisantaa waa godka tobnaad ee tiradii hore oo 3 lagu dhuftay. Waa maxay tiradu?

Cutub II

SUMMADAHA XISAABTA

Summadda	Waxay u Taagan tahay
✂	Xagal
✂lo	Xaglo
)	Qaanso
○	Goobo
≡	Isku sargo'an
~	Isku ekaansho
°	Digirii
//	Barbarro
	Barbarroole
∟	Qotome
∟sha	Qotomayaasha, ama qotomayaal
∴	Sidaa Awgeed
△	Saddexagal
△lo	Saddexagallo
=	Isle'eg
≠	Isma le'eg
>	Ka weyn
<	Ka yar
≥	Ka weyn ama le'eg
≤	Ka yar ama le'eg
{ }	Urur

BAR, XARRIIQ, IYO SALLAX

Bar waxa weeye waxaan ballaar iyo dherer midna lahayn, hase yeeshee muujinaya meel. Haddii xaashi korkeed aad qalin caaraddii taabsiisid, kolka calaamadda halkaa kaa-ga samaysanta ee aan dherer, dhumuc iyo ballaar toona lahayn ayaa la yidhaa bar sida tan hoos ku qoran.

Xarriiq: Xarriiqi waa urur ka kooban baro isdabayaal oo aan ballaar iyo dhumuc toona lahayn, laakiinse labadeeda jiho hadba kii la doono loo fidin karo. Sida loo magacaabaa xarriiq waxay tahay, adigoo laba barood oo ka mid ah ururka baraha ah qaata dabadeedna u magacaaba sida Xarriiqda AB ee hoos ku taal:



Xarriijin: Xarriijinta AB waa ururka baraha xarriiqeed ee ka kooban baraha A iyo B iyo baraha u dhexeeya labadooda. Si loo kala saaro xarriiqda AB iyo xarriijinta AB waxa had iyo jeer la isticmaalaa summadaha soo socda:

$$\frac{\text{Xarriiq } AB}{\text{Xarriijinta } AB}$$

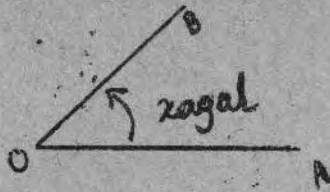


Sallax: Sallax waxa weeye wax fool kasta u fidsan oo dherer iyo ballaarba leh, hase yeeshee aan lahayn dhumuc sida sallaxa kor ku sawiran ee FQ. Mitaal ahaan, haddaynu qaadanno sabuuradda, miis dushii, iwm. waxad arkaysaa inay dhammaantood yihiin sallaxyo.

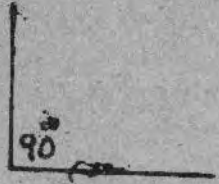
Xaglaha:

Q e e x: Xagali waxa weeye ururka baraha ka koobma isutagga labada xarriiqood iyo barta ay wadaagaan. Barta ay wadaagaan waxa loo yaqaanaa geeska xagasha, labada

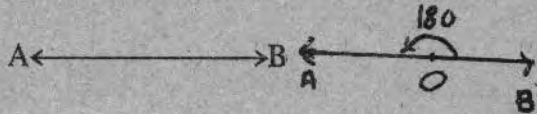
xarriiqoodna waxa lagu magacaabaa dhinacyada xagasha.



Xagal Qumman: Waxa weeye xagasha cabbirkeedu yahay 90° .



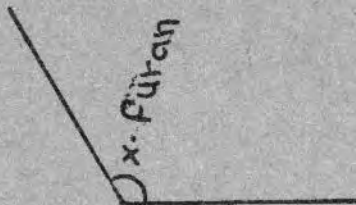
Xagal Toosan: Waxa weeye xagasha cabbirkeedu yahay 180° . Dhinacyada Xarriiqda toosani waa isku hal xarriiq oo toosan oo keliya.



Xagal Fiigah: Waxa weeye ta cabbirkeedu ka yar yahay 90° .

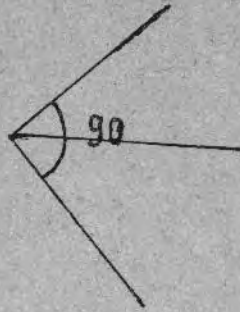


Xagal furan: Waxa weeye ta cabbirkeedu ka weyn yahay 90° kana yar yahay 180° .



Xagal Dhacsan: Waxa weeye tan cabbirkeedu ka weyn yahay 180° kana yar yahay 360° .

Xaglo Sidkan: Waxa weeye xaglaha wadarta cabbirraa-doodu tahay 90° .



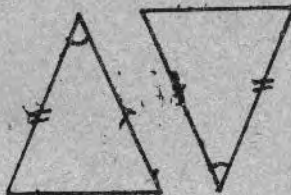
SADDEXGALLO ISKU SARGO'AN

Q e e x: Saddexgallo isku sargo'an waxa weeye qaar isku muuq ah iskuna baaxad ah oo si kasta isu le'eg. Summada la isticmaallo oo ah \cong , waxay ka kooban tahay laba qaybood oo kala ah $=$ iyo \sim , tan hore ($=$) waxay u taagan tahay isle'ekaansho ta dambena (\sim) isku muuq.

XEERARKA SADDEXGALLO ISKU SARGO'AN

1) Haddii laba dhinac iyo xagasha u dhexaysa ee saddexagal ay le'eg yihiin laba dhinac iyo xagasha u dhexaysa ee saddexagal kale, markaa labada seddexagal waa isku sargo'an yihiin.

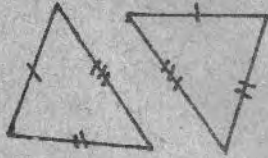
Sangaabtooduna waxay tahay (dh. x. dh.).



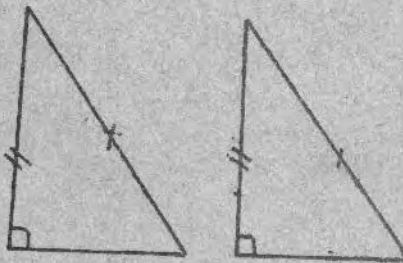
2) Haddii laba xaglood iyo dhinaca u dhexeeya ee saddexagal ay le'eg yihiin laba xaglood iyo dhinac u dhexeeya ee ku beegan ee saddexagal kale, kolkaa labada saddexagal way

isku sargo'an yihiin. (x. dh. x.)

3) Haddii saddexda dhinac ee saddexagal ay le'eg yihiin saddexda dhinac ee ku beegan ee saddexagal kale, markaa labada saddexagal waa ay isku sargo'an yihiin. (dh. dh. dh.)

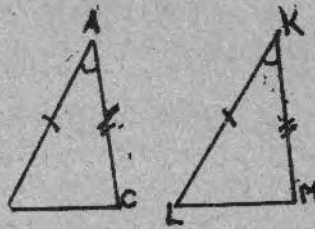


4) Haddii lug iyo shakaalka saddexagal qummani ay le'egyihiiin lugta iyo shakaalka ku beegan ee saddexagal qumman oo kale, markaa labada saddexagal way isku sargo'an yihiin (1. sh. 90°)



O g o w : Haddii laba saddexagal ay isku sargo'an yihiin qaybahooda isku beegani way is le'eg yihiin. Kolkaad rabtid inaad magacowdo laba saddexagal oo isku sargo'an, waa lagaama maarmaan inaad xaglahi iyo dhinacyada isle'eg hagaag isugu beegtid. Bal tusaalahan soo socda aad u dheeho. Labadan shaxan sida u fudud ee loo magacaabaa waxay tahay: $\triangle ABC \cong \triangle KLM$. Kolkaa halkan waxa inooga muuqata

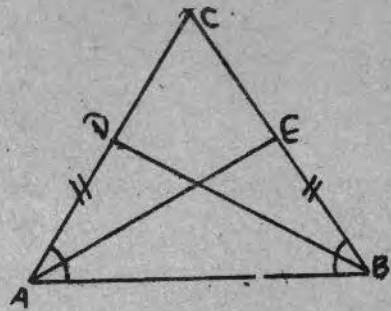
inay xaglahocdu iyo dhinacyadocdu ay isugu beegan yihiin siday xarfahoodu u kala horreeyaan.



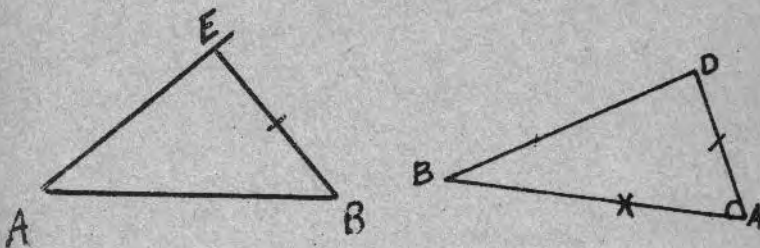
(t.a $\angle A$ waxay ku beegan tahay $\angle K$, $\angle B$ -na waxay ku beegan tahay $\angle L$, AB waxay ku beegan tahay KL iwm.)

Tusaale:

Haddii saddexagal ABC ay $AD = BE$,
 $\angle CAB = \angle CBA$, cad-dee in $AE = BD$.



Marka hore waxad samaysaa labada saddexagal ee ABD iyo BAE , si aad u muujisid labada dhinac ee AE iyo BD in ay isku beegan yihiin.



Caddayn:

$AD = BE$ (ogaal)
 $\angle DAB = \angle EBA$ (ogaal)

$AB = AB$ (astaanta isu noqodka)
 $\therefore \triangle ABE \cong \triangle BAD$ (dh. x. dh.)

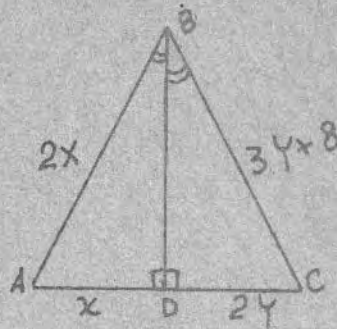
$\therefore AE = BC$ (dhinacyada isku beegan ee saddexagallo isku sargo'ani way isle'eg yihiin.)

?

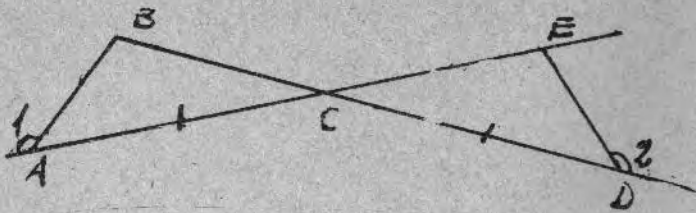
Layli:

Ma...

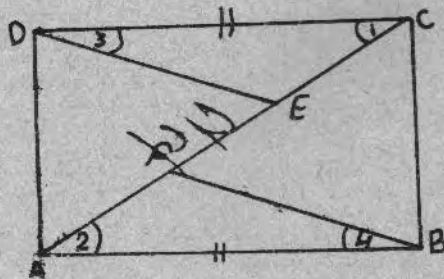
- 1) Haddii xarriiqda toosan ee XOY ay kala badho xarriiqda toosan ee AOB, xagasha ay iska gooyaanna ay qumman tahay, caddee in $XA = XB$.
- 2) Laba xarriiqood oo toosan AOB iyo COD oo aan isle'egkayn ayaa midba kan kale kala badhaa. Caddee in $AC = BD$.
- 3) Waxaad raadisaa qiimaha X iyo Y kadib markaad si fiican u dhechatid saddexagal ABC.
- 4) Xarriiqda AD baa kala badha xagasha BAC; DX iyo DY waa qotoma badhayaasha ka yimaadda D ee qummaati ugu taagan AB iyo AC. Waxad caddaysaa inay $DX = DY$.



- 5) Haddii $\angle 1 = \angle 2$, oo weliba
 $AC = CD$, Caddee in $AB = DE$

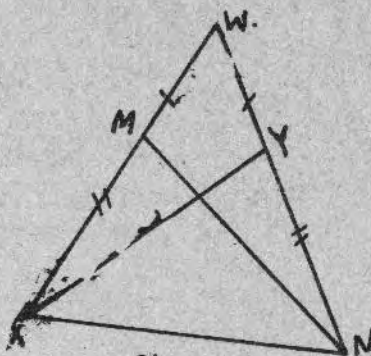


- 6) Ka dib markaad si hagaagsan u dheehatid shaxanka III aadna ogaatid inay $AB = CD$,
 $\angle 1 = \angle 2$, $\angle 3 = \angle 4$, waxay caddaysaa in
 $AF = EC$



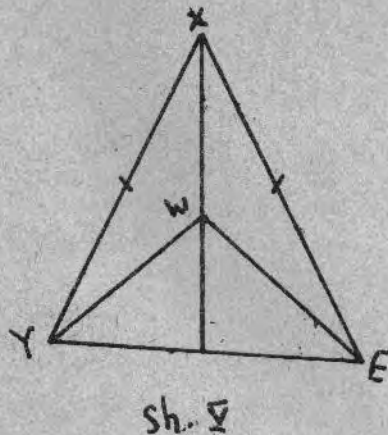
Sh. III

- 7) Si gumman markaad u deristid shaxanka IV, wa-
xaad sheegta saddexagalka ku sargo'an $\triangle XYW$,
sababtana sheeg adigoo isla markaa xaglaha u ratiba-
ya siday isugu beegan yihiin.



Sh. IV

- 8) Ka dib markaad si hagaagsan u deristid shaxanka, V, waxaad magacowdaa saddexagalka ku sargo'an saddexagalka XYW, adigoo sheegaya sababta.



- 9) FOQ iyo XOY waa laba xarriiqood oo toosan oo midba midka kale badho. Haddaba waxad caddeysaa in saddexagalka FOY uu ku sargo'an yahay saddexagalka QOX.
- 10) ABC waa saddexagal labaale ah oo ay dhinacyadiisa isle'eg yihiin AB iyo AC. X iyo Y-na waa laba barood oo ku dul yaalla AB iyo AC, siday u kala horreeyaan taasoo ay $AX = AY$. Caddee in saddexagalka ABY uu ku sargo'an yahay saddexagalka ACX.

Astaamaha Saddexagallada:

Q e e x: Saddexagalka asalkiisu waxa weeye shaxan kasta oo leh saddex dhinac isla markaasna leh saddex gees, waana ka ugu fudud geesoolayaasha.

Kala Hufka Saddexagallada:

- 1) Haddii saddexagal uu leeyahay saddex dhinac oo isle'eg, kolkaa waxa lagu magacaabaa **saddexagal siman**.

- 2) Haddii laba dhinac oo saddexagal ka mid ahi ay isle'eg yihiin waxa lagu magacaabaa **saddexagal labaale ah**.
- 3) Haddii saddexda dhinac ee saddexagal uu cabbirkoodu kala jaad yahay, markaa saddexagalka caynkaas ah waxa lagu magacaabaa **saddexagal ismale'eke ah**.

Qaybaha saddexagallayaasha:

Saddexagalku dhinac kasta oo uu leeyahay wuxuu noqon kara sal, markaa saddexagal kasta waxa suura geli karta inuu yeesho saddex sal.

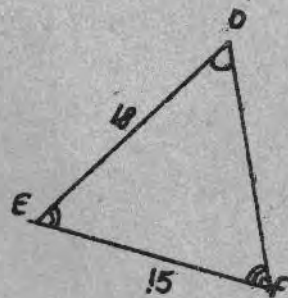
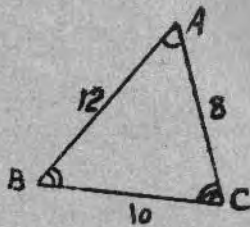
- 1) Xagasha ka soo horjeedda sal kasta ayaa la yiraa **Xagal gees**.
- 2) Joogga saddexagalku waa xarriiqda ka timaadda gees ka mid ah saddexagalka qummaatina ugu taagan dhinaca ka soo horjeeda geeska ama dhinacaas oo la fidiyey. Markaa saddexagal kasta wuxuu yeelan karaa saddex joog.
- 3) Saddexagalka leh xagal cabbirkeedu yahay 90° yaa la yiraa **saddexagal qumman**.

Layli:

- 1) Saddexagal qumman ayaa wuxuu leeyahay xagal cabbirkeedu-yahay 37° . Raadi xagasha kale.
- 2) Laba xaglood oo saddexagal ayaa middiiba cabbirkeedu yahay 53° . Soo saar ta saddexaad.
- 3) Haddii saddexagal ABC ay xagasha $BAC =$ xagasha $BCA +$ xagasha ABC , raadi xagasha BAC .
- 4) Saddexagal baa xaglihiisu yihiin sida soo socota: $x^\circ, 2x^\circ, 2x^\circ$. Doon qiimaha x° .
- 5) Saddexagal labaale ah baa xagashiisa taagani tahay 30° . Raadi labadiisa xagal-saleed.
- 6) Saddexagal baa xaglihiisu yihiin sidatan: $3x^\circ, 4x^\circ, \text{ iyo } 5x^\circ$. Doon xagashiisa ugu weyn iyo qiimaha x° .

Saddexagallayaal Isu'eg:

Qoex: Haddii saddexda xaglood ee saddexagal ay le'eg yihiin saddexda xaglood ee ku beegan ee saddexagal kale, markaa lagama yaabo inay labada saddexagal isku sargo'an yihiin, hase yeeshee waxaynu oran karraa waa ay isu eg yihiin Saddexagallayaashu waa inay isku muuq noqdaan, laakiinse way kala weynaan karaan.



Labada shaxan ee hore ma oran kartid waa isle'eg yihiin, maxaa yeelay dhinacyadooda isku beegani waa kala weyn yihiin, laakiinse way samigalsan yihiin. Markaynu leenahay way saamigalsan yihiin waxaynu u jeednaa saamiga dhinacyada isku beegan ee saddexagallayaasha ayaa isle'eg. Summada isu'ekaanshuhu waxa weeye « ~ ». Sida ugu fudud ee loo magacaabaa waxa weeye adigoo xuruufta u dhiga sida xaglahoodu isugu beegan yihiin. Haddaynu tusaale u qaadanno labadeena shaxan waxaynu u dhigaynaa sida soo socota.

$$\triangle ABC \sim \triangle DEF$$

$$\begin{aligned} \therefore \frac{AB}{DE} &= \frac{BC}{EF} = \frac{AC}{DF} \\ \frac{12}{18} &= \frac{10}{15} = \frac{8}{12} = \frac{2}{3} \end{aligned}$$

Markaa halkan waxa ka caddaatay in labadii dhinac ee kasta ee isku beegani marka la isu qaybsho ay ma doorsoome ku siiyaan. Haddii aan isticmaallo fikradaha saamigalka waxaynu gaari saamigalkan soo socda:

Saamiga laba dhinac kasta oo saddexagal wuxuu le'eg yahay saamiga labadii dhinac ee ku beegnaa, t. a. Haddii:

$$\frac{AB}{DE} = \frac{BC}{EF} \quad \text{waxaynu heli in}$$

$$\frac{AB}{BC} = \frac{DE}{EF}, \quad \frac{AB}{BC} = \frac{12}{10} = \frac{6}{5}, \quad \frac{DE}{EF} = \frac{18}{15} = \frac{6}{5}$$

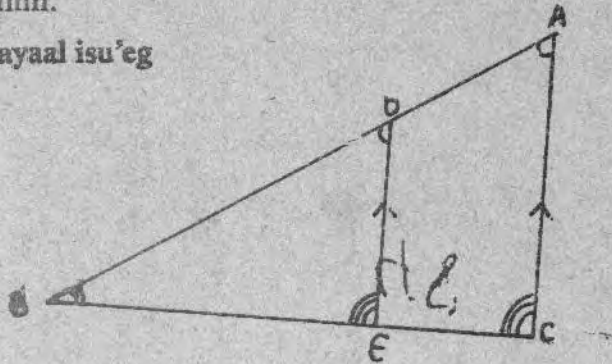
Waxaad, sidoo kale arki kartaa in

$$\frac{BC}{CA} = \frac{EF}{FD}, \quad \frac{CA}{AB} = \frac{FD}{DE} \quad \text{oo aad saamigood heli karto.}$$

Gebagabadii waxay tahay:

- 1) Saddexagalayaasha xaglahoodu isle'eg yihiin waa ay isu'eg yihiin.
- 2) Saddexagalayaasha xaglahoodu isle'eg yihiin dhinacyadooda isku beegani way saamigalsan yihiin.
- 3) Haddii saddexda dhinac ee saddexagal ay saamigal u yihiin saddexda dhinac ee saddexagal kale oo weliba saamigu yahay halbeeg cabbiraadeed, markaa xaglohoodu way isle'eg yihiin, waana isu'eg yihiin.

Saddexagallayaal isu'eg



Haddaad jeexdid xarriiq la barbarro ah dhinaca AC, sida DE, markaa \triangle sha ABC iyo DBE, $\angle BAC = \angle BDE$ (xaglo gudboon); $\angle B$ way wadaagaan; labada xaglood ee soo harayna waa ay isle'eg yihiin. Sidaa daraadeed $\triangle ABC \sim \triangle DBE$

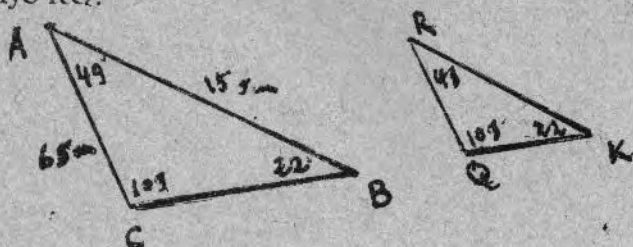
$$\therefore \frac{AB}{BD} = \frac{BC}{BE} = \frac{AC}{DE}$$

ama

$$\frac{AB}{BC} = \frac{DB}{BE}, \quad \frac{AC}{BC} = \frac{DE}{BE}, \quad \frac{AB}{AC} = \frac{DB}{DE}$$

Tusaale:

Waxaad magacowdaa \triangle ka u eg $\triangle ABC$, dabadeedna radi BC iyo RQ.



Furfuris:

$$\angle B = 180^\circ - (49^\circ + 109^\circ) = 22^\circ$$

$$\angle B = 180^\circ - (22^\circ + 109^\circ) = 49^\circ$$

\therefore Xaglohoodu waa isle'eg yihiin

A waxay ku beegan tahay R

B waxay ku beegan tahay K

C waxay ku beegan tahay Q

$\therefore \triangle ABC \sim \triangle RKQ$

$$\therefore \frac{AB}{RK} = \frac{AC}{RQ} = \frac{BC}{KQ}$$

$$\therefore \frac{15}{25} = \frac{6}{RQ} = \frac{BC}{20}$$

$$\frac{3}{5} = \frac{6}{RQ}$$

$$RQ = 10 \text{ sm}$$

Tan kale:

$$\frac{AB}{RK} = \frac{BC}{20}$$

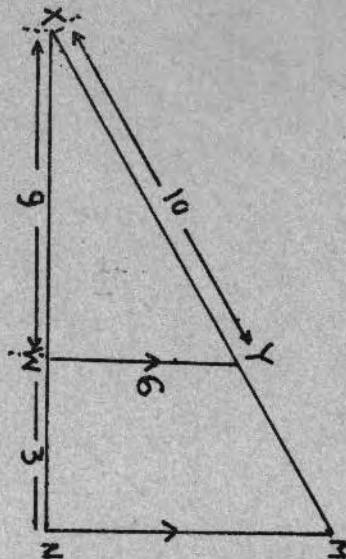
$$\frac{3}{5} = \frac{BC}{20}$$

$$5 BC = 60$$

$$BC = \frac{60}{5}$$

$$BC = 12 \text{ sm. jawaab}$$

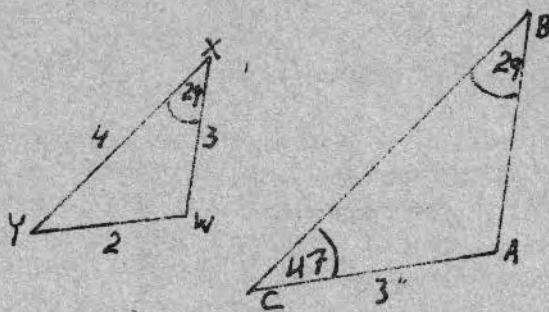
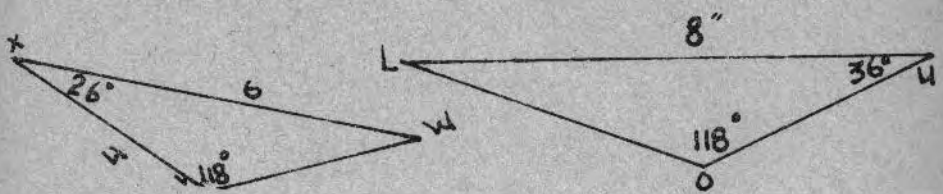
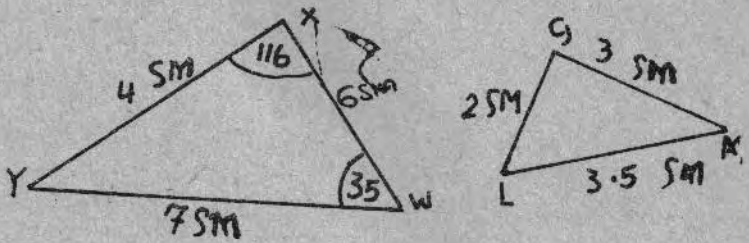
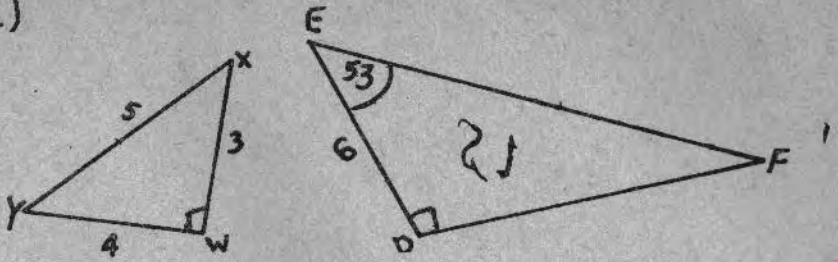
Layli:

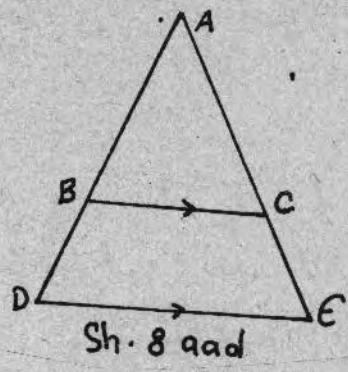
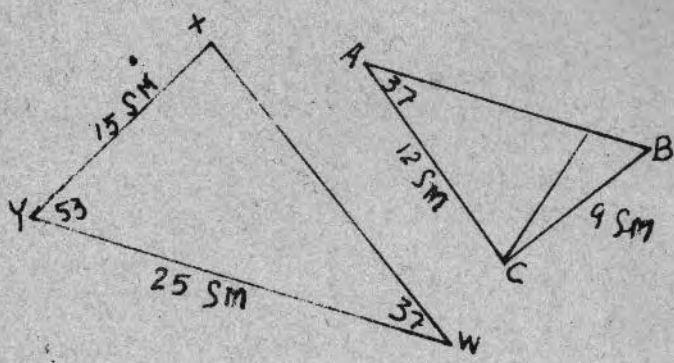
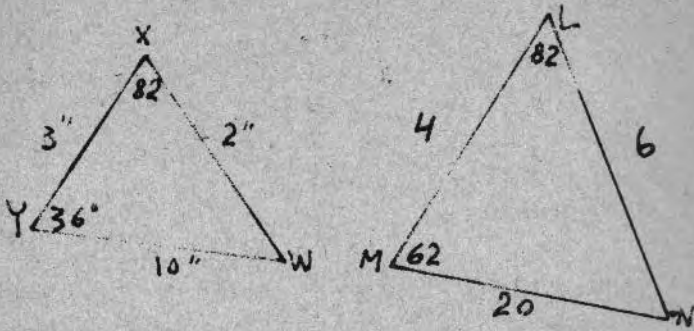


Raadi MN iyo MY, haddii $YW \parallel MN$.

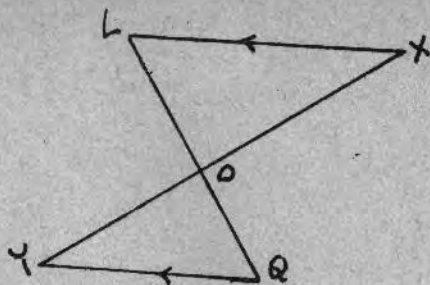
Layliyada 2 – 7 waxaad magacowdaa saddexagalka u eg $\triangle XYW$ adigoc xuruufta siday u kala horreeyaan u dhigaya dabadeedna raadi xaglaha dhinacyada maqan.

(2)



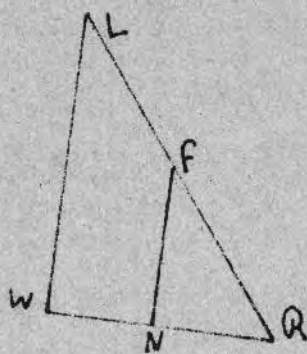


8. Shaxanka Saad, haddii $AB = 8$, $BD = 2$, $AC = 10$, $DE = 6.25$; raadi AE iyo BC.



9) Shaxanka 9aad markaad dheehatid; waxad magacowdaa \triangle ka u eg \triangle ka kale ee YDQ, sababta ay isugu ekaadeenna sheeg. Haddii $OL = 4m$, $OX = 7m$, $LX = 6m$, $YQ = 4.5m$, raadi OY iyo OQ.

10) Shaxanka 10aad wuxu u taagan yahay tiir FN oo qummaati u taagan, joogiisuna yahay 5.5m, oo gidaarka LW u jira 9m. Jaranjarada LR ayaa ku tiirsan gidaarka siina taabata tiirka fiiqiisa. Haddaba haddii jaranjarada gunteedu 1.5m u jirto tiirka waxad raadisaa gidaarka LW dhererkiisa.

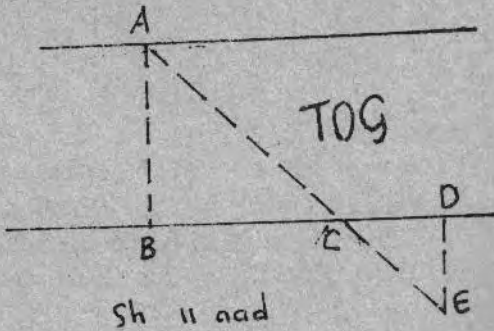


Sh. 10 aad

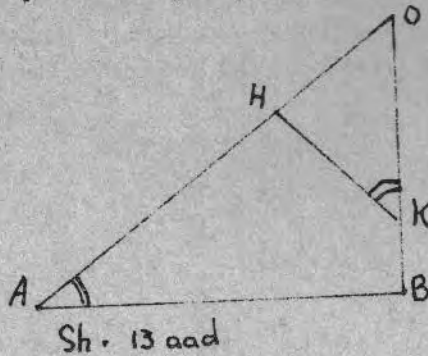
11) Shaxanka 11aad, nin baa wuxuu rabaa inuu soo saaro tog ballaarkii markaasuu qori ka taagay meesha A, qori kale-na wuxu ka taagay daanta kale ee togga meesha B oo saani ugu beegan A. Mid saddexaadna wuxuu ka taagay meesha E, taasoo ay A, B, E ku wada dhacayaan xarriiq toosan. EDna ay la samaynayso xagal qumman togga qarqiisa. Dabadeed-

na wuxu cabbiray BC, CD iyo DE; markaasu helay 117m, 26m iyo 16m siday u kala horreeyaan.

Haddaba muxuu noqonayaa togga ballaarkiisu.



12) Waxad doontaa bir-calan dhererkeeda haddii hadhkeedu yahay 112m; kaabad ku taal harkeeda yaa dhererkeedu yahay 27m, hadhka ay fidisaana yahay 48m.



Waxa aad magacowdaa saddexagalka u eg Δ ka kale ee OAB, sababta uu ugu ekaadayna sheeg.

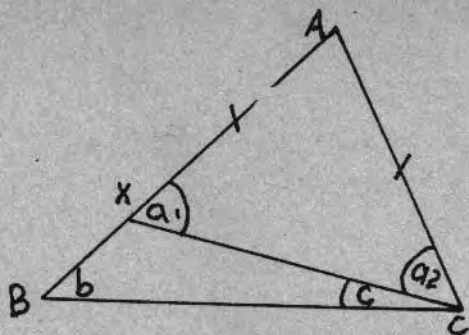
Haddii $OA = 10\text{m}$, $OK = 6\text{m}$, $AB = 7\text{m}$, raadi OK iyo KB.

Saddex-xagal isma le'eke ah:

Qeex: Saddexagal-isma le'eke ahi waa ka saddexdiisa dhinac cabbirraagoodu kala duwan yihiin, isla markaana aan lahayn xagal qumman.

Aragtiin 1

Saddex-xagalka isma le'eke ah dhiniciisa ugu weyni wuxu ka soo horjeeda xagasha ugu weyn.



Ogaal: Δ ka ABC, $AB > AC$, waxad caddaysaa in $\angle ACB > \angle ABC$.

Dhismo: Dhinaca AB dushiisa waxad ku muujisaa bar ah X $AX = AC$, isku xir CX.

Caddeyn: Δ AXC waa saddexagal labaale ah. Sida daraadeed $a_1 = a_2$.

Laakiinse $a_1 = b + c$ (Astaanta xagal dibadeedda ee Δ ka BXC)

$$\therefore a_2 = b + c$$

$$\therefore a_2 + c = b + 2c \text{ (c haa 2da dhinaca loo geeyey)}$$

$$\therefore \angle ACB = \angle ABC + 2c$$

$$\therefore \angle ACB > \angle ABC$$

Aragtiin 2

Saddexagalka isma le'eka ah xagasha ugu weyni waxay saani uga soo horjeeddaa dhinaciisa ugu weyn.

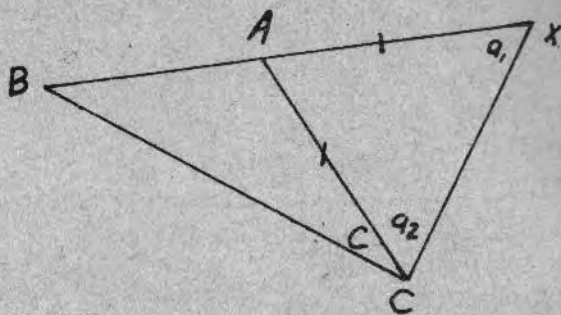
Ogaal: Saddexagal ABC, $\angle ACB > \angle ABC$ waxad caddaysaa inay $AB > AC$.

Caddayn: Haddii $AB < AC$ markaa $\angle C < \angle B$, laakiinse waa been.

Haddii $AB = AC$, markaa $\angle C = \angle B$, laakiinse waa been.

$$\therefore AB > AC$$

Aragtiin: Wadarta laba dhinac ee saddexagal kastaa way ka weyn tahay dhinaca saddexaad.



Ogaal: $\triangle ABC$

In la caddeeyo $AB + AC > BC$

Dhismo: Waxad fidisaa dhinaca BA ilaa iyo bartaxsi ay $AX = AC$.

Caddayn: $a_2 = a_1$ ($\triangle AXC$ waa labaale)

$$\therefore a_2 + C > a_1$$

$\therefore BX > BC$ (\angle sha u weyn \triangle waxay ka soo horjeeddaa dhinaca u weyn)

$$\therefore BA + AX > BC$$

$$\therefore BA + AC > BC.$$

Layli:

- 1) $\triangle ABC$ waa saddexagal ay xagashiisa furani tahay B, waxad caddaysaa in dhinaca AC uu yahay dhinaca ugu dheer ee saddexagalka.
- 2) Saddexagalka $\triangle ABC$, $\angle B = \angle C$, kala badhaha xagasha Bna wuxu ka jaraa dhinaca AC meesha X. Caddee in $BX > CX$.
- 3) Kala badhaha xagasha K ee saddexagalka $\triangle KQR$ wuxu ka jaraa dhinaca QR meesha A. Waxad caddaysaa in $KQ > QA$.
- 4) $\triangle BTJ$ waa saddex-agal labaale ah oo ay $BT = BJ$. A waa bar ku dul taal dhinaca TJ oo la fidiyey. Caddee in $BA > BT$.

- 5) ABC waa saddexagal ay $AB = AC$, Dna waxa weeye bar ku dul taal badhtamaha BC. Waxad caddaysaa in $\angle CAD > \angle BAD$.
- 6) Saddexagalka ABC, $AC > AB$. Kala badhayaa sha xaglaha B iyo C waxay ku kulmaan E. Waxad caddaysaa inay $EC > EB$.

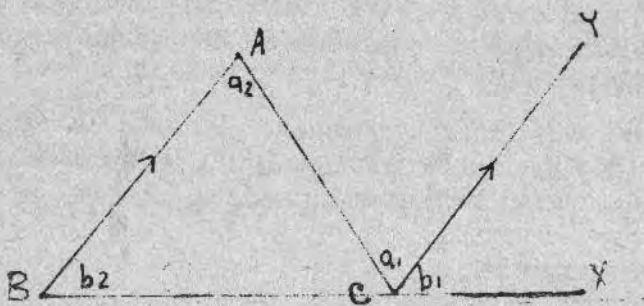
Aragtiin:

1) Haddii dhinac ka mid ah saddexagal la fidiyo, markaa xagal dibadeedda halkaa ka samaysantaa waxay le'eg tahay wadarta labada xagal gudeed ee aan la dariska ahayn ee saddexagalka.

2) Wadarta xagalaha saddexagal kasta waa 180°

Ogaal: Waxaynu haysanaa saddexagal ka ABC oo dhinaca BC loo fidiyey ilaa X, caddee inay $\angle ACX = \angle A + \angle B$ (2) inay $\angle A + \angle B + \angle ACB = 180^\circ$.

Dhismo: Waxad C ka jeexdaa xarriiq CY oo la barbarro ah dhinaca BA.



Caddayn 1:

$$a_1 = a_2 \text{ (xaglo talantaali ah)}$$

$$b_1 = b_2 \text{ (xaglo gudboon)}$$

$$\therefore a_1 + b_1 = a_2 + b_2$$

$$\therefore \angle ACX = \angle A + \angle B$$

$$2. \angle ACB + a_1 + b_1 = 180^\circ \text{ (BCX waa xagal toosan)}$$

$$\therefore \angle ACB + a_2 + b_2 = 180^\circ \text{ (} a_1 = a_2, b_1 = b_2 \text{)}$$

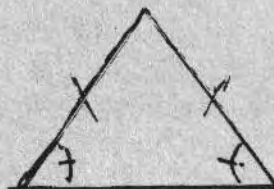
$$\therefore \angle ACB + \angle A + \angle B = 180^\circ$$

Layli:

- 1) Saddexagal ayaa xaglihiisu yihiin x° , $2x^\circ$, $3x^\circ$. Raadi x .
- 2) Labada xagal saleed ee saddexagal labaale ah ayaa middiiba tahay labanlaabka xagasha taagan. Raadi xaglihiisa oo dhan.
- 3) Saddexagal qumman baa xaglihiisa fiiqan mid 20° dheer tahay ta kale. Raadi xaglihiisa.
- 4) Laba xaglood oo saddexagal ayaa middiiba tahay 53° . Raadi ta saddexaad.
- 5) Saddexagal ayaa xaglihiisu yihiin x° , $2x^\circ$, iyo $2x^\circ$. Doon x .
- 6) Haddii A , B , iyo C ay yihiin xaglaha saddexagal oo $\angle A - \angle B = 15^\circ$, $\angle B - \angle C = 30^\circ$, maxay noqonaysaa $\angle A$.
- 7) Haddii xagasha taagan ee saddexagal labaale ahi tahay 110° , maxay noqonayaan labada xagal saleed.
- 8) Doon xaglaha saddexagal labaale ah haddii xagasha taagani tahay labanlaabka xagal saleedka (b) Haddii xagal saleedku tahay labanlaabka xagasha taagan.
- 9) ABC waa saddexagal siman. Dhinaca BC ayaa la fidiyey ilaa iyo D ; waxaana isle'eg BC iyo CD . Haddaba waxad caddaysaa in xagasha $BAD = 90^\circ$.

Saddex-xagal labaale ah:

Qeex: Saddexagalkii labaale ahi waa ka leh laba dhinac oo isle'eg. Dhan kale markaynu ka eegno, haddii labada xagal saleed ee saddexagal ay isle'eg yihiin, saddexagalku wuxu noqon karaa sadde xagal labaale ah.



Aragtiin: Haddii laba dhinac oo saddexagal ay isle'eg yihiin, markaa xaglaha ka soo horjeeda labada dhinac ee isle'eg way isle'eg yihiin.

Aragtiinkaas waxa kaloo loo qori karaa sida soo socota: Labada xagal saleed ee labaaluhu way isle'eg yihiin.

Ogaal: $\triangle ABC$, $AB = AC$.

Caddee in $\angle B = \angle C$

Dhismo: Waxaad jeexda xarriiq kala badha xagasha BAC, meesha uu ka jaro BC-na waxad ku magacowda D.

Caddayn:

Dheeho labada saddexagal ee ABD iyo ACD.

$AD = AD$ (Astaanta isu noqodka)

$AB = AC$ (Ogaal)

$X = Y$ (Dhismo)

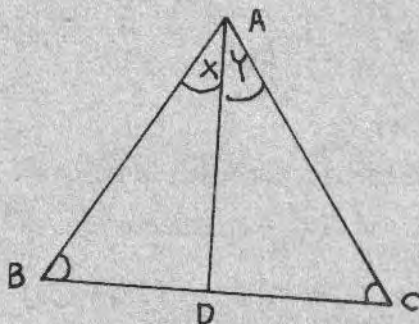
$\therefore \triangle ABD \cong \triangle ACD$ (dh. x. dh.)

$\therefore \angle B = \angle C$

Aragtiinka qaybteeda labaad waxay sheegaysaa sida soo socota: haddii laba xaglood oo saddexagal ay isle'eg yihiin, markaa labada dhinac ee ka soo horjeeda xaglahaasi way isle'eg yihiin.

Ogaal: $\triangle ABC$ oo ay $\angle B = \angle C$

Caddee in ay $AB = AC$



Dhismo: Waxaad jeexdaa xarriiq kala badhaysa xagasha BAC, barta uu kaga qotomo BCna waxad ku magacawdaa D.

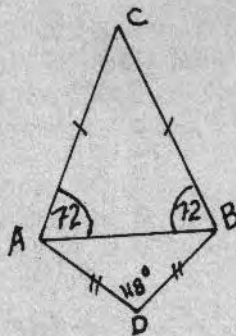
Caddayn:

Dheebo labada saddexagal ee ABD iyo ACD.

- $\angle B = \angle C$ (Ogaal)
- $X = Y$ (Dhismo)
- $AD = AD$ (Astaanta isu noqodka)
- $\therefore \triangle ABD \cong \triangle ACD$ (x. dh. x.)
- $\therefore AB = AC$ (Dhinacyada isku beegan ee \sphericalangle lo isku sargo'an)

Tusaale:

Saddexagalleyaal labaalayaal ah oo ah ABC iyo ABD baa waxay ku kala yaalliin labada dhinac ee salka AB, sida sawirka hoose muujinaayo. Haddii $\angle ABC = 72^\circ$ $\angle ADB = 118^\circ$. Raadi $\angle ACB$ iyo $\angle CBD$.



Furfuris:

Saddexagalka ABC, $\angle ABC = 72^\circ$ (ogaal)

$\angle BAC = 72^\circ$ (\sphericalangle saleedyada \triangle ka labaalaha ah way isle'eg yihiin)

$\therefore \angle ACB = 180^\circ - (72 + 72)^\circ = 36^\circ$. (wadarta \sphericalangle ha $\triangle = 180^\circ$)

\triangle ka ABD, $\angle ADB = 118^\circ$

$\therefore \angle ABD + \angle BAD = 180^\circ - 118^\circ = 62^\circ$ (wadarta \sphericalangle ha \triangle)

waa 180°)

$$\therefore 2 \times \angle ABD = 62^\circ (\text{<saleedyada } \triangle \text{ ku way =})$$

$$\therefore \angle ABD = 31$$

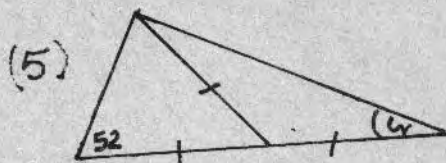
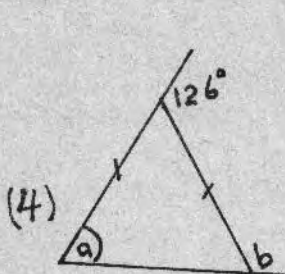
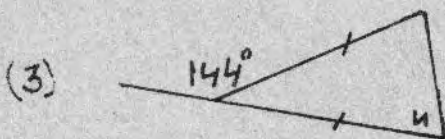
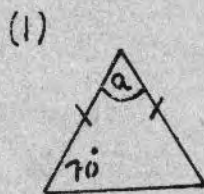
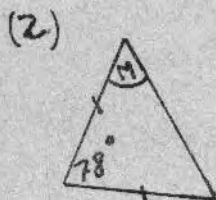
$$\therefore \angle CBD = \angle CBA + \angle ABD = 72^\circ + 31^\circ = 103^\circ$$

$$\angle ACB = 36^\circ, \angle CBD = 103^\circ \text{ Jawaab}$$

Layli:

Raadi xaglaha xuruuftu ku qoran tahay.

Shaxan:



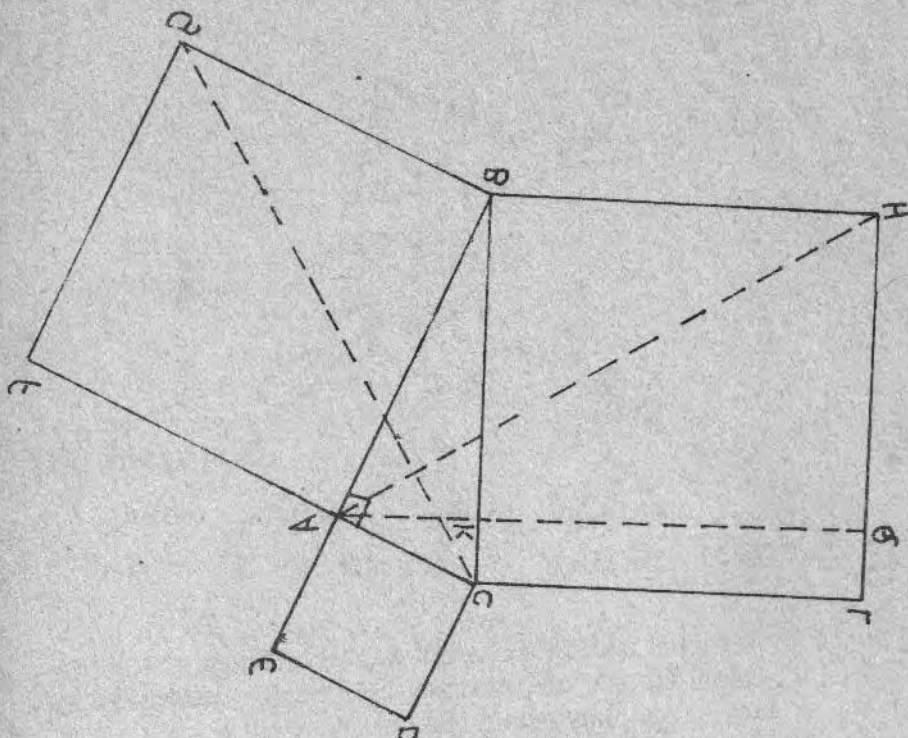
- 6) Waxaad caddaysa, haddii xagasha taagan ee saddex-xagal labaale ahi ay tahay 60° , marka saddexagalku wuxu noqonayaa mid siman.

- 7) Saddexagal labaale ah oo ah ABC, labada dhinac ee isle'egkuna yihiin AB iyo AC, $\angle B = 55^\circ$. Haddaba waxad raadisaa $\angle A$.
- 8) Saddexagal labaale ah, HJK, ayaa salkiisa oo ah JK loo fidiyey ilaa L. Haddii $\angle J = 69^\circ$, waxad doontaa $\angle HKL$.
- 9) Saddexagal labaale ah oo ah FQR ayaa salkiisoo ah QR loo fidiyey ilaa S. Haddii $\angle FRS = 102^\circ$. Raadi $\angle Q$.
- 10) Saddexagal labaale ah, ABC baa salkiisoo ah BC loo fidiyey ilaa D. Haddii $\angle A = 75^\circ$. Raadi $\angle ACD$.

ARAGTIINKA BAYTAAGOROS

Saddexagalka qumman.

Labajibbaarka shakaalku wuxu le'eg yahay wadarta labajibbaarrada labada dhinac ee kale.



Ogaal:

Waxaynu haysannaa $\triangle ABC$ oo $\angle A = 90^\circ$

In la caddeeyo: $BC^2 = AB^2 + AC^2$

Dhis mo: Dhinacyada \triangle ka ABC ku dhis labajibbaara-nayaasha kala ah ABGF, BCLH iyo CAED. A ka soo jeex xarriiq la barbarro ah dhinaca BH oo ka jaraysa dhinacyada BC iyo HL. meelaha K iyo Q siday u kala horreeyaan. Jeex AH iyo CG.

Caddayn: Saddexagalayaasha BGC iyo BAH; $BG = BA$ (dhinacyada labajibbaaranuhu waa =)

$BC = BH$ (dhinacyada labajibbaaranuhu waa =)

$\therefore \angle GBC = \angle ABH$ (middiiba waxa weeye $90^\circ + \angle ABC$)

$\therefore \triangle BGC \cong \triangle BAH$ (DH..X.DH.).

Hase yeeshee bedka \triangle ka BGC = $\frac{1}{2}$ bedka labajibba-

aranaha ABGF maxaa yeelay waa isku sal waxayna u dhexee-yaan laba xarriiqood oo barbarro ah. ($GB \parallel FA$) sidaasoo

kale bedka $\triangle BAH = \frac{1}{2}$ bedka laydiga BHQK.

Markaa labajibbaaranaha ABGF = laydiga BHQK.

Marka xiga haddaynu isku xirno BD iyo AL waxaynu helaynaa laba saddexagal oo isku sargo'an oo kala ah $\triangle BDC$ iyo $\triangle LAC$. Markaa waxaynu helaynaa, labajibbaara-naha ACDE = laydiga CLQK, laakiinse bedka labajibbaara-naha BHLC = bedka BHQK + bedka CLQK
= labajibbaaranaha ABGF +
labajibbaaranaha ACDE

Taas micnaheedu waxa weeye: $BC^2 = AB^2 + AC^2$.

Layli:

Laylisyada 1 ilaa 4 waxad raadisaa dhinaca maqan had-dii aad haysato $\triangle ABC$ oo $\angle A = 90^\circ$ markastaba.

1) $b = 8m, t = 15m$

2) $b = 18m, t = 16m$

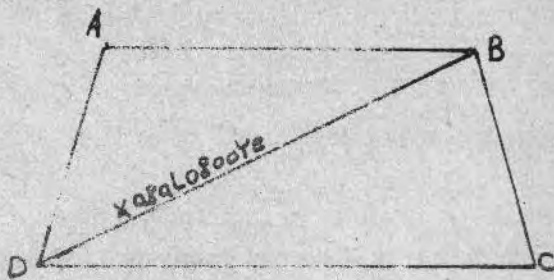
3) $a = 10m, b = 6m$

4) $a = 13m, b = 12$

- 5) Jaranjaro dhererkeedu yahay 50m ayaa gidaar ku tiirsan. Jaranjarada gunteeda iyo gidaarka salkiisu waxay isu jiraan 30m. Haddaba waxad doontaa gidaarka dhererkiisa.
- 6) Raadi dhererka xaglooyaha labajibbaarane haddii dhinacyadiisu yihiin 7m midba.
- 7) Laba bir calan oo dhererkoodu kala yahay 55m iyo 66m ayaa waxay isu jiraan 60m. Doon dhererka waayar isku xira labada bir calan madaxyadooda.
- 8) Fiilo ayaa waxay ku xiran tahay bir ku qotonta dhulka oo dhererkeedu yahay 70m. Haddaba raadi fiilada dhererkeeda haddii fiiladu meeshay dhulka kaga xiran tahay iyo birta gunteedu ay isu jiraan 24m.
- 9) Raadi joogga saddexagal siman haddii dhinacba yahay 8m.
- 10) Saddexagal qumman ayaa dhinacyadiisa mid ka midi yahay 15m shakaalkiisuna yahay 17m. Haddaba waxad doonta dhinaca kale dhererkiisa iyo bedka saddexagalkaba.

Afar geeslayaal iyo barbarroolayaal:

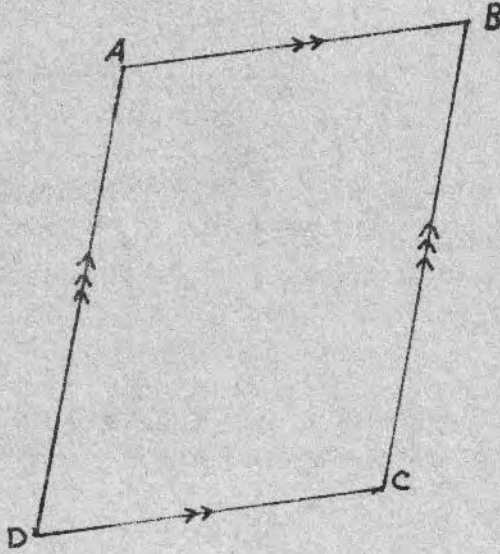
Q e e x : Afar geesle waa shaxan kasta oo afar xaglood iyo afar dhinac leh, dhinacyadiisu ha isle'ekaadeene ama ha kala weynaadeene.



Afar-geesle

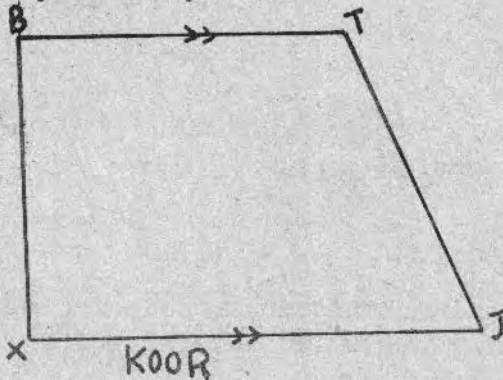
Barbaroole:

Qeex: Barbaroole waa afar geesle gaar ah oo ay labadiisa dhinac ee iska soo horjeedaaba ay barbarro yihiin. Markaad dhehatid shaxanka hocs ku muujisan waxad arkaysaa in AB iyo DC ay barbarro yihiin AD iyo BC-na ay barbarro yihiin. Waxa kaloo intaa raacda in barbarroolaha xaglihiisa iska soo horjeedaa ay isle'eg yihiin.



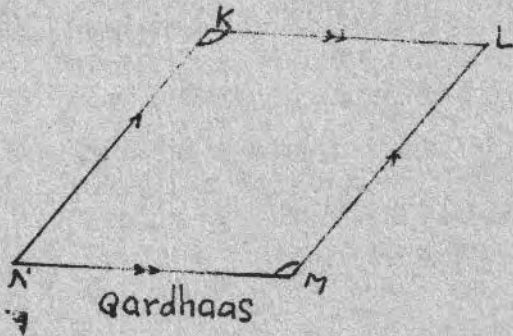
Koor Barbaroole

Qeex: Koori waa afargeesle ay laba dhinac oo iska soo horjeedaa ay barbarro yihiin.



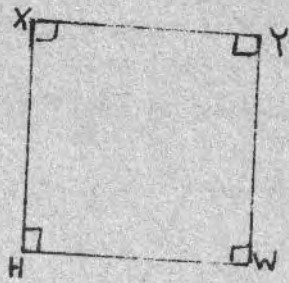
Qardhaas

Qeex: Qardhaastu waa afargeesle ay afartiisa dhinac isle'eg yihiin labadiisa dhinac ee kasta ee iska soo horjeedaane ay barbarro yihiin, hase yeeshee xaglo qumman ma laha.



Labajibbaarane

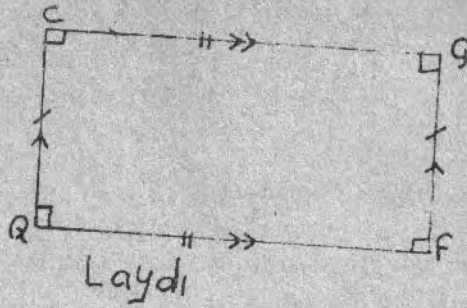
Qeex: Labajibbaarane waa afargeesle ay afartiisa dhinac isle'eg yihiin xaglihiisuna dhammaan qumman yihiin.



Labajibbaarane

Laydi

Qeex: Laydi waa farageesle ay labadiisa dhinac ee iska soo horjeedaaba isle'eg yihiin, barbarroona yihiin, xaglihiisoo dhammina qumman yihiin.

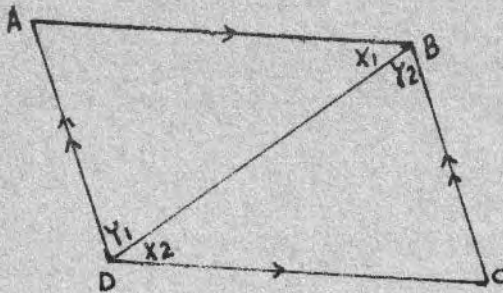


Barbarroolayaasha

Aragtiin:

Barbarroolaha labadiisa dhinac ee kasta iyo labadiisa xaglood ee iska soo horjeedaa waa isle'eg yihiin.

Ogaal: Waxaynu haysannaa barbarroole $ABCD$. Waa in la caddeeyo in (1) $AB = CD$, (2) $\angle B = \angle D$, $\angle A = \angle C$.



Dhismo: Isku xir xag!agooyaha BD .

Caddayn:

$\triangle ABD$, iyo $\triangle BCD$ tixgeli.

$x_1 = x_2$ (xaglo talantaali ah waayo $AB \parallel DC$)

$y_1 = y_2$ (xaglo talantaali ah waayo $AD \parallel BC$)

$BD = BD$ (astaanta isu noqodka)

$\triangle ABD \cong \triangle CDB$ (x. dh. x.)

$$1) \quad AB = CD, \quad BC = AD \quad (2) \quad A = C$$

$$\text{Talaabada } B = x_2 + y_2$$

$$= x_2 + y_1$$

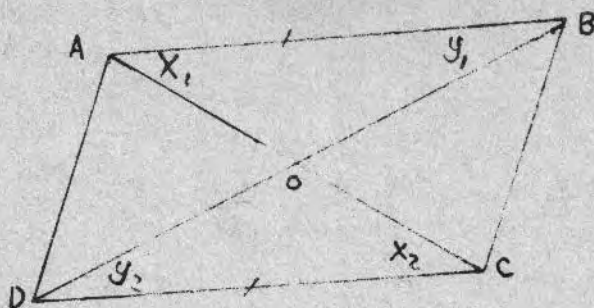
$$= \angle D$$

Xigasho: Mar haddii $\triangle ABD \cong \triangle CDB$, taasi waxay muujinaysaa in labada saddexagal bedkoodu isle'eg yahay. Markaa xaglagoooyuhu wuxuu u kala qaybiyaa barbarroolaha laba gobol oo isle'eg.

Aragtiin: Labada xaglagoooye ee barbarroole kastaa way is kala badhaan.

Qaadasho: Ka dhig in barbarroole ah ABCD ay xaglagoooyaaashiisu gooyaan barta O.

Waa in la caddeeyaa in : $AO = OC, \quad BO = OD$.



Caddayn:

$$x_1 = x_2 \quad (\sphericalangle \text{ lo talantaali ah})$$

$$y_1 = y_2 \quad (\sphericalangle \text{ lo talantaali ah})$$

$AB = CD$ (dhinacyada iska horjeeda ee barbarrooluhu way isle'eg yihiin)

$$\therefore \triangle AOB \cong \triangle COD \quad (\text{x. dh. x.})$$

$$\therefore AO = OC, \quad BO = OD$$

Gebagebo

Barbarroolaha:

- 1) Dhinacyada iska horjeedaa waa isle'eg yihiin
- 2) Xaglaha » » » » »
- 3) Dhinacyada » » » barbarro
- 4) Xaglagooyayaashu waa is kala badhaan.

Qardhaasta:

- 1) Afarta dhinac way isle'eg yihiin.
- 2) Xaglaha iska horjeedaa waa isle'eg yihiin.
- 3) Xaglagooyayaashu xaglo qumman bay iska gooyaan wayna is kala badhaan.
- 4) Dhinacyada iska horjeedaa waa barbarro.
- 5) Xaglagooyayaashu waxay kala badhaan xaglaha.

Labajibbaarane

Labajibbaaranuhu waxa weeye qardhaas gaar ah oo leh astaamaha qardhaasta, waxa weliba inta u dheer isago leh xaglo qumman.

Laydiga: Afarta qodob ee barbarroolaha oo dhammi waa ku run laydiga, waliba waxa intaa u dheer in uu leeyahay xaglo qumman.

Layli:

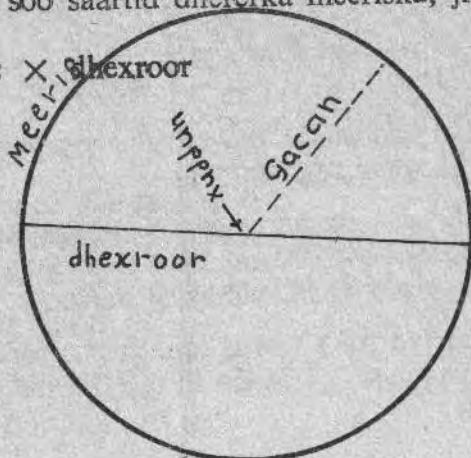
- 1) ABCD waa laydi ay $\angle BAC = 32^\circ$. Raadi xagasha DBC.
- 2) ABCD waa qardhaas ay $\angle ABC = 56^\circ$. Xisaabi $\angle ACD$.
- 3) Waxad caddaysaa inay xaglagooyayaasha qardhaasi iska gooyaan xaglo qumman.
- 4) ABCD waa barbarroole. CB ayaa loo fidiyey ilaa X, taasoo ay $BX = BC$. Haddaba waxad caddaysaa inuu AXBD yahay barbarroole.
- 5) ABCD iyo ABXY waa laba barbarroole oo dhinaca AB wadaaga. Caadee in XYDC uu yahay barbarroole.

- 6) ABC waa saddexagal, M-na waa bar ku dul taal BC badhtankeeda. Xarriiqda laga jeexo C ee la barbarro ah AB ayaa waxay kula kulantaa AM oo la fidiyey meesha lagu magacaabo X. Haddaba waxad caddaysaa inay $MX = MA$.
- 7) ABCD waa koor ay labadeeda dhinac ee barbarrada ahi yihiin AB iyo CD. X waxa weeye bar ku dul taal CD taasoo ay $CX = BA$. Markaa waxad caddaysaa inay AX iyo BC barbarro yihiin.
- 8) KQRS waa barbarroole. SK yaa loo fidiyey ilaa meesha X taasoo ay $KX = KS$, XR wuxu ka jaraa KQ barta Y. Haddaba waxad caddaysaa Y inay tahay badhtamaha KQ.
- 9) ABCD waxa weeye barbarroole. DM iyo BN waxa weeye qotomayaasha ka yimaada D iyo B siday u kala horreeyaan ee ku taagan xaglagooyaha AC. Markaa waxad caddaysaa in $BN = DQ$.

Goobo:

Qeex: Goobo waa gobol sallax ka mid ah, oo ku dhex jira xarriiq baraheedu in isle'eg u wada jiraan bar maguuraan ah oo isla sallax ku taal oo lagu magacaabo xuddunta goobada. Xarriiqdaa xoodan waxa la yiraa meeris. Xarriiqda meeriska iyo xuddunta isku xirta waxa lagu magacaabaa gacan. Xarriiqda laba barood oo meeriska ku yaal isku xirta iyadoo isla markaa xuddunta maraysa waxa la iyraa dhexroor. Haddaad rabtid inaad soo saartid dhererka meeriska, jidka loo maraa waa:

$$\text{Meeris} = \pi \times \text{dhexroor}$$



Summadda halkan ka muuqata (π) oo loo akhriyo (bay) $\frac{22}{7}$. Sida kale ee lagu soo

saaraa meeriska waxay tahay, meeris = $2\pi r$. Taasi waxba kama duwana jidka hore maxaa yeelay dhexroorku wuxu la mid yahay laba gacan.

Markaad doonaysid inaad soo saartid bedka goobadana jidkeedu wuxu yahay: $BED = \pi r^2$

Tusaale:

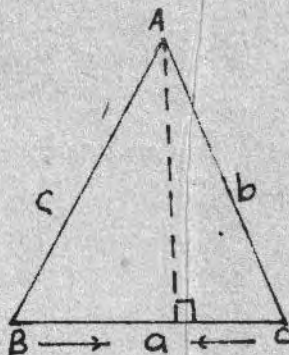
Muxuu noqonayaa bedka goobadu, haddii ga'ankeedu yahay 14 sm.

Furfuris:

$$\begin{aligned} BED &= \pi r^2 \\ &= \frac{22}{7} \times 14 \times 14 = 616 \text{ sm}^2 \end{aligned}$$

Bedka saddexagalka

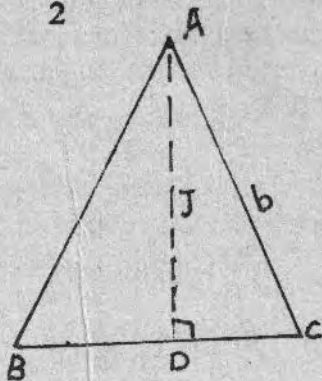
Saddexagalka ABC bedkiisu waa salka badhkiisa oo lagu dhuftay joogga. $BEDKA \triangle ABC = \frac{1}{2} BC \times J$



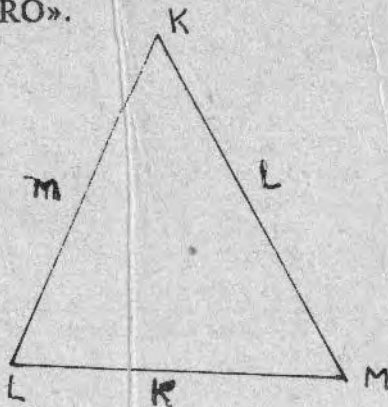
Saddexda dhinac mid kastaba wuxu noqon karaa sal, hase ye-
 eshee jooggiisu waxa weeye xarriiqda ka timaadda geeska xa-
 gasha ka soo horjeedda salka ee ku qotonta salka ama salka
 oo la fidiyey. Markaad jidka kor ka muuqda raacaysaa waa
 markaad haysatid salka iyo joogga, laakiinse way ka duwan
 tahay haddaad haysatid laba dhinac iyo xagasha u dhexaysa.

Jidka loo maraana wuxu yahay:

$$\begin{aligned} \text{BEDKA } \triangle ABC &= \frac{1}{2} ab \sin C, \text{ ama} \\ &= \frac{1}{2} ac \sin B, \text{ ama} \\ &= \frac{1}{2} bc \sin A \end{aligned}$$



Haddii aad haysatid seddexda dhinac oo qudha, jidka bedku
 waa jidkii uu soo saaray Masri ahaa xisaab yahan laguna ma-
 gacaabi jirey «HIRO».



Jidka Hiro wuxu yahay: 1

Bedka = $\sqrt{s(s-k)(s-l)(s-m)}$ taasoo ay
 $S = \frac{1}{2} (m+k+1) m$, k iyo 1 waa dhinacyada saddex-
agalka.

Tusaale:

Soo saar bedka saddexagalka haddii dhinacyadiisu yihiin sida soo socota:

$$a = 5 \text{ sm}, \quad b = 7 \text{ sm}, \quad c = 8 \text{ sm}.$$

Marka hore intaaranad shaqada bilaabin waa inaad fiiro gaar ah u yeelataa waxa lagu siiyey iyo waxa lagaa rabo, ka dibna aad raacdid dariiqada ugu haboon. Ta keliya ee inoo suuragelinaysaa inaynu soo saarro bedka saddexagalka kore waa innagoo raacna jidka Hiro.

$$S = \frac{1}{2} (5 + 7 + 8) \\ = 10 \text{ sm}.$$

$$\begin{aligned} \text{Bedka:} &= \sqrt{s(s-a)(s-b)(s-c)} \\ &= \sqrt{10(10-5)(10-7)(10-8)} \text{ sm}^2 \\ &= \sqrt{10 \times 5 \times 3 \times 2} \text{ sm}^2 \\ &= \sqrt{300} \\ &= 17.3 \text{ sm}^2 \quad \text{Jawaab} \end{aligned}$$

Layli:

Raadi bedka saddexagallada soo socda, adigoo raacaya dariiqada ugu haboon.

i.	$a = 7 \text{ sm},$	$b = 8 \text{ sm},$	$c = 9 \text{ sm}.$
ii.	$a = 5 \text{ sm},$	$b = 7 \text{ sm},$	$c = 6 \text{ sm}.$
iii.	$a = 5 \text{ sm},$	$b = 8 \text{ sm},$	$C = 40^\circ$
iv.	$a = 4.2 \text{ sm},$	$b = 3.3 \text{ sm},$	$c = 4.5 \text{ sm}$

$$\begin{aligned} \text{v. } a &= 40 \text{ m,} \\ \text{vi. } a &= 4 \text{ sm,} \end{aligned}$$

$$\begin{aligned} b &= 50 \text{ m,} & C &= 145^\circ \\ b &= 2.5 \text{ sm, } B &= 30^\circ \end{aligned}$$

Tusaalada II

Shaxankan halkan ka muuqda haddii bedkiisu yahay 15sm^2 , soo saar jooggiisa.

Furfuris:

$$\text{BEDKA } \triangle \text{ BRJ} = \frac{1}{2} \text{bj} \times \text{KT}$$

$$15 = \frac{1}{2} \times 6 \times x$$

$$15 = 3x$$

$$5 = x$$

Jooggiisu waa 5 sm.

Tusaale III

Soo saar qiimaha x ka dib markaad dhechatid saddex-agalka KLM.

$$\begin{aligned} \text{BEDKA } \triangle \text{ KLM} &= \frac{1}{2} \text{KL} \cdot \text{MN} \\ &= \frac{1}{2} \times 8 \times 3 \\ &= \frac{24}{2} \\ &= 12 \text{ sm}^2 \end{aligned}$$

$$\begin{aligned} \text{Ta labaad bedka KLM} &= \frac{1}{2} \cdot x \cdot 5 \\ &= \frac{5x}{2} \end{aligned}$$

$$\frac{5x}{2} = 12$$

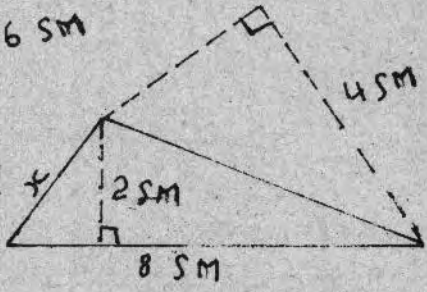
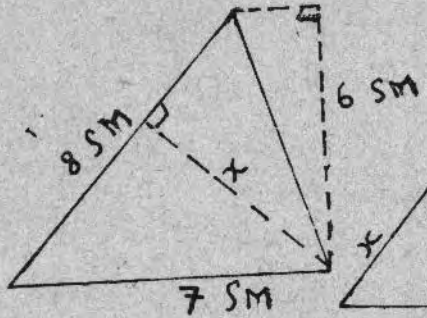
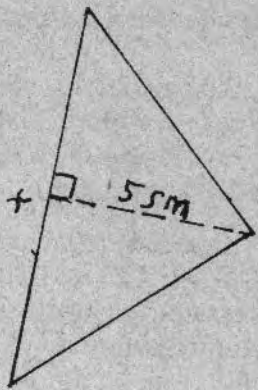
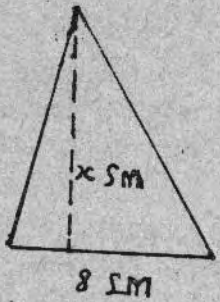
$$5x = 24$$

$$x = 4.8$$

Dhererka LM = 4.8 sm.

Layli:

Doon qiimaha X ee shaxan kastoo soo socda:

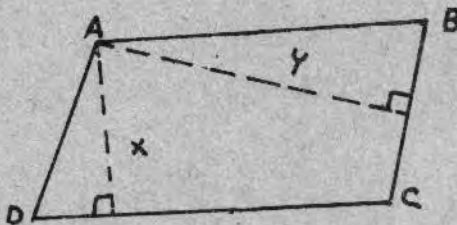


- 5) ABCD waa koor ay AB iyo CD barbarro yihiin. AD waa qotomaha AB. AB iyo DC dherekoodu waa 8 iyo 12sm sida ay u kale horreeyaan. $AD = 6\text{sm}$, $BD = 10\text{sm}$. Haddaba raadi qotomaha ka yimaadda C ee ku taagan BD.
- 6) X waa bar ku dul taal xarriiqda BC ee saddexagal-ka ABC, taasoo $BX = 3\text{sm}$, $XC = 5\text{sm}$. Haddii bedka $\triangle ABX$ uu yahay 9sm^2 , muxuu noqonayaa bedka $\triangle ABC$?
- 7) ABCD waa barbarroole uu bedkiisu yahay 36sm^2 . Dhinacyada AB iyo AD waxa weeye 9sm iyo 6sm siday u kale horreeyaan. DC ayaa loo fidiyey ilaa E, taasoo ay $CE = 7\text{sm}$. Doon bedka saddex-agallada BEC iyo AED.

Bedka barbarroolaha:

Barbarroolaha sidaynu hore u soo sheegnay waxa weeye afar geesle ay labadiisa dhinac ee iska horjeedaa barbarro yihiin, isna le'eg yihiin. Haddaba bedka barbarroole sida loo soo saaraa waxay tahay:

Taranka salka iyo dhererka jooggiisa. Labada dhinac ee DC iyo CB midkiiba wuxuu noqon karaa sal, hase yeeshee dhererrada joogaggu waa kala jaad. Haddaba bedka barbarrooluhu wuxuu noqon karaa: $DC \cdot X$ ama $CB \cdot Y$



Tusaale:

Barbarroole ayaa bedkiisu yahay 44m^2 . Haddaba muxuu noqonayaa jooggiisu, haddii salkiisu yahay 8m .

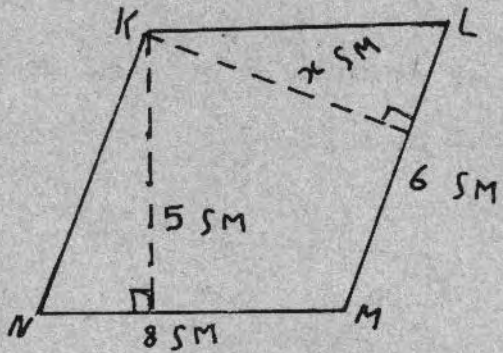
$$\begin{aligned}
 \text{Bed} &= \text{sal} \times \text{joog} \\
 &= 8 \times j \\
 8 \times j &= 44\text{m}^2 \\
 & \quad 44 \\
 j &= \frac{\quad}{8} \\
 \therefore j &= 5.5\text{m}
 \end{aligned}$$

Tusaale II

Doon qiimaha x ee shaxankan ku muujisan.

Furfuris :

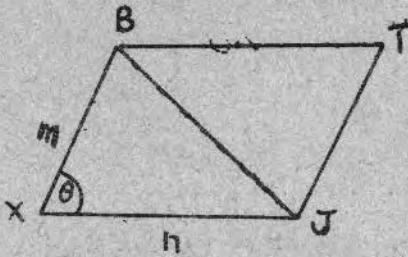
$$\begin{aligned}
 \text{Bedka barbarrooluhu} &= 8 \times 5 \\
 &= 40\text{sm}^2 \\
 6 \times x &= 40\text{sm}^2 \\
 & \quad 40 \\
 x &= \frac{\quad}{6} \\
 & \quad 2 \\
 x &= 6 \frac{2}{3} \text{ sm Jawaab} \\
 & \quad \text{—}
 \end{aligned}$$



Siyaabaha kale oo loo soo saari karaa bedka barbarroole waxa weeye sidan:

Bedka BJTX = mn sin Θ.

Markaad dariiqdan aad isticmaalaysaa waxa weeye kolkaad haysatid laba dhinac iyo xagasha u dhexaysa.



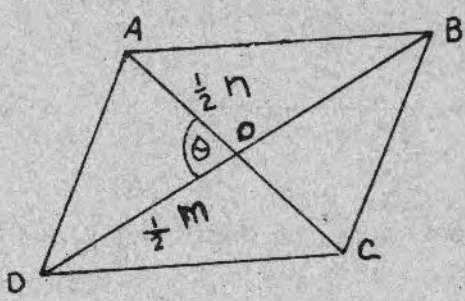
Haddaad jeexdid xaglagooyaha BJ, waxa kuu samaysmaya laba saddexagal oo isku sargo'an, markaa bedekooduna way isle'eg yihiin.

Sida aynu ku helnay jidkanna waxa weeye adigoo soo sara bedka BTJ iyo BJX, dabadeedna isu geeya.

$$\text{Bedka BTJ} = \frac{1}{2} mn \sin \theta.$$

$$\text{Bedka BJX} = \frac{1}{2} mn \sin \theta.$$

$$\begin{aligned} \text{Bedka BTJX} &= \frac{1}{2} mn \sin \theta + \frac{1}{2} mn \sin \theta \\ &= mn \sin \theta \end{aligned}$$



Haddii aynu haysanno labada xagagooye iyo xagasha u dhexaysa, dariiqada loo maraa waxay tahay sida soo socda: marka hore waxad la soo baxaysaa Bedka Δ AOD. Sida shaxanka ka muuqata.

$$\therefore \text{Bedka } \Delta \text{ AOD} = \frac{1}{2}n \times \frac{1}{2} \times \frac{1}{2}m \left(\frac{1}{2} \times \frac{1}{2}n \right) \sin \Theta.$$

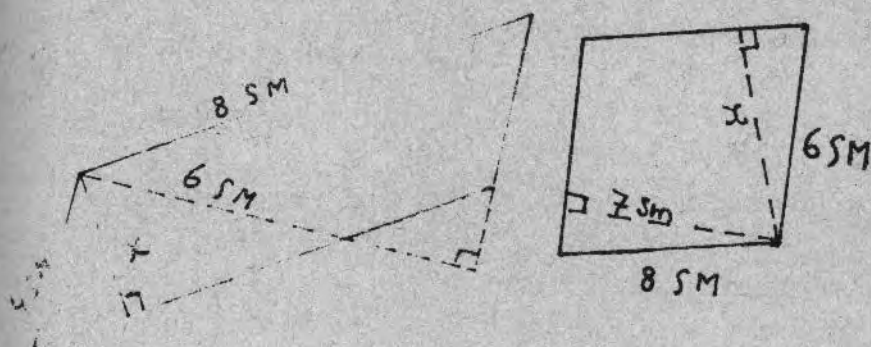
$$\begin{aligned} \therefore \text{Bedka } \Delta \text{ AOD} &= \frac{1}{2}n \times \frac{1}{2} \times \frac{1}{2}m \frac{1}{2} \times \frac{1}{2}n \sin \Theta. \\ &= \frac{1}{8}mn \sin \Theta. \end{aligned}$$

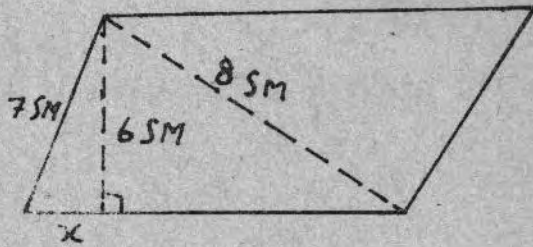
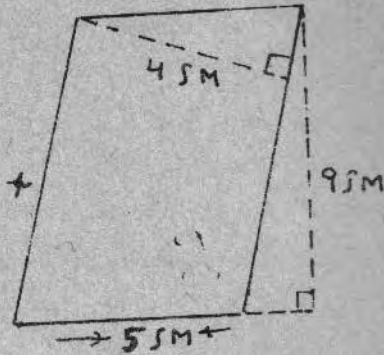
Laakiinse barbarrooluhu wuxuu ka kooban yahay afar saddexagal oo bededkoodu isle'eg yihiin. Markaa, bedka barbarrooluhu wuxuu le'eg yahay afarta saddexagal bededkooda oo la isu geeyey.

$$\begin{aligned} \text{Bedka } ||\text{le ABCD} &= \frac{1}{8}mn \sin \Theta \times 4 \\ &= \frac{1}{2}mn \sin \Theta \end{aligned}$$

Layli:

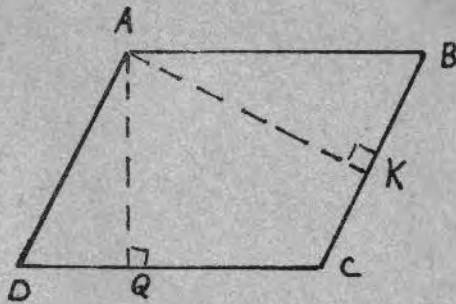
Doon qiimaha X ee barbarroolayaasha hoos ku sawiran.





- 5) Shaxanka hoose, AK iyo AD waxa weeye qotomaya-
 asha BC iyo DC. Markaa, haddii $AB = 7\text{sm}$,

$AQ = 3\text{sm}$, muxuu noqonayaa bedka \parallel ha ABCD?

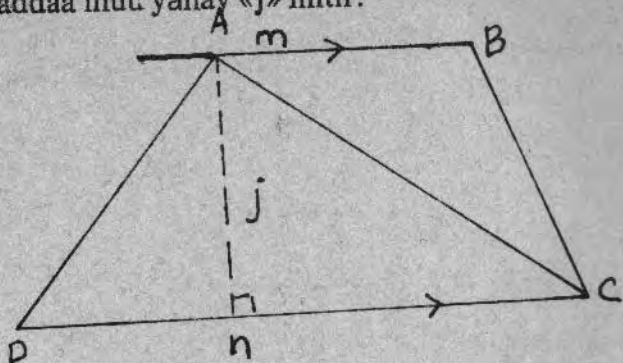


- 6) ABCD waxa weeye barbarroole. AM iyo AN waxa weeye qotomayaasha ku taagan BC iyo CD siday u kale horreeyaan. Haddii $AB = 6.3\text{sm}$, $AD = 4.9\text{sm}$, $AN = 4.2\text{sm}$, raadi bedka barbarroolaha, dabadeedna doon dhererka AM.
- 7) ABCD waxa weeye barbarroole ay $AB = 7\text{sm}$, $AD = 5\text{sm}$. AX iyo AY waxa weeye qotomayaasha ka yimaadda barta A ee ku taagan BC iyo CD siday u kale horreeyaan. Haddaba haddii $AY = 4\text{sm}$, doon bedka barbarroolaha, dabadeedna raadi dhererka AX.
- 8) Labada xaglagooye ee barbarroole ayaa dhererraddodu yihiin 10sm iyo 12sm . Bartay iska jaraan xagasha u dhexaysaana waa 124° . Markaa muxuu noqonayaa bedka barbarrooluhu?
- 9) Barbarroole ayaa dhinacyadiisu yihiin 4sm iyo 4.5sm , xagasha u dhexaysaana waa 123° . Raadi bedka barbarroolaha?

Koor:

Sidii hore aynu u qeexnay koortu waa afargeesle laba dhinac oo ka mid ah afartiisa dhinac ay barbarro yihiin. Haddaba bal aan gorfayno sida loo soo saaro bedka koorta oo ah: Taranka joogiisa, iyo wadarta labada dhinac ee barbarrada ah oo laba loo qaybshay.

Ka soo qaad in dhererka AB iyo CD ay yihiin «m» iyo «n» mitir siday u kala horreeyaan joogga qotomihiisuna waxad ka soo qaaddaa inuu yahay «j» mitir.



Waxad isku xirtaa AC. Haddaba bedka koorta ABCD = Bedka $\triangle ABC$ + bedka $\triangle ACD$

$$= \frac{1}{2} m j + \frac{1}{2} n j$$

$$= \frac{1}{2} j (m + n) \text{ ama } \frac{1}{2} (m + n) j$$

Waxad kale oo aad ku soo saari kartaa bedka koorta adigoo u kala qaybsha koorta barbarroole iyo seddexagal daba-deedna labada bed isu geeya.

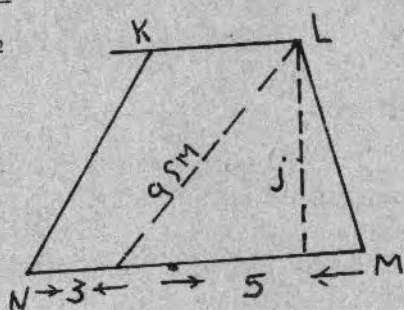
Tusaale II

Raadi bedka koorta KLMN?

$$\text{Bedka } \triangle LMN = \sqrt{11} (2 \times 3 \times 6) \text{ sm}^2$$

$$= \sqrt{396} \text{ sm}^2$$

$$= 19.9 \text{ sm}^2$$



$$\text{Laakiinse bedka } \Delta = \frac{1}{2} \times 5 \times j \rightarrow j = \frac{2}{5} \times 19.9 =$$

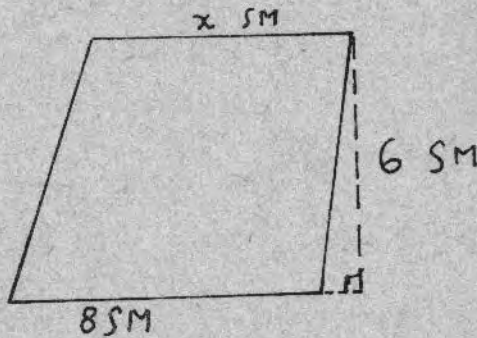
$$7.96 \text{ sm. Markaa bedka barbarooluhu} = 3j \\ = 3 \times 7.96 \text{ sm}^2 \\ = 23.88 \text{ sm}^2$$

$$\text{Bedka koorta} = 23.88 + 19.9 \text{ sm}^2 \\ = 43.78 \text{ sm}^2 \\ = 43.8 \text{ sm}^2$$

Tusaalaha II

Haddii shaxankan bidixda bedkiisu yahay 40.5 sm^2 , raadi cabbirraadda x.

$$\text{Bedka koortu} = \frac{1}{2} (x + 8) 6 \text{ sm}^2 \\ = 3 (x + 8) \text{ sm}^2 \\ = 3 (x + 8) = 40.5 \\ x + 8 = \frac{40.5}{3} = 13.5 \\ x = 13.5 - 8 \\ x = 13.5 - 8 = 5.5 \text{ sm}$$



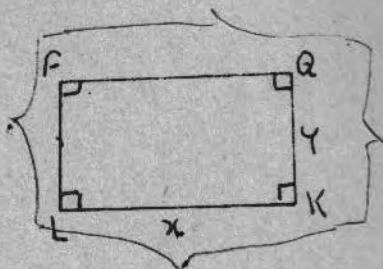
Laydi.

Laydiga bedkiisu waxa weeye taranka ballaarkiisa iyo dhererkiisa.

Haddii dhererku yahay x mitir ballarku-

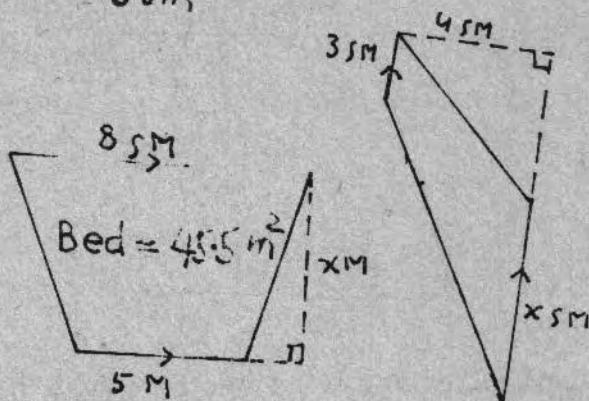
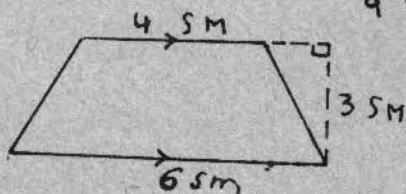
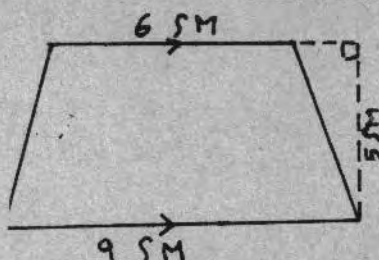
na «y» mitir, bedkiisu wuxuu noqonayaa sidatan:

Bedka laydiga = $xy \text{ m}^2$

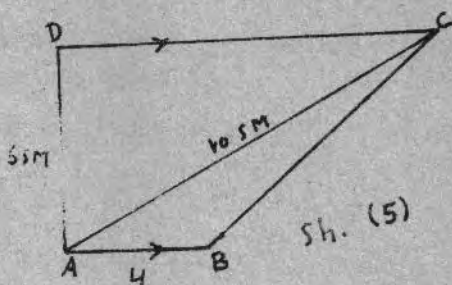


Layli:

Soo saar bedka kooraha hoos ku sawiran



- 5) Shaxanka 5aad, waxad raadisaa bedka $\triangle ABC$, iyo dhererka qotomaha ka yimaadda B ee qummaati ugu taagan AC.

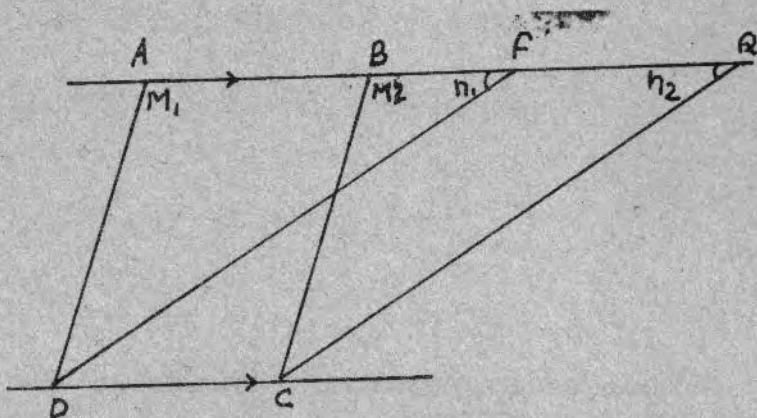


Xiriirka ka dhexeeya barbarroolayaasha, laydiga iyo barbarroolaha, laydiga iyo saddexagalka iwm.

BARBARROOLAYAASHA

Aragtiin I:

Haddii laba barbarroole ay isku sal yihiin, una dhexeeyaan laba xarriiqood oo barbarro ah, markaas bedekoodu waa isle'eg yihiin.



Ogaal: Waxaynu haysannaa labada barbarroole ee ah ABCD iyo FQCD oo isku sal ah (CD) una dhexeeya labada barbarro ee kala ah AQ iyo CD.

In la Caddeeyo: In bedka \parallel le ABCD = bedka \parallel le FQCD.

Caddayn: Saddexagallada AFD iyo BQC,

$$m_1 = m_2 \quad (\text{xaglo gudboon})$$

$$n_1 = n_2 \quad (\text{xaglo gudboon})$$

AD = BC (dhinacyada iska horjeeda ee \parallel le =)
 Δ AFD \cong Δ BQC (x. dh. x)

$$\Delta$$
 AFD = Δ BQC

$$\parallel$$
le FQCD = \parallel le ABCD.

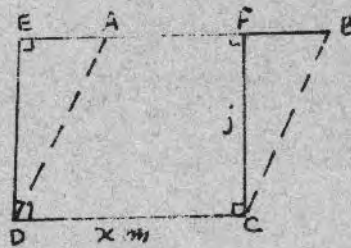
Xigasho:

Haddii barbarroole iyo laydi ay isku sal yihiin una dhexeeyaan laba xarriiqood oo barbarro ah, markaa bedekoodu waa isle'eg yihiin. Bedka \parallel le ABCD = bedka laydiga EFCD sababtoo ah, bedka \parallel laha oo ah:

$$DC \cdot j = \text{bedka laydiga}$$

$$= CD \cdot j$$

$$X \cdot j = X \cdot j$$

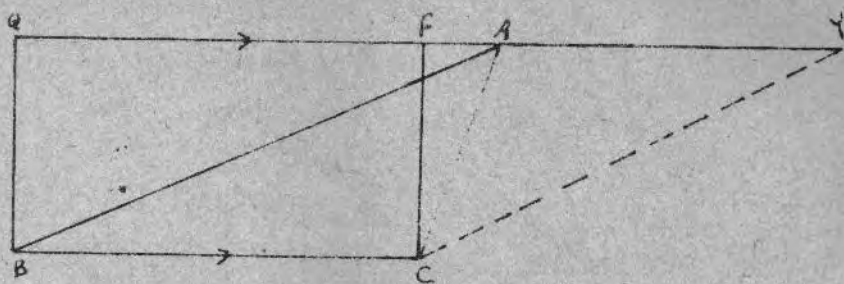


Sidaad u caddaynaysaana waxba kama duwana sidii aynu u caddaynay barbarroolayaasha.

Aragtiin II

Bedka saddexagal wuxu le'eg yahay badhka bedka lay-

di ay isku sal yihiin una wada dhexeeyaan laba xarriiqood oo barbarro ah.



Ogaal: Waxaynu haysannaa saddexgal ABC iyo laydi FQBC, oo isku sal ah una dhexeeya labada xarriiqood ee barrada ah (AQ iyo LB)

In la caddeeyo : In bedka $ABC = \frac{1}{2}$ FQBC

Caddayn: Markaad dhammaysid barbarroolaha ABCY, waxad halaysaa in bedka $\triangle ABC = \frac{1}{2}$ bedka ABCY, maxaa yeelay, xagiagooyuhu wuxu kala badhaa barbarroolaha ABCY = bedka laydiga FQBC [waa isku sal (BC), xarriiqo || ahna waa u dhexeeyaan. (FQ iyo BC)]

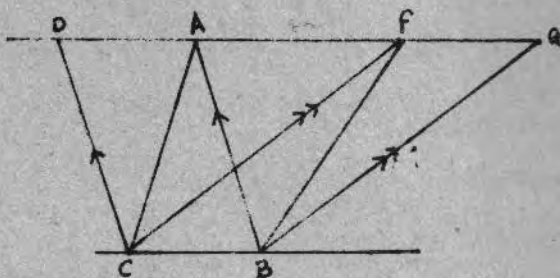
Bedka $ABC = \frac{1}{2}$ bedka laydiga FQBC

SADDEXAGALLO

Aragtiin:

Saddexagallada isku salka ah ama salalkoodu isle'eg yihiin, oo waliba u dhexeeya laba xarriiqood oo barbarro ah,

bedadkoodu way isle'eg yihiin. \parallel waxaynu caddaynayaan qaybta hore ee aragtiinka.



O g a a l: $\triangle ABC$ iyo $\triangle FBC$

oo ku wada yaal sal kaliya oo ah BC, una dhexeeya xarriiqyo barbarro ah oo kala ah AF iyo CB.

Waa in la caddeeyaa: In $\triangle ABC = \triangle FBC$.

Dhismo: Waxad samaysaa xarriiqda $CD \parallel AB$ iyo $CF \parallel BQ$, dabeedna dhammaystir barbarroolaha ABCD iyo FQBC.

C a d d a y n: $ABC = \frac{1}{2} DACB$ (xaglagoooyuhu waa kala badhaa \parallel aha)

$= \frac{1}{2} FQBC$ (waa isku sal xarriiqo \parallel ahna waa u dhex.)

$= \triangle FBC$ (xaglagoooyuhu waa kala badhaa \parallel ha)

Qaybta labaad ee saddexagallada isa sal le'eg una dhexeeya xarriiqo barbarro ahi waa is bed le'eg yihiin waxa loo caddayn karaa sida hore oo kale.

L a y l i:

- 1) Xarriiq la barbarro ah dhinaca BC ee saddexagalka ABC ayaa wuxu ka gooyaa AB iyo AC meelaha kala ah F iyo Q siday u kale horreeyaan.
Caddee inuu $\triangle BCQ = \triangle BCF$.

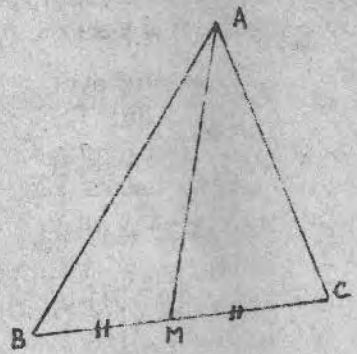
- 2) Laba xarriiqood oo toosan ayaa waxay iska gooyaan barta O. Haddii AC ay la barbarro tahay BD, waxad caddeysaa in $\triangle BOC = \triangle BOD$.
- 3) ABCD waa barbarroole. F waa bar ku taal badhtamaha BD. Markaa waxad caddaysaa in $\triangle FAD = \triangle FBC$.
- 4) H iyo K waa laba barood oo ku yaal badhtamaha dhinacyada AB iyo AC ee saddexagalka ABC. Haddaba waxad caddeysaa in bedka saddexagal-layaasha BHK iyo CHK ay isle'eg yihiin.
- 5) M waa bar ku taalla badhtamaha QR ee saddexagalka FQR. A waa bar ku taalla meel ka mid ah xarriiqda FM. Caddee in bedka saddexagallayaasha AFQ iyo AFR ay isle'eg yihiin.
- 6) Saddexagal ayaa bedkiisu le'eg yahay laydi dhinacyadiisu yihiin 10sm, iyo 9sm. Haddaba, haddii salka saddexagalku yahay 12 sm, muxuu noqonayaa joogga saddexagalku?
- 7) F waa bar ku taalla meel ka mid ah xarriiqda AB ee laydiga ABCD. Haddii $AB = 11$ sm, $AD = 8$ sm, waxad doontaa wadarta bedadka saddexagalada AFD iyo BFC.

Dhexfurka Saddexagalka

Qeex: Dhexfurka saddexagalku waa xarriiqda isku xirta xagal iyo badhtamaha dhinaca ka soo horjeeda xagasha.

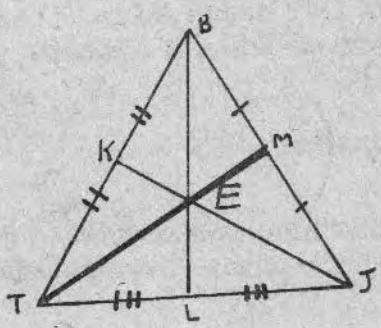
Dib markaad u dheehatid $\triangle ABC$, AM wuxu noqonayaa dhexfurka $\triangle ABC$, maxa yeelay intuu ka yimaaddo xagasha A ayuu laba xarrijimood oo isle'eg u qaybshaa dhinaca BC. Intaa dabadeed. $\triangle ABM$ iyo $\triangle ACM$ salalkoodu way isle'eg

yihiin, waana isku joog, marka bedadkooduna waa isle'eg yihiin.



Gundho:

Qeex: Gundho waa meesha ay saddexda dhexfur ee saddexagalku ay ku kulmaan. Saddexda dhexfur ee kala ah BL, KJ iyo TM meesha ay ku kulmaan oo ah E ayaa la yiraa gundhada saddexagalka BTJ.



Gundhadu waxay u qaybisaa dhexfurka saami ah 2 : 1, taasoo ah fogaanta gundhada iyo geeska u dhexaysaa waa labanlaabka fogaanta u dhexaysa gundhada iyo badhtamada dhinaca ka soo horjeeda geeska.

Tusaale:

$$BE : EL = TE : EM = JE : EK = 2 : 1$$

Mugga Adke:

Adkeyaasha aynu rabno inaynu soo saarno muggooda waxa ka mid ah: Toobinka, gunburta, dhulubada, iyo salxaalaha. Sida ugu fudud ee aynu ku kala saari karna waxay tahay inagoo marka hore muujinna shaxannadooda dabadeedna fiirinna waxay ku kala duwan yihiin.

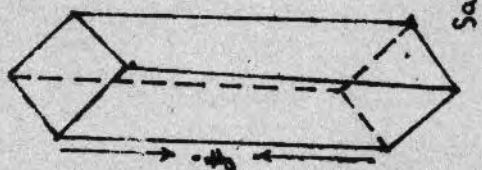
Mugga salxaale iyo dhululubada.

$$\text{Mug}_{\text{salx}} = \text{Mug}_{\text{dhul}}$$

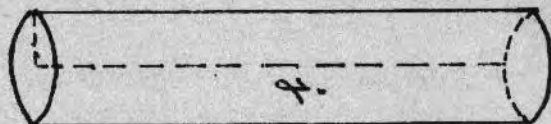
haddii bededka salalkoodu iyo joogoodu isle'eg yihiin:

$$\text{Mug}_{\text{salx}} = \text{Bedka Salka} \times \text{Joogga}$$

$$\text{Mug}_{\text{dhul}} = \text{Bedka Salka} \times \text{Joogga}$$



$$\text{Mug (salx)} = \text{Bedka Salka} \times \text{Joogga}$$



$$\text{Mug (dhul)} = \text{Bedka Sal.} \times \text{Joogga}$$

Dhululubada iyo salxaalaha aynnu rabno inaynu ka sheekayno waa kuwa qumman. Iraminka la inoogama baahna

inaynu gorfayno oo aan aad ugu soo gonda degno sida loo soo diiro jidka muggooda; tan keliya ee la inaga rabaa waxay tahay inagoo baranna mid walba mugeeda, dabadeedna ku dabagna laylisyadooda.

Jidka mugga dhululubada iyo salxaalaha:

$$\text{MUG} = \text{BEDKA SALKIISA} \times \text{JOOGGIISA.}$$

Tusaale:

Muxuu noqonayaa joogga salxaale qumman oo bedka salkiisu yahay 12sm^2 , muggiisuna yahay 240sm^3 .

Waxad ka soo qaaddaa inay J tahay jooggiisa, markaa jidka mugga salxaalaha:

$$240\text{sm}^3 = 12\text{sm}^2 \times J$$

$$m = B_s \times J$$

$$240\text{sm}^3$$

$$J = \frac{\quad}{\quad}$$

$$12\text{sm}^2$$

$$20\text{sm}$$

$$J = \frac{\quad}{\quad}$$

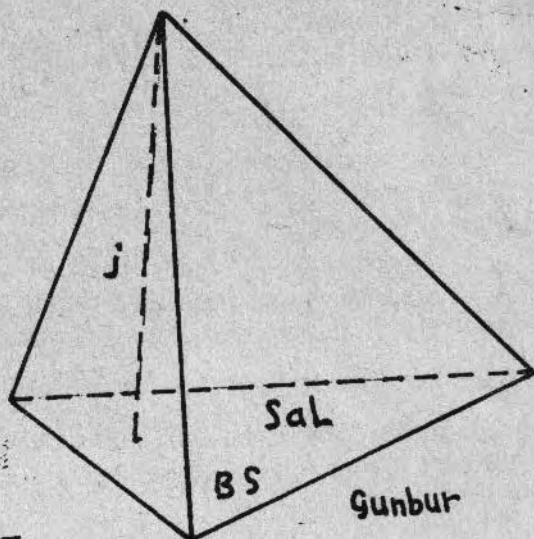
Layli:

- 1) Dhululubo ayaa bedka salkeedu yahay 4 m^2 , mugeeduna yahay 12m^3 . Haddaba muxuu noqonayaa joojgeedu?
- 2) Soo saar joogga dhululubo mugeedu yahay 30sm^3 , haddii addimaha salkeeda oo qaab laydi leh ay yihiin 5 sm iyo 3 sm ?
- 3) Raadi mugga salxaale qumman, haddii bedka salkiisu yahay 6 sm^2 , jooggiisuna yahay 10 m ?
- 4) Dhuun dhererkeedu yahay 100 m , ayaa mugeedu yahay 4m^3 . Doon bedka salkeeda.
- 5) Berked addimaha salkeedu yihiin 5m iyo 4m baa biyo lagu shubay ilaa joojgeedu gaaray 3 mitir. Soo saar mugga berkedda haddii ($1\text{ml} = 1\text{sm}^3$).

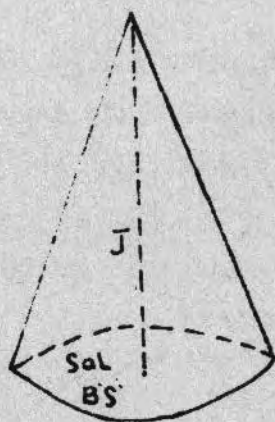
- 6) Haddii halka kalluun ahiba uu u baahan yahay 2 litir oo biyo ah, immisa kalluun ayaa ku noolaan kara berked biyo ka buuxaan oo addimaheedu yihiin 2, 15 iyo 1.5m ?
- 7) Laba dhululubo oo gacannadoodu kala yihiin 5m iyo 5.6m ayaa gudaha isugu jira. Soo saar mugga inta labadooda u dhexaysa.
- 8) Dhululubo dhererkeedu yahay 50sm ayaa muggaedu yahay 900sm³. Haddaba soo saar bedka salkeeda.
- 9) Muxuu noqonayaa dhererka salxaale muggiisu yahay 11.28 sm³, bedka salkiisuna yahay 0.05 sm²?
- 10) Soo saar ballaca salxaale salkiisu qaab laydi yahay haddii muggiisu yahay 5 waar dhererkiisuna 40 fdh, jooggiisuna 9 hiish?

Mugga Toobin iyo Gunbur

Mugga toobin iyo gunbur waa isle'eg yihiin, haddii salalkoodu iyo jooggoodu isku cabbirraad yihiin, maxaa yeelay, jidka lagu soo saaro muggooda ayaa isku mid ah (sida mugga sallxaalaha iyo dhululubo). Daruuri ma'aha in aynu si tafatiran u dhexgallo oo aynu ogaanno sida loo soo diiray jidka muggooda, hase yeeshee waxa lagama maarmaan ah in aad taqaanid muuqooda iyo jidka loo maro labadaba. Gunburuhu dhowr muuq bay yeelan karaan, hase yeeshee ta aynu rabno in aynu halkan ku falanqayno waa tan salkeedu qaab saddexgal yahay.



\bar{v}
 MUGGA = $\frac{1}{3} \times \text{bedka salkiisa} \times \text{jooggiisa.}$



Toobin

MUGGA = $\frac{1}{3} \text{bedka sal} \times \text{jooggiisa}$

$$M_t = \frac{1}{3} B_t \times J$$

$$M_g = \frac{1}{3} B_g \times J$$

$$M_g = M_t, \text{ haddii } B_g = B, J = J$$

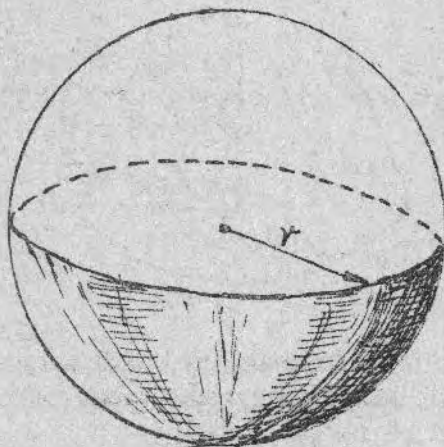
Mugga kubbad

Jidka mugga kubbadda wuu ka duwan yahay ka adkeya-asha kale oo dhan, kaasoo ah:

Mug = $\frac{4}{3} \pi r^3$, $\frac{4}{3}$ iyo π (bay) labaduba waa madoorso-omeyaal «r» na waxay u taagan tahay gacanka kubbadda.

Haddii aad haysatid labada doorsoome midkood, markaa way fudud dahay kan kale helistiisu.

Mugga kubbadda

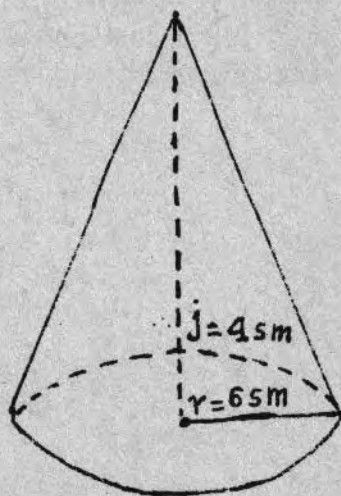


Kubbada

r waxay u taagan tahay gacanka kubbadda

Layli:

- 1) Soo saar mugga kubbadda dhexroorkedu yahay 8sm.
- 2) Soo saar mugga berked kubbad oo kale ah, haddii gacankeedu yahay 7 mitir.
- 3) Muxuu noqonayaa joogga gunbur bedka salkeedu yahay 11sm^2 ?
- 4) Soo saar joogga toobin gacankiisu yahay 5sm, mug-giisuna 500sm^3 .
- 5) Muxuu noqonayaa bedka gunbur jooggeedu yahay 1 fdh. muggeeduna 432hiish^3 ?
- 6) Soo saar mugga toobinka halkan ka muuqda.



- 7) Immisa litir oo biyo ah bay qaadi karaysaa berked toobin ah, haddii jooggeedu yahay 30m, gacankeeduna 14m ($1\text{ml} = 1\text{sm}^3$)

Cutub III

TIRIGNOOMETERI

Arar:

Ereyga «TIRIGNOOMETERI» waxuu ka yimi afka Giriiga, wuxuuna la mid yahay (tirigoon oo ah saddexagal iyo meri oo ah cabbiraad). Markii u horreysay oo la hirgeliyo xisaabta tirignoometerigga waxay ahayd 1595. Waagii hore tirignoometeriga waxa lagu isticmaali jiray xagga cilmiga xaddigiska iyo badmaaxidda.

Tirignoometerigu waa laan ka mid ah cilmiga xisaabta oo lagu isticmaalo furfurista saddexagallo. Hab kasta ha loo raaco furfuristaase, lix saami dhinacyo oo qudha ayaa ka dhasha. Barashada fikrad xisaabeedka lixdaa saami iyo sida loogu adeegsanayo layliyada xisaabeed ayay ku kooban tahay tirignoometerigu.

Si aynu u garanno sida loo soo saaro saamiyadaas waxa lagama maarmaan ah in aynu isticmaallo qeexo iyo sharciyo. kuwaasoo ku tifatiran xubnaha soo socda:

KULANNO IYO TIRIGNOOMETERI

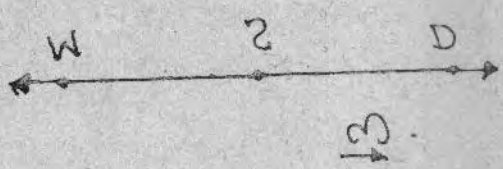
Fallaadho, Xaglo iyo Baro.

Bar kasta oo xarriiq ku taal, sida barta S ee xarriiqda L, (eeg sh 1), waxay xarriiqda u qaybisaa laba fallaadhood oo

→ →

kala jeeda, sida V iyo W, oo midkiiba bar bilawgiisu (geeskiisu) yahay S. Fallaadh waxa lagu muujiyaa laba barood

oo midi tahay geeska. Matalan, sh. 1, V waa fallaadha SM, W-na waa fallaadha SD.

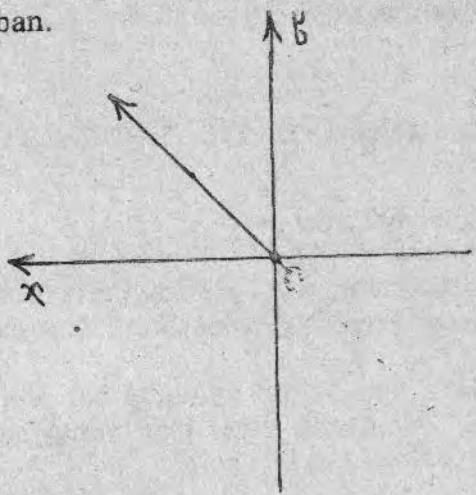


Fallaadh waa lagu muujin karaa kulannada habdhisan sida garaafka xarriiq toosan oo kale.

Tusaale ahaan: $\{(x, y) | y = 2x, x \geq 0\}$ garaafkiisu waa fallaadh ku taal waaxda kowaad oo geeskeedu yahay unugga (eeg sh. 2) fallaadha ka jeedda garaafkeeduna waa:

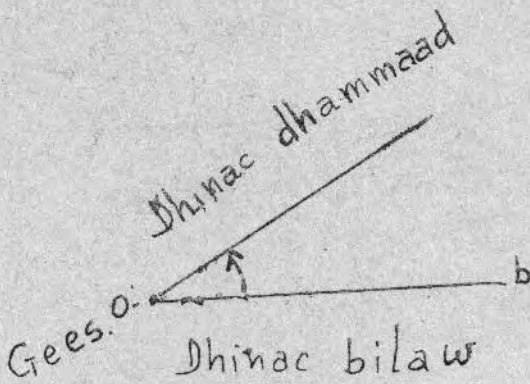
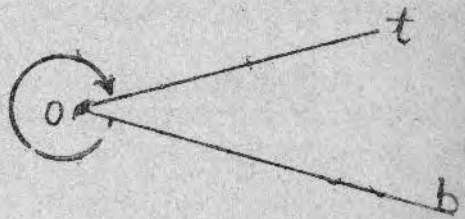
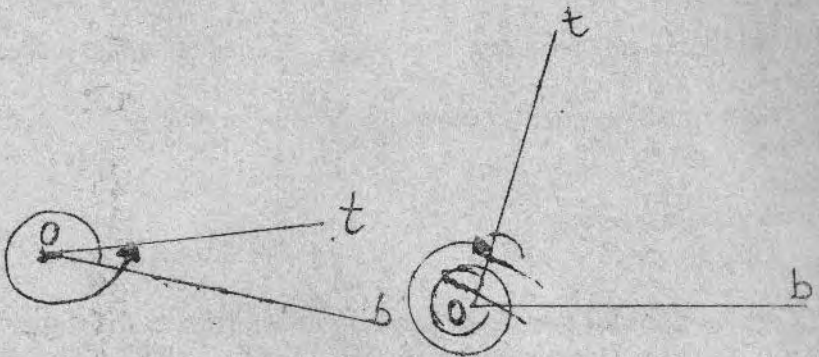
$$\{(x, y) | y = 2x, x \leq 0\}.$$

Ururka baraha ka koobma laba fallaadhood oo gees wadaag ah, oo uu la jiro waniinis fallaadhaha midkood u genaya ta kale, waxa la yiraa xagaljihar ama xagal. Waniinis lid saacad-wareeg ahi wuxuu dhaliyaa xagal togan, ka saacad-wareeguna xagal taban.



Shaxanka 2.

Shaxanka 3, fallaadha b waa dhinac bilawga, fallaadha t-na waa dhinac dhammaadka. Barta 0 waa geeska xagasha.



Shaxanka 3.

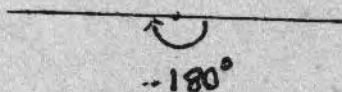
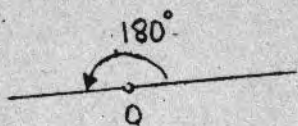
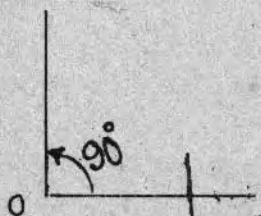
Waniinis lid-saacad wareeg

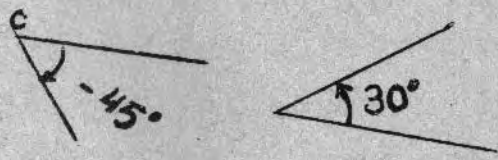
Waniinis saacad wareeg

Halbeeg cabbiraadeedka caadiga ah ee xagali waa digirii, loona qoro 1° . Kow digirii waa $\frac{1}{360}$ waniiniska buuxa ee bar lid saacad-wareeg u socota. Digiriiga waxa loo qaybiyaa minityo iyo sekenyo: $1 \text{ minit} = 1' = \frac{1}{60}$ digirii;

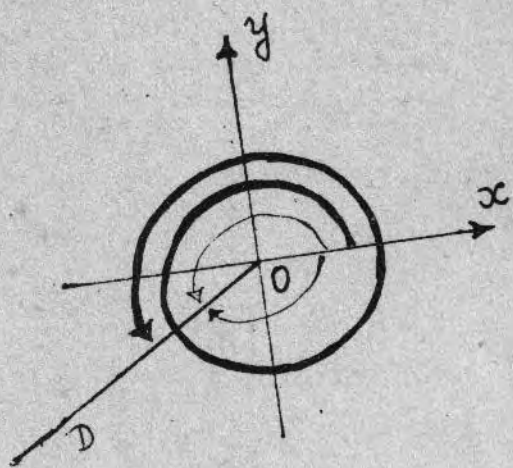
$1 \text{ seken} = 1'' = \frac{1}{60}$ minit.

Xaglaha hoos ku muujisan waa kuwa cabbiraadoodu yihiin 30° (loo akhriyo "sodon digirii"), 90° , 180° , -180° , -45° , iyo 360° .





Xaglihii isku dhinac bilaw iyo isku dhinac dhammaad ah waxa la yiraa Xaglo dhammaad wadaag ah. Bar kasta 0 oo kaga taal sallaxa — xy , meel aan ahayn unugga, waxay sugtaa urur xaglo tiradhaaf ah oo ah dhinac dhammaad wadaag, xagal kastana geeskeedu waa unugga, dhinac bilawgeedu waa dhanka togan ee dhidibka — x , fallaadha OD -na waa dhinac dhammaadka xagasha. Xagal kasta oo kuwaas ka mid ah ama la tastuur ahba waxa la yiraa xagal rug beeggaal ah. U fiirso in cabbirraada xaglaha dhinac dhammaad wadaaga ah oo ku yaal rug beeggal ay ku kale gaddisan yihiin dhufsane 360° . (sh. 5 eeg).



Shaxanka 5

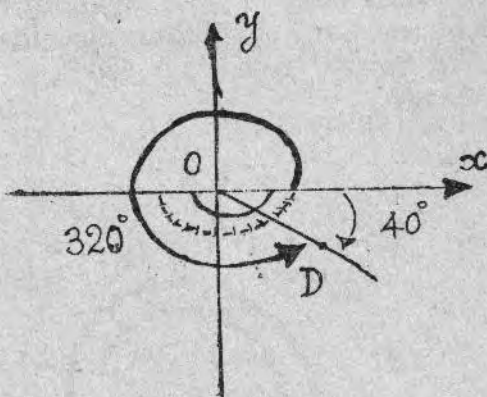
Haddii aad taqaan cabbirka xagal rug beeggal taalla iyo dhererka OD , markaa xagasha waad ku bar muujin kartaa sal-laxa $-xy$.

Tusaale:

Bar muuji barta D , haddii $OD = 3$, cabbirka xagal ka mid ah xaglo ruggeedka D -na yahay -40° . Sheeg, muujina cabbirka xagal ruggeedka togan ee D .

Furfuris:

- 1) Adoo isticmaalaya xagal-beeg sawir fallaadha q , taaso la samayneysa dhidibka $-x$ togan xagal cabbirkeedu yahay -40°
- 2) q ka cabbir 3 halbeeg laga bilaabo 0 . Barta aad gaartay waa D .
- 3) Xagal ruggeedka togan ee D waa $(-40^\circ + 360^\circ)$, ama 320°



Shaxanka 6

Layii:

- b) Adoo isticmaalaya fogaanta lagu siiyay ee ka bilaabanta unugga, muuji barta leh xagal ruggeedka cab-

hirkeeda lagu siiyay. Muuji, sheegna cabbirka laba xaglood oo kale, mid togan iyo mid taban, oo iyaguna ah xaglo rugeedka bartaa.

- 1) 2 (fogaanta laga bilaabo unugga); 180° (cabbir xaxal)
- 2) 3 ; 210°
- 3) 4 ; 60°
- 4) 3 ; 70°
- 5) 5 ; -40°
- 6) $\frac{3}{2}$; -320°
- 7) 1 ; -60°
- 8) $\frac{5}{2}$; -225°
- 9) $3\frac{1}{2}$; 720°
- 10) $\frac{1}{4}$; -540°
- 11) 0 ; 140°

Sawir fallaadha ah garaafka urur kasta oo soo socda, muujina xagal rugeed togan iyo mid taban oo uu garaafku dhinac dhammaadka u yahay.

$$12) \left\{ (x,y) : y = \frac{1}{2}x, x \geq 0 \right\}$$

$$13) \left\{ (x,y) : y = \frac{1}{3}x, x \leq 0 \right\}$$

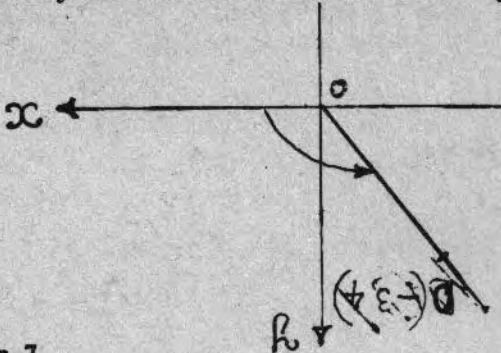
$$14) \left\{ (x,y) : y = -4x, x \leq 0 \right\}$$

$$15) \left\{ (x,y) : y = -5x, x \geq 0 \right\}$$

$$16) \left\{ (x,y) : x = 0, y \leq 0 \right\}$$

$$17) \left\{ (x,y) : y = 0, x \leq 0 \right\}$$

Haddii barta D ay leedahay kulannada la isa siiyay, sawir fallaadha OD, sheeg urur ay OD garaaf u tahay, muujina xagal rugeedka ay OD dhinac dhammaadka u tahay.



Shaxan 7

Tusaale: A (-3,4)

Furfuris:

$$\text{Tiirada OD} = -\frac{4}{3}$$

\therefore Fallaadha OD waa garaafka $\left\{ (x,y) : y = -\frac{4}{3}x, x \leq 0 \right\}$

18) (6,8)

19) (12,4)

20) (-1, -2)

21) (-3, 2)

22) (-5, 10)

23) (0, -2)

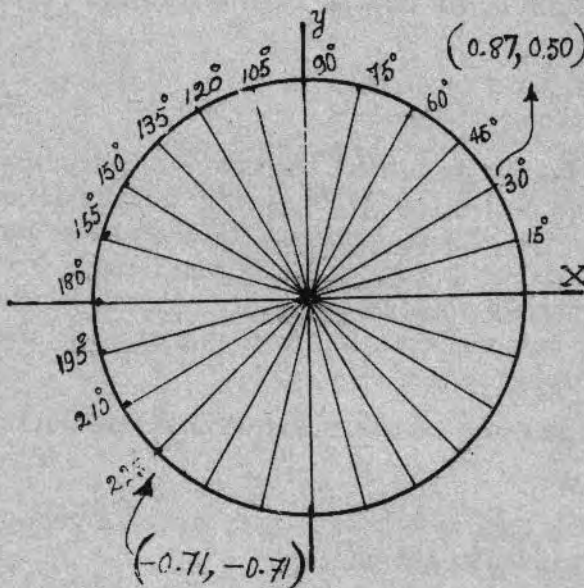
24) Sharax sababta cabbirraada xaglo dhammaad wada-ahii oo rug beeggal ku yaal ay ugu kala gaddisa-naadeen dhufsane 360° .

25) Sharax rogga layliska 24.

4 — 2 Fansaarrada Sayn iyo Koosayn:

Tixgeli bar, D, oo ku waniinaysa goobo gacankeedu le'eg yahay 1, xuddunteeduna ku taal unugga. Haddii D ka dhaqaaqdo barta (1,0) ayadoo u socota lid saacad wareega, markaa cabbirka xagal rugeedkeedu wuxuu qaadanayaa qiimeyaasha min 0° ilaa 360° (eeg sh. 8). Haddii aynu u oggolaanno D in ay socodkeeda lid saacad-wareeg ugu noqnoqoto goobada hal beeg, iyo haddii ay jiho saacad-wareeg socodkeeda u waddaba, mar kasta waxan heleynaa xagal rugeed cabbirkeeda digirii uu ku beegan yahay lammaanayaal horsan oo tiro maangal ah (a,b).

Cabbirka	a.	b.
0°	1	0
15°	0.97	0.26
30°	0.87	0.50
45°	0.71	0.71
90°	0	1
180°	-1	0
225°	-0.71	-0.71
270°	0	-1
360°	1	0



Shaxan 8.

Ka soo qaad in xarafka Giriigga ah Θ teyta uu yahay doorsoome qaadan kara qiime kasta oo ururka dhammaan xagal rugeedyada sallaxa ku yaal. Marka D ku wareegayso goobada, Θ waa beddelmaysaa, isla markaa kulannada ku beegan Θ , (a,b), waa beddelmayaan, bishardi in $\sqrt{a^2 + b^2} = 1$. Dhab ahaan, xagal kasta Θ waxaa u jira lammaane madi ah (a,b) oo ku beegan. Shaxanka 8 waxaad ku aragtaa kulannada 30° iyo 225° oo seeban.

Ururka dhammaan lamaanayaasha (Θ , b) (oo lagu sugay $b = \sqrt{1 - a^2}$) waxa la yiraa **fansaarka saynka**; ururka dhammaan lamaanayaasha (Θ , a) waxa la yiraa **fansaarka koosaynka**.

Ma aragtaa in Θ ay ku tirsan tahay ururka xaglo rugeed, a iyo b ay yihiin tirooyinka maangal ah oo u dhaxeeya -1 iyo $+1$ ku jirid?

Xagal kasta Θ , waxan qiimayaasha fansaarradeeda nira «saynka xagal Θ » iyo «koosaynka xagal Θ » sida qeexda soo socotaa qabto. Qeex (1) ka soo qaad in Θ tahay xagal kasta oo rug beeggal.

Haddii (a, b) ay muujinayso kulannada bar hal cabbirraadeed u jirta unugga kuna taal dhinac dhammaadka Θ , marka:

$$\text{Koosayn xagal } \Theta = a$$

$$\text{Sayn xagal } \Theta = b$$

Waxa loo soo gaabshaa Cos Θ iyo Sin Θ say isugu xigaan. U fiirso in (Cos Θ , Sin Θ) ay yihiin kulannada barta goobada halbeeg iyo dhinac dhammaadka Θ ay iska jaraan. Haddii lagu siiyo bar kasta T oo ka duwan unugga, kuna taal dhinac dhammaadka xagal Θ oo ah rug beeggal, markaa waad sugi kartaa kulannada barta D oo ah isgoyska fallaadha OT iyo goobada hal beeg, $x^2 + y^2 = 1$.

Taasoo ah waad heli kartaa Cos Θ iyo Sin Θ .

Fiiro:

Isle'egta $x^2 + y^2 = 1$ waa garaafka goobo hal beeg. Isku day inaad kastid taas.

$$(x, y) = (a, b)$$

Tusaale:

T (-4, 3) waa bar ku taal dhinac dhammaadka xagal rugga θ . Hel Cos θ iyo Sin θ .

Furfuris:

Ka dhig in D tahay barta isgooyaska OT iyo goobada $x^2 + y^2 = 1$.

- 1) Fallaadha OT waa garaafka :

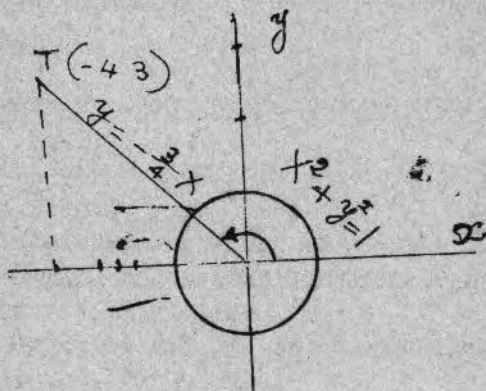
$$\left\{ (x, y) : y = -\frac{3}{4}x, x \leq 0 \right\}$$

- 2) Kulannada D waa inay raalligeliyaan saddexdan we-
edhood ee Furan:

$$x^2 + y^2 = 1$$

$$y = -\frac{3}{4}x$$

$$x \leq 0$$



- 3) Markaa $x^2 + y^2 = 1$ iyo $y = -\frac{3}{4}x$ wadajir

loo furfuro, waxa la heli laba lammaane oo horsan
 $(-\frac{4}{5}, \frac{3}{5})$ iyo $(\frac{4}{5}, -\frac{3}{5})$. Lammaanaha ho-
 re oo qudha ayaa raalli gelin shardiga ah $x \leq 0$

\therefore Kulannada D waa $(-\frac{4}{5}, \frac{3}{5})$, sidaas awgeed,

$$\cos \Theta = -\frac{4}{5}, \quad \sin \Theta = \frac{3}{5}$$

Haddii aad ogaatid in 5, hooseeyaha jabjab kasta, $-\frac{4}{5}$

iyo $\frac{3}{5}$, uu yahay cabbirka gacanka r ee goobada marta

T $(-4, 3)$ ($5 = \sqrt{(-4)^2 + (3)^2}$ halka $r = \sqrt{(a^2 + b^2)}$),
 markaa natiijada tusaale kowaad waxad u qori kartaa sidan
 soo socota:

$$\cos \Theta = \frac{\text{absiisaha T}}{r}, \quad \sin \Theta = \frac{\text{ordinaytka T}}{r}$$

Taasi waxay soo dhaweyneysaa aragtiinka soo socda:

Aragtiinka 1:

Haddii (a, b) ay yihiin kulannada bar kasta oo aan
 ahayn unugga, kuna taal dhinac dhammaadka Θ , oo ah xagal

rugeed, markaa $\cos \Theta = \frac{a}{r}$, $\sin \Theta = \frac{b}{r}$ halka

$$r = \sqrt{a^2 + b^2}$$

Haddii la doono caddaynta aragtiinka, tallaabooyinka la
 qaadayaa waxay la mid yihiin kuwa tusaale 1 oo $(-4, 3)$
 lagu beddelay (a, b)

Tusaale 2:

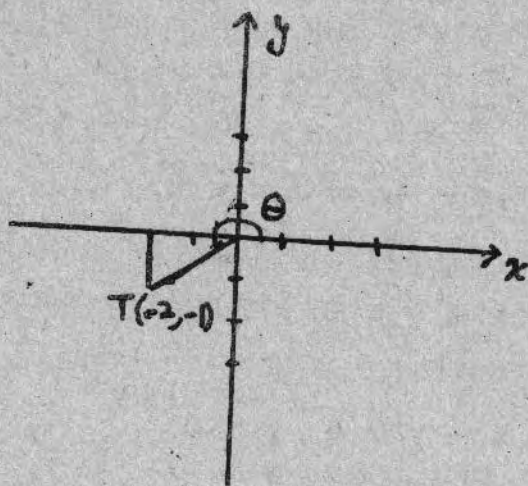
Adoo raacaya aragtiinka sare, raadi Cos Θ , haddii $T(-2, -1)$ ay ku taal dhinac dhammaadka xagal rugeedka Θ .

Furfuris:

$$a = -2, b = -1; \quad r = \sqrt{(-2)^2 + (-1)^2} \\ = \sqrt{5}$$

$$\therefore \cos \Theta = -\frac{2}{\sqrt{5}}, = -\frac{2}{5} \sqrt{5}$$

$$\sin \Theta = -\frac{1}{\sqrt{5}} = -\frac{1}{5} \sqrt{5}$$



Layli:

Xagal kasta oo soo socota ku washar sallax — xy (tixraac shaxan 8):

- | | |
|-----------------|------------------|
| 1) 015° | 2) 120° |
| 3) 210° | 4) 315° |
| 5) 330° | 6) -385° |
| 7) -60° | 8) -150° |
| 9) -225° | 10) 1080° |
| 11) 810° | 12) 80° |

Raadi Cos Θ iyo Sin Θ , haddii Θ tahay xagal rugeedka barta kulannadeeda la isa siiyay.

- | | |
|----------------|----------------|
| 13) $(-8, 15)$ | 14) $(3, 4)$ |
| 15) $(-3, 0)$ | 16) $(0, -4)$ |
| 17) $(-2, 2)$ | 18) $(5, 5)$ |
| 19) $(4, 2)$ | 20) $(-6, -3)$ |

Raadi Cos Θ iyo Sin Θ haddii Θ ay tahay xagal rugeed dhinac dhammaadkeedu yahay ururrada lagu siiyay

$$21) \left\{ (x, y) : 2x + 5y = 0, x \geq 0 \right\}$$

$$22) \left\{ (x, y) : 3x - 4y = 0, x \leq 0 \right\}$$

$$23) \left\{ (x, y) : x + y = 0, y \geq 0 \right\}$$

$$24) \left\{ (x, y) : x - y = 0, y \leq 0 \right\}$$

$$25) \left\{ (x, y) : y = 0, x \leq 0 \right\}$$

$$26) \left\{ (x, y) : x = 0, y \geq 0 \right\}$$

⊙ waa xagal rugeed cabbirkeedu u dhexeeyo 0° iyo 360°. Sawir ⊙, raadina qiimaha ku aaddan meesha calaamadda weydiinta ee hawraarta run ka dhigaya.

$$27) \sin \ominus = \frac{1}{5} \text{ islamarkaa } \cos \ominus = \frac{?}{?}$$

$$28) \sin \ominus = \frac{2}{7} \text{ islamarkaa } \cos \ominus = \frac{?}{?}$$

$$29) \cos \ominus = \frac{\sqrt{2}}{2} \text{ islamarkaa } \sin \ominus = \frac{?}{?}$$

$$30) \cos \ominus = \frac{\sqrt{3}}{2} \text{ islamarkaa } \sin \ominus = \frac{?}{?}$$

FANSAARRADA TIRIGNOOMETERI EE KALE

Saamiyo kale oo afar ah oo qiimayaasha sayn iyo koosayn ay keenaan ayaa la siiyaa magacyo gaar ah. Haddii ⊙ tahay xagal rugeed (eeg sh. 10), markaa $\cos \ominus = + \frac{8}{17}$,

$$\sin \ominus = - \frac{15}{17}$$

$$\text{Qaybta } \frac{\cos \ominus}{\sin \ominus}$$

$$= \frac{-15}{-}$$

$$= \frac{17}{8} = - \frac{15}{8}$$

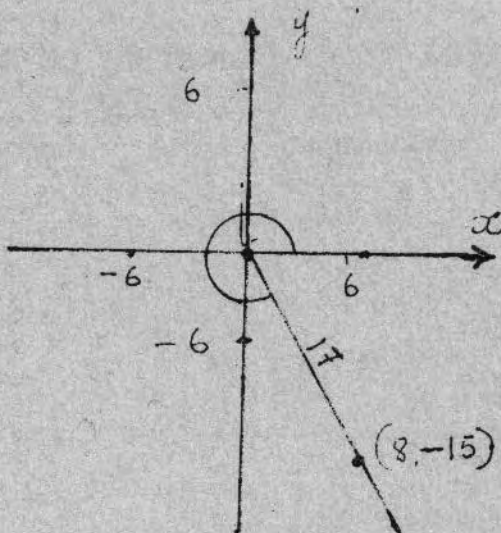
Waa taanjentiga xagasha ⊙ (tan ⊙)

$$= \frac{17}{8}$$

$$\text{Qaybta } \frac{\cos \theta}{\sin \theta} = \frac{8}{-15} = -\frac{8}{15} \text{ waa kotoanjentiga xagasha } \theta$$

$$\frac{1}{\cos \theta} = \frac{1}{8} = \frac{17}{8} \text{ waa siikanka xagasha } \theta \text{ (Sec } \theta)$$

$$\frac{1}{\sin \theta} = \frac{1}{-15} = -\frac{17}{15} \text{ waa kosiikanka xagasha } \theta \text{ (Csc } \theta)$$



Shaxan 10

Qeex 2:

$$\text{Fansaarka taanjentiga} = \left\{ (\Theta, \tan \Theta) : \tan \Theta = \frac{\sin \Theta}{\cos \Theta}, \cos \Theta \neq 0 \right\}$$

$$\text{Fansaarka Kootaanjenti} = \left\{ (\Theta, \cot \Theta) : \cot \Theta = \frac{\cos \Theta}{\sin \Theta}, \sin \Theta \neq 0 \right\}$$

$$\text{Fansaarka siikanaku} = \left\{ (\Theta, \sec \Theta) : \sec \Theta = \frac{1}{\cos \Theta}, \cos \Theta \neq 0 \right\}$$

$$\text{Fansaarka kosiikanaku} = \left\{ (\Theta, \csc \Theta) : \csc \Theta = \frac{1}{\sin \Theta}, \sin \Theta \neq 0 \right\}$$

Sayn, Koosayn, Kootaanjenti Siikanti iyo Kosiikanti waxa la yiraahda Fansaarrada tirignoometeri.

Qeexahooda, iyo aragtiinka 1 haddii la isticmaalo, markaa waan heli karraa dhammaan qiimayaasha fansaarradaa. Tusaale ahaan, haddii $\cos \Theta \neq 0$:

$$\tan \Theta = \frac{b}{\sqrt{a^2+b^2}} \div \frac{a}{\sqrt{a^2+b^2}} \therefore \tan \Theta = \frac{b}{a} \text{ haddii } a \neq 0$$

Garaadintaas oo kale marka la raaco tibaaxaha $\cot \Theta$, $\sec \Theta$, iyo $\csc \Theta$ waa sida aragtiinka soo socda.

Aragtiin 2:

Haddii Θ tahay xagal rugeedka barta (a, b) oo aan ahayn unugga, markaa:

$$\sin \Theta = \frac{b}{\sqrt{a^2 + b^2}},$$

$$\csc \Theta = \frac{\sqrt{a^2 + b^2}}{b}, b \neq 0$$

$$\cos \Theta = \frac{a}{\sqrt{a^2 + b^2}},$$

$$\sec \Theta = \frac{\sqrt{a^2 + b^2}}{a}, a \neq 0$$

$$\tan \Theta = \frac{b}{a}, a \neq 0$$

$$\cot \Theta = \frac{a}{b}, b \neq 0$$

Tusaale 3:

Raadi qiimaha fansaarrada tirignoometri ee xagal rugeedka barta D (-5, -12). Washir xagasha ugu yar ururkaa xagal rugeedyada ah.

$$a = -5, b = -12$$

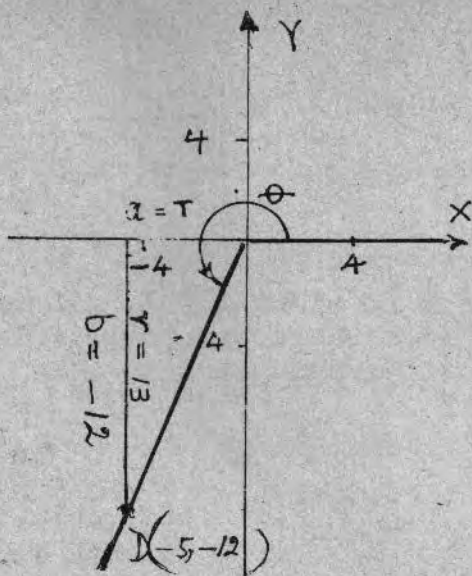
Furfuris:

$$\begin{aligned} \sqrt{a^2 + b^2} &= \sqrt{(-5)^2 + (-12)^2} \\ &= \sqrt{169} = 13 \end{aligned}$$

$$\sin \Theta = -\frac{12}{13}, \cos \Theta = -\frac{5}{13}$$

$$\tan \Theta = +\frac{12}{5}, \cot \Theta = \frac{5}{12}$$

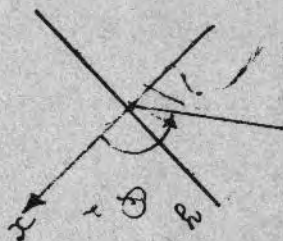
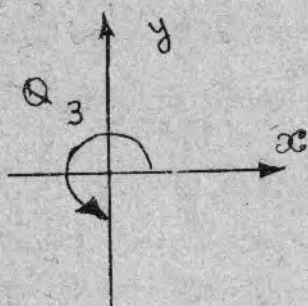
$$\sec \Theta = -\frac{13}{5}, \csc \Theta = -\frac{13}{12}$$

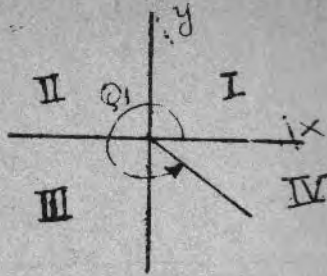


Shaxan 12

U fiirso in qiimayaasha fansaarrada tirignoometeri ay ku xiran yihiin rugta dhinac dhammaadka xagashaa oo qudha.

Xagal rugeed waxa badanaaba loo kala qaadaa u eegidda waaxda dhinac dhammaadkeedu ku yaal. Sidaa daraadeed, xagasha Θ_1 ee shaxanka 13 waxa la yiraa **Xagal Waax-afraad**, ta Θ_2 waxa la yiraa Xagal Waax-labaad. Markaa dhinac dhammaadka xagashu yahay dhidibka $-x$ ama dhidibka $-y$, sida Θ_3 , xagasha waxa la yiraa **xagal waaxeed**.





Tusaha soo socdaa wuxuu u kala saarayaa qiimayaa-sha fansaarrada tirignoometeri ee xagal rugeed aan ahayn xagal — waaxeed tirooyin togan ama kuwa taban, siday waaxaha u kale yaalliin.

W A A X

Qiime	I	II	III	IV
Cos \ominus iyo Sec $\omin�$	Togan	Taban	Taban	Taban
Tan $\omin�$ iyo Cot $\omin�$	Togan	Taban	Togan	Taban
Sin $\omin�$ iyo Csc $\omin�$	Togan	Togan	Taban	Taban

Haddii la ogyahay waaxda dhinac dhammaadka, $\omin�$ ku taal iyo hal qiime oo fansaar tirignoometeri oo $\omin�$, markaa waan sheegi karraa qiimayaasha fansaarrada kale.

Tusaale :

Haddii $\omin�$ ay tahay xagal waax — labaad ah oo togan haddiina $\text{Cos } \omin� = -\frac{2}{3}$, markaa sawir $\omin�$ -da ugu yar, raadina qiimayaasha fansaarrada tirignoometeri ee kale.

Furfuris:

Ka dhig D (a , b) bar ku taal dhinac dhammaadka $\omin�$ oo aan ahayn (0 , 0).

$$1) \text{ Mar haddii } \cos \theta = \frac{a}{r} = -\frac{2}{3}, \text{ waad dooran}$$

kartaa $a = -2$ $r = 3$. Markaa D waa bar waaxda labaad ku taal halka $x = -2$ iyo goobada xuddunteedu tahay unugga gacankeeduna yahay 3 ay iska gooyaan.

2) Muuji in OD tahay dhinac dhammaadka θ .

$$3) \text{ Sug } b : a^2 + b^2 = r^2$$

$$(-2)^2 + b^2 = 3^2$$

$$\therefore b = +\sqrt{5} \text{ (maxay } b \neq -\sqrt{5})$$

4) Isticmaal aragtiin 2 sidaad u heshid:

$$\sin \theta = \frac{\sqrt{5}}{3} \quad \csc \theta = \frac{3}{\sqrt{5}} = \frac{3\sqrt{5}}{5}$$

$$\cos \theta = -\frac{2}{3} \quad \sec \theta = -\frac{3}{2}$$

$$\tan \theta = -\frac{\sqrt{5}}{2} \quad \cot \theta = \frac{-2}{\sqrt{5}} = -\frac{2\sqrt{5}}{5}$$

Layli I (AFKA)

Sheeg qiimaha fansaarka xagal θ ee lagu weyddiiyay.

Tusaale:

$$\cos \theta = -\frac{8}{17}, \quad \sin \theta = \frac{15}{17}, \quad \cot \theta = ?$$

$$\text{Waxaad odhan: } \cot \theta = \frac{8}{15}$$

$$1) \cos \theta = \frac{3}{8}, \quad \sec \theta = ?$$

$$2) \sin \theta = \frac{3}{8}, \quad \sec \theta = ?$$

$$3) \sec \theta = -\frac{3}{2}, \quad \cos \theta = ?$$

$$4) \sin \theta = -\frac{2}{3}, \quad \cos \theta = \frac{-\sqrt{5}}{3}, \quad \tan \theta = ?$$

$$5) \sin \theta = \frac{\sqrt{3}}{2}, \quad \cos \theta = ?; \quad \cot \theta = ?$$

$$6) \tan \theta = 4, \quad \cot \theta = ?$$

$$7) \cot \theta = -5, \quad \tan \theta = ?$$

Magacaw waaxda dhinac dhammaadka θ ku oolli karo.

$$8) \sin \theta > 0$$

$$9) \cos \theta > 0$$

$$10) \tan \theta > 0$$

$$11) \csc \theta > 0$$

$$12) \sec \theta < 0$$

$$13) \cot \theta < 0$$

Sheeg waaxda dhinac dhammaadka θ uu yahay inuu yaal

$$14) \sin \theta > 0, \quad \cos \theta > 0$$

$$15) \sin \theta > 0, \quad \cos \theta < 0$$

$$16) \cos \theta > 0, \quad \tan \theta < 0$$

$$17) \sin \theta < 0, \quad \tan \theta > 0$$

$$18) \csc \theta > 0, \quad \cos \theta > 0,$$

$$19) \sec \theta < 0, \quad \sin \theta < 0$$

$$20) \cot \theta < 0, \quad \sec \theta > 0$$

$$21) \csc \theta < 0, \quad \tan \theta < 0$$

$$22) \csc \theta < 0, \quad \tan \theta < 0$$

Sheeg baddelka ku dhacaya (b) $\cos \theta$ iyo (t) $\sin \theta$, haddii θ u kordheyso min waaxda kowaad ilaa tan labaad.

Tusaale:

0° ilaa 90°

Furfuris:

(b) $\cos \theta$ waxay u kordhaysa 1 ilaa 0; t. a., way yaraanaysaa.

(t) $\sin \theta$ wuxuu u kordhayaa min 0 ilaa 1.

- | | |
|-----------------------------------|----------------------------------|
| 22) 90° ilaa 180° | 23) 180° ilaa 270° |
| 24) 270° ilaa 360° | 25) -90° ilaa 0° |
| 26) -180° ilaa -90° | 27) 360° ilaa 450° |

Layliyo:

Sawir xagal rugeedka togan, θ , ee ugu yar ee baraha la isa siiyey ay ku yaalliin dhinac dhammaadkeeda; qiimee fansaar-rada tirignoometeri ee θ .

- | | |
|-----------------------------|------------------------------|
| 1) $(-9, -12)$ | 2) $(8, 6)$ |
| 3) $(\sqrt{3}, 1)$ | 4) $(-1, -\sqrt{3})$ |
| 5) $(2, -2)$ | 6) $(-3, -3)$ |
| 7) $(0, 4)$ | 8) $(-3, 0)$ |
| 9) $(-1, 7)$ | 10) $(-5, 3)$ |
| 11) $(-\sqrt{2}, \sqrt{6})$ | 12) $(\sqrt{3}, -\sqrt{13})$ |

Ku sawir xagasha θ taban oo ugu tiro yar rugteeda beeggal marka dhinaca dhammaadkeedu ku yaal waaxda lagu siiyay; sheeg qiimayaasha fansaar-rada tirignoometeri ee θ .

13) $\sin \theta = -\frac{2}{5}$; iii

$$14) \quad \text{Cos } \Theta = \frac{3}{7}; \quad \text{iv}$$

$$15) \quad \text{Tan } \Theta = \frac{5}{4}; \quad \text{i}$$

$$16) \quad \text{Cot } \Theta = \frac{1}{2}; \quad \text{iii}$$

$$17) \quad \text{Cot } \Theta = -2; \quad \text{iv}$$

$$18) \quad \text{Tan } \Theta = 3; \quad \text{i}$$

$$19) \quad \text{Sec } \Theta = 1.5; \quad \text{iv}$$

$$20) \quad \text{Csc } \Theta = -1.25; \quad \text{iii}$$

Qiimee Fansaarrada tirignoometeri ee Θ .

$$21) \quad \text{Sin } \Theta = \frac{3}{8}, \quad \Theta \text{-na ma aha xagal waax-kowaad.}$$

$$22) \quad \text{Cos } \Theta = -\frac{1}{2}, \quad \Theta \text{-na ma aha xagal waax-labaad.}$$

$$23) \quad \text{Tan } \Theta = \sqrt{7} \text{ islamarkaa } \text{Sec } \Theta > 0$$

Raadi kulannada barta ku taal waaxda la isa siiyay una jirta unugga tirada la isa siiyay, haddii Θ ay tahay xa'aal rugeed.

$$24) \quad 10; \quad \text{II}; \quad \text{Sin } \Theta = +\frac{4}{5}$$

$$25) \quad \sqrt{2}; \quad \text{III}; \quad \text{Sin } \Theta = -\frac{\sqrt{2}}{2}$$

$$26) \quad 4; \quad \text{IV}; \quad \text{Tan } \Theta = -1$$

$$27) \quad 5; \quad \text{I}; \quad \text{Cot } \Theta = 1$$

Ku buuxi meesha bannaan tirada run ka dhigaysa hawraarta:

28) $\sin \theta = \cos \theta = \text{-----}$

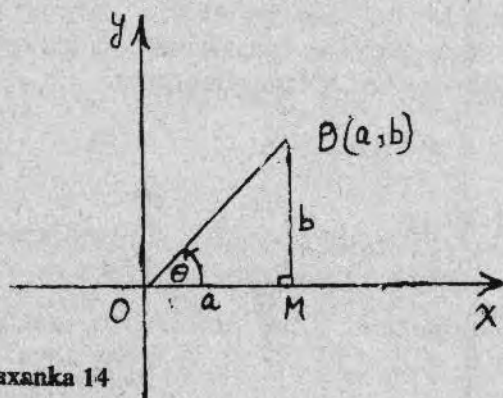
29) $\cos \theta = \sec \theta = 1, \cos \theta = \text{-----}$

XAGALLO GAAR AH

Haddii aad tixraacdo sh. 8 iyo qeexaha Fansaarrada tirig-noomteri, waad kartaa in aad caddayso qiimayaasha xaglo-waaxeed ee ku jira tusaha soo socda. Jiitinta (-) macnahe-
edu waa qiime ma jiro (xusuuso in qaybshe 0 aanu qeexnayn):

θ	Sin θ	Cos θ	Tan θ	Csc θ	Sec θ	Cot θ
0°	0	1	0	-	1	-
90°	1	0	-	1	-	0
180°	0	-1	0	-	-1	-
270°	-1	0	-	-1	-	0

Xagashii cabbirkeedu u dhexeeyo 0° iyo 90° waxaa la yi-
raa Xagal Fiiqan oo togan. Haddii la isticmaalo unugga iyo
bar kasta oo kale D oo ku taal dhinac dhammaadka xagal ru-
geed fiiqan ee togan, markaa waxan karraa in aynu samayno
saddexagal qumman oo geeskiisa saddexaad yahay barta M
ee ah isgoyska dhidibka - x iyo xarriiqda ku qotonta ee D (a,b)
(eeg sh. 14)



Shaxanka 14

Qiimayaasha fansaarrada tirignoometeri ee Θ waxaa lagu tibaaxi karaa dhinacyada saddexagalka qumman OMD:

$$\text{Sin } \Theta = \frac{b}{\sqrt{a^2 + b^2}} = \frac{\text{dhererka dhinac ka soo horjeeda}}{\text{dhererka shakaalka}}$$

$$\text{Cos } \Theta = \frac{a}{\sqrt{a^2 + b^2}} = \frac{\text{dhererka dhinacyada la dariska ah}}{\text{dhererka shakaalka}}$$

Sidoo kale, marka dhinacyada loo eego sida ay ku yihiin xagal Θ , waxan heleynaa:

$$\text{Tan } \Theta = \frac{\text{dhererka dhinca ka horjeeda } \Theta}{\text{dhererka dhinac la dariska ah } \Theta}$$

$$\text{Cot } \Theta = \frac{\text{dhererka dhinac la dariska } \Theta}{\text{dhererka dhinac ka horjeeda } \Theta}$$

$$\text{Sec } \Theta = \frac{\text{dhererka shakaalka}}{\text{dhererka dhinac la dariska ah } \Theta}$$

$$\text{Csc } \Theta = \frac{\text{dhererka shakaalka}}{\text{dhererka dhinaca ka horjeeda } \Theta}$$

Hawraarahan aan ku lug lahayn habdhis kulanno waad ku isticmaali kartaa inay qeexaan fansaarrada tirignoometeri ee xagal kasta oo fiiqan oo saddexagal qumman.

Tusaale:

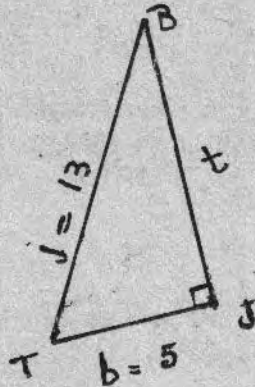
Tixgeli Δ BTJ, ka dhig b, t, j, inay yihiin dhererrada ka soo horjeeda B, T, J, siday u kala horreeyaan.

Raadi qiimayaasha fansaarrada $\angle B$ (loo akhriyo «xagal B») iyo $\angle T$, haddii $b = 5$, $j = 13$, J-na ay tahay xagal qumman.

Furfuris:

- 1) Isticmaal aragtiinka Baytaagoras si aad u heshid t

$$t = \sqrt{j^2 - b^2}$$
$$= \sqrt{(13)^2 - 5^2} = \sqrt{144} = 12$$



- 2) Markaan isticmaallo qeexaha fansaarrada tirig ee xaglo fiiqan, marka loo eego dhinacyada, waxan heleynaa qii-mavaasha soo socda:

$$(I) \quad \sin (B) = \frac{5}{13}, \quad \cos (B) = \frac{12}{13}, \quad \tan (B) = \frac{5}{12}$$

$$\cot (B) = \frac{12}{5}, \quad \csc (B) = \frac{13}{5}, \quad \sec (B) = \frac{13}{12}$$

$$(II) \quad \sin (T) = \frac{12}{13}, \quad \cos (T) = \frac{5}{13}, \quad \tan (T) = \frac{12}{5}$$

$$\cot (T) = \frac{5}{12}, \quad \csc (T) = \frac{13}{12}, \quad \sec (T) = \frac{13}{5}$$

Saddexagalka BTJ, $\angle B$ iyo $\angle J$ waa xaglo fiiqan waayo wadartoodu waa 90° . U fiirso in sidoo kale:

$$\sin B = \frac{b}{j} = \cos T, \quad \cos B = \frac{t}{j} = \sin T, \quad \tan B = \frac{b}{t} = \cot T.$$

Isle'egyadaasi waa ku run xaglo kasta oo sidkan, B iyo T, lam-maana kasta sida sayn iyo kosayn, waxaa la yiraa Fansaar Wa-daagyo.

Aragtiin:

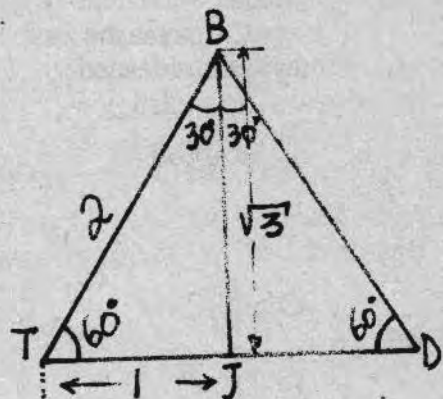
Fansaar Tirignometeri oo xagal fiiqan oo togan oo kastaa wuxuu le'eg yahay fansaar wadaagga xagasha ku sidkan.

Tusaale ahaan:

$$\sin 60^\circ = \cos 30^\circ, \quad \tan 20^\circ = \cot 70^\circ.$$

$$\csc 45^\circ = \sec 45^\circ.$$

Shaxan 16 wuxuu muujinayaa saddexagal siman BTD, oo dhinac kasta la dherer yahay 2 halbeeg, xagal kastana le'eg tahay 60° . BJ, oo ah qotome kala badhaha dhinaca TD, wuxuu kala badhayaa xagasha B. Saddexagal BTJ waa saddexagal qumman oo xaglihiisa fiiqan iyo dhinacyadiisu ay leeyihiin cabbir-rada ku muujisan shaxanka. Markaan isku xiriirinno xaglaha fiiqan ee saddexagalka iyo dhinacyada ka soo horjeeda ama deriska la ah, waxa aad heli kartaa isle'egyada soo socda:



shaxan 16

$$\sin 60^\circ = \frac{\sqrt{3}}{2} = \cos 30^\circ ,$$

$$\csc 60^\circ = \frac{2}{\sqrt{3}} = \frac{2\sqrt{3}}{3} = \sec 30^\circ$$

$$\cos 60^\circ = \frac{1}{2} = \sin 30^\circ ,$$

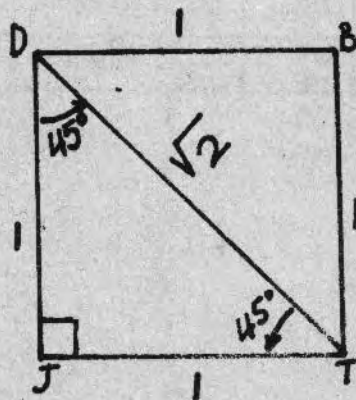
$$\sec 60^\circ = 2 = \csc 30^\circ$$

$$\tan 60^\circ = \sqrt{3} = \cot 30^\circ ,$$

$$\cot 60^\circ = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} = \tan 30^\circ$$

Si loo sugo qiimayaasha fansaarrada tirignoometeri ee xagal 45° ah, tixgali saddexagalka qumman TJD oo ka samaysmay afargeesle dhiniciisu yahay halbeeg, xaglooyinkiisa TD-na

$\sqrt{2}$, waxaad heli



$$\sin 45^\circ = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2} = \cos 45^\circ$$

$$\tan 45^\circ = \frac{1}{1} = 1 = \cot 45^\circ$$

$$\sec 45^\circ = \sqrt{2} = \csc 45^\circ$$

Tusaha soo socda wuxuu koobayaa qiimayaasha fansaar-rada tirignoometeri ee xagalaha 30° , 60° , iyo 45° . Haddii aad maskaxdaada ku sawirto sh. 16. sh. 17 iyo sh. 6, waaxad kari in aad xusuusato kujirayaasha tusahan iyo kuwa xaglo waaxeedba.

ϕ	$\sin \phi$	$\cos \phi$	$\tan \phi$	$\csc \phi$	$\sec \phi$	$\cot \phi$
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$	2	$\frac{2\sqrt{3}}{3}$	$\sqrt{3}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1	$\sqrt{2}$	$\sqrt{2}$	1
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$	$\frac{2\sqrt{3}}{3}$	2	$\frac{\sqrt{3}}{3}$

Looma baahna in aad xusuusato lixda qiime fansaar ee xagla-ha, mar haddii saddexda dambe ay yihiin isweydaarka isku-dhufashada saddexda hore.

Layli:

$$1) \sin 30^\circ + \cos 45^\circ - \sin 45^\circ$$

$$2) \tan 60^\circ - \cot 30^\circ + \tan 45^\circ$$

$$3) \tan 280^\circ + \cot 90^\circ - \cot 45^\circ$$

$$4) \sin 0^\circ + \cos 180^\circ - \sin 270^\circ$$

$$5) \sin 30^\circ \cos 60^\circ + \cos 30^\circ \sin 60^\circ$$

$$6) \cos 0^\circ \cos 180^\circ - \sin 0^\circ \sin 180^\circ$$

Caddee in hawraar kastoo soo socotaa run tahay:

$$7) \sin^2 30^\circ + \cos^2 30^\circ = \sin^2 45^\circ + \cos^2 45^\circ$$

(ogow in $\sin^2 30^\circ = (\sin 30^\circ)^2$)

$$8) 1 - 2 \sin^2 30^\circ = \cos 60^\circ$$

$$9) 1 + \tan^2 60^\circ = \sec^2 60^\circ$$

$$10) 1 + \cot^2 45^\circ = \csc^2 45^\circ$$

$$11) 2 \cos^2 30^\circ - 1 = \cos 60^\circ$$

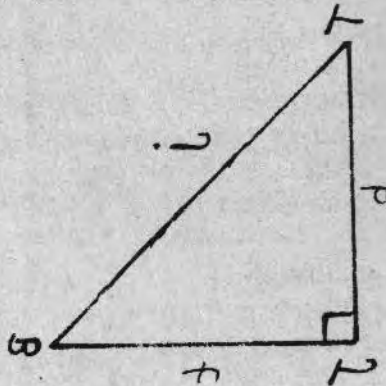
$$12) \frac{\tan 60^\circ - \tan 30^\circ}{1 + \tan 60^\circ \tan 30^\circ} = \tan 30^\circ$$

$$13) \sin 45^\circ = \sqrt{\frac{1 - \cos 90^\circ}{2}}$$

$$14) \cos 90^\circ = \sqrt{\frac{1 + \cos 180^\circ}{2}}$$

Layliyada 15 – 18, tixraac saddexagalka qumman BTJ ee shaxanka 18

- 15) Raadi b, haddii $t = 4$, B tahay 30°
- 16) Raadi j, haddii $b = 9$, T-na tahay 45°
- 17) Raadi $\sin B$, haddii $b = 5$, $t = 9$.
- 18) Raadi $\tan B$, B haddii $b = 3$, $j = 7$.



Shaxan 18

**FURFURISTA SADDEXAGALLO QUMMAN
TUSAYAASHA QIIMAYAASHA FANSAARRO
TIRIGNOOMETERI**

Qiimayaasha fansaarrada xaglaha 30° , 45° iyo 60° helidoodu waa sidii aynu horey u soo barannay, laakiin xisaabin-ta qiimaha fansaarrada xagal kasta oo fiiqani uma 'dhib yara sida kuwa sare, kumana baran doonno buuggani. Hase ahaatee, waxa jira tusayaal aynu ka heli karro qiimayaasha xaglo fiiqan. Aan ku bilawnee, xaglaha aalaaba waxa tusayaasha loogu taxaa gaalisyo ay u dhexeeyaan hal (koow) minit, ama lix minit, ama toban minit hadba tii qoruhu bido. Qiimayaasha saynka, kooska, tanka iyo fansaar — wadaag-

yadooda waa afar rug — cuddoon siday ugu qoran yihiin tusayaasha.

TUSAYAASHA FANSAARRADA TIRIGNOOMETERI IYO SIDA LOO ISTICMAALO :

Tusaha fansaarrada tirignoometeri wuxuu u dejisan yahay una shaqeeyaa si u fudud sida tusaha iskudhufashadu u shaqeeyo. Tusaha waxa loo isticmaalaa in laga helo qiimayaasha tirignoometeri marka xaglaha la ogyahay, ama si loo helo xaglaha marka qiimayaasha la ogyahay. Tirooyinka ku jira joogtaxa ugu horreeya tusaha waa xaglaha oo la isku siiyay digirii, kuwa ku jira dhinactaxa kowaadna waa xaglo ah minityo, kujireyaasha tusaha ee kalena waa qiimayaasha ku beegan kuwaasi oo ah afar rugcuddon.

Sida dhabta ah, tusuhu sida uu u shaqeeyaa waa fududahay laakiin sida uu dhismay ma dhib yara, buugganna kuma baraan doonno. Siduu u shaqeeyo baan ku koobnaan doonna.

Ugu horrayn, aan tixgelinno xagasha 30° taasoo qiimaha saynkeeda aan naqaan. Si looga akhriyo tusaha qiimaha sin 30° , marka hore waxan helnaa bogagga ay ku qoran tahay «Saynyada dabiiciga ah», joogutaxa kocwaad ka hel tirada 30° . Mar haddii minityadu eber yihiin, waxan eberkaa ka helaynaa dhinactaxa koowaad, haddii aan hoos u raacno joogtaxa eber u horreeyo ilaa aan gaaraynno tirada ku jirta dhinactaxa ka bilaawda 30° , markaa waxaa heleynaa 0.5000 taasoo u dhiganta qiimaha aynu u naqaanay sin 30° .
 Qiimaha sin $\Theta, 0^\circ \leq \Theta \leq 90^\circ$

0	6	12	18	24	30	36	42	48	54	1	2	3	4	5	
30'	5000	5015	5030	5045	5060	5075	5090	5105	5120	5135	3	5	0	10	13

Qiimaha Sin $30^\circ 6'$ sida sin 30° loo helay oo kale ayaa loo heli, laakiin meeshii eber minit waxan haysannaa 6 minit. Sidaa daraadeed, qiimaha sin $30^\circ 6'$ waa kujiraha ku yaal meesha joogtaxa ka bilawda $6'$ iyo dhinactaxa ka bilawda 30° ay iska gooyaan oo ah 0.5015. Imminka haddii aan dooneyno in aan helno qiimaha sin $30^\circ 8'$, waxa aynu arki in $8'$ uuna ku

qornayn dhinactaxa kooraad, sidaa daraadeed waxan raadinaynaa qiimaha sin $30^{\circ}6'$ sidii hilinka hore loogu sharxay. Mar haddii aan dooneynno qiimaha sin $30^{\circ}8'$, faraquna uu yahay 2 minit, waa inaan si u xisaabinnaa faraqaa. Xisaabinta waxa lagaga fursanaya joogtaxyada ugu dambeeya ee midba ka bilawdo $1'$ ilaa $5'$, hoos haddii aan u raacano joogtaxa ku bilawda $2'$ ilaa iyo dhinactaxa 30° waxan heleynaa qiimaha 5. Taas macnaheedu waa 0.0005, waxana loo yaqaan faraq tirosin.

Mar haddii xagasha la xisaabiyay sin $30^{\circ}6'$, ay ka yar tahay xagasha qiimaheeda sayn la doonayo 2 minit, aan ognahayna haddii xagashu ka kororto min 0° ilaa 90° in qiimaheeda sayn kordho, markaa faraq tirosin waxa loo geynayaa qiimaha sin $30^{\circ}6'$. Haddaba sin $30^{\circ}8'$ waa 0.5020.

Sidoo kale, kooska, taanka iwm., ee xagal kasta waxa loo raacaa tabtaas oo kale.

Faraq tirosin ma loo geynayaa, mise waa laga goynayaa kos $30^{\circ}6'$ marka la doonayo kos $30^{\circ}8'$?

Inminka aan tixgalinno marka qiimaha fansaarka la isa-siiyo, matalan sin $\Theta = 0.8660$, lana doonayo in la sugo xagasha Θ . Tuse-kosaynka ka raadi tirada 0.8660. Tiradaas aad heshay joogtaxa ay ku jirto bilawgiisu (cirifka sare) waa minityo, cirifka bidix ee dhinactaxa ay ku jirtaana waa digiriyo. Sida awgeed $\Theta = 60^{\circ}$.

Tuseyaasha qaarkood ma laha qaybta faraq tirosin, sidaa awgeed tab la yiraa dhexbeegid oo ah tan soo socota ayaa lagu soo saaraa faraqaa tirosin.

Dhexbeegid:

Dhexbeegidda tuseyaasha aan lahayn faraq tirosin waxa looga shaqeeyaa sidan soo socota: Ka soo qaad in aan doonayno inaan xisaabinno $\text{Cos } 32^{\circ}51.4'$, haddaba ugu horrayn waxaan qorraa:

$$1.0 \left\{ 0.4 \left\{ \begin{array}{l} \text{Cos } 32^{\circ}51' = 0.84009 \\ \text{Cos } 32^{\circ}51'.4' = ? \end{array} \right. \Delta \right\} 0.00015$$

$$\left. \begin{array}{l} \\ \text{Cos } 32^{\circ}52' = 0.83994 \end{array} \right\}$$

Marka xagashu kororto 1 minit, qiimaha kosaynku wuxuu dhinmayaa 0.00015. Marka aan dhexbeegidda toosan adeegsanayno, waxan xisaabinnaa xaddiga saamigalka ah ee kosaynku dhinmo marka xagashu kororto 0.4 minit. Taas waxay la macno tahay, dhinmiddu waa $(0.4) (0.00015) = 0.00006$. Sidaa daraadeed, $\text{Cos } 32^{\circ}51.4' = 0.84009 - 0.00006 = 0.84003$.

Weydaarka dhexbeegidda — marka qiimaha fansaarka la isa siiyo lana doonayo in la raadiyo xagasha — sida looga shaqeeyo murti ahaan waa sidii hore oo kale. Matalan, haddii aan dooneyno inaan raadinno Θ marka la ogyahay in $\tan \Theta = 0.63530$, markaa waxa loo raaci sidan: Tusaha waxan ka heleynaa :

$$1.0' \left\{ \Delta \left\{ \begin{array}{l} \text{Tan } 32^{\circ}25' = 0.63503 \\ \text{Tan } \Theta = 0.63530 \end{array} \right. 0.00027 \right\} 0.00041$$

$$\left\{ \begin{array}{l} \\ \text{Tan } 32^{\circ}26' = 0.63544 \end{array} \right\}$$

$$\text{Haddaba } \frac{\Delta}{1.0} = \frac{0.00027}{0.00041}, \Delta = 0.658 = 0.7'$$

Sidaa awgeed, $\Theta = 32^{\circ}25.7'$

Qeexaha fansaarrada iyo isticmaalka tusayaasha aan soo barannay waxay inoo awood siinayaan in haddii aan ognahay qaybaha saddexagal qumman qaarkood, markaa aan soo saari karro qaarka dahsoon. Taasoo ah, si loogu furfuro qaybta dahsoon, waa in aan doorannaa fansaarrada xagal ee qaybta dahsoon ku xiriirinaya laba qaybood oo la ogyahay (si waafaqsan qeexaha).

Tusaale:

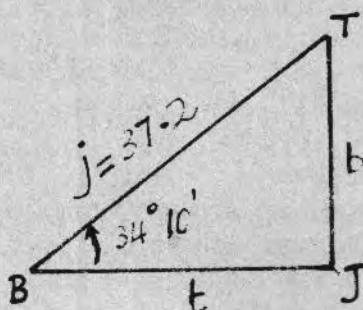
Furfur saddexagalga qumman BTJ, ee shakaalkiisu le'eg yahay $37.2, \angle B = 34^{\circ}10'$.

Furfuris:

Qaybaha dahsooni waa b, t , iyo $\angle T$.

Mar haddii $\angle B$ iyo $\angle T$ ay yihiin xaglo sidkan,

$$\begin{aligned}\angle T &= 90^\circ - 34^\circ 10' \\ &= 55^\circ 50'\end{aligned}$$



Shaxan 19

Marka waa in aan raadinnaa b , si loo raadiyana waa inaan isticmaallaa $\sin B$, waayo qeexda saynku waxay isticmaayaysaa qaybta dahsoon b , iyo laba qaybood oo loo yaqaan j

iyo $\angle B$. Haddaba $\sin 34^\circ 10' = \frac{b}{37.2}$. Taasoo u dhiganta

$$b = \sin 34^\circ 10' \times 37.2; \text{ marka la isticmaalo tusaaha}$$

$$b = (0.5616) \times 37.2 = 20.9$$

Si loo helo t isticmaal $\cos B$.

$$\cos 34^\circ 10' = \frac{t}{37.2} \rightarrow t = \cos 34^\circ 10' \times 37.2$$

haddii la adeegsado tusaaha

$$t = (0.8274) \times 37.2 = 30.8$$

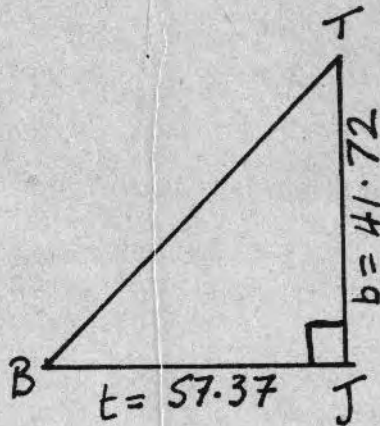
Tusaale 2:

Furfur saddexagalka qumman BTJ ee ah sida shaxanka 20 ku muujisan.

Furfuris:

Marka hore isticmaal tan B
si loo helo $\angle B$

$$\tan B = \frac{b}{t} = \frac{41.72}{57.37}$$



$\tan B = 0.7276$, afar rugeed.

Haddaba, haddii tusaha la isticmaalo, lana dhexbeego waxaan heleynaa in $\angle B = 36^{\circ}2'$

Xagasha T waxan ku heli karra haddii aynu 90° ka goyno $\angle B$, waayo $\angle B$ iyo $\angle T$ waa xaglo sidkan. Si kaloo $\angle T$ lagu heli karaase waa haddii aan isticmaaloo tan T. Taasoo ah:

$$\tan T = \frac{57.37}{41.72} = 1.374 \text{ (afar rug)}$$

Haddii tusaha la isticmaalo, lana dhexbeego, waxan heleynaa $\angle T = 53^{\circ}58'$

Hubin:

$$\angle B + \angle T = 36^{\circ}2' + 36^{\circ}58' = 90^{\circ}$$

Si loo helo j' waxa la isticmaali karaa aragtiinka Baytaagoras, laakiin aan isticmaallo fansaarka tirignoometeri, sin B. Taasoo ah:

$$\sin 36^{\circ}2' = \frac{41.72}{j}$$

$$j = \frac{41.72}{\sin 36^{\circ}2'}$$

Marka tusaha lagu dhexbeego

$$j = \frac{41.72}{0.5883} = 70.90 \text{ (afar rug)}$$

Layli:

Layliyada 1 ilaa 16, waxa la isa siiyay xaglo. Adoo isticmaalaya tusayaal, raadi qiimayaasha fansaarrada tirignoometeri ee xusan.

Sin	Cos	Tan
1) 73°25	5) 45°45'	9) 62°55'
2) 40°19.7	6) 30°18.2'	10) 20°46.6'
3) 67°51.4'	7) 85°15'	11) 50°22.2'
4) 109°16'	8) 97°7.7'	12) 122°35.5'
	Cot	
13) 46°50'	14) 72°27.4'	15) 12°49.9'
16) 130°30'		

Layliyada 17 ilaa 22, waxa lagu siiyay qiimayaasha fannaarrda iyo waaxda dhinac dhammaadku ku yaal. Haddaba,

1

raali xagasha la xusay adoo ku seebaya — minit. U qaado in
10

$$0^\circ \leq \Theta \leq 360^\circ$$

17)	$\text{Sin } \Theta = 0.58712$	(Θ waa xagal waax-kowaad ah)
18)	$\text{Sin } \Theta = 0.96112$	(» » » » »)
19)	$\text{Cos } \Theta = 0.81432$	(» » » » »)
20)	$\text{Cos } \Theta = 0.42316$	(» » » 4aad »)
21)	$\text{Tan } \Theta = 0.42316$	(» » » 1aad »)
21)	$\text{Cot } \Theta = 2.2465$	(» » » 3aad »)

Furfur saddexagallada qumman ee layliyada min 23 ilaa 32. Natiijo kasta ugu dhawaan ku hel munityo iyo far rug. Dhexbeeg haddii loo baahdo.

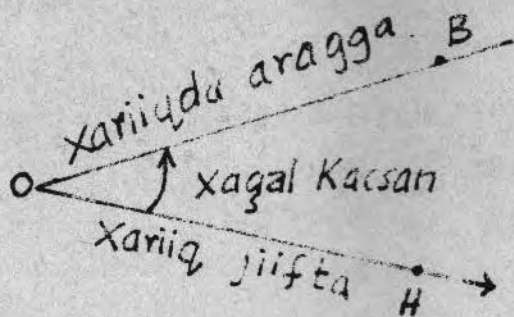
23)	$\angle B = 28^\circ 10'$,	$j = 32.7$
24)	$\angle T = 63^\circ 40'$,	$j = 71.4$
25)	$\angle B = 38^\circ$,	$b = 20$
26)	$b = 27$,	$t = 34$
27)	$t = 0.3142$,	$j = 0.5717$
28)	$\angle B = 57^\circ 20'$,	$j = 4.551$
29)	$\angle T = 35^\circ 30'$,	$j = 284$
30)	$\angle T = 26^\circ$,	$t = 15$
31)	$b = 73$,	$t = 37$
32)	$\angle B = 41^\circ 18'$,	$b = 0.1929$

XAGLAHA KACSAN IYO KUWA DHACSAN

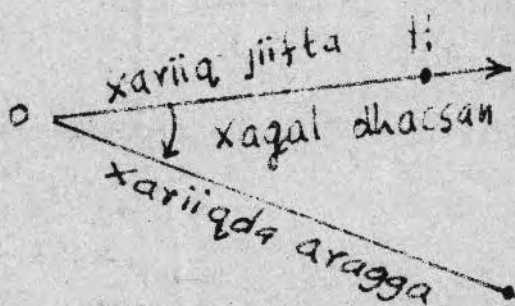
Haddii qof taagan barta O, uu eegayo barta B, markaa OB waxaa la yiraa xarriiqda aragga, sida ku muujisan shaxanka 21 (b); waliba haddii H ay tahay bar ku taal fallaadh jiiifta

oo maraysa O kana mid ah sallaxa qotoma ee OB ku taal markaa xagasha OH iyo OB ay samaynayaan ($\angle HOB$) waxaa la yiraa xagasha kacsan ee B, bishardi barta B inay ka korrayso

OH, haddii kale oo ay B ka hooseeyso OH, waxa la yiraa xagasha dhacsan ee B. Eeg shaxanka 21 (t)



sh. 21 (b)



Sh. 21 (t)

Tusaale 1:

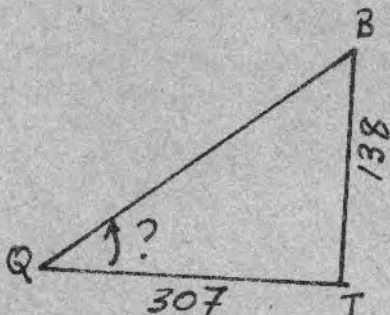
Harka aqal, joogiisu yahay 138m, baa wuxuu gaarayaa bar jiif ahaan u jirta aqalka 307m. Waa maxay xagasha kacsan ee qoraxdu?

Furfuris:

Marka hore aan samayno washir u taagan xaaladda laylisku ka hadlayo, sida kan hoos ku muujisan. Si loo helo xagasha Q, ugu dhawaan 10', waa inaan isticmaallaa:

$$\tan Q = \frac{138}{307} = 0.4495$$

$$Q = 24^{\circ}10'$$



Shaxan 22

Tusaale:

Qof guri korkii jooga baa ogaaday in xagasha dhacsan ee dhagax dhulka yaal tahay $36^{\circ}40'$, fogaanta u dhaxaysa dhagaxa iyo guriga salkiisuna tahay 20m. Raadi joogga guriga.

Furfuris:

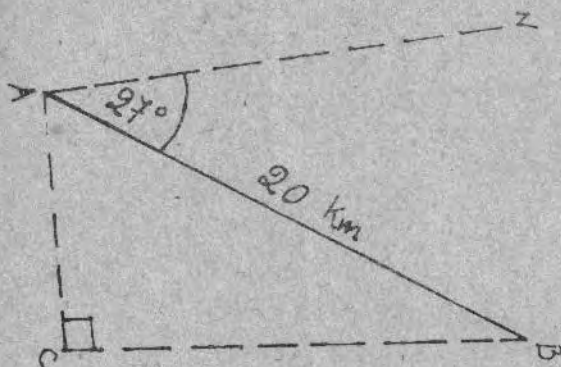
Haddii aan u qaadanno in shaxanka 23 ee hoose uu u taagan yahay xaaladda laylisku ka hadlayo, markaa:

$$\tan 36^{\circ}40' = \frac{BJ}{20}, \text{ BJ waa joogga guriga}$$

- b) 113° iyo 236°
- t) 030° iyo 171°
- j) 115° iyo 313°
- x) 004° iyo 358°
- kh) 083° iyo 272°
- d) 0 iyo 360°
- r) W. 47° G iyo K. 47° B
- s) W. 10° B. iyo K. 72° B
- sh) W. 20° G iyo W. 55° B.
- dh) W. 17° B. iyo W. 23° G.
- c) K. 75° B iyo W. 21° G.

Tusaale:

A iyo B waa laba barood oo isu jira 20 km. Foolka B ee ka yimid A waa 027° (W. 27° B.) Soo saar inta B ka xigto A, wacqooyi iyo bari.



Furfurid:

Waxa la inaga doonayaa fogaanta BC (oo la yiraahdo waqooyaynta B ee ka yimid A) iyo AC (oo la yiraahdo bariyaynta B iyo A).

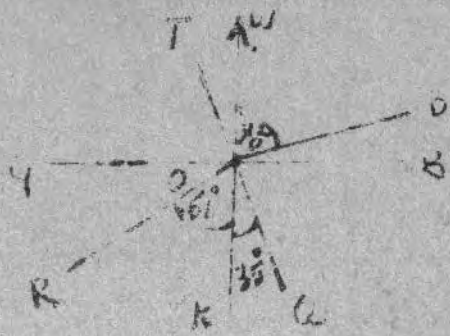
Δ ABC waa saddexagal ka qumman halka C
 $BAC = 90^\circ - 27^\circ = 63^\circ$

$$\sin \angle BAC = \frac{BC}{AB}$$

ga koofur). Foolalka kambaska ee meeli waa inta bari ama galbeed, ay meeli ka xigto xarriiqa u kala socda waqooyi iyo koofur.

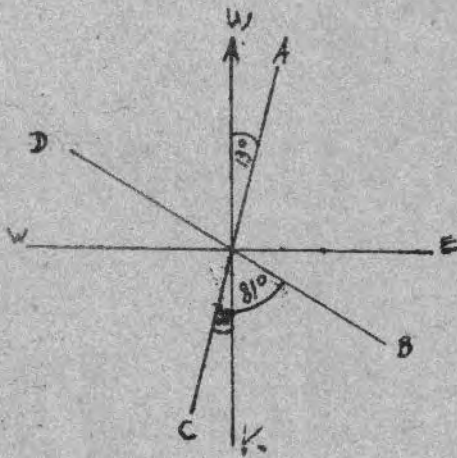
Bal tusahan soo socda si qumman u deris

- Foolka B ee ka yimid 0 waa 075° ama $W.75^\circ B.$
- Foolka Q ee ka yimid 0 waa 145° ama $K.35^\circ B.$
- Foolka R ee ka yimid 0 waa 231° ama $K.51^\circ G.$
- Foolka T ee ka yimid 0 waa 347° ama $W.13^\circ G.$



Layli:

- 1) Foolalka A, B, C iyo D ee ka yimid 0 u tibaax si foalal kambas iyo si foalal rumeed.



- 2) Raadi xaglaha u dhexeeya foolalkan soo socda. Washir

- 10) Xarig 16m dherer le'eg baa xagal 120° ah ku sameeya goobo xuddunteed. Soo saar gacanka gobada.
- 11) Nin taagan Guriga Ummadda hoostiisa baa Taallada Dhagax-Tuur 120m u jira. Haddii taallada dhererkeedu 18m yahay, soo saar xagasha dhacsan ee ninka ilaa taallada gunteeda. (U garo in guriga iyo taalladu isku sallax ku yaalliin.).

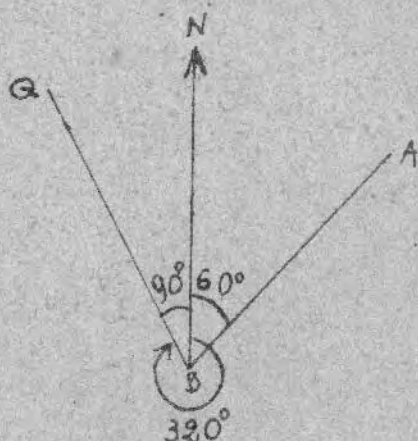
F O O L

Qeex:

Fool waa xagasha u dhexaysa jihada meel iyo xarriiq u kala socda waqooyi iyo koofur.

Foolasha runta ah:

Kuwan waxa loo cabbiraa si saacadwareeg, oo had iyo goor laga bilaabo xarriiqda waqooyiga runta ah, waxaanay u kala socdaan 0° ilaa 360° .

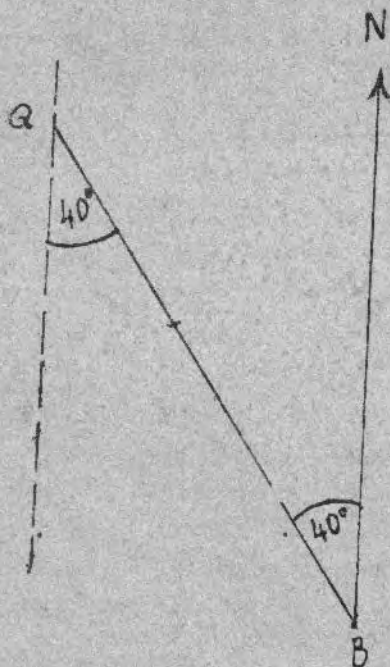


Foolka A ee ka yimid B waa 060° , eberka waxaa loogu hor qoray 60 si foolasha runta ah dhammaantood loogu tiibaaxo saddex astiro. Si aad u hesho foolka Q ee ka yimid

B, bal suuree inaad taagan tahay B eegeysana waqooyiga runta ah. Dabadeedna saacadwareeg u jeeso (t.a xagga midig) ilaa aad eegayso tooska BQ. Imminka cabbirka xagasha aad is rogtey waa 320 (t.a $360^\circ - 40^\circ$). Marka foolka runta ah ee Q ee ka yimid B waa 320 .

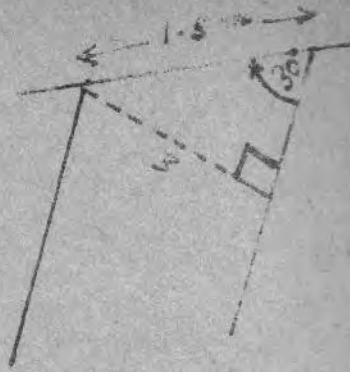
Foolka kambas :

B iyo Q waa laba barood oo khariidad ku yaal. Haddii QB la samayso xagal cabbirkeedu yahay 40° waqooyiga birla-beedka, markaas foolka Q ee ka yimid B wuxuu noqonayaa W. 40 G ama $40G$. ka W. (40° Galbeedka waqooyiga).



Ogow:

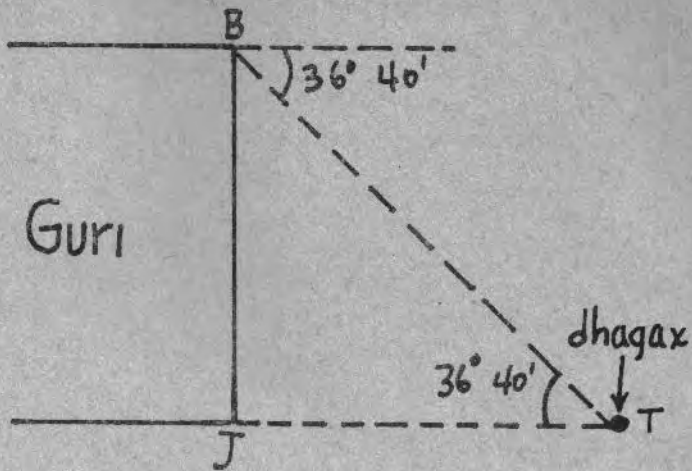
BQ xagal cabbirkeedu yahay 40° ayay la samaynaysaa xarriiqda koofur u socota ee maraysa Q, markaas foolka B ee Q ka yimid wuxuu noqonayaa K.40B. ama 40 B.K (40° bari-



Shaxan 24

- 4) Sallaan gidaar ku tiirsan baa dhulka la sameeyaa xagal 75° ah. Sallaanka dhererkiisu waa 30m. Soo saar inta sallaanka guntiisu u jirto gidaarka.
- 5) Xagasha dhacsan ee diyaarad cirka maraysaa la samaynayso markab badda maraya oo ka heeseeyaa waa $50^\circ 20'$. Haddii diyaaraddu 700m ka sarraysoc markabka, markaa raadi fogaanta markabku ka durugsan yahay diyaaradda ?
- 6) Laba geed baa midba dhererkiisu yahay 150m, barta B oo dhulka ah yaa badha fogaanta labada geed isu jiraan. Haddii B geed 50m u jirto, soo saar xagasha kacsan ee B ilaa geedka. Waa maxay xagasha kacsan ee min geed guntii ilaa ka kale baarkii.
- 7) Nin dayaarad xarbi ah wada baa wuxuu arkay in xagasha dhacsan ee meel 4.00 mayl u jirtaa tahay $11^\circ 40'$. Waa maxay joogga dayaaraddu markaa maraysaa?
- 8) Axmed xarig 40 mitiri ah buu ku hayaa abeteygiisa, joogga abeteygu ka sarreeyaa Axmed waa 27m. Raadi xagasha kacsan ee abiteyga.
- 9) Sahanshe laag taagan yaa wuxuu arkay in xagasha kacsan ee dhagax dhinac ka xigaa tahay $15^\circ 13'$. Haddii sahanshuhu dhagaxa guntiisa 14.00m, ka durugsan yahay, soo saar markaa joogga min guntii ilaa dhagaxa.

$$\begin{aligned} \therefore BJ &= \tan 36^{\circ}40' \times 20 \\ &= 0.7445 \times 20 \\ &= 14.890\text{m} \end{aligned}$$



Shaxan 23

Layli:

Raadi jadeeyooyinka haddii jabaytooyin laysa siiyay yihiin (B) qaar sugan (T) qaar seeban.

- 1) Minaarad baa xagasha kacsan ee ka timaadda dhagax 3km u jira, (fogaanta jiif) tahay 18° . Waa maxay dhererka minaaraddu ka sarraysa dhagaxa?
- 2) Xagasha kacsan ee buur fiiqeed kana timaadda buurta gunteedu waa 33° . Haddii fogaanta qof buurta fiiqeeda ku tegi karaa tahay 10000m. Waa maxay joogga buurtu?
- 3) God dhurwaa baa afkiisa dhan dhulka jiif kula sammeyaa xagal ah 30° . Haddii ballaca dusha u furan ee godku yahay 1.5m, waa maxay ballaca dhabta ah ee godku? (eeg shaxanka).

$$\sin 63^\circ = \frac{BC}{20}$$

$$\begin{aligned} \therefore BC &= 20 \sin 63^\circ \\ &= 20 \times 0.8910 \\ &= 17.82 \end{aligned}$$

$$\therefore BC = 17.8 \text{ km.}$$

$$\cos \angle BAC = \frac{AC}{AB}$$

$$\cos 63^\circ = \frac{AC}{20}$$

$$\begin{aligned} AC &= 20 \times \cos 63^\circ \\ AC &= 20 \times 0.4540 \\ &= 9.080 \end{aligned}$$

$$\therefore AC = 9.08 \text{ km.}$$

\therefore B waa 17.8 km W. iyo 9.08 B. ga A.

Layli:

X iyo Y waa laba barood oo isu jira 15km. Foolka X ee ka yimid Y waa 227° (K. 47G.). Soo saar inta X u jirto koofurta iyo galbeedka Y.

2) B iyo Q waa laba markab oo isu jira 18km. Foolka Q ee ka yimid B waa 146° . Soo saar inta Q ka tahay koofur iyo bari B.

3) C iyo D waa laba barood oo isu jira 1072 mitir. Foolka D ee ka yimid C waa 334° . Xisaabi fogaanta ay C ka xigto W. iyo G.

- 4) A 3km bay u jirtaa waqooyiga B, bariga B-na waxay u jirtaa 4km. Raadi foolka A ee runta ah ee ka yimid B, iyo fogaanta u dhexaysa A iyo B.
- 5) Y 14km bay u jirtaa koofurta W. galbeedka W-na waxay u jirtaa 8km. Raadi foolka Y ee runta ah ee ka yimid W. iyo fogaanta YW.
- 6) Markab (A) ayaa 57km u jira koofurta barta (O), galbeedka O-na u jira 10km. Markab kalena (B) 33km ayuu u jira waqooyiga O, bariga O-na 51km. Raadi foolka mid waliba uu u soconayo si ay ugu kulmaan O. Haddana raadi fogaanta mid waliba uu u jiro O.

$\{x : x \text{ tahay hal-godle mutuxan}\}$ waxa loo akhriyaa: «ururka x kasta, ee x tahay hal-godle mutuxan».

Summadda $|$ ama : waxa loo akhriyaa «ee ama «oo» Qormadu guud ahaan, waxay noqotaa sansaankan:

$$\{x | \text{astaa}n x\} \text{ ama } \{x | C(x)\}.$$

Haddii $C(x)$ ay tahay astaa'n x .

Badanaaba, qormada waa la soo gaabiyaa oo waxaa loo qoraa sidan: $B = \{x \in M | x \text{ tahay hal godle}\}$. M waxay u taagan tahay ururka tirooyinka mutuxan oo dhan. Markaas oo kale B waa loo akhriyaa «ururka x kasta oo kutirsane M ah, oo x tahay hal godle», taasi waxay inoo sheegaysaa in x tahay tiro mutuxan isla markaana ay tahay hal-godle.

Xarafka x waxa la yiraa doorsoome. Ogow in doorsoomaha summaddii la doono loo qaadan karayo. Matalan, doorsoomuhu wuxuu noqon karaa: $w, y, a_1, a_2, *, \Delta, \square, \alpha, B, \phi$ iwm.

Doorsoomuhu wuxuu u taagan yahay kutirsane kasta oo astaanta la sheegay leh. Kutirsaneyaasha ururkaa la qeexay waxa la yiraa qiimaha doorsoomaha.

$$\text{Tusaale ahaan, } B = \{x \in M | x \text{ tahay hal-godle}\}.$$

Tirooyinka 2, 3, 5 iyo 7 mid walba waa qiimaha doorsoomaha x yeelan karto.

Layli 2:

- 1) Ku sifee ururradan habka taxidda (Habka Roostar):
 - b) Ururka xarafyada ku jira ereyga Hargeysa.
 - t) Ururka abyooniyaasha dhabanka ah.
 - j) Ururka dhufsaneyaash 3 ee togan.

wuxu u qormayaa sidar: $\{2, 4, 6, \dots, 99, 998\}$, waxana loo akhriyaa «ururka ka kooban laba, afar, lix, ilaa sagaal iyo sagaashan kun, sagaal boqol, sagaashan iyo siddeed».

T. Habka astaan qeexda.

Mararka qaarkood, waxa laga yaabaa in aan loo baahan in la taxo kutirsaneyaasha amaba la kari waayo. Markaas oo kale waxa la isticmaalaa habka astaan qeexda. Tusaale ahaan, ururka dhufsaneyaasha 7 ee u dhexeeya 10 iyo 100 waxa loo sifeeyaa sidan:

B = Dhufsaneyaasha 7 ee 10 iyo 100 u dhexeeya. Si daas oo kale, ururka abyooneyaasha togan ee 1 iyo 25 u dhexeeya waxa loo sifeeyaa sidan:

T = Abyooneyaasha 1 iyo 25 u dhexeeya.

Astaan qeexdaasi waxay qaadan kartaa sansaamo badan, waxay ka koobnaan kartaa erayo sifa ah, summado xisaabeed ama labadaba, kutirsane kasta waxa laga rabaa in uu yeesho astaamo loo baahan yahay si uu u noqdo kutirsane ururkaas.

Tusaale ahaan, haddii aan rabno in aan ogaanno kutirsaneyaasha ururka B, marka ay B = { Tirooyinka dhabanka

ah ee 5 iyo 25 u dhexeeya } Waxan eegaynaa in kutirsane

kastaa labadan astaamood leeyahay, taasoo ah, in uu yahay tiro dhaban ah iyo in uu yahay tiro 5 iyo 25 u dhexaysa. Matalan, 17 iyo 26 midna kutirsane B maaha, waayo 17 tiro dhaban ah maaha, 26-na uma dhexeeyo 5 iyo 25.

Habka Roostar, B = { 2, 3, 5, 7 }. Habka astaan qeexda.

B = { x | x tahay hal-godde mutuxan }, ama

- 5) Sheeg kutirsaneyaasha urur kasta oo hoos ku qoran:
- b) Tirooyinka mutuxan ee toban ka yar.
 - t) Dhufsaneyaasha 5 ee laba god leh.
 - j) Barayaasha xisaabta ee dugsigaaga.
 - x) Madaxweynayaasha Dawladaha Afrikada Bar
 - kh) Degmooyinka Gobolka Hiiraan.
- 6) Ka jawaab su'aalahan ku saabsan kutirsaneyaasha urur:
- b) Maroodigu ma yahay kutirsane urur nafley.
 - t) Labajibbaarranuhu ma yahay kutirsane ururka shaxannada sallax.
 - j) «V» ma tahay kutirsane alifka Soomaaliyeed.
 - x) 25 ma tahay kutirsane ururka tirooyinka labajibbaaran.
 - kh) 4 ma yahay kutirsane ururka tirooyinka mutuxan.

3. Sida loo sifeeyo ururrada.

B. Taxidda kutirsaneyaasha (Habka Roostar):

Waxa jira laba hab oo loo sifeeyo ururrada. Mid waa kutirsaneyaasha oo la taxo. Tusaale ahaan, haddii urur kutirsaneyaashiisu yihiin tirooyinka kisiga ah ee ka yar 11, waxa loo taxaa sida soo socota: { 1, 3, 5, 7, 9 } waxaana loo akhriyaa «Ururka kutirsaneyaashiisu yihiin 1, 3, 7, iyo 9. Tidicu wuxu qaydayaa kutirsaneyaasha taxan, hakadyaduna way kala soocayaan. Hakadyada looma baahna haddii la haysto taswiirta kutirsaneyaasha urur. Matalan, urur hoos ku yaal oo ka kooban balooni, saddexagal, xiddig iyo labajibbaarane waxan haysanna taswiirka kutirsaneyaasha. Markaa hakadyo looma baahna.



Bal u fiirso ururradan: $\{1, 2, 3, 4, 5\}$ iyo $\{12345\}$

Maxaa dhici lahaa haddii laga tago hakadyada kala sooca kutirsaneyaasha urur tirooyin? Labada urur ee $\{1, 2, 3, 4, 4\}$

iyo $\{12345\}$ ma isku mid baa?

Had iyo jeer, inoo suurtoobi mayso in aan wada taxno dhammaan kutirsaneyaasha urur kasta. Tusaale ahaan, haddii lagu yiraa tax, dhammaan kutirsaneyaasha ururka tirooyinka kisiga ah, waxaad arkaysaa in ayna suuragal ahayn, waayo, tiro kasta oo kisi ah oo aad ka magacawdo waxa la helayaa mid ka weyn. Markaa waxan taxnaa dhowr tiro oo kisi ah, dabadeedna waxa dhignaa saddex barood. Barooyinku waxay ina tusayaan in ururka tirooyinka kisiga ahi uuna dhammaad lahayn. Hadda, ururka tirooyinka kisiga ahi wu-

xuu u qormayaa sidan: $\{1, 3, 5, \dots\}$, sidaas oo kale urur-

ka tirsiimadu wuxuu u qormayaa sidan: $\{1, 2, 3, 4, \dots\}$.

Ururrada kooban qaarkood baan la wada taxi karin ama ay dhibaato leedahay wada taxiddoodu, waayo wxaay u baahan yihiin waqti badan iyo xaashiyo badan. Tusaale ahaan, waan sheegi karnaa kutirsaneyaasha ururka tirooyinka dhabanka ah ee 100,000 ka yar. Ka u horreeyaa waa 2, ka la-baad waa 4, ka saddexaad waa 6, ka u dambeeyaana waa 99,998. Haddii aan is niraaxna kutirsaneyaasha ururkaas oo dhan hubaal waxan u baahanaynaa waqti badan iyo xaashii aad u ballaaran. Markan oo kale baruhu waa lagama maarmaan. Waxan qoreynaa dhowrka kutirsane ee ururka ugu horreeya, dabadeedna waxan dhigaynaa saddex barood, dabadeedna kutirsanaha ugu dambeeya. Markan, ururku

Dhurwaa waa kutirsane ururka xayawaanka dugaagga ah, laakiin, sac ma aha kutirsane ururka xayawaanka dugaagga ah, waayo sac dugaag maaha.

Astada «€» waxay u taagan tahay «waa kutirsane» kii aan ka qori lahayn, Ugaandha waa kutirsane ururka ladaha Afrika ee madax bannaan, waxan qoreyna, Ugaandha € Dawladaha Afrika ee madax bannaan. Dhurwaa € ururka xayawaanka dugaagga ah.

Astada «¢» waxay u taagan tahay «maaha kutirsane», markaa halkii aan ka qori lahayn sac maaha kutirsane ururka xayawaanka dugaagga ah, waxan qoreynaa sac ¢ ururka xayawaanka dugaagga ah, Soomaaliya ¢ ururka Dawladaha Afrikada Galbeed. Waxan ognahay in 2€ ururka tirooyinka dhabanka, laakiin 2¢ ururka tirooyinka kisiga ah.

(«€» waxa loo akhriyaa waa kutirsane. «¢» waxa loo akhriyaa maaha kutirsane).

Layli 1:

- 1) Sheeg saddex urur oo ka kooban waxyaalo kala jaad ah.
- 2) Sheeg afar urur oo ka kooban waxyaalo isku jaad ah.
- 3) **Qor kutirsanayaasha ururradan soo socda:**
 - b) Gobollada Dalka J.D.S.
 - t) Tirsiimada dhabanka ah ee 20 ka yar.
 - j) Ardayda Fasalkan ee 16 jir ka yar.
 - x) Isirrada 16.
 - kh) Dhufsaneyaasha 6 ee 100 ka yar.
 - d) Shaqallada gaaban ee afka Soomaaliyeed.
 - r) Cayaartoyada kubbadda koleyga ee fasalkan.
 - s) Maamuleyaasha dugsigan.
 - sh) Shaqallada afka Ingiriiska.
 - dh) Dawladaha Afrika ee Faransiisku gumeysto.
- 4) Sidee baad u sifeyn lahayd ururkan $\{2, 4, 6, 8\}$

URUR

1. Waa maxay urur?

Badanaaba, marka aan rabno in aan tilmaanno wax koox ah, waxaan isticmaalnaa erayo gaar ah, sida xayn ariya, raxan libaaxyo ah, kadin geel ah, guuto askar ah, iwm.

Xisaabtu, wixii koox ah oo dhan waxay tiraa URUR. Erayada «xayn», «raxan», «kadin», «guuto» iyo erayga urur waa isla micne.

Tusaalooyin Ururro:

- b) Ururka kuraasta fasalka
- t) Ururka baraha xarriijinta BT
- j) Ururka tirsiimada ee toban ka yar
- x) Ururka ardayda fasalka koowaad ee dugsiyada sare ee J.D.S.
- kh) Ururka saddexagallada oo dhan.

Ururadan aan soo sheegnay oo dhan, mid walba wuxu ka kooban yahay, waxyaalo isku nooc ah. Laakiin, waxa dhici karta in urur uu ka koobmo waxyaalo kala nooc ah. Tusaale ahaan, waxa dhici karta in la helo urur ka kooban dabaashiir, qalin, buug, dhagax.

2. Kutirsane Urur:

Waa lagama maarmaan in urur kasta hagaag loo sifeeyo, si aan ruuxna uga murmin waxyaalaha ku jira ururkaa. Tusaale ahaan, haddii lagu yiraahdo sheeg urur tirooyin, waxaad sheegi kartaa ururro badan oo tirooyin, laakiin haddii lagu yiraa sheeg ururka tirsiimada ee toban ka yar, waxad sheegi kartaa urur keliya, kaasoo ah kan ka kooban 1, 2, 3, 4, 5, 6, 7, 8 iyo 9. Waxyaabaha urur uu ka kooban yahay, mid walba waxa la yiraa Kutirsane urur. Matalan, Ugaandha waa kutirsane ururka Dawladaha Afrika ee madaxa bannaan.

- x) Ururka shibbaneyaasha afka Soomaaliyeed.
- kh) Ururka gobollada Dalka J.D.S.
- d) Ururka dhufsaneyaasha 6 ee ka weyn 10 kana yar 100.
- r) Ururka shaqallada afka Ingiriiska.
- s) Ururka Madaxweyneyaasha J.D.S.
- sh) Ururka tirooyinka idil.
- dh) Ururka tirooyinka labo godlaha ah ee taban.
- g) Ururka xaruumaha gobollada dalka J.D.S.
- c) Ururka isirrada 484.
- f) Ururka barayaasha dugsiigaaga.

2) Adoo isticmaalaya habka astaan qeexda, sif ee urur kasta.

$$b) B = \{2, 4, 6, 8, 10, 12\}$$

$$t) T = \{1, 2, 3, 4, 5, 6\}$$

$$j) J = \{4, 5, 6, \dots, 99\}$$

$$x) X = \{2\}$$

$$kh) KH = \{\text{Beledweyne, Boosaaso, Burco, Baydhabo}\}$$

$$d) D = \{2, 3, 5, 7\}$$

$$r) R = \{B, D, R, G, L, M, N\}$$

$$s) S = \{1, 2, 3, \dots\}$$

$$\text{sh) SH} = \{3, 6, 9, \dots\}$$

$$\text{dh) DH} = \{aa, ee, ii, oo, uu\}$$

3) Haddii $H = \{x \mid x \text{ tahay dad}\}$, sifee ururka rag oo dhan adoo la kaashanaaya H.

4) Haddii $S = \{\text{ardayda dugsigan dhigata oo dhan}\}$, sifee ururka ardayda fasalka 1aad ee dugsigan.

5) Kala sheeg hawraaraha runta ah iyo kuwa beenta ah:

$$\text{b) } 2 \in \{x \mid x \text{ tahay tirsiimo}\}$$

$$\text{i) } 2 \in \{2\}$$

$$\text{j) } 2 \in \{2, 1\}$$

$$\text{x) } \{2\} \in \{1, 2, 3, 4, 5, 6\}$$

$$\text{kh) } \{2\} \in \{2\}$$

$$\text{d) } \{2\} \in 2$$

$$\text{r) } \{2\} \notin \{2\}$$

$$s) \quad 3 \in \left\{ x \mid x \text{ tahay dhufsanaha } 2 \right\}$$

$$sh) \quad 21 \in \left\{ x \mid x \text{ tahay tiro mutuxan} \right\}$$

$$dh) \quad \text{Libaax} \in \left\{ x \mid x \text{ tahay dugaag} \right\}$$

URUR HAGAAG U QEEXAN

Haddii urur loo sifeeyo si aan qo'na shaki uga gelin inta kutirsane u ah iyo inta aan u ahayn, waxa la yiraa **urur hagaag u qeexan**. Ururka ardayda fasalkani waa urur hagaag u qeexan, laakiin ururka cayaartoyda wanaagsan ee dugsigani hagaag uma qeexna. Ka hore hagaag buu u qeexan yahay, maxaa yeelay, jawaabta su'aashan, «kani fasalka ma ku jiraa?», baa inoo kala sheegi karta kutirsaneyaasha ururkan iyo kuwa aan kutirsaneyaal u ahayn. Haddii jawaabtu ay «haa» noqoto, waa kutirsane ururka, haddii kalese maaha kutirsane. Ururka dambe hagaag uma qeexna waayo marka aan su'aasha «kani cayaartoy wanaagsan ma yahay?» dadka weydiinno waxa laga yaabaa in la isku afgaran waayo oo dadka qaarkii dhaho «haa», qaarkoodna maya. Ururka kale ee aan hagaag u qeexnayni' waa ururka ardayda wanaagsan ee fasalka dhigata.

Layli 3:

- 1) Sheeg saddex urur oo hagaag u qeexan.
- 2) Sheeg afar urur oo aan hagaag u qeexneyn.
- 3) Oraahahan soo socda, kala sheeg kuwa sifeeya urur hagaag u qeexan iyo kuwa kale:
 - b) Ururka baararka magaaladan.
 - t) Ururka ardayda kubbadda aad u taqaanna, ee dugsigan dhigata.
 - j) Ururka buugagga xisaabta ee dugsigan taal.
 - x) Ururka abyooneyaasha shan ka weyn.
 - kh) Ururka ardayda edebta badan ee fasalkaaga ku jira.

- d) Ururka ardayda fasalkaaga.
- r) Ururka ardayda dhaadheer ee fasalkan dhigata.
- sh) Ururka shaqaalaha magaaladan jooga.
- dh) Ururka dadka kacaanka ah ee fasalkan dhigta.

4) Sheeg in urur kasta oo soo socdaa mid hagaag u qeexan yahay iyo in kale.

b) $\{x \mid x \text{ tahay tiro}\}$

t) $\{x \mid x \text{ yahay fanaan cod wanaagsan}\}$

j) $\{x \mid x \text{ tahay wax kasta oo adduunka yaal}\}$

x) $\{t \mid t^2 = b + 2\}$

5. Urur Madhan.

Badanaaba, marka aan maqallo urur, maskaxda waxa ku soo dhaca wax ka kooban laba walaxood ama ka badan. Xi-saab ahaan, ururku hal kutirsane wuu yeelan karaa ama wuu-xuu noqon karaa mid aan kutirsaneba lahayn.

Ururka aan kutirsane lahayn waxa la yiraa: **Urur madhan.**

summaddiisuna waa $\{ \}$ ama ϕ .

Bal isku day in aad taxdid kutirsaneyaasha ururradan soo socda:

$$B = \{x \mid x \text{ tahay tirsiimo ka yar } 5\}$$

$$T = \{x \mid x \text{ tahay dhufsaneyaasha } 6 \text{ ee ka weyn } 7 \text{ kana yar } 12\}$$

$$I = \{x \mid x \text{ tahay labajibbaarane shan dhinac leh}\}$$

$$KH = \{\text{Ururka ardayda fasalkan dhigata ee 6 jir ka yar}\}.$$

Kutirsaneyaasha ururka B waa 1, 2, 3, iyo 4, laakiin ururrada T, J iyo KH midna kutirsane ma leh. T, J iyo KH waa ururro madhan.

Ogow in ϕ iyo $\{\phi\}$ ayna isla mid ahayn, waayo ka hore

waa urur madhan ka danbase maaha urur madhan. Wuxuu

leeyahay hal kutirsane kaasoo ah ϕ . Waliba, ϕ iyo $\{0\}$

isla mid maaha, waayo ururka $\{0\}$ wuxuu leeyahay hal kutirsane kaasoo ah 0; laakiin ϕ kutirsane ma leh.

Layli 4:

1) Ururradan kuwee baa madhan?

$$B = \{x \mid x \text{ tahay tiro mutuxan oo dhaban ah oo ka weyn 5}\}.$$

$$T = \{x \mid x \text{ tahay tiro mutuxan oo togan oo 2 ka yar}\}$$

$$J = \{x \mid x \text{ tahay tiro kisi ah oo 4 u qaybsanta}\}$$

$$X = \text{Ururka ardayda fasalkaaga ee lixdan jir ah.}$$

$$KH = \text{Ururka Madaxweynayaasha Afrika.}$$

$$D = \text{Ururka shaxannada sallax ee labo xarriiq ku dhex oodan.}$$

$$R = \text{Ururka saddexagallada laba dhinac leh.}$$

2) Kala sheeg kuwa runta ah iyo kuwa beenta ah:

$$\text{b) } 2 \in \{ \}$$

$$\text{t) } \{ \} \in \phi$$

$$\text{j) } \{ \} \text{ waa } \phi$$

$$\text{x) } \{ \} \text{ waa urur madhan}$$

$$\text{kh) } \{ \phi \} \text{ waa urur madhan}$$

$$\text{d) } \phi \in \phi$$

$$\text{r) } \phi \in \{ x \mid x \text{ tahay tirsiiimo} \}$$

$$\text{s) } \phi \in \{ 2, \phi \}$$

$$\text{sh) } \{ \} \in \{ \phi, \{ 1 \}, \{ 2 \} \}$$

$$\text{dh) } 2 \in \{ x \mid x \text{ tahay abyoone togan} \}$$

6. Hormo qumman iyo ta aan qummaneyn.

Ururka X waxa la yiraa wuxuu u yahay hormo ururka Y, haddii kutirsane kasta oo X uu isla markaas yahay kutirsane Y. Si kalena, haddii X hormo Y tahay, ma jiro kutirsane X oo aan kutirsaneyn Y.

Tusaalooyin :

- i) Ururka shaqalladu waa hormo ururka xarfaha, waayo, shaqal kasta waa xaraf afka ka mid ah.
- ii) Ururka ardayda fasalkani waa hormo ururka ardayda dugsigan, waayo arday kasta oo fasalkan ku jiraa waa arday dugsigan ku jira.

iii) Haddii $B = \{b, t, j, x, d\}$, $T = \{l, m, b, q, t, j, x, d, r\}$

B waa hormo T. T ma tahay hormo B?

iv) Haddii $D = \{1, 2, 3, 4, 5\}$, $R = \{2, 3, 1, 5, 4\}$

Ururka D waa hormo ururka R, waayo ma jiro kutirsane D oo aan kutirsaneyn R. R ma tahay hormo ururka D? Haa, waayo ma jiro kutirsane R oo aan kutirsaneyn D. Markaas oo kale, waxaan nira ururka $D =$ ururka R ama $D = R$.

Qeex :

Ururka X wuxuu le'egyahay ururka Y, t.a. $X = Y$, haddii X hormo Y tahay, isla markaas Y hormo X tahay. X baa Y le'eg, micnaheedu waxa weeye, xarfka X iyo xarfka Y waa laba summadood oo urur keliya magacaaba. Mar haddii X iyo Y ay yihiin, laba magac oo urur quri wada leeyahay, waxan oran karnaa hawraarta X waa hormo Y, isla markaas Y waa hormo X, waxay inoo sheegaysaa in urur kastaa hormo isu yahay.

Hormada aan qummaneyn ee urur kasta waa isla ururka laftiisa. Hormooyinka kale oo idili way qumman yihiin.

Bal ka warran ururka madhan. Ururka madhan wuxuu u yahay hormo, ama waa hormo, urur kasta, waayo ma jiro kutirsane ururka madhan oo aan kutirsaneyn ururka laga hadlayo.

Tusaale:

Haddii ay $B \approx \{1, 2, 3, 4, 5\}$ bal u fiiro ururrada

$$T = \{1, 2, 5\}, J = \{2, 3, 6, 7\}, D = \{\}$$

T waa hormo B, waayo ma jiro kutirsane T oo aan kutirsaneyn B; J maaha hormo B waayo 6 yio 7 waa kutirsaneyaal J, laakiin maaha kutirsaneyaal B; D waa hormo B, waayo ma jiro kutirsane D oo aan kutirsaneyn B. Ma oran karnaa D waa hormo J ama T? Haa, waayo ma jiro kutirsane D oo aan kutirsaneyn J ama T.

Ururka B, hormo wuxuu u yahay ururka T, waxa keliya oy inoo sheegaysaa in kutirsane kasta oo B uu isla markaa yahay kutirsane T, laakiin waxba inoogama sheegayso in $B = T$, oo ay B tahay hormada aan qummaneyn ee T ama in $B = \phi$. Tusaale ahaan, haddii B tahay hormo T oo $T = \{1, 2, 3, 4, 5\}$ markaa B waxay noqon kartaa ururrada soo socda miduun:

i) $\{\}$

ii) $\{1, 2, 3, 4, 5\}$

iii) $\{2, 3, 4\}$

iv) $\{1\}$

Markasta B waa hormo T, ama B waxay ku jirtaa T. Summadda \subseteq waxay la micne tahay «ku jirid» ama «hormo». Tusaalaheennii, waxan u qori karnaa $B \subseteq T$. Haddii B ayna hormo u ahayn T, waxan qoraynaa $B \not\subseteq T$ (loo akhriyo: B hormo T maaha ama B maaha hormo T).

Tusaalooyin :

$$\text{Ka soo qaad in } B = \{1, 2, 3, 4, 5\}, \quad D = \{1, 3, 4, 5\}$$

$$R = \{2, 5, 6, 7\}, \quad S = \{1, 2, 3, 4, 5\}, \quad \text{markaa } D \subseteq B, \\ S \subseteq B, \text{ laakiin } R \not\subseteq B.$$

Qeex: Hormo Qumman.

Ururka X waa hormo qumman oo ururka Y, haddii X tahay hormo Y, oo ay jiraan ugu yaraan hal kutirsane oo Y, oo aan kutirsaneyn X. Si aan u tusno in X hormo qumman oo Y tahay waxaan qoraa $X \subset Y$. Marka X ayna ahayn hormo qumman oo Y waxan qorraa $X \not\subseteq Y$.

Tusaalooyin :

i) Haddii $B = \{1, 2, 3, 4, 5\}$, $T = \{2, 5, 6, 7\}$,
 $D = \{1, 2, 3, 4, 5\}$ markaa:

b) $T \not\subseteq B$, waayo 6 yo 7 waa kutirsane T laakiin maaha kutirsane B.

t) $B \subseteq D$, waayo kutirsane kasta oo B isla markaa waa kutirsane D.

j) $D \subseteq B$, waayo kutirsane kasta oo D isla markaa waa kutirsane T.

x) $B = D$ waayo $B \subseteq D$ islamarkaa $D \subseteq B$.

ii) Haddii $X = \{a, b, c, d, e\}$, $Y = \{a, e\}$ $W = \{\}$
markaa:

b) $Y \subset X$ waayo $Y \subseteq X$, isla markaa b, c iyo d oo ah kutirsane X kama-tirsana Y.

t) $W \subset X$, waayo $W \subseteq X$, isla markaa waxa jira kutirsaneyaal X oo aan kutirsaneyn W.

j) $W \subset Y$, waayo?

x) $X \not\subseteq Y$, waayo?

Layli 5:

1. Haddii aad haysato ururradan soo socda ee shaxanada sallax ah:

- B — Saddexagallo
- T — Saddexagallo Siman
- J — Saddexagallo Labaale ah
- X — Saddexagallo isma le'eke ah
- KH — Saddexagallo isle'eke ah
- D — Saddexagallo qumman
- R — Saddexagallo labaale ah oo qumman.

Adigoo isticmaalaya summadaha \subseteq , $=$, $\not\subseteq$, sheeg xiriirka ka dhexeeya lammaaneyaashan ururrada ah.

- | | |
|-----------|------------|
| i) J, T | v) R, B |
| ii) B, T | vi) X, B |
| iii) D, T | vii) Kh, B |
| iv) Kh, D | viii) R, J |

2. Adigoo isticmaalaya summadaha \subseteq ama \subset , sheeg xiriirka ka dhexeeya ururradan marka labo-labo la iskugu qaado.

- B — Afargeesyo
- T — Laydi
- J — Labajibbaarane
- X — Barbarroole
- KH — Koor

Tusaale, haddii B iyo T aan isku qaadno, waxan oranaynaa $T \subset B$.

3. Hawraarahan, kala sheeg kuwa runta ah iyo kuwa beenta ah.

b) $\{2, 3, 5\} \subset \{x \mid x \text{ tahay tiro mutuxan}\}$

t) $\left\{x \mid x \text{ tahay tirsiiimo}\right\} \subseteq \left\{x \mid x \text{ tahay abyoone aan tabnayn}\right\}$

$$j) \{4, 5, 6, 7\} \subseteq \{1, 2, 3, \dots, 100\}$$

$$x) 2 \subseteq \{2\}$$

$$kh) \{2, 3\} \subset \{2\}$$

$$d) \phi \subset \{2\}$$

$$r) \{\} \subset \{0\}$$

$$s) \{1, 2, 3, 4\} \subset \{4, 3, 2, 1\}$$

$$sh) \{\text{Bareyaal}\} \subset \{\text{rag}\}$$

$$dh) \{\dots, -3, -2, -1, 0, 1, 2, 3, \dots\} \subset \{x \mid x \text{ tahay abyoone}\}.$$

4. Sheeg nita hormo ee aad karto ee ururka $B = \{1, 2, 3\}$

5. Urur kasta oo soo socda hormooyinkiisa oo dhan sheeg:

$$b) X = \{0\}$$

$$t) Y = \{2\}$$

$$j) W = \{\phi\}$$

$$x) B = \{0, 1\}$$

$$\text{kh) } T = \{1, 2\}$$

$$\text{d) } J = \{b, t, j\}$$

$$\text{r) } KH = \{0, 1, 2\}$$

$$\text{s) } D = \{\Delta, \square, \circ\}$$

$$\text{sh) } R = \{1, 2, 3, 4\}$$

$$\text{dh) } S = \phi$$

$$6. \text{ Maxaa u dhexeeya } \left\{ \right\}, \phi, \left\{ \phi \right\} \text{ iyo } \left\{ 0 \right\}$$

$$7. \text{ Haddii } B = \{b, t, j, x\}, \quad T = \{1, 2, 3, 4\}, \text{ ma}$$

oran karnaa $B = T$?

8. Su'uusha 5aad, bal ka fikir dariiqo lagu helo tirada hormooyinka urur kasta.

URUR GUUD

Mar alla markii ururro la falanqeeyo waxan heli karaa urur ay ururrada la falanqeynayo oo dhammi hormo u yihiin. Ururka caynkaasa waxa la yiraa: **Urur Guud**, summaddiisu-na waa U.

Ogow in ururka guud uu yahay ka ugu weyn ururrada la falanqeynayo oo dhan. Ururka guud wax go'an oo joogta ah maaha ee wuxuu ku xiran yahay hadba ururrada laga hadlayo. Doorashada la dooranayo urur guud waxay ku xiran tahay layliska la furfurayo. Tusaale ahaan, ka soo qaad in laga hadlayo ururka cayaartoyga kubbadda cagta, kubbadda koleyga, kubbadda laliska iyo cayaartooyga xeegada ee J.D.S.

Ururka guud ee ururradaasi wuxuu noqon karaa ururka cayaartoyga JDS; waxa kale uu noqon karaa ururka cayaartoyga Afrika ama dunida. Sidoo kale, haddii:

$$B = \{1, 2, 3, \dots, 99\} \quad T = \{4, 5, 7\}$$

$$J = \{2, 4, 6, \dots, 1002\} \quad X = \{1001, 1002, \dots, 10,000\}$$

$$KH = \{2, 3, 5, 7, 11, 13, 17, 19, 23, 29\}$$

$$D = \{1, 3, 5, \dots, 999\}.$$

Ururka guud ee ururradaas oo dhammi wuxuu noqon karaa ururka tirsimada; waayo urur kasta oo kor ku yaal wuxuu hormo u noqonayaa ururka tirsimada. Ururka kale ee urur guud u noqon kara ururradaas oo dhan waa ururka $\{1, 2, 3, \dots, 10,000\}$.

Urur kasta oo ururrada la falanqeynayo oo dhammi ay hormo u yihiin wuxuu noqon karaa ururka guud ee ururradaas.

Layli 6:

1. Sifee urur kasta oo soo socda adoo isticmaalaya habka taxidda (H. Roostar) ama habka astaan qeexda. Sheeg urur ay ururradaas oo dhammi hormo u yihiin:

- b) Ururka ayaamaha toddobaadka ee xarafka A ka bilaabma.
- t) Magaalo madaxyada gobollada J.D.S. ee xarafka B ka bilaabma.
- j) Abyooneyaasha 4 iyo 7 u dhexeeya.

2. Haddii:

$$B = \{1, 2, 3, \dots, 20\}$$

$$T = \{0, 2, 4, \dots, 10\}$$

$$J = \{12, 20, \dots, 20\}$$

$$X = \{1, 3, 5, \dots, 101\}$$

$$KH = \{2\}$$

$$D = \{3, 6, 9, \dots, 192\}$$

$$R = \{21, 91, 7, 28\}$$

$$S = \{1, 2, 3, 4, 6, 12\}$$

Ururrada hoos ku qorani ma u noqon karaan urur guud ururrada kor ku qoran? Waliba, sheeg inta urur ee ay urur guud u noqon karaan:

b) Ururka dhufsaneyaasha 2.

t) Ururka tirsiiimada.

j) Ururka D

x) Ururka $\{0, 1, 2, 3, \dots, 192\}$

kh) Ururka abyooneyaasha aan tabnayn.

d) ϕ

r) Ururka abyooneyaasha.

$$s) \{0, 2, 4, 6, \dots\}$$

3. Sheeg hal urur oo urur guud u noqon kara ururrada soo socda:

i) b) $\{x \mid x \text{ yahay cayaartoy kubbadeed oo Xamar jooga}\}$

t) $\{x \mid x \text{ yahay arday Baydhaba jooga}\}$

j) $\{x \mid x \text{ yahay Jaalle ku jira G.S.K.}\}$

x) $\{x \mid x \text{ tahay macallimad Jowhar joogta}\}$

ii) b) $\{x, s, a, n\}$

t) $\{x, y, w\}$

t) $\{l, m, n, o\}$

x) $\{m, a, x\}$

iii) b) $\{1, 2, 3, \dots, 10\}$

t) $\{x \mid x \text{ tahay dhufsane 5 oo ka yar 15}\}$

j) $\{x \mid x \text{ ardayad dugsigan dhigata oo 120 jir ah}\}$

$$x) \{x \mid x \text{ tahay hal godle mutuxan}\}$$

4. Haddii aad haysato $U = \{x \mid x \text{ yahay arday fa-salkan ku jira}\}$, sheeg inta hormo ee aad karto.

5. Hawraarahan, kuwee baa been ah, kuwee baana run ah:

i) Haddii

$$B = \{1, 2, 3, 4\} \quad T = \{2, 3, 5\} \quad J = \{1, 2, 3, 4, 5\}$$

markaa J urur guud bay u tahay ururradaan.

ii) Haddii $B = \{x \mid x \text{ tahay tirsiiimo}\}$

$$T = \{x \mid x \text{ tahay dhufsane 2 oo ka weyn 2}\}$$

$J = \{0, 1, 2, 3, \dots\}$, markaa B waxay urur guud u tahay T iyo J.

ISUTAG, DHEXTAAL IYO DULEEDIN

Haddii la ina siiyo ururro iyo ururkoodii guud, waxan abuuri karnaa ururro cusub marka aan ururradaa siyaabo gaar ah iskugu-darno. Ururrada cusub ee soo baxaanna waxay hormo u yihiin ururkii guud. Tusaale ahaan haddii $B = \{1, 2, 3, \dots, 10\}$, $T = \{2, 4, 6, \dots, 16\}$, ururka guudna uu yahay, $U = \{x \mid x \text{ tahay tirsiiimo}\}$, siyaabaha

soo socda baan B iyo T iskugu dari karnaa:

1. Isutagga B iyo T oo lo qoro $B \cup T$
2. Dhextaalka B iyo T oo loo qoro $B \cap T$
3. Urur duleedka B ama duleedka B oo loo qoro \bar{B}

1. **Isutagga B iyo T:** waa ururka kutirsaneyaashiisu ka yimaadaan B iyo T ama labadaba. $B \cup T$ waxa loo akhriyaa «**B u tag T**». Markaa, $B \cup T = \{1, 2, 3, \dots, 16\}$

Ogow in $B \cup T$ uu hormo u yahay ururka guud:

$$U = \{x \mid x \text{ tahay tirsiiimo}\}.$$

1. **Dhextaalka B iyo T:** waa ururka kutirsaneyaashiisu yihiin kutirsaneyaasha B iyo T wadaagaan. $B \cap T$ waxa loo akhriyaa, «**B dhextaal T**» ama dhextaalka B iyo T. Mar-

kaa, $B \cap T = \{2, 4, 6, \dots, 10\}$. U fiirso in $B \cap T$ uu hormo u yahay ururka guud.

3. **Duleedka B:** oo loo qoro B (loona akhriyo «**duleed B**») waa ururka ka kooban kutirsaneyaasha ururka guud ee aan kutirsaneyn B. Haddii la rabo in la helo urur duleed, waxa lagama maarmaan ah in la ogaado ururka guud.

Tusaalooyin:

$$\text{i) Haddii } B = \{1, 3, 5, 7\}; T = \{2, 4, 6, 8\}$$

$$\text{markaa } B \cup T = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$\text{ii) } J = \{1, 2, 3\} \quad X = \{0\},$$

$$\text{markaa } J \cup X = \{0, 1, 2, 3\}$$

iii) Haddii $Kh = \{1, 2, 3, 4, 5\}$, $D = \{ \}$ markaa

$$Kh \cup D = \{1, 2, 3, 4, 5\}$$

iv) Haddii $R = \{1, 2, 3, 4, 5\}$, $S = \{2, 4, 6, 8\}$

markaa $R \cup S = \{1, 2, 3, 4, 5, 6, 8\}$

v) Haddii $B = \{1, 2, 3, 4\}$, $T = \{2, 4, 6, 8, 10\}$

$$B \cap T = \{2, 4\}$$

vi) Haddii $J = \{b, t, j, x\}$, $X = \{b, t, l, m, n, h\}$

markaa $J \cap X = \{b, t\}$

vii) Haddii

$$Kh = \{1, 2, 3, 4, 5, 7, 9, 11\}, \quad D = \{6, 8, 10, 12, 14\}$$

markaa $Kh \cap D = \{ \}$

viii) Haddii

$$R = \{6, 8, 10, 12, 14\}, \quad U = \{2, 4, 6, 10, 12, 14, 16, 18\}$$

markaa $R \bar{U} = \{2, 4, 16, 18\}$

- ix) Haddii $S = \text{Ururka waddamada hantiwadaagga ah.}$
 $U = \text{Ururka waddamada dunida oo dhan.}$

Markaa $\bar{S} = \text{Ururka waddamada aan hantiwadaagga ahayn.}$

- x) Haddii $Sh = \text{Ururka ardayda fasalka dhigata.}$
 $U = \text{Ururka ardayda dugsigan dhigata.}$

Markaa $\bar{Sh} = \text{Ururka ardayda dugsigan dhigata ee aan fasalkan ku jirin.}$

10. Xeerarka Dimoorgan (De Morgan).

Maddii B iyo T ay ururro yihiin, markaa:

i) $\overline{(B \cup T)} = \bar{B} \cap \bar{T}$

ii) $\overline{(B \cap T)} = \bar{B} \cup \bar{T}$

Tusaalooyin:

- i) Haddii $U = \{1, 2, 3, \dots, 15\}$, $B = \{11, 12, 13, 14\}$

$$T = \{1, 2, 3, 4\}$$

Markaa $B \cup T = \{1, 2, 3, 4, 11, 12, 13, 14\}$

$$\therefore \overline{(B \cup T)} = \{5, 6, 7, 8, 9, 10, 15\}$$

$$\bar{B} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15\}$$

$$\bar{T} = \{5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$$

$$\therefore \overline{B} \cap \overline{T} = \{5, 6, 7, 8, 9, 10\}$$

U fiirso in $(\overline{B \cup T})$ iyo $\overline{B} \cap \overline{T}$ ay isle'eg yihiin.

ii) Haddii $U = \{1, 2, 3, \dots, 10\}$, $J = \{4, 5, 6, 7, 8\}$

$$X = \{5, 6\}$$

$$\text{Markaa } J \cup X = \{4, 5, 6, 7, 8\}$$

$$\therefore \overline{(J \cup X)} = \{1, 2, 3, 9, 10\}$$

$$\overline{J} = \{1, 2, 3, 9, 10\}$$

$$\overline{X} = \{1, 2, 3, 4, 8, 9, 10\}$$

$$\overline{J} \cap \overline{X} = \{1, 2, 3, 9, 10\}$$

U fiirso $(\overline{J \cup X})$ iyo $\overline{J} \cap \overline{X}$ ay isle'eg yihiin

iii) Haddii $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$$Kh = \{1, 3, 5, 7, 9\}$$

$$D = \{1, 2, 3, 4, 5\}$$

$$\text{Markaa } Kh \cap D = \{1, 3, 5\}$$

$$\overline{(\text{Kh} \cap \text{D})} = \{2, 4, 6, 7, 8, 9, 10\}$$

$$\text{Waliba } \overline{\text{KH}} = \{2, 4, 6, 8, 10\}$$

$$\overline{\text{D}} = \{6, 7, 8, 9, 10\}$$

$$\overline{\text{KH}} \cup \overline{\text{D}} = \{2, 4, 6, 7, 8, 9, 10\}$$

U fiiro in $\overline{(\text{Kh} \cap \text{D})}$ iyo $\overline{\text{Kh}} \cup \overline{\text{D}}$ ay isle'eg yihiin.

$$\text{iv) Haddii } U = \{1, m, n, f, g, r\}, \quad B = \{1, m, n\}$$

$$T = \{f, g, r\}$$

$$\text{Markaa } B \cap T = \{ \}$$

$$\overline{(B \cap T)} = \{1, m, n, f, g, r\} = U$$

$$\overline{B} = \{f, g, r\}$$

$$\overline{T} = \{1, m, n\}$$

$$\text{Markaa } \overline{B} \cup \overline{T} = \{1, m, n, f, g, r\}$$

$\sim U$ fiirso in $(\overline{B \cap T})$ iyo $\overline{B} \cup \overline{T}$ ay isle'eg yihiin oo mid walba ay tahay $\{1, m, n, f, g, r\}$

$$v) \text{ Haddii } U = \{b, t, j, x, kh, d, r\}, \quad L = \{t, j\}$$

$$M = \{b, t, j, x, kh\}$$

$$\text{Markaa } L \cap M = \{t, j\}$$

$$\therefore (\overline{L \cap M}) = \{b, x, kh, d, r\}$$

U fiirso in $(\overline{L \cap M})$ iyo $\overline{L} \cup \overline{M}$ ay isle'eg yihiin.

Layli 7:

$$1) \text{ Haddii } B = \{\text{Cali, Xasan, Cumar, Cawil}\},$$

$$T = \{\text{Ahmed, Cawil}\}. \text{ Raadi } B \cup T \text{ iyo } B \cap T.$$

$$2) \text{ Haddii } B = \{1, 2, 3, \dots, 13\} \quad T = \{2, 4, 6, 8\}$$

$$J = \{8, 9, \dots, 15\}, \text{ raadi } B \cup T, B \cup J, T \cap J.$$

3) Haddii $U =$ ururka abyooneyaasha:

$$B = \{x \mid x \text{ tahay tirsiiimo}\}$$

$$T = \{x \mid x \text{ tahay abyoone togan oo kisi ah}\}$$

Raadi \overline{B} , $B \cup T$ iyo $B \cap T$.

$$4) \text{ Haddii } U = \{1, 2, 3, 4, 5, 6, 7, 8\},$$

$$B = \{1, 2, 3, 4\} \quad T = \{4, 6, 8\}$$

Raadi:

- | | |
|---------------------------|-----------------------------|
| b) \overline{B} | sh) $(\overline{B \cap T})$ |
| t) \overline{T} | dh) $(\overline{B \cup T})$ |
| j) $B \cap T$ | g) $B \cap U$ |
| x) $B \cup T$ | c) $B \cup U$ |
| kh) $B \cap \overline{T}$ | f) $T \cap U$ |
| d) $\overline{B} \cap T$ | q) $T \cup U$ |
| r) $B \cup T$ | k) $\overline{T} \cap U$ |
| s) $B \cup \overline{T}$ | l) $B \cup U$ |

- 5) Haddii $G =$ Ururka tirsiiimada
 $B =$ Ururka abyooneyaasha togan ee kiswa ah.
 $T =$ Ururka abyooneyaasha togan ee dhabanka ah.
 $J =$ Ururka dhufsaneyaasha 5 ee togan.

Raadi:

- | | |
|--------------------------------------|------------------|
| b) $B \cup T$ | sh) $B \cup G$ |
| t) $B \cap T$ | dh) $B \cap G$ |
| j) \overline{B} | g) $T \cup G$ |
| x) \overline{T} | c) $T \cap G$ |
| kh) $\overline{B} \cup \overline{T}$ | f) $B \cup \phi$ |
| d) $\overline{B} \cap \overline{T}$ | q) $B \cap \phi$ |
| r) $(\overline{B \cup T})$ | k) $T \cup \phi$ |
| s) $(\overline{B \cap T})$ | l) $T \cap \phi$ |

6) Haddii $G = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$$B = \{1, 2, 3\}, \quad T = \{2, 3, 4, 5, 6\}$$

$$J = \{1, 6, 7\}$$

Raadi:

- | | |
|------------------------|-------------------------|
| b) $B \cup T$ | d) $B \cap T$ |
| t) $T \cup J$ | r) $T \cap J$ |
| j) $B \cup (T \cup J)$ | s) $(B \cap T) \cap J$ |
| x) $(B \cup T) \cup J$ | sh) $B \cap (T \cap J)$ |
| kh) $T \cup B$ | dh) $T \cap B$ |

7) Haddii $G = \{b, t, j, x, kh, d, r\}$, $M = \{b, t, j, x\}$
 $N = \{t, x, d\}$

Raadi:

- | | |
|-----------------------------|-------------------------------------|
| b) \overline{M} | d) $M \cup N$ |
| t) \overline{N} | r) $\overline{(M \cup N)}$ |
| j) $\overline{M \cup N}$ | s) $\overline{M} \cap \overline{N}$ |
| x) $M \cap N$ | sh) $\overline{M} \cup M$ |
| kh) $\overline{(M \cap N)}$ | dh) $\overline{M} \cap M$ |

8) Haddii $G = \{1, 2, 3, 4, 5\}$, $B = \{1, 2, 3\}$

Raadi:

- | | |
|---------------------------|------------------------------|
| b) $B \cup \phi$ | d) $\overline{B} \cap B$ |
| t) $B \cap \phi$ | r) $\overline{B} \cup G$ |
| j) $B \cup G$ | s) $\overline{B} \cap G$ |
| x) $B \cap G$ | sh) $\overline{B} \cup \phi$ |
| kh) $\overline{B} \cup B$ | dh) $\overline{B} \cap \phi$ |

9) Haddii U iyo \cap ay yihiin xisaab fallada ururrada, ma kala hormari karaan mana hormageli karaan.

10) Haddii $G = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$$B = \{1, 2, 3, 7, 8\}$$

$$T = \{4, 6, 8, 9, 10\}$$

$$J = \{1, 2, 4, 6\}$$

Tus in:

b)	$B \cup T$	$= T \cup B$
t)	$B \cap T$	$= T \cap B$
j)	$(B \cup T)$	$= B \cup (T \cup J)$
x)	$(B \cap T) \cup J$	$= B \cap (T \cap J)$
kh)	$B \cup (T \cap J)$	$= (B \cup T) \cap (B \cup J)$
d)	$B \cap (T \cup J)$	$= (B \cap T) \cup (B \cap J)$
r)	$B \cup B$	$= B$
s)	$B \cap B$	$= B$
sh)	$B \cup (B \cap T)$	$= B$
dh)	$B \cap (B \cup T)$	$= B$
g)	$B \cup \bar{B}$	$= U$
c)	$B \cap \bar{B}$	$= \phi$
f)	(\bar{B})	$= \bar{B}$
q)	$\overline{(B \cup T)}$	$= \bar{B} \cap \bar{T}$
k)	$\overline{(B \cap T)}$	$= \bar{B} \cup \bar{T}$
l)	$G \cup B$	$= G$
m)	$\phi \cap B$	$= \phi$
n)	$\phi \cup B$	$= B$
w)	$G \cap B$	$= B$

11. Urur Kooban iyo urur aan Koobneyn.

Haddii aan tirinno kuraasta fasalkan, ama ardayda dugsigan ama xarfaha buugga ku yaal, waxan ogaaneynaa inta kutirsane ee ku jirta ururka kuraasta fasalkan, ururka ardayda dugsigan iyo ururka xarfaha buuggan. Ururrada caynkaas ah ee la ogaan karo inta kutirsane ee ku jirta waxa la yiraa: **Ururro kooban**. Urur kooban waa ururka marka ku-

tirsaneyaasha la tiriyo dabadiisa la gaaro. Waxan oran karnaa haddii urur kooban yahay waxa ku jira N kutirsane, oo N ay tahay tiro idil. Ururka aan koobneyn waxa la yiraa: **Urur ma-koobane.** Ururka tirsiiimadu waa urur ma-koobane.

Tusaalooyin kale oo urur ma-koobane waa:

1. Ururka abyoooneyaasha saddex u qaybsama.
2. Ururka tirooyinka maangalka ah ee 0 iyo 1 u dheexeya.
3. Ururka barah xarriiq.

Tusaalooyin ku saabsan urur kooban.

1. Ururka bilaha sannadka.
2. Ururka xarfaha alifka Soomaaliyeed.
3. Ururka shimbiraha adduunka ku nool.

Haddii urur kooban yahay waa suuragal in la helo tirada kutirsaneyaashiisa.

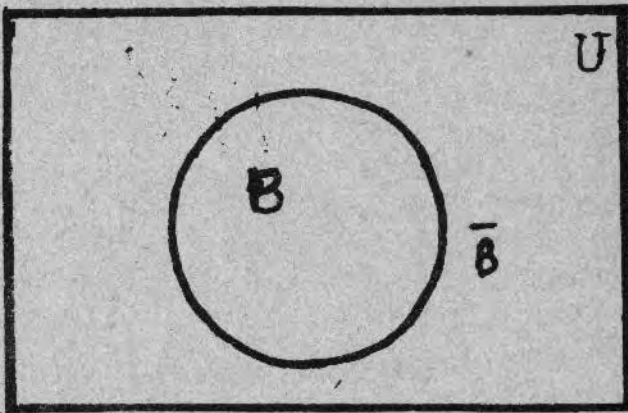
Layli 8:

- 1) Sheeg saddex urur oo kooban.
- 2) Sheeg afar urur oo aan koobnayn?
- 3) Ururrada hoos ku yaal, kala sheeg kuwa kooban iyo kuwa aan koobnayn.
 - b) Ururka abyoooneyaasha togan ee 3 malyuun ka yar.
 - t) Ururka tirsiiimada ee 100 ka weyn.
 - j) Ururka bareyaasha af-Talyaaniga dhiga ee dug-sigan.
 - x) Ururka tirooyinka lakabka ah ee 1 iyo 0 u dheexeya.
 - kh) Ururka dhufsaneyaasha 48.
 - d) Ururka isirrada 48.
 - r) Ururka dadka adduunka ku nool.
 - s) Ururka goobooyinka isku xuddunta ah.
 - sh) Ururka xarriiqaha toosan ee barta B isku gooya.
 - dh) Ururka saddexagallada.
 - g) Ururka tirooyinka dhabanka ah.
 - c) Ururka tirooyinka kisiga ah.

12. Jaantuska Fen.

Jaantuska Fen, oo loogu magac daray xisaab yahankii Ingiriiska ahaa ee la oran jiray Joon Fen (1834 - 1883) jaantus lagu muujiyo kutirsananimada, hormoonimada, iiga, dhextaalka iyo duleedinta ururrada.

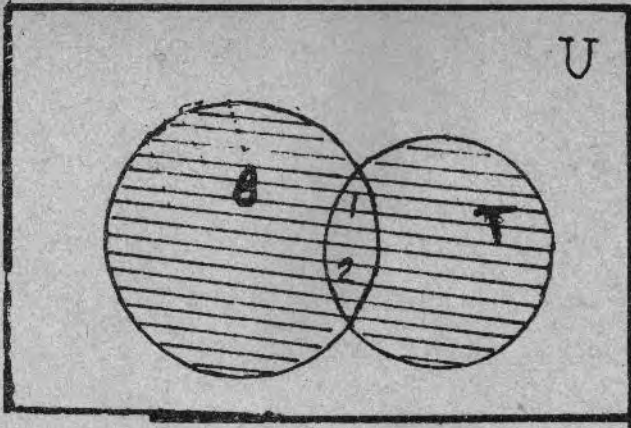
Laydibaa la sameeyaa u taagan ururka guud, U , waxaana lagu dhex sameeyaa goobooyin u taagan hormooyinka U , sida shaxankan ku muujisan.



Sh. 1: Kutirsaneyaasha U waxa u taagan baraha laydiga ku jira oo dhan; kutirsaneyaasha B waxa u taagan baraha goobada B ku jira; kutirsaneyaasha \bar{B} waxa u taagan baraha laydiga ku jira ee ka baxsan goobada B .

Mar haddii $B \cup T$ tahay ururka kutirsaneyaashiisu yihiin kutirsaneyaasha B , ama kutirsaneyaasha T ama kutirsaneyaasha B iyo T labadaba, markaa $B \cup T$ waxa jaantuska loo-

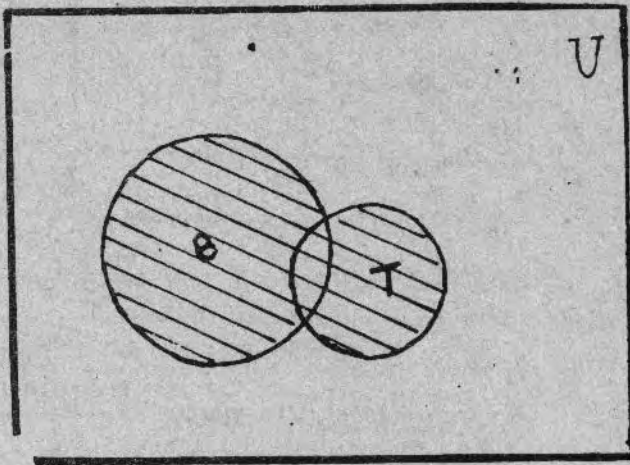
gu muujin karaa sida soo socota:



Sh. 2: Inta xardhani waxay u taagan tahay $B \cup T$.

Haddii $B = \{1, 2, 3, 4\}$, $T = \{1, 2, 5, 6\}$, markaa

B iyo T waxa u kala taagan goobooyinka laydiga ku jira. Inta xardhani waxay u taagan tahay $B \cup T$.



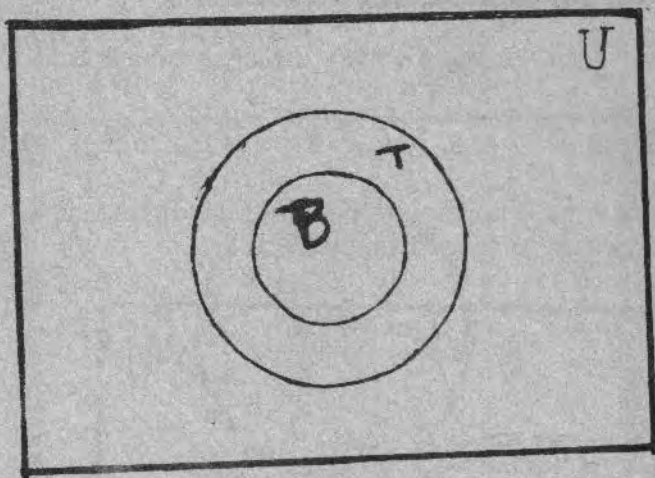
Sh. 3: $B \cup T = \{1, 2, 3, 4, 5, 6\}$ sida inta xardhani

ay muujinayso.

Guud ahaan, isutagga ururro waxa u taagan dhammaan baraha ku jira goobooyinka u taagan ururrada laga hadlayo.

Hormo:

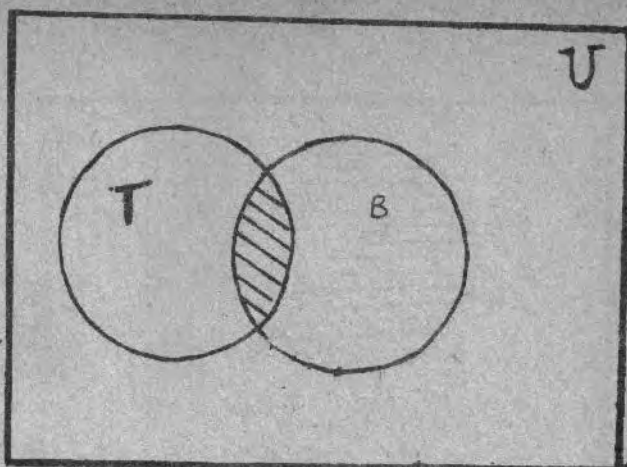
Haddii $B \subset T$, kutirsane kasta oo B waa kutirsane T . Markaa bar kasta oo ku jirta goobada B u taagan waxay ku jirtaa goobada T u taagan, sida hoos ku muujisan.



Sh. 4: U fiirso in goobada B u taagani ku jirto goobada T u taagan.

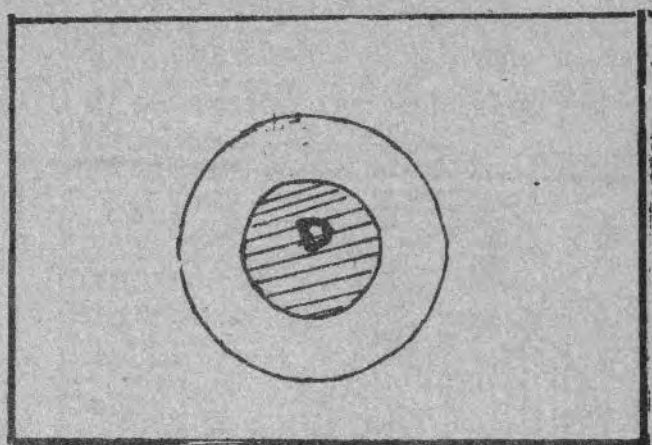
DHEXTAALKA URURRO

Mar haddii $B \cap T$ tahay ururka ka kooban kutirsane-yaasha B iyo T ay wadaagaan markaa, $B \cap T$ waxay u taagan tahay baraha ay wadaagaan goobooyinka B iyo T , sida hoos ku muujisan:



Sh. 5: Inta xardhani waxay u taagan tahay $B \cap T$.

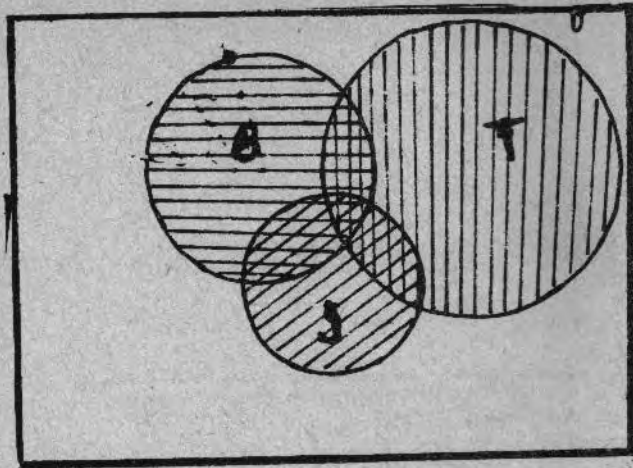
Haddii $D \subset R$, markaa $D \cap R$ waxay la mid tahay D , waayo ma jiro kutirsane D oo aan kutirsaneyn R , markaa kutirsaneyaasha D ayaa R iyo D ay wadaagaan.



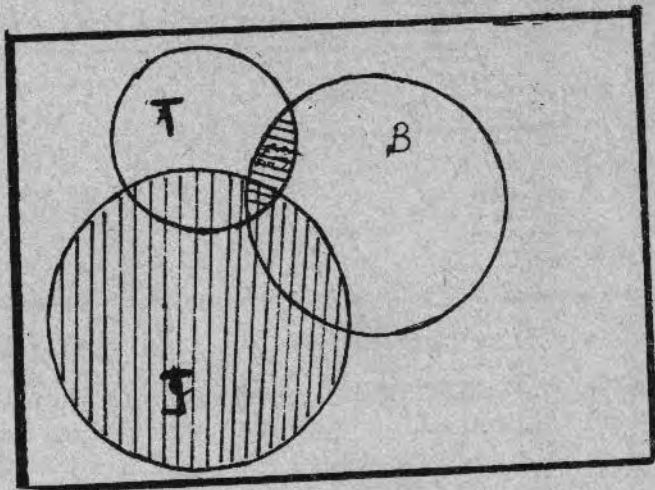
Sh. 6: Inta xardhani waxay u taagan tahay $D \cap K$.

Marka la rabo, in lagu muujiyo xisaab fallada ka dhe xeeya ururro jaantusta Fen, waxa loo shaqeeya sida soo socota:

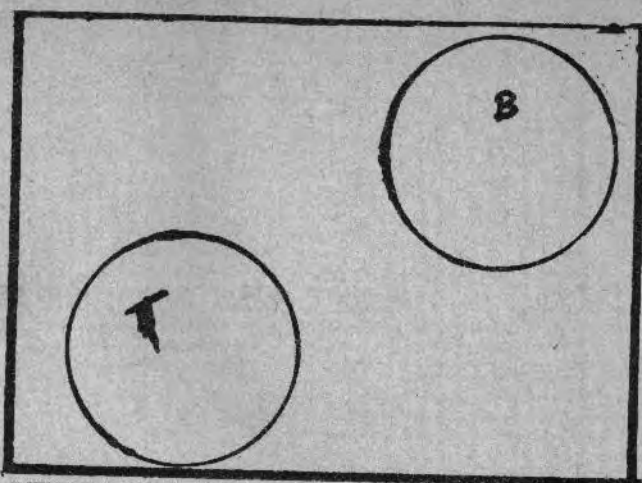
Shaxanka hoos ku yaal, jiif u xaradh B , T -na joog u xaradh, J -na jaanjeedh. Inta saddexda jeer xardhani waxay u taagan tahay $B \cap T \cap J$, waayo waxa ku jira baraha saddexda goobo ay wadaagaan.



Sh. 7: Haddii la rabo in jaantuska lagu muujiyo $(B \cap T) \cap J$. Jiif u xaradh isgooyaska B iyo T. Intaasi waxay u taagan tahay $B \cap T$. Marka xiga, joog u xaradh J. Inta labada jeer xardhani waxay u taagan tahay $(B \cap T) \cap J$.

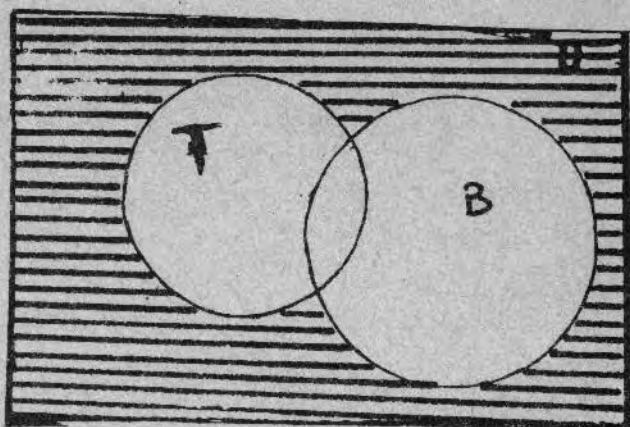


Sh. 8: Bal u fiirso shaxanka hoos ku yaal. Gooboo-yinka B iyo T isma gooyaan. Markaa, ma jirto bar B iyo T ay wadaagaan. $B \cap T$ waxay u taagan tahay urur madhan, t, a, $B \cap T = \phi$.

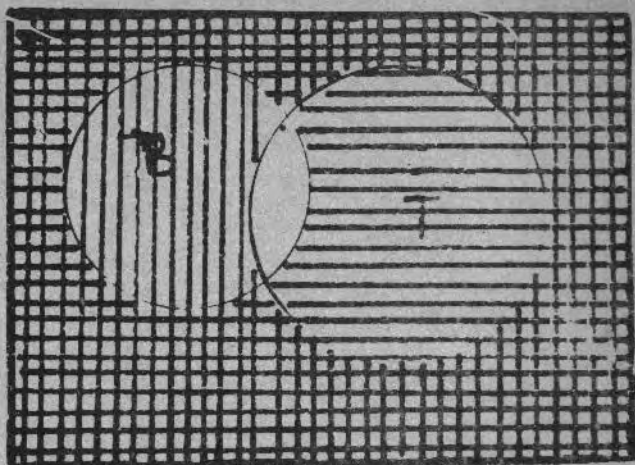


XEERARKA DIMOORGAN (De Morgan)

Innagoo la kaashanayna jaantusta Fen, waxan caddayn karnaa Xeerarka Dimoorgan. Shaxanka hoos ku yaal, xaradh inta laydiga ku dhex jirta ee ka baxsan goobooyinka B ama T. Inta xardhani waxay u taagan tahay $(B \cup T)$



Sh. 10: Shaxanka 10aad soo guuri. Jiif u xaradh inta laydiga ku jirta ee ka baxsan B, joogna u xaradh inta laydiga ku dhex jirta ee ka baxsan T. Inta labada jeer xardhani waxay u taagan tahay $\overline{B \cap T}$. Markaa aan isku fiirino Sh. 10 iyo Sh. 11, waxan arkaynaa in $\overline{(B \cup T)}$ iyo $(\overline{B} \cap \overline{T})$ ay isla mid yihiin.



Sh. 11: Xeerka labaad ee Dimoorgan waxa lagu cad-daynayaa laydiga dhexdiisa.

Qeexid:

Labo urur waa kala edeg, haddii dhextaalkoodu yahay urur madhan. Tusaale ahaan, haddii $B = \{1, 2, 3\}$

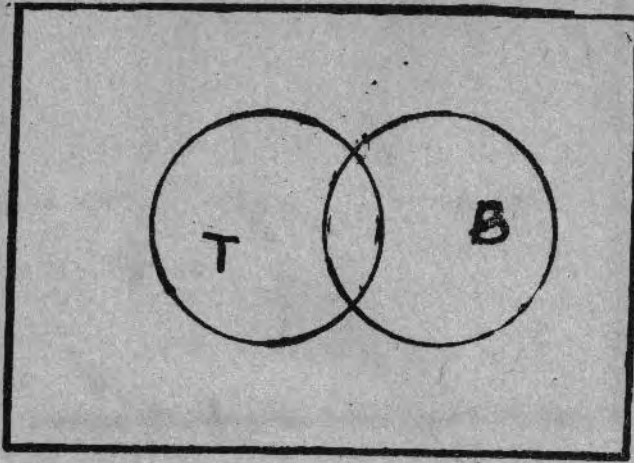
$T = \{6, 7\}$; markaa B iyo T waa kala edeg waayo

$B \cap T = \phi$. Sidaas oo kale ururka tirooyinka dhabanka ah iyo ururka tirooyinka kisiga ahi waa kala edeg.

Layli 8:

B. Layli kasta oo ka mid ah 1, -16, guuri jaantuska Fen, ee hoos ku muujisan, dabadeedna xaradh inta ku beegan

layliska:



- 1) $B \cap T$
- 2) $T \cap B$
- 3) $J \cap B$
- 4) $J \cap T$
- 5) $\overline{B} \cap \overline{J}$
- 6) $\overline{T} \cap \overline{J}$
- 7) $\overline{T} \cap \overline{B}$
- 8) $\overline{T} \cup \overline{B}$

- 9) $\overline{T} \cap B$
- 10) $(\overline{T} \cap \overline{B})$
- 11) $(\overline{J} \cap \overline{B})$
- 12) $(\overline{T} \cap \overline{B})$
- 13) $(\overline{T} \cup \overline{B})$
- 14) $(\overline{J} \cap \overline{B})$
- 15) $(\overline{B} \cap \overline{T})$
- 16) $B \cup (T \cap J)$

T. Adoo la kaashanaya jaantusta Fen, dhammee isle'eg kasta:

- | | |
|----------------------------|---------------------------|
| 1) $(\overline{B}) =$ | 6) $B \cup \phi =$ |
| 2) $B \cap \overline{B} =$ | 7) $B \cap U =$ |
| 3) $B \cap \phi =$ | 8) $B \cup B =$ |
| 4) $B \cup \overline{B} =$ | 9) $B \cap B =$ |
| 5) $B \cup U =$ | 10) $(B \cup B) \cup B =$ |

J. Goormay mid kasta oo hoos ku taal run noqon kartaa?

Samee jaantusta Fen ee mid kasta u taagan:

$$1) B \cup T = \phi$$

$$2) B \cup \phi = \phi$$

$$3) B \cap T = B$$

$$4) B \cup T = B$$

$$5) T \cup \phi = T$$

$$6) \bar{B} \cup U = U$$

$$7) B \cap U = U$$

$$8) B \cap T = T$$

$$9) \bar{B} \cap \phi = \phi$$

$$10) B \cup T = B \cap T$$

X. Adoo la kaashanaya xaradh, caddee hawraar kasta:

$$1) B \cup T = T \cup B$$

$$2) B \cap T = T \cap B$$

$$3) (B \cup T) \cup J = B \cup (T \cup J)$$

$$4) (B \cap T) \cap J = B \cap (T \cap J)$$

$$5) B \cap (T \cup J) = (B \cap T) \cup (B \cap J)$$

$$6) B \cup (T \cap J) = (B \cup T) \cap (B \cup J)$$

$$7) B \cup B = B$$

$$8) B \cap B = B$$

$$9) B \cup (B \cap T) = B$$

$$10) B \cap (B \cup T) = B$$

$$11) B \cup \bar{B} = U$$

$$12) B \cap \bar{B} = \phi$$

$$\text{KH. Haddii } B = \{1, 2, 3, 4, 5, 6\}$$

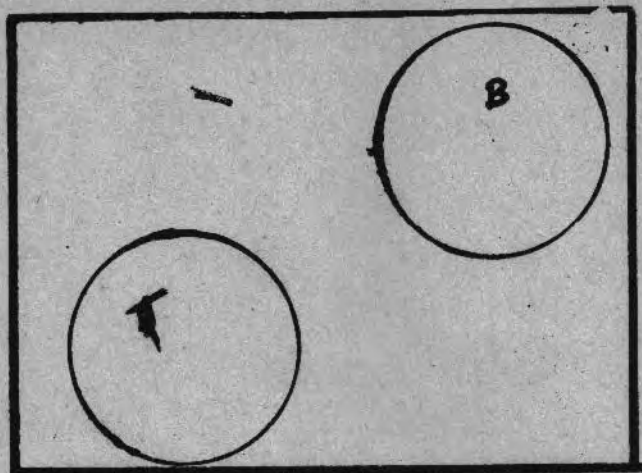
$$T = \{2, 4, 6, 8, 10\} \quad J = \{5, 8, 10, 14\}$$

$$G = \{1, 2, 3, \dots, 14\} \text{ hubi su'aal kasta oo layliska X}$$

ku jirta.

D. Guuri jaantusta Fen ee hoos ku taalla mar alla mar kii aad ka shaqeynayso su'aallaha min i-viii, dabadeedna xa-

radh inta la gudboon su'aasha.



$$i - B \cup T$$

$$ii - \overline{(B \cup T)}$$

$$iii - \overline{B}$$

$$iv - \overline{T}$$

$$v - \overline{B} \cap \overline{T}$$

$$vi - B \cap T$$

$$vii - \overline{(B \cap T)}$$

$$viii - \overline{B} \cup \overline{T}$$

R — Adoo la kaashanaya layliska D, caddee xeerarka Dimoorgan.

ISKU AADINTA URURRADA IYO TIRADA KUTIRSANEYAASHA

Urur:

$$\text{Haddii ururka } B = \{b, t, j, x, d\}$$

$$T = \{\Delta, o, *, \diamond, x\}$$

Markaa kutirsane kasta oo ururka B jaal buu ku leeyahay ururka T.

Tusaale:

$$\begin{array}{l}
 B = \left\{ b, t, j, x, d \right\} \\
 T = \left\{ \Delta, O, *, \square, , \right\} \\
 B = \left\{ b, t, j, x, d \right\} \\
 T = \left\{ \Delta, O, *, \square, , \right\}
 \end{array}
 \qquad
 \begin{array}{l}
 B = \left\{ b, t, j, x, d \right\} \\
 T = \left\{ \Delta, O, *, \square, , \right\} \\
 B = \left\{ b, t, j, x, d \right\} \\
 T = \left\{ \Delta, O, *, \square, , \right\}
 \end{array}$$

Tusaalahan kor ku yaal leebabka labada af lihi waxay *ina tusayaan in kutirsane kasta oo B uu ku aaddan yahay kutirsane keliya oo B*. Isku aaddinta waxa loo sameyn karaa siyaabo badan, laakiin tusaaluhu wuxuu inna tusayaa afar siyood oo keliya. Immisa siyood oo kale baad qutirsaneyaasha B iyo T iskuugu aaddin kartaa? Si alla sidii aan isugu aaddinno kutirsaneyaasha B iyo kuwa T, waxan heleynaa in kutirsane kasta oo B uu ku aaddan yahay kutirsane keliya oo T, isla markaana in kutirsane kasta oo T uu ku aaddan yahay kutirsane keliya oo B.

innawaa

Guud ahaan; haddii M iyo N ururro yihiin, oo kutirsane kasta oo ururka M uu ku aaddan yahay kutirsane keliya oo ururka N, isla markaana kutirsane kasta oo ururka N uu ku aaddan yahay kutirsane keliya oo ururka M; markaa waxa la yiraa labada urur ee M iyo N hagaag bay isugu aaddan yihiin. Haddii laba urur hagaag isugu aaddan yihiin, markaa mid walba inta kutirsane ee ku jirta baa ka kalena ku jirta. Ururrada caynkaas oo kale isku ah waxa la yiraa ururro **Isu-dhigma**.

Ma jiraan ururro aan isu dhigmin? Jawaabtu waa haa.

Bal u fiirso ururrada W iyo Y, marka $W = \{ \circ, \Delta, \diamond, \square \}$

$Y = \{ \text{Buug, Qalin, Faras, Hal, Sac} \}$

$W = \{ \circ \quad \Delta \quad \diamond \quad \square \quad \}$

$Y = \{ \text{Buug, Qalin, Faras, Hal, Sac} \}$

ku tirsane kasta oo ka mid ah W wuxuu ku aaddan yahay kutirsane keliya oo Y, ka mid ah, laakiin kutirsane kasta oo Y ku jira kuma aaddana kutirsane W ku jira. Waayo Sac oo kutirsane Y ah, kuma aaddana kutirsane W. Markaa, W iyo Y haagaag iskuguma aaddana mana aha ururro isku dhigma.

Haddii urur B uu u dhigmo urur T, urur T-na uu u dhigmo urur H, markaa urur B wuxu dhigmaa urur J. Taas oo ah, iskudhigaanta ururradu way dhaxdaa. U fiirso tusaalaha hoos ku yaal:

Haddii

$$B = \left\{ b, \quad t, \quad j \right\} \qquad T = \left\{ \Delta, \quad \square, \quad \circ \right\}$$

$$T = \left\{ \Delta, \quad \square, \quad \circ \right\} \qquad J = \left\{ \text{Cali, Xasan, Weli} \right\}$$

Markaa

$$B = \left\{ b, \quad t, \quad j \right\}$$

$$J = \left\{ \text{Cali, Xasan, Weli} \right\}$$

Marka aan leenahay ururrada B iyo T way isu-dhigmaan, waxaan u jeednaa, inta kutirsane ee B ku jirta uunbaa T-na ku jirta. Ka soo qaad in $B = \{1, 2, 3, 4, 5\}$,

Ka fikir ururrada B u dhigma oo dhan. Hubaal, wada sheegi kari mayno ururrada B u dhigma oo dhan, laakiin waxoogay ka mid ah bal aan sheegno $\{\square \square \square \square \square\}$,

$\{Xasan, Cali, Cumar, Axmed, Faarax\}, \{*, \Delta, \circ, \circ, \circ\}$
 $\{\Delta, \Delta, \Delta, \Delta, \Delta\} \{a, a, a, a, a\}, \{., ., ., .\}$

Ma jiraa wax ururradaas oo dhammi ay wadaagaan? Haa! Mid walba inta kutirsane ee ku jirta uunbaa ka kalena ku jirta. Waxan niraa tirada kutirsaneyaashooda yaa isku mid ah. Waxa dhib yar in magacyo loo bixiyo tirooyinka. Matalan; urur B iyo ururrada u dhigma oo dhan, tirada sifayneysa waxa la yiraa «Shan». Waxan oranaynaa shan kutirsane baa B ku jirta.

Tirada Shan waxa lagu xiriirshaa urur kasta oo B u dhigma. Tusaale ahaan, waxan ka hadallaa ururro ka kooban Shan buug, Shan qalin, Shan qof, Shan dhagax, iwm. Ururradaas oo dhammi waxay wadaagaan astaanta «Shannimada» ama tirada shan.

Tiro kastaa waxay leedahay magac iyo summad, summada «5» waxay u taagan tahay tirada magaceedu yahay «Shan». ogow in tiro ay tahay astaan ururradu leeyihiin, gaar ahaan ururrada isku dhigma. Tirada summaddeeda waxa la yiraa **astiro**.

Astirada kutirsaneyaasha ururka $D =$ waxa loo qoraa $n(D)$. Markaa $n(D) = 4$

TIRADA HORMOYINKA URUR

Mararka qaarkood waxa loo baahdaa in la ogaado ururka kutirsaneyaashiisu ay yihiin dhammaan hormooyinka suura-galka ah ee urur kooban oo lagu siiyay. Ururka ka kooban dhammaan hormooyinka urur B waxa la yiraa urur-jibbaarka B waxaana loo qoraa $J(B)$ ama 2^B . Marka, urur-jibbaarka B, $2^B = \{X \mid X \subseteq B\}$ (ururka X kasta ee X tahay hormo-B, ee B-na tahay urur kooban). U fiirso in urur jibbaarku yahay urur kutirsaneyaashiisu yihiin ururro. Tusaale

ahaan, haddii $B = \{b, t\}$ markaa hormooyinka B waa urur-

radan $\phi, \{b\}, \{t\}$ iyo $\{b, t\}$. Hubi in mid kasta hormo u yahay B. Haddaba, urur — jibbaarka B waan sheegi kar-

naa waxana weeye $\left\{ \{\phi\}, \{b\}, \{b, t\}, \{t\} \right\}$

Mar haddii kutirsaneyaasha urur-jibbaarka B yihiin ururro; waxan oran karnaa tirada hormooyinka B waxay le'eg yihiin tirada kutirsaneyaasha urur-jibbaarka B. Tirada kutirsaneyaasha ururka B waa 2, tirada kutirsaneyaasha urur jibbaarkuna waa 4.

Bal ka waran tirada kutirsaneyaasha ururka madhan? Qeex ahaan, tirada kutirsaneyaasha ururka madhani waa eber, laakiin tirada kutirsaneyaasha urur-jibbaarkiisu waa kow, ama kow hormo ayuu ururka madhani leeyahay, kaasoo ah ururka madhan laftiisa (ogow in urur kastaa uu hormo isii yahay).

Haddii $D = \phi$ waxan leenahay $n(D) = 0$, laakiin $n(2^D) = 1$

Taas oo ah, tirada kutirsaneyaasha D waa eber, tirada kutir-

saneyaasha urur-jibbaarka D-na waa kow. Haddii $B = \{a\}$ markaa $n(B) = 1$, laakiin $n(2^B) = 2$. Mar haddii B ay leedahay kutirsane keliya, tirada kutirsaneyaasha B waa kow,

tirada urur-jibbaarka B-naa waa laba, waayo 2^B waxa ku jira laba kutirsane ϕ iyo $\{b\}$.

Tusaha hoos ku yaal wuxuu muujinayaa tirada hormooyinka

ururka B marka B leedahay $\left\{0, 1, 2\right\}$ ama 3 kutirsane.

$n(B)$ waxay u taagan tahay tirada kutirsaneyaasha ururka B, $n(2^B)$ waxay u taagan tahay tirada kutirsaneyaasha urur-jibbaarka B.

Urur B	$n(B)$	$2^B =$ Urur-jibbaarka B	$n(2^B)$
ϕ	0	ϕ	1
$\{b\}$	1	$\{\phi, \{b\}\}$	2
$\{b, t\}$	2	$\{\phi, \{b\}, \{t\}, \{b, t\}\}$	4
$\{b, t, j\}$	3	$\{\phi, \{b\}, \{t\}, \{j\}, \{b, t\}, \{b, j\}, \{t, j\}, \{b, t, j\}\}$	8

Bal hadda ka warran urur-jibbaarka B haddii $B = \{b, t, j, x\}$?

Hormooyinka B waxay noqonayaan kuwa hoos ku yaal.

$\{\phi, \{b\}, \{t\}, \{j\}, \{x\}, \{b, t\}, \{b, j\}, \{b, x\}, \{t, j\}, \{t, x\}, \{j, x\}, \{b, t, j\}, \{b, t, x\}, \{b, j, x\}, \{t, j, x\}, \{b, t, j, x\}\}$.

Gebigood waxay isku yihiin 16 hormo, markaa hormooyinka $B = \{b, t, j, x\}$ waa 16 ama $n(2^B) = 16$.

Bal u fiirso tusaalooyinka kor ku yaal, dabadeedna ka jawaab su'aashan. Maxaa ka dhexeeya tirada kutirsaneyaasha urur iyo tirada kutirsaneyaasha urur-jibbaarkiisa?

Tusahan hoos ku yaal bal aad u dhugo, dabadeedna hel xiriir-

ka lagu weydiiday.

Urur B	$n(B)$	$n(2^B)$
ϕ	0	1
$\{b\}$	1	2
$\{b, t\}$	2	4
$\{b, t, j\}$	3	8
$\{b, t, j, x\}$	4	16

Waxan arki karnaa in $16 = 2^4$; $8 = 2^3$; $4 = 2^2$; $2 = 2^1$. Kow waxaa loo qori karaa 2^0 . Markaa, waxan oran karnaa, tirada kutirsaneyaasha urur-jibbaarka urur waxay le'eg tahay 2 ku jibbaaran tirada kutirsaneyaasha ururkaa.

Matalan, marka $B = \{b, t, j\}$, tirada kutirsaneyaasha urur-jibbaarka B, ama $n(2^B)$ waxay le'eg tahay $2^3 = 8$. Guud ahaan, $n(2^B) = 2^{n(B)}$.

Tusaale:

Haddii $R = \{O, \Delta, \square, \square, *\}$, immisa hormo baa R ku jirta?

Furfuris:

$$n(R) = 5$$

$$\text{Markaa, } n(2^R) = 2^{n(R)} = 2^5 = 32.$$

Layli:

1) Sheeg hormooyinka ururrada hoos ku yaal.

b) $\{1, 2, 3\}$

t) $\{0\}$

j) $\{\Delta, \square, *, \circ, \circ\}$

x) \emptyset

kh) $\{Xasan, Cali\}$

2) Waa imisa tirada hormooyinka ururrada hoos ku yaal?

b) $\{0\}$

t) $\{0,1\}$

j) \emptyset

x) $\{99,102,104,89\}$

kh) $\{0,1,2,3,4,5,6,7,8,9\}$

d) $\{\emptyset\}$

$$r) \left\{ \left\{ b \right\}, \left\{ t \right\} \right\}$$

$$s) \left\{ 999, 23 \right\}$$

$$sh) \left\{ \right\}$$

3) b) Waa maxay **Astiro**

t) Sheeg 6 urur oo u dhigma ururka $\left\{ 0, 1, 2 \right\}$

j) Goormay laba urur hagaag isugu aaddan yihiin.

x) Sharax hawraartan: Iskudhignaanta urur way dhaxdaa.

CUTUB V

DHARDHAARADA TIROOYINKA MAANGALKA HORSIIMADA URURKA TIROOYINKA MAANGALKA AH

Ururka, dhammaan tirooyinka togan, kuwa taban iyo eber waxa la yiraa ururka tirooyinka maangalka ah. Marka xarriiq tiro aan dhigno, waxaa niraa isku beegnaan mid-mid ah ayaa ka dhexaysa ururka baraha xarriiqda iyo ururka tirooyinka maangalka ah.

Isku beegnaantaa ururka tirooyinka maangalka ah iyo ururka xarriiq waxay ku xiran tahay qaadashooyin dhowr ah. Xisaabtu qaadashooyinka waxay tiraa **Dhardhaarro**. Mid ka mid ah dhardhaaradaa, oo loo yaqaanno dhardhaarka garab-dhigga wuxuu leeyahay, tirooyinka maangalka ah waxa loo ratibi karaa horsanaan huban. Dheelliga $4 > 1$ wuxuu u taagan yahay «4 ka weyn1». Marka xarriiqda tirada loo leexo waxay noqonaysaa «garaafka 4 ayaa midig ka xiga garaafka 1». Dheelliga $1 < 4$ wuxuu inoo sheegayaa intii kii hore inoo sheegay, waxase loo ahkriyaa «1 ka yar 4» Astaan aasaas u ah tirooyinka maangalka ah waa jiritaanka «Xiriirka horsanaanta, oo loo qoro $< \text{ama} >$. Xiriirkaasi wuxuu raalli geliyaa dhardhaarkan soo socda.

Dhardhaarka is garab-dhigga.

Haddii b iyo t ay tirooyin maangal ah yihiin, markaa saddexdan hawraarood mid uun baa run ah:

$b < t$, $b = t$, $b > t$.

Si aan la isugu qaldin $s u m m a d a h a$ dheelliga ee ah $< iyo >$, hadba tirada geesku ku jeedo baa yar. Hawraarta « $x < 2$ ama $x = 2$ » waxa badanaaba loo qoraa $x \leq 2$, waxana loo ahkriyaa « x le'eg ama ka yar 2». Sidaas oo kale, $b \geq t$ waxay u taagan tahay « b le'eg ama ka weyn t ».

Garaafka hormo kasta oo ururka tirooyinka maangalka ah, waxan ku sawiri karnaa xarriiqda tirada.

Tusaale:

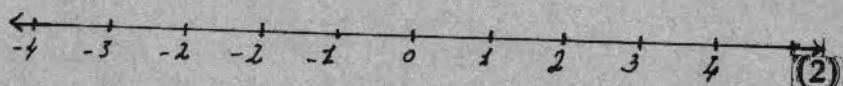
Samee garaafka hormooyinka ururka tirooyinka maangalka.

Furfuris:

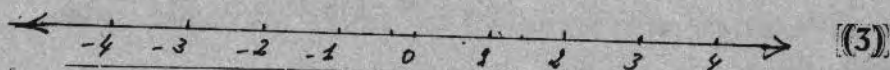
$$b) \left\{ t \mid t = 1 \text{ ama } t = -1 \right\} \quad (1)$$



$$t) \left\{ x \mid x > 2 \right\} \quad (2)$$



$$j) \left\{ y \mid y \leq 0 \right\} \quad (3)$$



Astaanta Dhaxidda ee Horsaanaanta.

Ka soo qaad in b , t iyo j ay yihiin tirooyin maangal ah.

1) Haddii $b < t$; $t < j$,
markaa $b < j$ (4)

(4)

2) Haddii $b \geq t$; $t > j$,
markaa $b > j$

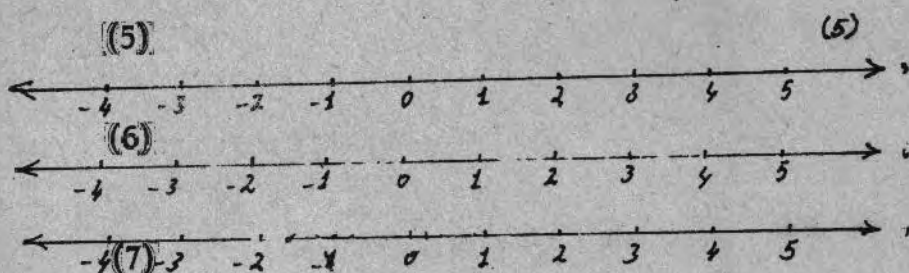
Badanaaba, weedhan labada dheelli ka kooban « $b < t$ » iyo « $t < j$ » waa la isku xiriirshaa oo loo qoraa, « $b < t < j$ »

waxaana loo akhriyaa, «t ka weyn b kana yar j» amà t baa u dhexaysa b iyo j». Shaxanka 5aad wuxuu muujinayaa garaafka urur furfurista laba lammaane oo jaad kaas ah:

$$\{x \mid -2 < x < 3\}$$

$$\{x \mid -2 < x \leq 3\}$$

$$\{x \mid -2 \leq x \leq 3\}$$



Layli:

Sawir garaafka hormooyinka ururka tirooyinka maangalka ah.

1) $\{0, 1\}$

2) $\{-1, 0, 1\}$

3) $\{u \mid u \geq -1\}$

4) $\{y \mid y \leq 3\}$

- 5) $\{x | x = -2 \text{ ama } x = 5\}$
- 6) $\{r | r = 0 \text{ ama } r = 1\}$
- 7) $\{s | s \text{ tahay abyoone 2 ka yar}\}$
- 8) $\{t | t \text{ tahay abyoone ka weyn } -2\}$
- 9) $\{x | -2 \leq x < 4\}$
- 10) $\{y | -1 \leq y \leq 6\}$
- 11) $\{k | k \text{ tahay abyoone, isla markaana } -3 \leq k \leq 7\}$
- 12) $\{x | x \text{ tahay abyoone, isla markaa } 2 < x \leq 5\}$

2) Astaamaha Isugyeeynta iyo kala Goynta:

Labada xisaabfal ee salka u ah tirooyinka waa isugeynta iyo isku dhufashada. Haddii b iyo t ay yihiin laba tiro, $b + t$ waxa la yiraa wadarta b iyo t . Taranka b iyo t (oo loo qoro $b \times t$, $b \cdot t$, $b(t)$, $(b) \cdot (t)$ ama $(b t)$) wuxuu ka soo baxaa b lagu dhuftay t . Marka aan ka hadlayno wadarta $b + t$, tirooyinka b iyo t waxa la yiraa **tibxo**, marka aan taranka $b \cdot t$ ka hadlaynona, tirooyinka b iyo t waxa la yiraa **isirro**.

Bal u fiirso waxa ka soo baxa marka laba tiro oo maangal ah la isugeeyo ama la isku dhufto. Had iyo jeer wadartu ama tarantu waa tiro maangal ah. Dhardhaarkan soo socda ayaa taa ka hadlaaya.

Dhardhaarka oodnaanta isugeynta iyo isku dhufashada. Haddii b iyo t yihiin tirooyin maangal ah, $b + t$ waa tiro maangal ah oo madi ah, sidaas oo kale, bt waa tiro maangal ah oo madi ah.

Eereyga oodnaanta waxa lagu isticmaalaa urur iyo xisaabfale. Waxa la yiraa urur baa ku oodan xisaabfale, haddii laba kutirsane oo kasta oo ururkaa ka mid ah, marka lagu sameeyo xisaabfalaha, natiijadu ay noqoto kutirasane ururkaas.

Bal sheeg waxa ururka $\left\{ -1, 1 \right\}$ uu ugu oodan yahay isku dhufashada laakiin uuna ugu oodneyn isugeynta.

Dhardhaaradan soo socdaa waxay xukumaan isticmaalka astadan:

DHARDHAARADA ISLE'EKAANSHDA

Ka soo qaad in b, t, j , iyo x yihiin tirooyin maangal ah.

- 1) Isku noqod: $b = b$
- 2) Wanqaaran: haddii $b = t$ markaa $t = b$
- 3) Dhaxid: haddii $b = t, t = j$ markaa $b = j$
- 4) Isku beddel:
 - (i) Haddii $b = t, b + j = x$ markaa $t + j = x$
 - (ii) $b = t, bj = x$, markaa $tj = x$.

Dhardhaarka isku beddelku wuxuu ballan qaadayaa in wadar ama taran midna uusan isbeddelin, haddii biiro kasta ama isir kasta lagu beddelo astiro le'eg. Haddii aan ognahay in $6 = 2 + 4, 6 + 5 = 11, 6 \times 5 = 30$, dhardhaarkani wuxuu inoo ogol yahay in aan gaarno in $(2 + 4) + 5 = 11$, isla markaani in $(2 + 4) \cdot 5 = 30$.

Weedhahan hoos ku qorani waxay muujinayaan afar

sharci oo kale oo ka mid ah sharciyada tirooyinka maangalka ah:

$$3 + 5 = 5 + 3; \quad 5 \times 3 = 3 \times 5$$

$$(5 + 4) + 6 = 5 + (4 + 6);$$

$$(5 \times 4) \times 6 = 5 \times (4 \times 6)$$

labada hore waxay muujinayaan dhardhaarrada kala hormarinta ee isugeynta iyo isku dhufashada labada dambena waxay muujinayaan dhardhaarrada hormogelinta ee isugeynta iyo isku dhufashada.

Dhardhaarrada kala hormarinta:

Haddii b iyo t ay yihiin tirooyin maangal ah, markaa, $b + t = t + b$; $bt + tb$.

Dhardhaarrada hormogelinta:

Haddii b , t iyo j ay yihiin tirooyin maangal ah, markaa $(b+t)+j = b+(t+j)$; $(bt)j + b(tj)$

Layli 1:

Sheeg dhardhaarka kuu ogolaaday tallaabo kasta.

Tusaale:

Tallaabo	Dhardhaar
$6 + (b + 4) = 6 + (4 + b)$	Kala hormarinta isugeynta
$= (6 + 4) + b$	Hormogelinta isugeynta.
$\therefore 6 + (b + 4) = (6 + 4) + b$	Dhaxid isle'ekaansho.
Laakiin	
$6 + 4 = 10$	Hubaal isugeyneed.
$\therefore 6 + (b + 4) = (10 + b)$	Dhardhaarka isku beddelka

1) $(r + 4) + 5 = r + (4 + 5)$

Laakiin $4 + 5 = 9$

$$\therefore (r + 4) + 5 = r + 9$$

$$= 9 + r$$

$$\therefore (r + 4) + 5 = 9 + r$$

2) $3(n \times 3) = 3(3n)$

$$= (3 \times 3) \cdot n$$

$$\therefore 3(n \times 3) = (3 \times 3)n$$

$$\text{Laakiin } 3 \times 3 = 9$$

$$\therefore 3(n \times 3) = 9n$$

$$\begin{aligned} 3) \quad b(tj) &= (bt)j \\ &= (tb)j \\ &= t(bj) \\ &= t(jb) \end{aligned}$$

$$\therefore b(tj) = t(bj)$$

$$4) \quad b + (t + j) = (b + t) + j$$

$$\therefore b + (t + j) = t + (b + j)$$

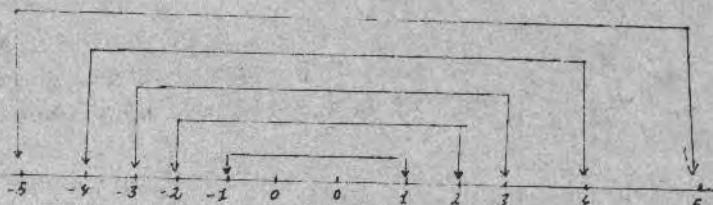
Asal ma doorshe iyo Weydaar:

Waxaan oran karnaa $3 + 0 = 0 + 3 = 3$ ama $(-4) + 0 = 0 + (-4) = -4$. Tirada 0 kaalin madiya ayay ka cayaartaa ururka tirooyinka maangalka ah. Marka tiro loo geeyo 0, wadartu waxay la mid tahay tirada lafteeda. Eber waxa la yiraa asal madoorshaha isugeynta.

DHADHAARKA EBER

Ururka tirooyinka maangalka ah waxa ku jira tiro madiya, 0, oo marka loo geeyo tiro kasta oo maangal ah b , wadartoodu noqon $b, t \cdot a$, haddii $b \in r$, markaa, $b + 0 = 0 + b = b$

U fiirso shaxanka hoos ku yaal:



Tirooyinka isku lamaan, wadartoodu waa eber. Matalan $-1 + 1 = 0$, $-2 + 2 = 0$, $4 + (-4) = 0$. Tiro kasta oo ka mid ah lamaanaha aan soo sheegnay ama la nooca waxa la yiraa weydaarka isugeynta, kaasoo ah horjeedka tirada kale ee ku lamaan. Weydaarka isugeynta ee tiro kasta oo maangal ah, b , waa tiro maangal ah oo marka b loo geeyo ka dhigta wadarta eber, waxaana loo qoraa $-b$.

Tusaale:

- (3) = -3, oo loo akhriyo: «weydaarka isugeynta ee 3 waa 3 taban».
- (0) = 0, oo loo akhriyo: «weydaarka isugeynta ee 0 waa 0».
- (-4) = 4, oo loo akhriyo: «weydaarka isugeynta ee 4 taban waa 4».

DHARDHAARKA WEYDAARKA ISUGEYNTA

Haddii b ay tahay tiro maangal ah, waxa jira tiro madiya oo maangal ah oo loo qoro $-b$, oo sifadan leh $b + (-b) = 0$, isla markaa $(-b) + b = 0$.

1 waa asal madoorshaha isku dhufashada.
Bal u fiirso tusaaalahan: $1 \cdot 5 = 5 \cdot 1 = 5$

DHARDHAARKA KOW

Ururka tirooyinka maangalka ah waxa kutirsan tiro madiya 1, oo astaantan leh: Haddii b tahay tiro maangala, $1 \cdot b = b \cdot 1 = b$.

Haddii laba tiro tarankoodu 1 yahay, waxa la yiraa mid walba ta kale waa u rogaal ama u weydaar.

Tusaale ahaan, $\frac{1}{4}$ waa rogaalka 4, isla markaa 4 waa roga-

alka $\frac{1}{4}$. Lammaane kale oo, isku rogaal ahi waa 5 iyo 0.2.

1 isagaa isu rogaal ah. Tiro kasta oo maangal ah oo aan eber ahayn waxay leedahay rogaal sida dhardhaarka soo socdaa sheegayo.

**DHARDHAARKA WEYDAARKA ISKU
DHUFASHADA**

Haddii b tahay tiro maangal ah oo aan eber ahayn,
waxa jira tiro madiya oo maangal ah oo loo qoro $\frac{1}{b}$

$$\text{oo astaantan leh } b \begin{pmatrix} 1 \\ - \\ b \end{pmatrix} = 1 \text{ isla markaa } \begin{pmatrix} 1 \\ - \\ b \end{pmatrix} b = 1.$$

Rogaal «0» ma leeyahay? Haddii eber leeyahay rogaal waa in la helaa tiro maangal ah oo rumaysa isle'egtan, $0 \cdot x = 1$. Waxaan naqaan in taranka 0 iyo tiro kasta oo maangal eber yahay. Sidaa awgeed ma jirto tiro marka eber lagu dhufto ku siisa 1.

ASTAANTA ISKU DHUFASHADA EE EBER

Haddii b tahay tiro maangal ah, markaa $0 \cdot b = 0$, weliba $b \cdot 0 = 0$.

Dhardhaar kale oo ku saabsan isku dhufashada waa kan hoos ku qoran:

ASTAANTA ROGAALKA TARANEED

Haddii b iyo t ay yihiin tirooyin maangal ah oo aan eber ahayn, rogaalka tarankoodu wuxuu la mid yahay taranka rogaalooda $t \cdot a$,

$$\frac{1}{bt} = \frac{1}{b} \cdot \frac{1}{t}$$

Tusaale ahaan, $\frac{1}{3 \times 5} = \frac{1}{3} \times \frac{1}{5}$;

$$\frac{1}{5} = \frac{2}{5} \times \frac{1}{4}$$

$$\frac{1}{2} \times 4$$

Dhardhaarkan soo socda laftiisu wuxuu la jaal yahay kii ka horreeyay:

ASTAANTA TABANAHA WADAREED

Haddii b iyo t ay yihiin tirooyin maangal ah, tabanaha wadartoodu wuxuu la mid yahay wadarta tabana-

yaashooda, t. a, $-(b + t) = (-b) + (-t)$

Tusaale:

$$-(2 + 3) = (-2) + (-3); -\{(-4) + 7\} = 4 + (-7)$$

Layli 3:

1) Sheeg weydaarka isugeynta ee tiro kasta:

b) $\frac{3}{1}$	t) 7	j) $\frac{1}{4}$
xl) $\frac{1}{3}$	kh) - 8	d) - 6
r) - $\frac{1}{5}$	s) - $\frac{1}{9}$	sh) - 2
dh) 0	c) $-(-2 \times 5)$	g) $-(-0 \times 8)$

2) Sheeg rogaalka tiro kasta, haddii ay rogaal leedahay:

b) $\frac{5}{8}$	t) $\frac{7}{4}$	j) 0
x) 1	kh) 0.1	d) 0.01
r) 1.1	s) 1.5	sh) 2
dh) $3 \frac{1}{2}$		

3) Sheeg tibaaxda u ah weydaar isugeyneed tibaax kasta oo soo socota:

Waxa lagu siiyay

Waxa lagaa rabo

	$2 + (-3)$		$-2 + 3$
b)	$-1 + (-4)$	d)	$-2 + 7 + (-9)$
t)	$-6 + 9$	r)	$(-3) + (-4) + 5$
j)	$7 + 8$	s)	$(-6) + (-7) + (-8)$
kh)	$10 + (-15) + (-3)$	sh)	$2 + 3 + 4$
x)	$-4 + (-9)$	dh)	$(2 + 3) + 8$

4) Keen sababaha tallaabo kasta kuu ogolaatay:

$$\begin{aligned}
 \text{b) } & (b + t) + [(-b) + (-t)] \\
 &= (b + t) + [(-t) + (-b)] \\
 &= [(b + t) + (-t)] + (-b) \\
 &= \left[b + [t + (-t)] \right] + (-b) \\
 &= 0 + [b + (-b)] \\
 &= 0 + 0 \\
 &= 0 \\
 \therefore & (b + t) + [(-b) + (-t)] =
 \end{aligned}$$

$$\begin{aligned}
 \text{t) } & (ab) \cdot \left(\frac{1}{a} \cdot \frac{1}{b} \right) \\
 &= (ab) \left(\frac{1}{b} \cdot \frac{1}{a} \right) \\
 &= \left((ab) \cdot \frac{1}{b} \right) \cdot \frac{1}{a} \\
 &= \left\{ a \cdot \left[b \cdot \frac{1}{b} \right] \right\} \cdot \frac{1}{a} \\
 &= (a \cdot 1) \cdot \frac{1}{a} \\
 &= a \cdot \frac{1}{a} \\
 &= 1
 \end{aligned}$$

$$\therefore ab \cdot \left(\frac{1}{a} \cdot \frac{1}{b} \right) = 1$$

Isticmaalka Dhardhaarrada

3. Caddaynta:

Dhardhaarrada iyo qeexaha aan samaynno ayaa sifeeya

astaamaha saldhigga u ah habdhiska tirooyinka maangalka ah. Astaamaha saldhigga ah waxaan ka soo diiri karnaa astaamo kale oo tirooyinka maangalku leeyihiin, sida tan soo socota oo kale.

**ASTAANTA ISUGEYNTA
EE
ISLE'EGKAANSHAHA**

Haddii b , t iyo j ay yihiin tirooyin maangal ah,
oo $b = t$, markaa $b + j = t + j$.

Afeefaha aan haysannaa waa b , t iyo j oo tirooyin maangal ah iyo $b = t$. Go'aanka la rabo in aan gaarno waa $b + j = t + j$. Tallaabooyinkan isku xiga ee mid waliba dhardhaar innoo banneeyay ama run la ogyahay ah ayaan raacaynaa.

- | | |
|---|---|
| <p>1) b, t iyo j waa tirooyin maangal ah, $b = t$</p> <p>2) \therefore Waxa jira tiro maangal ah, x oo $b + j = x$</p> <p>3) $t + j = x$</p> <p>4) $\therefore x = t + j$</p> <p>5) $\therefore b + j = t + j$</p> | <p>1) Ogaal,</p> <p>2) Dhar. Oodnaanta,</p> <p>3) Dhar. isku beddel,</p> <p>4) Astaanta wanqaaran ee isle'egkaanshada,</p> <p>5) Astaanta dhaxidda ee isle'egkaanshada.</p> |
|---|---|

Sansaankan garaadayn loojik, oo intoo afeef lagaga bilaabo go'aan la gaaro, oo waliba tallaabo walba sabab loojik ah loo keeno, waxa la yiraa **Caddayn**. Qaadashooyinka la caddeeyo waxa la yiraa, **Aragtiinno**. Bal isku day in aad caddayso aragtiinka hoos ku yaal.

**ASTAANTA ISKU DHUFASHADA
EE
ISLE'EKAANSHAHA**

Haddii b , t iyo j ay yihiin tirooyin maangal ah, oo
 $= t$ markaa $bj = tj$.

Aragtiinka soc socda wuxuu innoo sheegayaa hubaal kale oo loo baahan yahay kuna saabsan tirooyinka maangal ah.

Aragtiin:

Haddii b iyo t ay yihiin tirooyin maangal ah markaa $(b + t) + (-t) = b$.

Caddayn:

- | | |
|---|-------------------------------|
| 1) b iyo t waa tirooyin maangal ah | 1) Ogaal. |
| 2) $b + t$ waa tiro maangal ah | 2) Oodnaanta isugeynta. |
| 3) $-t$ waa tiro maangal ah | 3) Dhar. weydaarka isugeynta. |
| 4) $(b + t) + (-t)$ waa tiro maangal ah | 4) Oodnaanta isugeynta. |
| 5) $(b + t) + (-t) = b + [t + (-t)]$ | 5) Hormogelinta isugeynta. |
| 6) $t + (-t) = 0$ | 6) weydaarka isugeynta. |
| 7) $(b + t) + (-t) = b + 0$ | 7) Dhar. isku beddelka. |
| 8) $b + 0 = b$ | 8) Dhar. Eber. |
| 9) $\therefore (b + t) + (-t) = b$ | 9) Dhexidda isle'ekaanshaha. |

Badanaaba, waa la soo gaabiyaa caddaynta oo tallaabooyinka ku saabsan isku beddelka iyo dhexidda isle'egkaanshaha ayaa aan loo qorin sida ay yihiin. Halkoodii waxa gala silsilad isle'egkaansho ah. Tusaale ahaan; tallaabooyinka 5, ilaa 9 ee caddaynta sare waxa loo soo gaabin karaa sidan soo socota:

$$\begin{aligned}
 (b + t) + (-t) &= b + [t + (-t)] && \text{Hormogelinta isugeynta.} \\
 &= b + 0 && \text{Weydaarka isugeynta.} \\
 &= b && \text{Dhardhaarka eber.} \\
 (b + t) + (-t) &= b && \text{Dhexidda isle'egkaanshaha.}
 \end{aligned}$$

Aragtiin la caddeeyay iyo dhardhaarada ayaa lagu soo diiri karaa aragtiinyo kale. Tusaale ahaan, aragtiinka kor aan

ku caddaynay baan ku isticmaali karnaa si aan ugu caddayno aragtiinka soo socda.

Aragtiin 2:

Haddii b , t iyo j ay yihiin tirooyin maangal ah, isla markaana $b + j = t + j$, markaa $b = t$.

Caddayn:

b , t iyo j waa tirooyin maangal ah	Ogaal
$b + j$ iyo $t + j$ waa tirooyin maangal ah	Codnaanta isugeynta.
$(-j)$ waa tiro maangal ah	Weydaarka isugeynta.
$b + j = t + j$	Ogaal.
$(b + j) + (-j) =$ $(t + j) + (-j)$	Astaanta isugeynta ee isle'egkaanshaha
$(t + j) + (-j) = t$	Aragtiin I
$(b + j) + (-j) = t$	Dhaxidda ee isle'egkaanshaha
Laakiin $(b + j) + (-j) = b$	Aragtiin I
$\therefore b = (b + j) + (-j)$	Wanqaaranka isle'egkaansho
$\therefore b = t$	Dhaxidda isle'egkaanshaha

Layli 4:

Sheeg dhardhaarka, aragtiinka, ama qeexda kuu bannaysay tallaabo kasta oo caddayntan ka mid ah. U gaado in b , t , j , x iyo c ay yihiin tirooyin maangal ah.

Tusaale:

Caddee: $-(-b) = b$

Tallaabooyin	Waxa laga rabo
b waa tiro maangal ah	Ogaal.
$-b$ waa weydaarka isugeynta ee b	Qeexda astada weydaarka isugeynta.
$-(-b)$ waa weydaarka isugeynta ee $(-b)$	» » »
$b + (-b) = 0$	Dhardhaarka weydaarka isu-

$$-(-b) + (-b) = 0$$

$$0 = b + (-b)$$

$$-(-b) + (-b) =$$

$$b + (-b)$$

$$\therefore -(-b) = b$$

geynta.

» » »
Wanqaaranka isle'egkaansha-
ha.

Dhaxidda isle'egkaanshaha.

Haddii $b + j = t + j$, mar-
kaa $b = t$.

1. Caddee: Haddii $b = t$; $j = t$ markaa $b = j$

Caddayn:

- 1) $b = t$; $j = t$
- 2) $t = j$
- 3) $\therefore b = j$

2. Caddee: Haddii $b = t$, markaa $bj = tj$

Caddayn:

- 1) b, t iyo j waa tirooyin maangal ah.
- 2) waxa jira tiro maangal ah x , oo sidan sameysa:
 $bj = x$.
- 3) mar haddii $b = t$ markaa $tj = x$.
- 4) $x = tj$
- 5) $\therefore bj = tj$

3. Caddee: Haddii $b = t$; $b = j$; $t = x$, markaa $j = x$.

Caddayn:

- 1) $b = t$; $b = j$; $t = x$
- 2) $t = b$
- 3) $\therefore t = j$
- 4) $j = t$
- 5) $\therefore j = x$

4. Caddee: Haddii $b = t$ markaa $j + b = j + t$

Caddayn:

- 1) b, t iyo j waa tirooyin maangal ah.
- 2) $b = t$
- 3) $b + j = t + j$

- 4) $b + j = j + b$
 5) $t + j = j + t$
 6) $\therefore j + b = j + t$

5. Caddee: Haddii $b = t$, markaa $-b = -t$

Caddayn:

- 1) b iyo t waa tirooyin maangal ah
 2) $-b$ iyo $-t$ waa tirooyin madiya oo maangal ah sidan sameeya:
 $-b + b = 0$ isla markaa $-t + t = 0$
 3) $-t + b = 0$
 $-b + b = -t + b$
 $\therefore -b = -t$

6) Caddee: Haddii $c \neq 0$; $(bc) \frac{1}{c} = b$

Caddayn:

b iyo c waa tirooyin maangal ah, $c \neq 0$
 bc waa tiro maangal ah.

$\frac{1}{c}$ waa tiro maangal ah.

$(bc) \cdot \frac{1}{c}$ waa tiro maangal ah.

$$\begin{aligned} (bc) \frac{1}{c} &= b \left(c \frac{1}{c} \right) \\ &= b \cdot 1 \\ &= b \end{aligned}$$

$$\therefore (bc) \frac{1}{c} = b$$

7. Aragtiiin kasta oo hoos ku qoran caddee. U qaado in b, t, j iyo x ay yihiin tirooyin maangal ah.

- b) Haddii $bj = tj$; $j \neq 0$, markaa $b = t$
- t) Haddii $jb = jt$; $j \neq 0$, markaa $b = t$
- j) Haddii $j + b = j + t$, markaa $b = t$
- x) Haddii $b = t$, b iyo t midna uuna ahayn

eber, markaa $\frac{1}{b} = \frac{1}{t}$

- kh) Haddii $b + t = 0$, markaa $b = -t$; $t = -b$.
- d) Haddii $bt = 1$, b iyo t midna uuna ahayn eber
markaa $b = \frac{1}{t}$; $t = \frac{1}{b}$

- r) Haddii $b = j$, $b + t = j + x$, markaa $t = x$.
- s) Haddii $b = j$, $b \neq 0$, $bt = jx$ markaa $t = x$.

sh) Haddii $b \neq 0$, $\frac{1}{b} = \frac{1}{b}$

- dh) Haddii $bt = t$, $t \neq 0$, markaa $b = 1$
- c) Haddii $t = x$, $b - t = j - x$, markaa $b = j$
- g) Haddii $b = tj$, $t \neq 0$ markaa $j = b \cdot \frac{1}{t}$

4. Isugeynta iyo kala goynta tirooyinka maangalka ah:

Dhardhaarradii aan soo sheegnay iyo hubaalaha ku saabsan isugeynta tirooyinka maangalka ah ayaa innoo awood siin kara in aan helno wadarta laba tiro oo kasta oo maangal ah. Isla markaa waxaan banaysan karnaa weer guud oo ku saabsan isugeynta tirooyinka.

Tusaale 1:

Isku gee : $-2 + (-3)$

Furfuris:

$$\begin{aligned}
 -2 + (-3) &= -(2 + 3) \text{ Astaanta tabanaha} \\
 &= -5 \text{ Wadarta isku beddo!}
 \end{aligned}$$

Tusaale 2:

$$\text{isku gee: } 5 + (-3)$$

Furfuris:

$$\begin{aligned}
 5 + (-3) &= (2 + 3) + (-3) \\
 &= 2 + [3 + (-3)] \\
 &= 2 + 0 \\
 &= 2
 \end{aligned}$$

Tusaale 3:

$$\text{isku gee: } -5 + 3$$

Furfuris:

$$\begin{aligned}
 -5 + 3 &= -(2 + 3) + 3 \\
 &= [-2 + (-3)] + 3 \\
 &= -2 + [(-3) + 3] \\
 &= -2 + 0 \\
 &= -2.
 \end{aligned}$$

Kale goynta tirooyinka maangalka ah waan qeexi kar-naa haddii aan la kaasharno isugeynta.

Matalan, $7 - 2 = 7 + (-2)$, $5 - (-3) = 5 + 3$; $(-2) - (-1) = -2 + 1$. Tusaalooyinkani waxay inoo horseedayaan qeexdan hoos ku taal.

Qeex:

Haddii b iyo t ay yihiin tirooyin maangal ah, markaa $b - t = b + (-t)$

Mar haddii tiro kasta oo maangal ahi ay leedahay weydaar madiya, markaa, haddaan magacawno tiro maangal ah, weydaarkeedana waa heli karraa. Matalan, haddii aan ogayn t, markaa $-t$ na waan naqaan. Waliba, mar haddii

$b + (-t)$ ay wadar tahay, waxay u taagan tahay tiro maangal ah. Markaa, qeexdani waxay innoo bidaalin in ururka tirooyinka maangalka ahi uu ku oodan yahay kala goynta.

U fiirso in $7 - 2 \neq 2 - 7$, kala goynta tirooyinka maangalka ahi ma kala hormarto. Waliba, $(7 - 2) - 3 = 5 - 3 = 2$, laakiin $7 - (2 - 3) = 7 - (-1) = 8$. Markaa $(7 - 2) - 3 \neq 7 - (2 - 3)$ taasi waxay inoo sheegaysaa in kala goynta tirooyinka maangal ahi ayna hormogelin. Hadda, si aan micno ugu sameyno tibaaxda astirada ah ee caynkan oo kala ah $7 - 2 - 3$ waa in aan u qaadanaa in ay la micno tahay $(+7 - 2) - 3$, guud ahaan, aan qeexno : $b - t - j = (b - t) - j$.

Layli:

Raadi wadarta iyo faraaqa: —

- 1) $14 + (-7)$
- 2) $7 - 2 - 3$
- 3) $7 - 2 + 3$
- 4) $-4 - (-1)$
- 5) $2 + (-9)$

Laylisyada 6, 7, 8 iyo 9, sheeg waxa inoo banneeyay talabo kasta: b , t , j iyo x waa tirooyin maangal ah.

$$6) \quad b - (-t) = b + t$$

Caddayn:

b iyo t waa tirooyin maangal ah

$-t$ waa tiro maangal ah

$$b - (-t) = b + -(-t)$$

$$-(-t) = t$$

$$\therefore b - (-t) = b + t$$

$$7) \quad -b + t = t - b$$

Caddayn:

b iyo t waa tirooyin maangal ah

- b waa tiro maangal ah.

$$-b + t = t + (-b)$$

$$t + (-b) = t - b$$

$$\therefore -b + t = t - b$$

$$8) \quad -(b - t) = t - b$$

Caddayn:

b iyo t waa tirooyin maangal ah.

$$b - t = b + (-t)$$

$$-(b - t) = -[b + (-t)]$$

$$= (-b) + [-(-t)]$$

$$= -b + t$$

$$= t - b$$

$$9) \quad b - (t - j) = (b - t) + j$$

Caddayn:

b, t iyo j waa tirooyin maangal ah

$$b - (t - j)$$

$$= b - (t + [-j])$$

$$= b + \left[-(t + [-j]) \right]$$

$$= b + \left[[-t] + (-[-j]) \right]$$

$$= (b + [-t]) + j$$

$$= (b - t) + j$$

5. ISKU DHUFASHADA IYO TIROOYINKA MAANGALKA AH

Marka aan xisaab ka shaqaynayno, isugeynta iyo isku dhufashada labadaba waan u baahannahay. Dhardhaarka kala dhigga ayaa isku xira labada xisaab fal. Tusaalooyinkan soo socda ayaa kaa caawinaya si aad u ogaato in isku dhufashadu kala dhigto isugeynta.

$$\begin{aligned} 1) \quad 18(2+3) &= 18 \times 5 = 90 \\ 18(2+3) &= 18 \times 2 + 18 \times 3 \\ &= 36 + 54 \\ &= 90 \end{aligned}$$

$$2) \quad 42 \left(\frac{1}{3} + \frac{1}{7} \right) = 42 \left(\frac{7+3}{21} \right) = 42 \times \frac{10}{21} = 20$$

$$\begin{aligned} \text{ama } 42 \left(\frac{1}{3} + \frac{1}{7} \right) &= 42 \times \frac{1}{3} + 42 \times \frac{1}{7} \\ &= 14 + 6 \\ &= 20 \end{aligned}$$

DHARDHAARKA KALA DHIGGA

Haddii b , t iyo j ay yihiin tirooyin maangal ah, markaa:

$$1) \quad b(t+j) = (bt) + (bj)$$

$$2) \quad (t+j)b = tb + jb$$

Dhardhaarka kala dhiggu wuxu innaga caawiyaa cad-daynta aragtiin lagama maarmaan ah, kaas oo ah fikrad xisaabeedka isku dhufashada ee -1 . Aragtiinkan wuxu leeyahay, «haddii tiro kasta oo maangal ah lagu dhufto -1 , tarantu waxay la mid tahay weydaarka isugeynta ee tirada». Matalan: $4(-1) = -4$, $(-1)(-5) = 5$, $(-1)(-1) = 1$, $8(-1) = -8$, iwm.

Aragtiin:

Haddii b ay tahay tiro maangal ah, $b(-1) = -b$ isla markaa $(-1)b = -b$

Caddayn:

b waa tiro maangal ah
 b (- 1) iyo (- 1) b waa ti-
 ro maangal ah

[b (- 1)] + b waa tiro ma-
 angal ah

$$\begin{aligned} & [b (- 1)] + b \\ & = [b (- 1)] + b \\ & = [b (- 1)] + [b \cdot 1] \\ & = b [(- 1) + 1] \\ & = b \cdot 0 \\ & = 0 \\ \therefore [b (- 1)] + b & = 0 \end{aligned}$$

$$\begin{aligned} 0 & = (- b) + b \\ \therefore [b(-1)] + b & = - b + b \\ b(-1) & = - b \end{aligned}$$

$$(- 1) b = b (- 1)$$

$$\therefore (- 1) b = - b$$

Ogaal.

Oodnaanta iskudhufashada.

Oodnaanta isugeynta.

Astaanta isku noqodka isle'-
 egkaanshaha.

Dhardhaarka kow.

Kala dhigga.

Weydaarka isugeynta.

Iskudhufashada ee eber.

Dhaxidda isle'egkaanshaha.

Weydaarka isugeynta.

Dhaxidda isle'egkaanshaha.

Haddii $b + j = t + j$, mar-
 kaa $b = t$.

Kala hormarinta isku dhufa-
 shada.

Dhexidda isle'egkaanshaha.

Fikrad xisaabeedka isku dhufashada ee - 1, dhardhaa-
 rada iyo hubaalada isku dhufashada ee tirooyinka togan ayaa
 inoo awood siiya inaan isku dhufanno laba tiro oo kasta oo
 maangal ah. Matalan:

$$4 \cdot 3 = 12$$

$$(- 4) \cdot 3 = (- 1 \cdot 4) \cdot 3 = - 1 (4 \cdot 3) = - 1 (12) = - 12.$$

$$4 (- 3) = 4 [3 (- 1)] = (4 \cdot 3 (- 1)) = 12 (- 1) = - 12.$$

$$\begin{aligned} (- 4) (- 3) & = (- 1 \cdot 4) (- 1 \cdot 3) = \\ [- 1 (- 1)] (4 \cdot 3) & = 1 (12) = 12. \end{aligned}$$

Sidaas oo kale, haddii b iyo t ay yihiin tirooyin maangal
 ah, markaas:

$$\begin{aligned} (- b) t & = (- 1 \cdot b) t = - 1 (bt) = - bt \\ b (- t) & = b [t (- 1)] = (bt) (- 1) = - bt \\ (- b) (- t) & = (- 1 \cdot b) (- 1 \cdot t) = \\ [- 1 (- 1)] (bt) & = bt \end{aligned}$$

Haddii aan la kaashanno tirooyinka maangalka ah; waxaan qeexi karnaa isu-qeybinta tirooyinka maangalka ah, matalan:

$$14 \div 2 = 14 \cdot \frac{1}{2}; \frac{-28}{7} = -28 \cdot \frac{1}{7}; \frac{0}{3} = 0 \cdot \frac{1}{3}$$

Qeex:

Haddii b iyo t ay yihiin tirooyin maangal ah.

$$t \neq 0, \text{ markaa } \frac{b}{t} = b \cdot \frac{1}{t}$$

Qeexdani waxay inoo sheegaysaa in isu-qeybinta aan u beddeli karno isku dhufasho haddii qaybshaha aan ku beddelno rogaalkiisa, dabadeedna aan isku dhufanno, taas oo ah, waxan isku dhufanaynaa la qaybshaha iyo rogaalka qaybshaha. Tiro kasta oo maangal ah, eber mooyiye, waxay leedahay weydaar isku dhufasho oo madi ah, markaa, haddii t

ay tahay tiro maangal ah, $t \neq 0$, markaa $\frac{1}{t}$ waa tiro maangal

ah, waliba $b \cdot \frac{1}{t}$ waa tiro maangal ah. Markaa, qeexdu wa-

xay inoo bidaalin in ururka tirooyinka maangalka ahi ku oodan yahay isu qaybinta, haddii eber la iska dhaafo.

Waxaa muuqata in isu qaybintu aanay kala hormarin. Isuqaybintu ma hormagasho, waayo:

$$\begin{aligned} (8 \div 4) \div 2 &= 2 \div 2 = 1 \\ 8 \div (4 \div 2) &= 8 \div 2 = 4 \\ (8 \div 4) \div 2 &\neq 8 \div (4 \div 2) \end{aligned}$$

Haddii b, t iyo j ay yihiin tirooyin maangal ah, $t \neq 0$, $j \neq 0$, markaa $b \div t \div j$ waxaan u qeexnaa sidan hoos ku qoran:

$$b \div t \div j = (b \div t) \div j$$

Layli:

B. Raadi taranka iyo qaybta kolba kii lagu weydiyo:

- 1) $(-3)(0)(-5)(8)$
- 2) $29 \times 3 + 29 \times 7$
- 3) $31 \times 2 + 31 \times 8$
- 4) $(-4)2 + 21 \div 3 + 4$
- 5) $15 - (4 + 8 \div 2) - 6$
- 6) $64 - 5(1 + 4) \div (-8 - 5)$

T. Haddii b , t iyo j ay yihiin tirooyin maangal ah, caddee aragtiin kasta:

- 1) $b(t - j) = bt - bj$
- 2) Haddii $b \neq 0$, $\frac{1}{-b} = \frac{-1}{b}$
- 3) Haddii $b \neq 0$, markaa $\frac{b}{b} = 1$
- 4) Haddii $b \neq 0$, $\frac{-b}{b} = -1$
- 5) Haddii $b = t$, $j \neq 0$, $\frac{b}{j} = \frac{t}{j}$
- 6) $b \div 1 = b$.
- 7) Haddii doorsoomayaashu ay u taagan yihiin tirooyin maangal ah, sheeg waxa talaabo kasta kuu banneeyay.

Caddayn:

Caddee: Haddii $b = t$, $j = x$ markaa $b + j = t + x$.

1) $b = t$

2) $b + j = t + j$

3) $j = x$

4) $t + j = t + x$

5) $\therefore b + j = t + x$

CUTÚB VI

Garaaf:

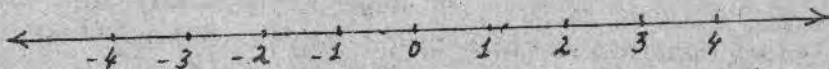
Waxaan naqaanaa inuu urur wax yaabo ka kooban yahay, waxaan halkan kaga hadlaynaa ururro kutirsanayaashoodu yihiin tirooyin maangal ah, sida:

$$\left\{0, 1, -2, 3, \dots\right\} \text{ ama } \frac{-1^0 \ 1^3}{4 \ 2}$$

Waxaa aad u wanaagsan, haddii aan rabno inaan muujinno ururro ka kooban tirooyin, inaan isticmaallo xarriiqda tirada. Waxaan ku beegi karnaa baraha ay ka kooban tahay xarriiqda tiradu, tirada urur ka kooban yahay sida hoos ku sheegan:

Qaado xarriiq toosan. Bar u qaado bar bilow kuna beeg tirada ah 0 (eber). Qaado bar kale oo xagga midig ka xigta 0 (eber) kuna beeg tirada ah 1 (kow). Fogaanta u dhexaysa eber iyo kow waxay tahay halbeeg cabbiraadeed.

U qaybi xarriiqda tirada si labadii barood ee isku xigaba ay isu jiraan halbeeg cabbiraadeed. Barta midigta ka xigta kow sii tirada ah (2); ta kale 3, . . . Baraha bidixda ka xiga eber oo halbeeg cabbiraadeed is u jira, sii tirooyinka $-1, -2, -3, \dots$ siday isugu xigaan. Waxaan niraa tirooyinka midigta ka xiga eber tirooyin togan, kuwa bidixda ka xigana tirooyin taban. Waxaan aragnaa in baraha xarriiqda ee aan soo sheegnay yihiin ururka abyoonayaasha.



Haddii aan sii qaybinno meelaha u dhexeeya tirooyinka ku muujisan xarriiqda tirada, waxan heli karnaa tirooyin maangal.

Sidaasi waxay inna tusinaysaa in barahaasi iyo tirooyin maangal ay u dhexayso isku beegnaan mid-mid ah. Bar kasta oo taal xarriiqda waxay ku beegan tahay tiro maangal ah, ama tiro kasta oo maangal ahi waxay ka joogtaa bar.

Sidaas darteed weedh kasta oo furan waxaan ku muujin karnaa xarriiqda tirada.

Tusaale 1:

Ku sawir garaafka ururkan $\{-1, 1, 3, 5\}$ xarriiqda tirada:



Tusaale 2:

Ku sawir garaafka ururrada soo socda xarriiqda tirada:

- b) Abyoonayaasha togan ee ka yar 9.
- t) Tirooyinka maangalka ah ee u dhexeeya 2 iyo 5 oo ay ku jiraan labada tiro.

Furferis (b):



(t)



Ogow:

Tirooyinka u dhexeeya 2 iyo 5 si aaday u badan yihiin sida 2,1, 2.01, 2.001, ..., sidaas darteed way adag tahay in lagu muujiyo barta tiro kasta. Kolkaa waxaa habboon in la calaamadeeyo inta u dhexaysa labada tiro.

Tusaale 3:

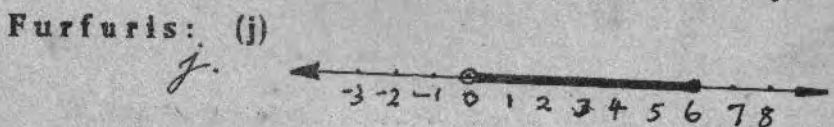
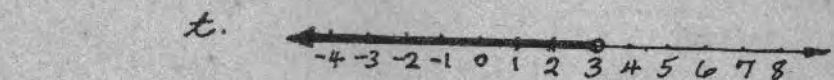
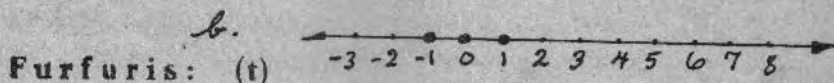
Sawir garaafka weedhan furan ee soo socota:

- b) Dhammaan abyoonayaasha ka yar 2 kaha weyn - 2.

t) Dhammaan tirooyinka maangalka ah ee ka yar 3.

j) $\{x|x \leq 6, x \text{ waa tiro maangal ah oo togan}\}$

Furfuris: (b)



Layli:

I. Ku sawir garaafka ururradan, xarriiqda tiro.

- a) $\{0, 1, 3, 5, 7\}$
- b) $\{-1, 0, 1\}$
- c) $\{12, -8, -4, ?, 0\}$

d) $\left\{1, \frac{1}{2}, \frac{3}{4}, -2\right\}$

II. Sawir garaafka ururradan ka kooban:

- a) Dhammaan tirooyinka mutuxan ee ka weyn 2 kana yar 19.
- b) Dhammaan tirooyikna maangal ah ee u dhexeeya -1 iyo 1 , oo ay ku jiraan.

III. Ku sawir xarriiqda tirada garaafka ururrada soo socda:

- a) $\{x|x < 3\}$, ururka x ee x tahay tiro maangal ah oo ka yar 3.
- b) $\{x|x \geq 5\}$
- c) $\{x|x \leq -3\}$
- d) $\{x|-2 \leq x \leq 2, x \text{ waa abyoone}\}$

IV. Tirooyinka raalli geliya weedh furan waxa loo yaqaanaa urur furfurista weedha.

- a) Raadi kutirsanayaasha ururro furfurista weedhaha (b), (c), (d) ee kor ku qoran.
- b) Kuwa soo socda waa ururro furfurada weedho gaar ah. Ku sifee weedhaha ku beegan qormo urur ama hawraaro.

Tusaale:

- a) $\{1, 2, 3, 4\}$

Furfuris:

Erayo: Ururka abyoonaasha togan ee ka yar 5.

Qormo urur: $\{x \mid x \text{ waa abyoone togan, } x < 5\}$

- b) $\{5, 6, 7\}$
- c) $\{-2, -1, 0, 1, 2\}$
- d) $\{2, 3, 5, 7, 11\}$

V. Haddii lagu siiyo ururka $A = \{-1, 0, 2\}$ ku sawir garaafka ururrada soo socda xarriiqda tirada:

- a) $\{x, x \in A \mid x + 2 < 5\}$
- b) $\{x, x \in A \mid -1 < x < 2\}$
- c) $\{x, x \in A \mid -x \leq 2\}$
- d) $\{x, x \in A \mid x^2 = 1\}$
- e) $\{x, x \in A \mid 0 \leq x \leq 3\}$

KULANNADA KU YAAL SALLAX

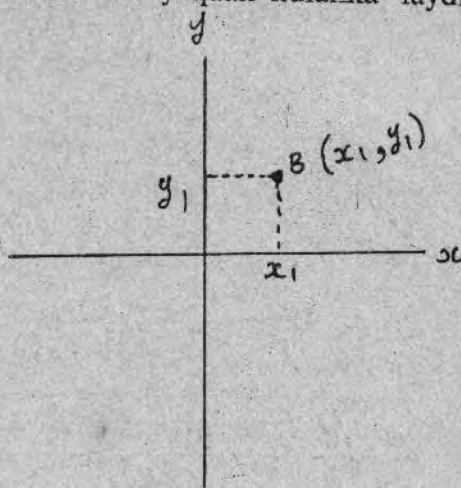
Sidaan u samaynay iskubeegeen mid-mid ah oo ka dhe-xaysa tirooyinka maangalka ah iyo baraha xarriiqda tirada, ayaan uga dhaxsamayn karnaa lammaanayaalka horsan ee tirooyinka maangal ah iyo baraha ku yaal sallax. Habka la isugu beegayana halkan aan ku sheegno.

Ka soo qaad inaan haysanno laba xarriiq ama laba dhi-dib oo ku yaal sallax iskagana qotoma bar aan ku magacow-no 0 ama unug. Adoo isticmaalaya halbeegyo cabbiraadeed oo habboon, dhidib kasta waxaad ka dhigtaa xarriiq tiro oo

barta eber ay tahay 0. Labada dhidib mid wuu jiiifaa mid kalena wuu qotomaa. Ka jiiifa waxa la yiraa dhidibka $-x$, ka qotomana waa dhidibka $-y$. Dhidibka $-x$, inta midigta ka xigta 0, barihiisa waxaan siinaa tiroocayn togan, inta bidixda ka xigtana tiroocayn taban. Sidaas oo kale dhidibka $-y$ intiisa kor ka xigta 0 way togan yihiin, inta ka hoosaysaana way taban yihiin. Afarta qaybood ee dhidibyadu u qaybshaan sallaxa waxa la yiraa: **Waaxo**.

Qaado barta B ee sallaxa ku taal, ka soo qaad inay x_1 — halbeeg u jirto dhidibka y , y_1 — halbeegna ay u jirto dhidibka x . Haddii xarriiq la barbarro ah dhidibka $-x$ oo marta barteena iyo xarriiq kale oo la barbarro ah dhidibka $-y$ marta barteena ay isjaraan, meeshay iska jaraan waa barta B. Haddaba kulannada barta B waa (x_1, y_1) . x_1 waa kulanka x ama absiisa, y_1 waa kulanka y ama oordinayt. Waxaana la hormariyaa kulanka x .

Habdhiskan waxa loo yaqaan kulanka laydi ama habdhiska kartis.

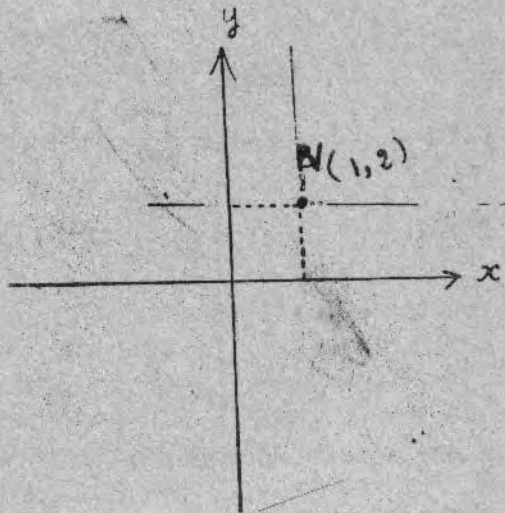


Haddii aan haysanno laba urur oo ah $A = \{1, 2, 4\}$ iyo $B = \{2, 3, 5\}$, tiroocaynka ku jira B waxa la helayaa haddii loo geeyo 1 tiro kasta oo ku jirta ururka A.

Kutirsane kasta oo ku jira ururka A waxaad ku aaddisaa kan ku beegan ee ururka B. Kolkaa waxaan helaynaa ururka $c = \{(1, 2), (2, 3), (4, 5)\}$. Kutirsanayaasha ururka c waxa loo yaqaan lammaanayaasha tirooyin horsan oo ku jira ururka c. Tirada labaad waxay ku xiriirsan tahay tan ka horaysa.

Kuma sawiri karno garaafka ururka c xarriiqda tirada. Sidaas darteed waa inaan isticmaallaa kulannada kaartis. Lammaanayaasha ururka c waxay samaynayaan baro marka la raaco habdhiskan. Sida loo sawiro garaafka baraha waa sidan soo socota:

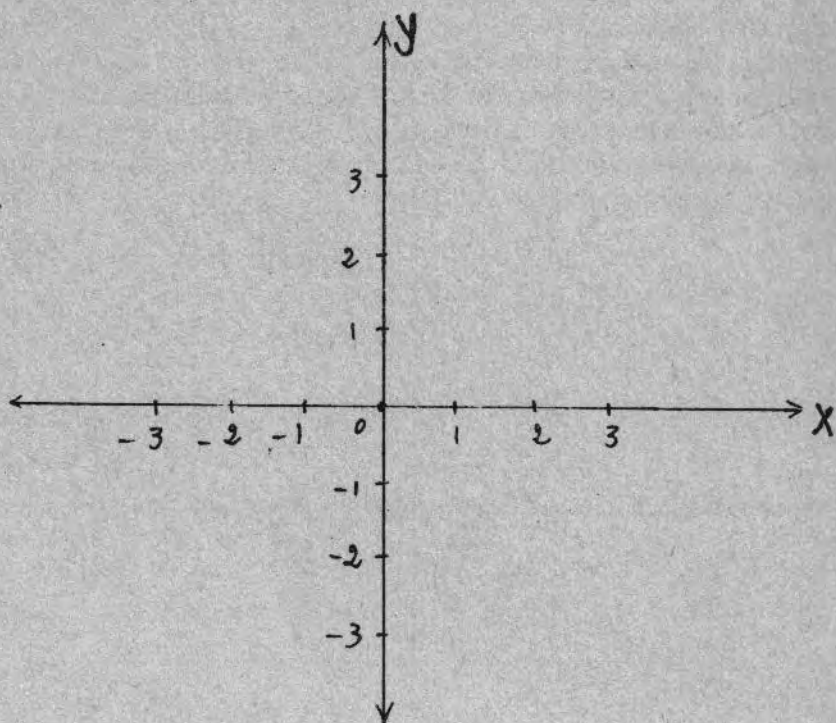
Tirada hore ee lammaanaha $N(1, 2)$ waxa iska leh dhidibka x , ta dambana dhidibka y . Si loogu sawiro bartan $N(1, 2)$ sallaxa ka raadi 1 dhidibka x , jeex xarriiq la barbarro ah dhidibka y oo marta meesha dhidibka $-x$ ka yahay 1; ka raadi 2 dhidibka $-y$, jeex xarriiq la barbarro ah dhidibka $-x$, oo marta halka dhidibka $-y$ ka yahay 2. Dhexyaalka labada xarriiqood waxa weeye barta ah $N(1, 2)$.



Adoo raacaya sida aan bartan $N(1, 2)$ u helnay ayaad baraha ururka c oo dhanna u wada heli kartaa.

Layli:

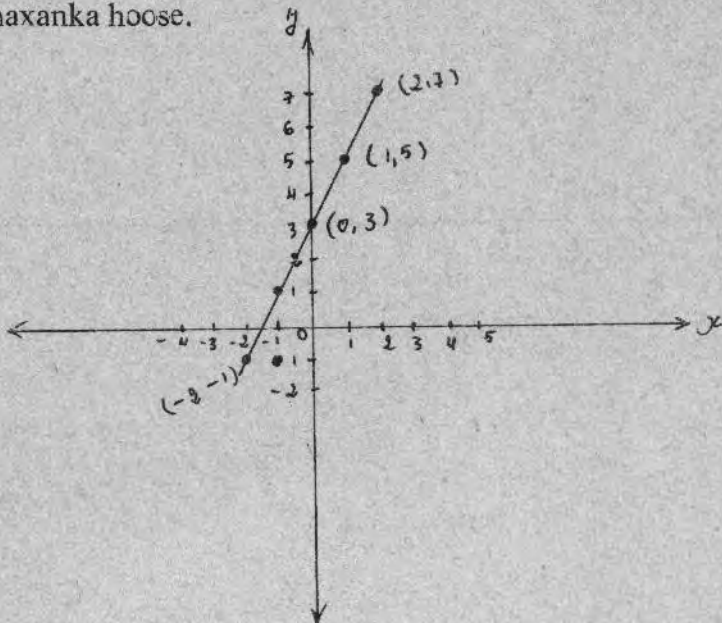
- 1) Ku sawir habdhiska kartis garaafka baraha urur-radan:
 - a) $\{(2,1), (3,2), (3,4)\}$
 - b) $\{(4,6), (1,3), (2,4), (3,5)\}$
 - t) $\{(1,1), (2,2), (3,3), (6,6)\}$
 - j) $\{(0,2), (2,0)\}$
 - x) $\{(-1,3), (-2, -3), (-2,0), (0,0)\}$
- 2) Qor baraha sallax ku yaal:



- 3) Haddii lagu siiyo $A = \{-1, 1, 2, 3\}$ iyo $B = \{-2, 0, 1, 2\}$
- Kutirsanayaasha A si horsan ugu aaddi kutirsanayaasha B. Sawir garaafka lammaanayaasha horsan ee aad heshid.
 - 2 u gee kutirsane kasta oo ku jira ururka A. Kutirsanayaasha ururka cusub si horsan ugu aaddi kuwa B.
Sawir garaafka lammaanayaasha aad heshid.
 - Isku xir baraha garaafka (b). Malee waxay isugu xarriiqda noqdeen.

ISLE'EG TOOSAN

Ka soo qaad inaan haysano lammaane horsan oo ah $(1,5)$ oo ka mid ah urur furfurista isle'egta $y = 2x + 3$. Sidaan hore u aragnay lammaanahaasi wuxuu u taagan yahay bar gaar ah oo baraha sallax ka mid ah. Si aan u sawirno garaafka barahan $(-2, -1)$, $(-1, 1)$, $(0, 3)$, $(2, 7)$ oo iyaguna ka mid ah urur furfurista isle'egtan $y = 2x + 3$. Haddaba, haddii aan sawiri karno garaafka dhammaan lammaanayaasha horsan ee sameeya urur furfurista isle'egtaa, waxaan helaynaa xarriiqda toosan ee in ka midihi ku muujisan tahay shaxanka hoose.



Xarriiqda waxa la yiraa garaafka isle'egta $y = 2x + 3$.
 Isle'egta $y = 2x + 3$ waxa iyana loo yaqaannaa isle'eg xarriiqeed ama isle'eg toosan.

Tusaale:

Sawir garaafka isle'egta $y = x - 1$

Furfuris:

Si aan u sawirno garaafka isle'egtaas, ku beddel x tiro si aad u raadisid qiimaha y . Sidaas u wad ilaa aad heshid lammaanayaal horsan oo badan.

Ku sawir lammaanayaasha sallaxa

Waxaan haysannaa: $y = x - 1$.

$$x = -1, \quad y = (-1) - 1 = -2$$

$$x = -2, \quad y = (-2) - 1 = -3$$

$$x = -3, \quad y = (-3) - 1 = -4$$

$$x = 0, \quad y = (0) - 1 = -1$$

$$x = 1, \quad y = (1) - 1 = 0$$

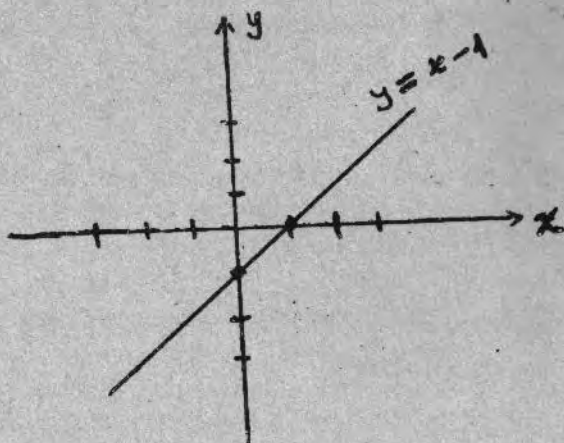
$$x = 2, \quad y = (+2) - 1 = 1$$

$$x = 3, \quad y = (3) - 1 = 2$$

Sawir garaafka $(-1, -2)$, $(-2, -3)$, $(-3, -4)$, $(0, -1)$, $(2, 1)$.

Sidaas waxa ka wanaagsan ama ka gaaban adoo isticmaala tuse:

X	-1	-2	-3	0	1	2	3
Y	-2	-3	-4	-1	0	1	2



Dhammaan baraha la socda tirooyinka lammaanayaasha horsan ee urur furfurista weedh furan (isle'eg toosan) oo leh laba doorsoome waxa la yiraa: «Garaafka urur furfurista» ama «Garaafka isle'eg toosan» waxa muuqata in isle'eg kasta oo sansaankeedu yahay: $Ax + By = C$; oo A , B , iyo C ay yihiin ma doorsoomayaal, ayna A iyo B labadooduba ahayn eber (0), ay tahay xarriiq toosan. U fiirso in tibix kasta oo ku jirta isle'egtan toosan ee sansaanka $Ax + By = C$ leh ay tahay madoorsoome ama haltibix heerkiisu yahay 1 . Sidaa darteed isle'egta ah $Y = x = -1$ waa isle'eg toosan, laakiin isle'egyada $y = x^2$ iyo $xy = 5$ garaafkoodu xarriiq toosan ma aha.

Tusaale 2:

Sawir garaafka: $\{ (x, y) \mid 3x + 2y = 0, x \geq 0, y > -6 \}$

Furfuris :

U qor isle'egta sansaanka u dambeeya:

$$Ax + By = C$$

$$By = -Ax + C$$

$$y = \frac{-Ax}{B} + \frac{C}{B}$$

Dabadeed X marba qiima sii si aad u raadisid qiimayaa-sha Y. Tuse samayso.

$$3x + 2y = 0$$

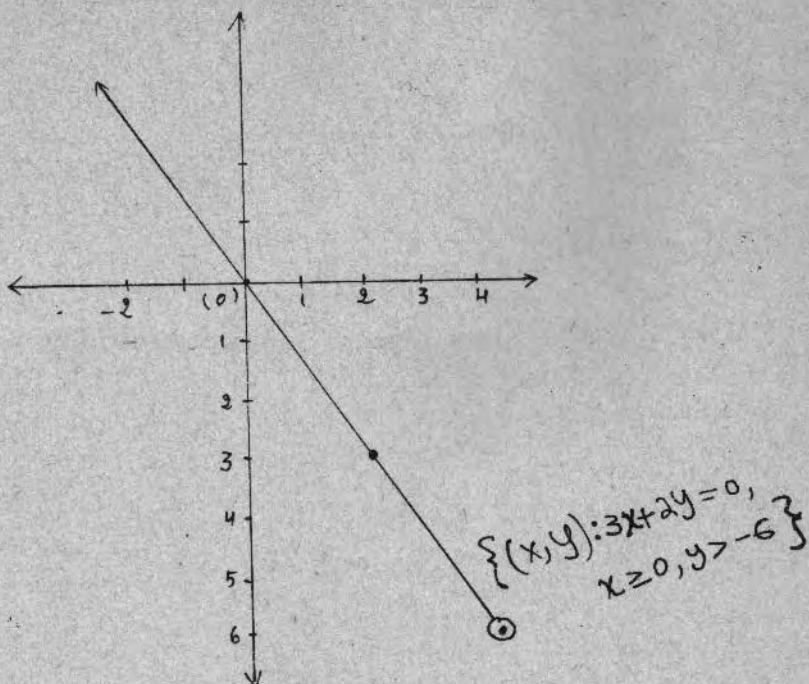
$$2y = -3x + 0$$

$$y = \frac{-3x}{2}$$

Tuse.

x	$-\frac{3}{2}x$	y
0	$-\frac{3 \cdot 0}{2}$	0
2	$-\frac{3 \cdot 2}{2}$	-3
4	$-\frac{3 \cdot 4}{2}$	-6
-2	$-\frac{3 \cdot -2}{2}$	3

Sawir garaafka $\{(0, 0), (2, -3), (4, -6)\}$.

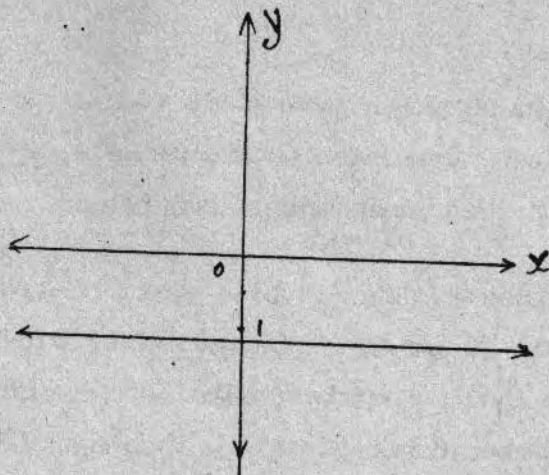


Tusaale 3:

Sawir garaafka: $\{x, y\}. y = -1\}.$

Furfuris :

Isle'egtan waxa loo dhigi karaa sida $y = 0 \cdot x - 1$.
Garaafkeedu waa xarriiq jiifta oo marta meesha ay $y = -1$,
xarriiqdaasu waa la barbarro dhidibka $-x$.



Laylis :

Sawir garaafka isle'eg kasta oo soo socota:

1. $y = 2x + 2$
2. $y = 2x - 2$
3. $y = 3x$
4. $y = x + 1$
5. $y - x = 0$
6. $2x - y = 5$
7. $y = \frac{1}{2}x + 1$
8. $\frac{3}{4}y - \frac{1}{2}x = \frac{2}{3}$

$$9. \quad y = \frac{x + 1}{2}$$

$$10. \quad \frac{1}{2}y - x = 0$$

Isle'eg kasta oo toosan garaafkeedu waa xarriiq toosan. Haddaba markaan rabno inaan sawirro garaafka isle'eg toosan waxa innagu filan inaan raadinno laba barood.

Waxaa badiba la raadshaa labada barood ee xarriiqdu ka jarto dhidibka $-X$ iyo ka Y . Sidaasi waxay la mid tahay in la raadiyo qiimaha y marka x tahay eber, iyo qiimaha x marka y tahay eber. Barahaasi waxa la yiraahdaa: **Tikraarro.**

Tusaale :

Sawir garaafka isle'egtan:

$$2y + x + 4 = 0$$

Furfuris :

$$y = -\frac{1}{2}x - 2$$

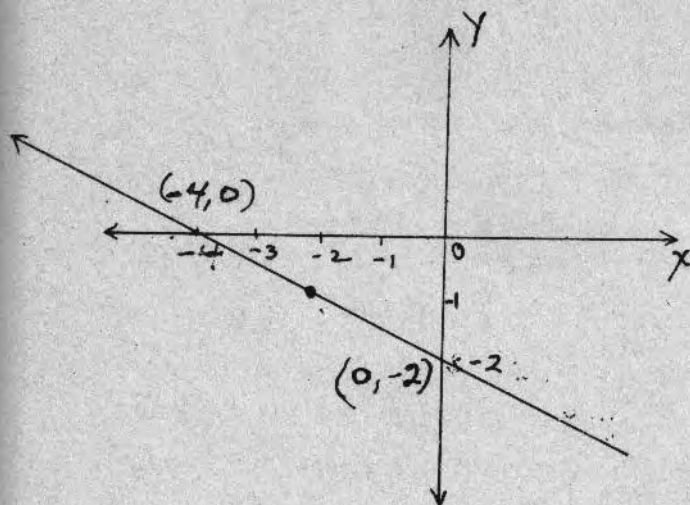
eg

U qaado X eber, markaa $Y = -2$

U qaado Y eber, markaa $X = -4$

Tikraarradu waa $(0, -2)$ iyo $(-4, 0)$

Ku dhig labada barood garaafka; isku xir labada barood.
 U fidi xarriiqda labadeeda jaho.



Kulannada bar kasta oo ku taal xarriiqda way raalli geliyaan isle'egta. Barta $(2, -1)$ waxa weeye bar xarriiqda ku taal. Haddii kulannadeeda aad ku beddelato x iyo y waaxaad gaari in isle'egta labadeeda dhinac isku mid yihiin.

$$y = \frac{1}{2}x - 2$$

$$-1 = \frac{1}{2}(2) - 2$$

$$-1 = 1 - 2$$

$$-1 = -1$$

Lammaane kasta oo horsan oo ka mid ah urur furfurista isle'eg bartiisu waxay ku taal xarriiqda. Kulannada barta $(-2, -3)$ waxay ka mid yihiin lammaanayaasha horsan ee urur-furfurista. Markaa way raalli geliyaan isle'egta:

$$\begin{aligned} 2(-3) - (-2) + 4 &= 0 \\ 0 &= 0 \end{aligned}$$

Laylis :

Sawir garaafka isle'egyadan:

$$1. \quad 2x + 3y = -2$$

$$2. \quad \frac{1}{2}x - \frac{1}{3}y = \frac{1}{2}$$

$$3. \quad y = \frac{1}{2}x$$

$$4. \quad \frac{1}{2}y = x$$

$$5. \quad x - 3 = 3 - y$$

$$6. \quad y - 3 = 3 - x$$

$$7. \quad y = 2$$

$$8. \quad x = 1$$

$$9. \quad y = 0$$

TIIRADA XARRIIQ

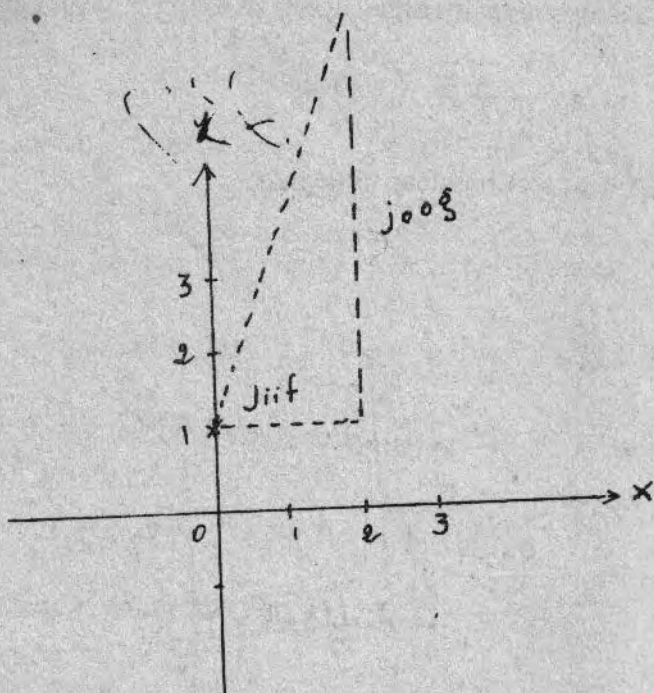
Tiirada xarriiq toosani waa tanjantka janjeedhka. Waxa loo qeexaa tiirada xarriiqda sidan:

$$m = \frac{\text{Kororka oordinaytka}}{\text{Kororka absiisaha}}$$

Haddii aan rabno inaan cabbirno tiirada xarriiqda isle'egteedu tahay $y = 2x + 1$, waxaan qaadannaa laba barood oo ku yaal xarriiqda isle'egtu sameyso. Ka soo qaad labada

barood inay yihiin (1, 3) iyo (2,5), markaa tiirada xarriiq-
da isku xirta labada barood waxay tahay:

$$\begin{aligned}
 m_1 &= \frac{\text{Kororka aardinaytka}}{\text{Kororka absiisaha}} \\
 &= \frac{5 - 3}{2 - 1} = \frac{2}{1} = 2
 \end{aligned}$$



Sidaas oo kale waan isticmaali karnaa laba barood oo
kasta oo ku yaal xarriiqda. Qaado labada barood ee ah
(3, 7) iyo (4, 9). Markaa tiiradu waxay tahay:

$$m_2 = \frac{9 - 7}{4 - 3} = \frac{2}{1} = 2$$

Qaado labadan barood ee kala ah $(-2, -3)$ iyo $(-3, -5)$.
 Markaa tiiradu waxay tahay:

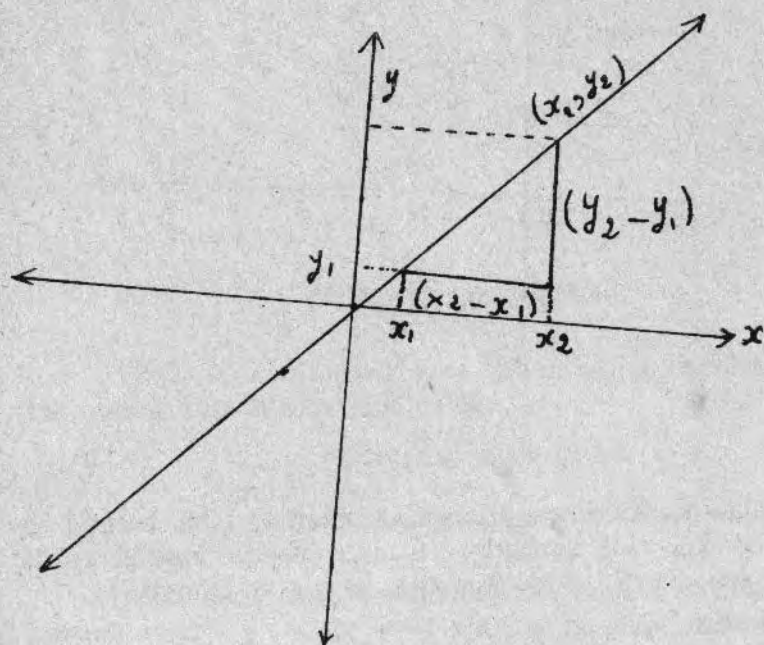
$$m_3 = \frac{-5 - (-3)}{-3 - (-2)} = \frac{-2}{-1} = 2$$

Haddaba $m_1 = m_2 = m_3$.

Guud ahaan haddii aan haysanno laba barood oo ka mid ah isle'eg toosan, sida (x_1, y_1) iyo (x_2, y_2) , tiirada xarriiqda isle'egtu sameyso waxay tahay:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Garaaf ahaan haddaan u eegno.



$$m = \frac{\text{Kororka } -y}{\text{Kororka } -x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Tusaale 1:

Soo saar tiirada isle'egtan.

$$3y = x + 1$$

Furfuris :

Qaado laba barood oo raalli geliya isle'egta sida (2, 1) iyo (5, 2).

$$\text{Tiiro} = m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 1}{5 - 2} = \frac{1}{3}$$

Qaado baro kale oo raalli geliya isle'egta, markaa hubi in tiiradu isla tii tahay. Haddii aan u beddelno isle'egtan

$$3y = x + 1 \text{ sidan } y = \frac{1}{3}x + \frac{1}{3} \text{ waxaan arki karnaa}$$

xiriirka ka dhexeeya weheliyaha x iyo tiirada. Tiirada si dhib yar ayaad u soo saari kartaa:

Tusaale 2:

Soo saar tiirada isle'egtan:

$$y = 2x + 7$$

$$m = 2.$$

Layli :

1) Soo saar tiirooyinka isle'egyadan:

1. $y = 3x + 9$

2. $y = x + 2$

3. $y = -2x + 7$

$$4. \quad \frac{1}{2}x - y = \frac{1}{2}$$

$$5. \quad y = \frac{2}{3}x$$

$$6. \quad ay = bx + c$$

$$7. \quad ay - bx + c = 0$$

$$8. \quad y = ax + b$$

2) Soo saar tiirada xarriiqda marta baraha:

$$1. \quad (-4, -3), (2, 1)$$

$$2. \quad (0, -6), (6, 6)$$

$$3. \quad (-8, -3), (-2, 5)$$

$$4. \quad (-3, -4), (3, 2)$$

Raadinta tiirada xarriiq toosani waxay dhalisaa go'aan-nada soo socda:

1. Laba xarriiqood oo barbarro ahi waxay leeyihiin tiirooyin isku mid ah.

2. Tiiroovinka labada xarriiqood ee isgooyaa way kala duwan yihiin.

3. Labada xarriiqood ee isku qotoma tiirooyinkoodu waa isku rogaal taban, sida:

$$m_1 = \frac{-1}{m_2}$$

4. Tiirada dhidibka $-x$ ama xarriiq kasta oo la barbarro ah dhidibkaasi waa eber.

5. Xarriiqda qotonta tiiradeedu ma jirto, dhidibka $-y$ ama kuwa la barbarro ah tiirooyinkoodu ma jiraan.

Tusaale 3:

Soo saar tiirada isle'egyadan:

$$L_1 : y = 2x + 1$$

$$L_2 : 6y - 12x = 3$$

Furfuris :

$$\begin{aligned}m_1 &= 2, & m_2 &= 2 \\m_1 &= m_2\end{aligned}$$

Marka labada xarriiqood waa barbarro.

Layli :

1) Sawir garaafka isle'egyadan. Sheeg inay barbarro yihiin iyo in kale adoo adeegsanaaya garaafka:

$$\begin{aligned}\text{b) } x - y &= 5 \\3y &= 3x - 10\end{aligned}$$

$$\begin{aligned}\text{t) } y &= 3x + 3 \\x - 2y &= 4\end{aligned}$$

$$\begin{aligned}\text{j) } 2x &= 5 - y \\3x - y &= 2y\end{aligned}$$

$$\begin{aligned}\text{x) } y &= 8 \\y &= -3\end{aligned}$$

2. Soo saar tirooyinka isle'egyada layliska 1. Ma-
xaad ka sheegi kartaa tirooyinka xarriiqyada barbarrada ah?

3. Tus inay saddexdan barood A $(-3, 4)$; B $(3, 2)$;
C $(6, 1)$ ku wada yaallaan xarriiq keliya.

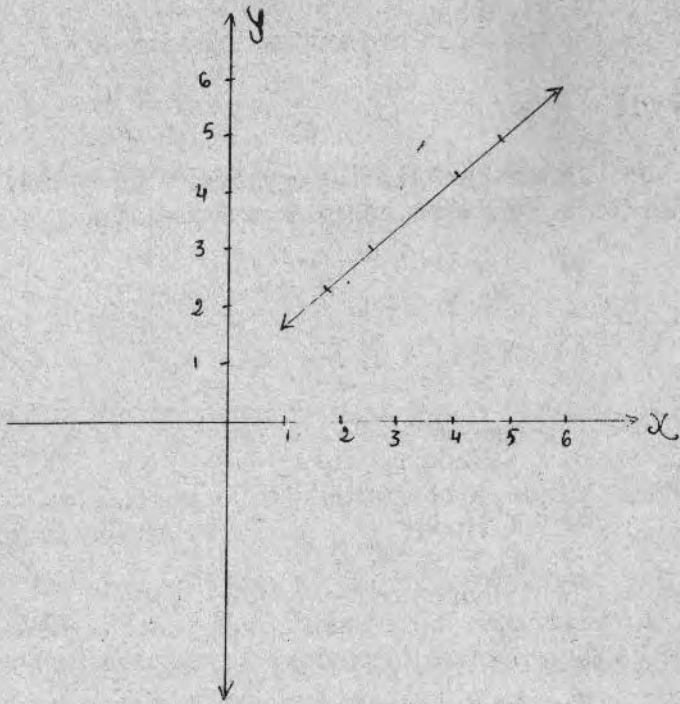
4. Adoo adeegsanaaya tirooyinka, tus in barahani
A $(8, 6)$; B $(4, 8)$; C $(2, 4)$ yihiin geesaha saddexagal
qumman.

ISLE'EG XARRIIQEED

Waxaan ognahay ilaa hadda in isle'egta toosani ay u
taagan tahay xarriiq toosan. Isle'egtaasina waxay ka kooban
tahay laba doorsome oo heerkoodu yahay 1.

Xagga kale haddaan ka eegnana garaafka isle'egta heer-
keedu yahay 1 kana kooban laba doorsome waa xarriiq
toosan. Laakiin sidee loo helaa isle'egta xarriiqda, haddii
lagu siiyo xarriiq ku sifaysan shuruud joomatari?

Ka soo qaad inaan haysanno urur ka kooban baro sida:
{ (1, 2), (2, 3), (3, 4), (4, 5), (5, 6) }.



Haddii aan sawirro garaafka baraha (eeg shaxanka sare), waxa muuqata in baraha oo dhammi ay ku yaallaan xarriiq keliya. Taasi waxay ina tusaysaa in ay jirto isle'eg dhammaan barahu raalli geliyaan. Markaa bar kasta oo ku taal xarriiq way raalli gelisaa isle'egta.

Haddii aad u fiirsatid lammaanayaasha ururka kor ku qoran, waxaad arki kartaa in qiimaha kulanka $-y$ la mid yahay qiimaha kulanka $-x$ oo 1 loo geeyo. Sidaa waxa loo qoraa $y = x + 1$. Hubso in baraha oo dhammi raalli geliyaan isle'egta. Isle'egta xarriiqda garaafkeedu kor ku sawiran yahay waxay tahay $y = x + 1$.

Layli :

Raadi isle'egyada xarriiqaha ay sameeyaan baraha soo socdaa, adoo sawiraaya garaafkooda.

- b. $\{(2, 1), (3, 2), (4, 3), (5, 4)\}$
- t. $\{(1, 3), (2, 4), (3, 5), (0, 2)\}$
- j. $\{(1, 1), (2, 2), (3, 3), (-1, -1)\}$

Waxaan naqaannaa sida loo soo saaro tiirada haddii layna siiyo isle'eg. Haddaba marka u qorno isle'eg kasta sannaanka $y = mx + b$, tiiradeeda waxa ina siiya weheliyaha x oo ah m . Haddii tiirada xarriiqdu tahay 3, isle'egteedu waxay tahay $y = 3x + b$. Haddaba isle'egtani uma taagna xarriiq keliya ee waxay ka taagan tahay qoys xarriiqyo ah oo barbarro ah.

Haddii tiirada xarriiqda marta bartan $(1, 2)$ ay tahay 3, maxay noqonaysaa isle'egta xarriiqdu? Sidaan horay u aragnay, kulannada barahani way raalli geliyaan isle'egta. Haddii aan x ku beddello 1, y -na ku beddello 2, waxaan heleynaa b sida:

$$2 = 3(1) + b; \quad b = -1.$$

Markaa isle'egta xarriiqdu waxay tahay $y = 3x - 1$.

Tusaale 1:

Soo saar isle'egta xarriiqda marta bartan $(-5, -2)$, tiirteeduna tahay $-\frac{3}{4}$.

Furfuris :

$$y = mx + b$$

$$-2 = -\frac{3}{4}(-5) + b$$

$$b = \frac{-23}{4}$$

$$y = mx + b$$

Isle'egtu waa $y = -\frac{3}{4}x - \frac{23}{4}$

ama $4y + 3x + 23 = 0.$

Tusaale 2:

Soo saar isle'egta xarriiqda marta barahan:

$$(-1, -6) \text{ iyo } (-5, -2)$$

Furfuris :

Waxaad soo saartaa tiirada xarriiqda adoo adeegsanaya jidkan:

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-6)}{-5 - (-1)} \\ &= \frac{-2 + 6}{-5 + 1} = \frac{4}{-4} = -1 \end{aligned}$$

Adoo labada barood mid qaadanaya waxad raadisaa isle'egta xarriiqda sida:

$$\begin{aligned} y &= mx + b \\ -1 &= -1(-6) + b \\ b &= -7 \end{aligned}$$

∴ Isle'egta xarriiqdu waxay tahay

$$y = (-1) \cdot x - 7$$

$$y = -x - 7$$

$$y + x + 7 = 0$$

Layli :

1) Raadi isle'egta xarriiqda haddii lagu siiyo tiiraddeeda iyo bar ay marto:

1. $(2, 3), \quad m = 5$

2. $(5, 1), \quad m = 2$

3. $(-2, 4), \quad m = -3$

4. $(-4, -5), \quad m = \frac{2}{3}$

5. $(0, -2), \quad m = -\frac{5}{8}$

6. $(0, 0), \quad m = 1$

7. $(0, 0), \quad m = -\frac{2}{3}$

8. $(5, 4), \quad m = 0$

2) Raadi isle'egta xarriiqda marta barahan:

1. $(-1, 6), \quad (-5, -2)$

2. $(2, -5), \quad (6, 3)$

3. $(-4, 2), \quad (-2, -6)$

4. $(6, 5), \quad (4, 11)$

5. $(0, 0), \quad (-2, 3)$

6. $(-3, 0), \quad (4, 0)$

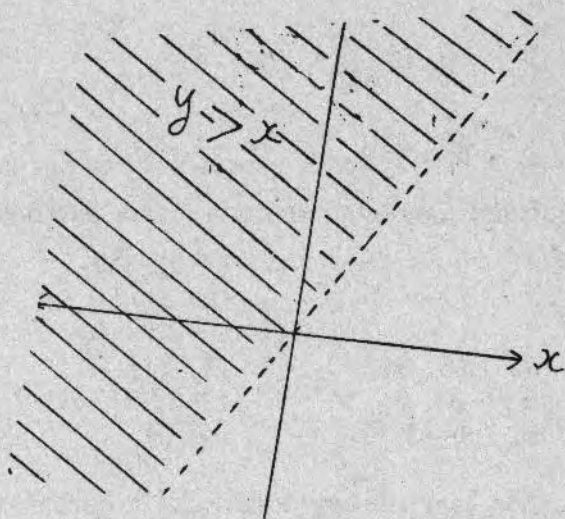
3) Soo saar isle'egta xarriiqda la barbarro ah dhidibka $-x$, martana barta $(0, -3)$.

4) Soo saar isle'egta xarriiqda la barbarro ah dhidibka $-y$, martana barta $(-5, 4)$.

- 5) Soo saar isle'egyada xarriiqaha sameeya saddexa-galka ABC haddii geesihisu yihiin barahan:
 $A(0, 3)$; $B(0, 0)$; $C(4, 0)$.
- 6) Barahani waxay yihiin geesaha barbaroolaha ABCD:
 $A(-2, 4)$, $B(6, 4)$, $C(8, 7)$, $D(0, 7)$, mar-
 kaa soo saar isle'egyada xaglogooyaasha AC iyo BD.

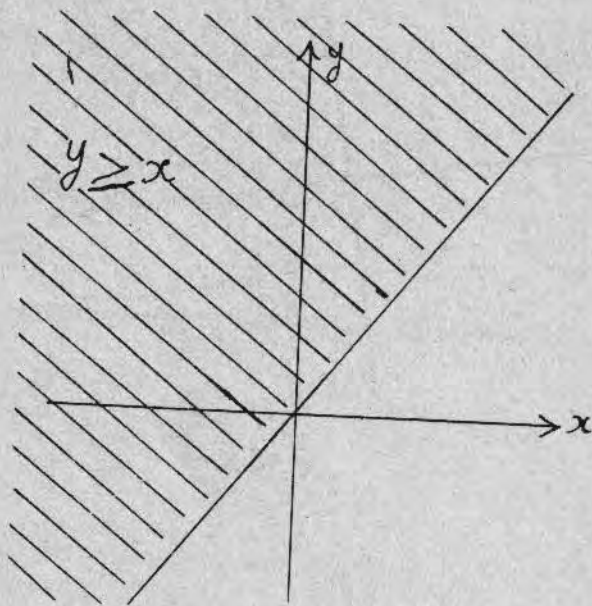
GARAAFKA DHEELI TOOSAN

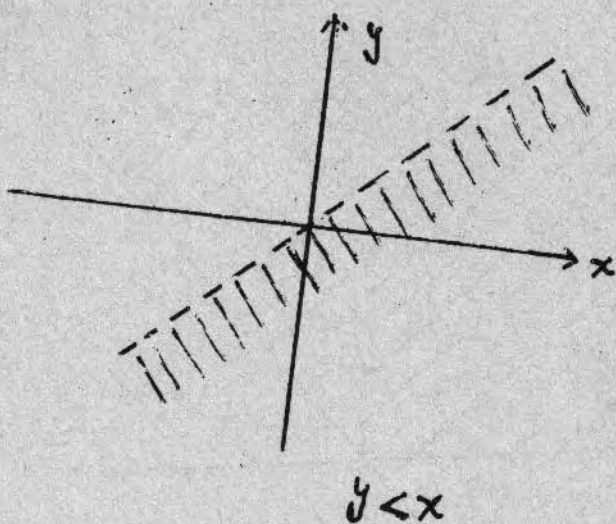
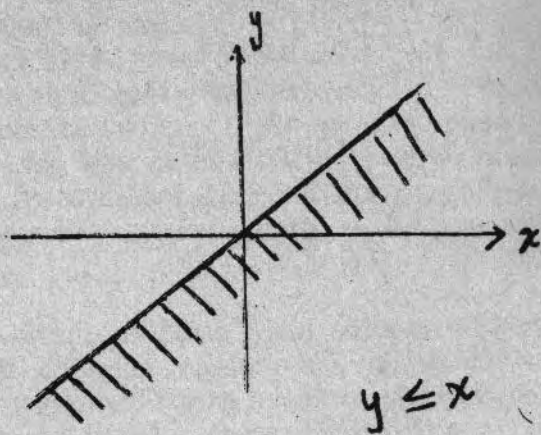
Waxaan naqaan garaafka isle'eg toosani inuu yahay xarriiq toosan. Garaafka isle'egta $y = x$ sawirkeedu waa xarriiq toosan sida hoos ku muujisan.

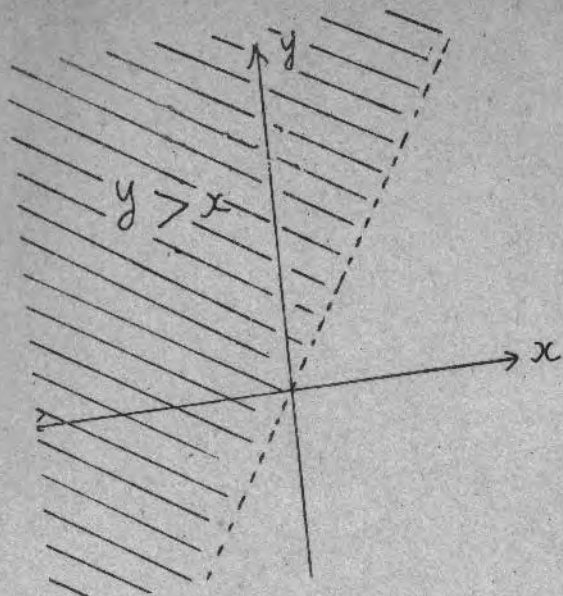


Haddii aan qaadanno bar xarriiqdeenna kor ka xigta oo kulannadeedu yihiin $(3, 3)$ iyo bar kale oo hoos ka xigta oo kulannadeedu yihiin $(3, -1)$, ma sheegi kartaa xiriirka ka dhexeeya kulannada bartan $(3, 7)$ ama kulannada bartan $(3, -1)$? Waxaan aragnaa in kulanka $-y$ ee bartani $(3, 7)$ ka weyn yahay kulanka $-x$. Barta kalena kulanka $-y$ wuu ka yar yahay kulanka $-x$. Barta ku taal xarriiqda oo ah $(3, 3)$ kulannadeedu way isle'eg yihiin. Sidaas darteed baraha kor ka xiga garaafka xarriiqda waxay raalli geliyaan dheelliga toosan ee $y > x$. Kuwa hoos ka xigaana waxay raalli geliyaan dheelliga toosan ee $y < x$.

Haddaba hilinka loo maro garaafka dheelli toosani waxay la mid tahay hilinkii aan u marnay garaafka isle'eg toosan. Hase yeeshee, waxa kala duwan garaafkooda, garaafka isle'eg toosani waxa weeye xarriiq toosan. Garaafka dheelli toosani waa gobolka kor ama hoos ka xiga xarriiqda oo marna xarriiqdu ku jirto, marna ayna ku jirin. Garaafka $y = x$ wuxuu xad u yahay kolba qaybta aan rabno. Tusaale ahaan baro garaafyadan kala duwan ee hoos ku sawiran:







Marka aan haysanno dhelli toosan oo ay la socoto sum-madda isle'egkaanshuhu sida $y \geq x$ ama $y \leq x$, xarriiqdu way ku jirtaa garaafka. Haddii aanay la soconse sida $y > x$ ama $y < x$, xarriiqdu kuma jirto garaafka. Marka ay ku jirto xarriiqdu garaafka waxa lagu muujiyaa xarriiq ishaysata; marka kalana xarriiq googo'an.

Tusaale 1:

Sawir garaafka dheelligan toosan $2x - y < 3$.

Furfuris:

U beddel dheelliga toosan mid ay isu dhigmaan sida:

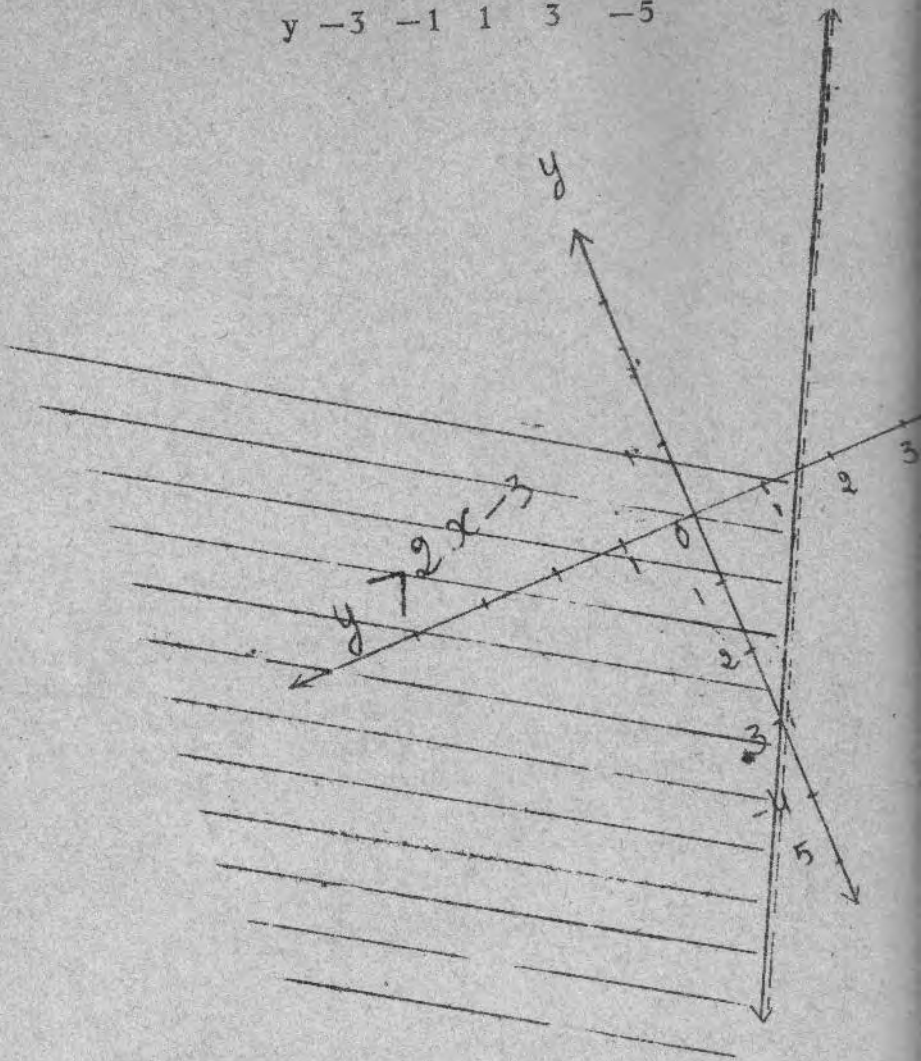
$$2x - y < 3$$

$$-y < 3 - 2x$$

$$y > 2x - 3$$

Sawir garaafka isle'egta toosan ee ah $y = 2x - 3$, ku muuji xarriiq googo'an.

x	0	1	2	3	-1
y	-3	-1	1	3	-5



Xaradh inta ka korraysa xarriiqda googo'an.

Tusaale :

Sawir garaafka $x - 1 \leq y \leq x + 1$.

Furfris :

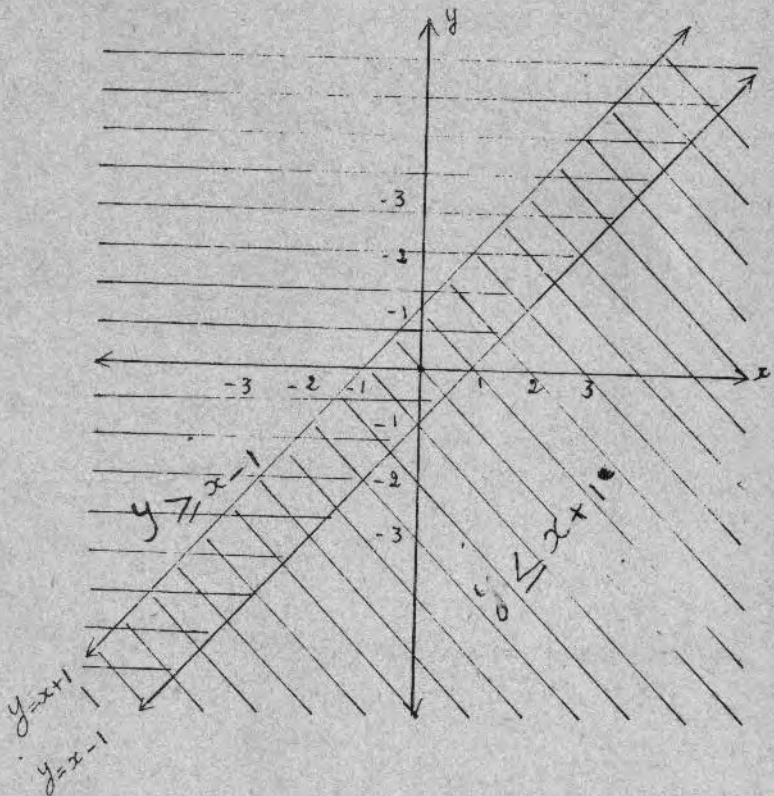
Sawir garaafyada: $y \leq x + 1$ iyo $y \geq x - 1$

$$y = x + 1$$

x	-1	-2	-3	0	1	2
y	0	-1	-2	1	2	3

$$y = x - 1$$

x	-1	-2	0	1	2	3
y	-2	-3	1	0	1	2



Inta u dhexaysa labada garaaf oo ay ku jiraan labada xarriiq ayaa ah garaafka $x - 1 \leq y \leq x + 1$. Baraha intaas ku yaalli way raalli geliyaan dheelliga.

Layli :

1) U beddel weedh kasta oo furan mid u dhiganta oo y tahay gooni.

1. $x + y < 6$
2. $y - x < 2$
3. $y - 3x \leq 4$
4. $5x + y > -1$
5. $2x + 6y < 0$
6. $9x + 3y \leq 0$

2) Barta ku hor qoran weedh kasta oo furan ma tahay mid ka mid ah urur furfurista weedh furan?

1. $x - y \leq 0;$ (2, 2)
2. $y - x \geq 0;$ (1, 1)
3. $2y - x \geq 2;$ (1, 1)
4. $2x + y \leq 1;$ (3, -3)
5. $5x - 2y > 4;$ (2, 3)

3) Sawir garaafka weedhaha furan ee soo socda:

- | | |
|----------------|---------------------------|
| 1. $y > x$ | 7. $x \geq 0$ |
| 2. $y \geq 3x$ | 8. $y < 1$ |
| 3. $y \leq 2x$ | 9. $y + 5x > 0$ |
| 4. $y < -x$ | 10. $x + y \geq 1$ |
| 5. $y > -2$ | 11. $y - 4x \leq -2$ |
| 6. $x \geq 3$ | 12. $3x + 6y \leq 2$ |
| | 13. $4y - 3x + 12 \geq 0$ |
| | 14. $-2y > 3x - 3$ |
| | 15. $-y \geq 0$ |

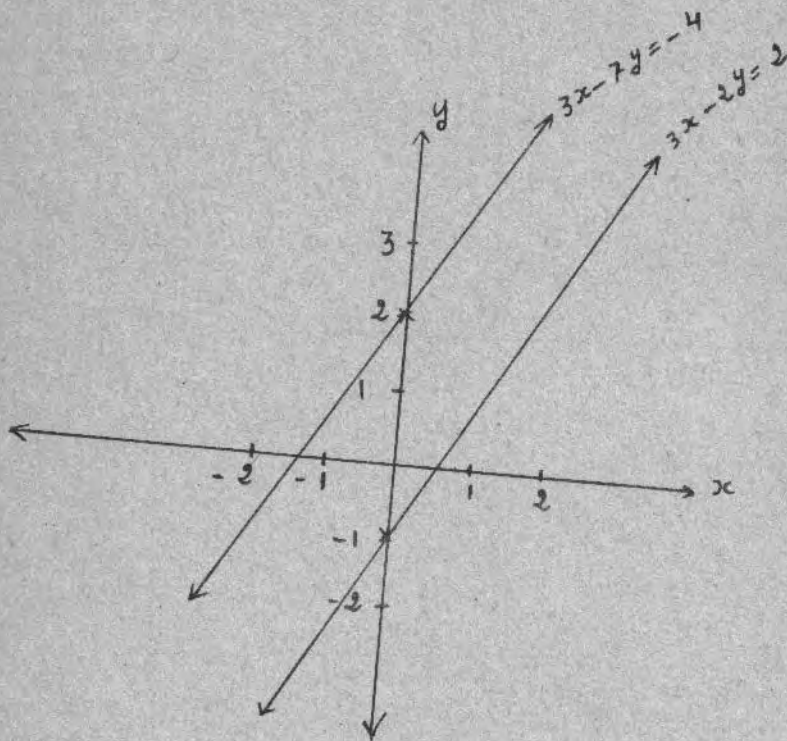
4) Sawir garaafka habdhisyadan dheelli toosan:

- | | |
|---------------|----------------------|
| 1. $y \leq x$ | 4. $y \geq 2x - 3$ |
| $y \geq x$ | $y < 2 - x$ |
| 2. $y \leq x$ | 5. $3x - 2y \leq 6$ |
| $y \geq 0$ | $2x + 3y \geq 6$ |
| 3. $y > 2x$ | 6. $2x + 3y \leq 12$ |
| $y < 2x + 1$ | $3x - 2y \leq 6$ |

FURFURISTA ISLE'EGYADA WADAJIRA

Dhowr dariiqo baa loo furfuraa laba isle'eg oo toosan oo leh laba doorsoome. Hase ahaatee, waxaad taqaan sida loogu furfuro dariiqada isu bixinta iyo dariiqada isku beddelka. Hadda halkan waxa aynu ku sheegaynaa sida loogu furfuro garaafka.

Markaan ku sawirayno garaafka laba isleeg oo toosan oo leh laba doorsoome isla sallax qudha, garaafkoodu wuxuu noqon karaa kuwa hoos ku sawiran:

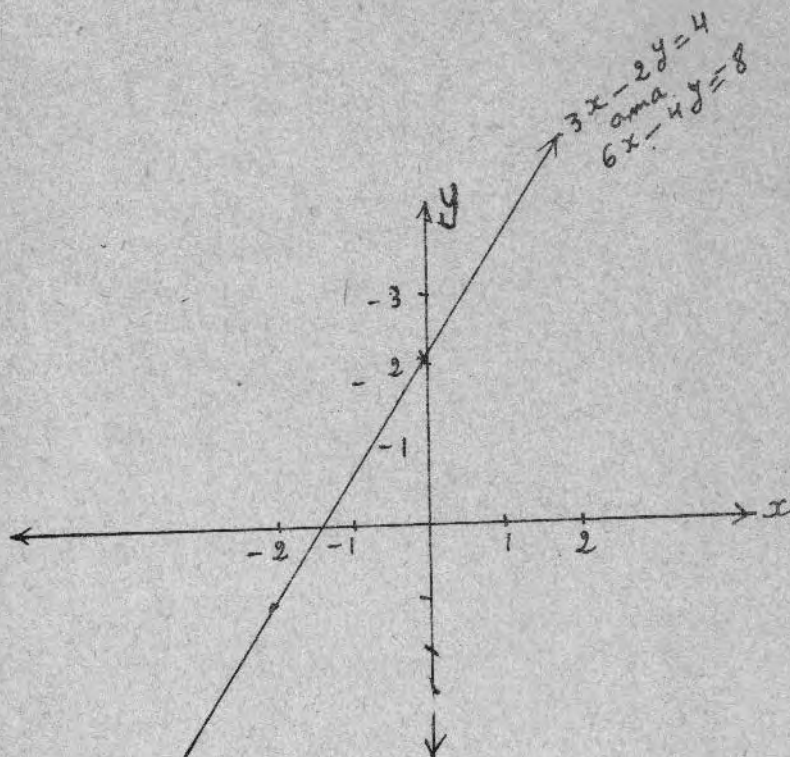


Garaaf I

$$\begin{aligned} \text{A. } 3x - 2y &= -4 \quad (1) \\ 3x - 2y &= 2 \quad (2) \end{aligned}$$

$$y = \frac{3}{2}x + 2 \quad (1)$$

$$y = \frac{3}{2}x - 1 \quad (2)$$



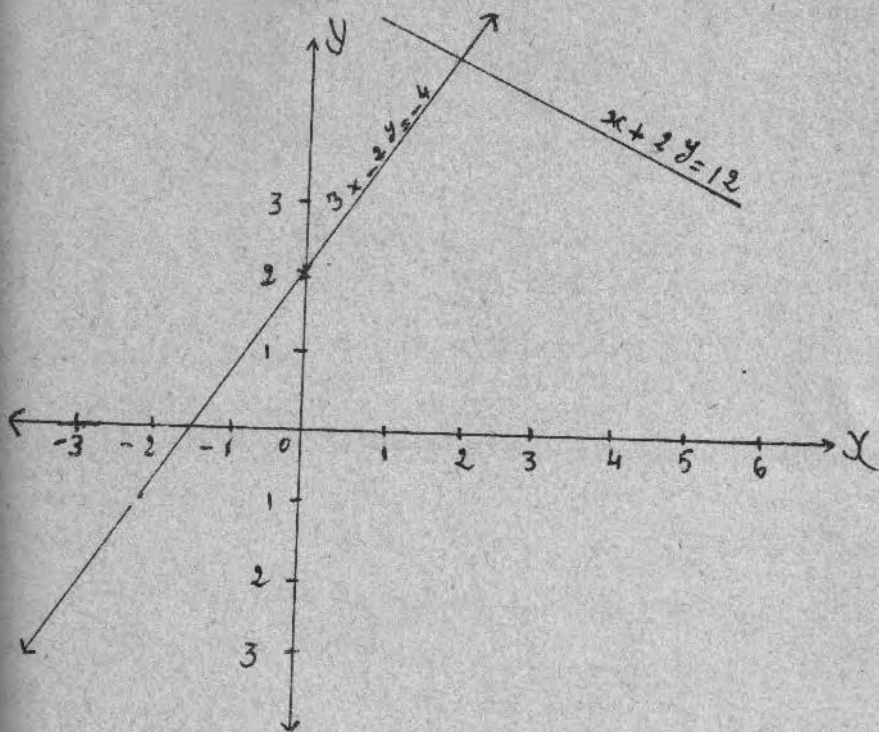
Garaaf II

B. $3x - 2y = -4 \quad (1)$

$6x - 4y = -8 \quad (2)$

$$y = \frac{3}{2}x + 2 \quad (1)$$

$$y = \frac{3}{2}x - 2 \quad (2)$$



Garaaf III

C. $3x - 2y = -4$ (1)
 $x + 2y = 12$ (2)

$$y = \frac{3}{2}x + 2 \quad (1)$$

$$y = -\frac{1}{2}x + 6 \quad (2)$$

Haddii S iyo T ay yihiin ururro furfurisyada laba isle'eg oo toosan, ururraddaasi waxay wadaagaan:

A. Labadii isle'eg ee toosan ee sameeya laba xarriiqood oo barbarro ah, baro ay wadaagaan ma jiraan. Urur dhexyaalkooduna wuu maran yahay, $S \cap T = \phi$. Isle'egyadaa waxa la yiraa isle'eygo Sarmaseegto. (Eeg garaafka I).

B. Labada isle'eg ee toosan ee sameeya laba xarriiq oo is-duldhaca way wadaagaan dhammaan baraha. Urur dhexyaalkooduna kolba midkii la doono ayuu noqon karaa, t.a $S \cap T = S = T$.

Isle'egyadu markaa way isku dhigmaan waxaana la yiraa isle'eygo Siyaab. (Eeg garaafka II).

C. Labadii isle'eg ee toosan ee sameeya laba xarriiq oo is-jara waxay leeyihiin bar keliya oo dhexyaal u ah. Urur dhexyaalkooduna waa lammaane horsan oo keliya, isle'egyadaa waxa la yiraa isle'eygo Seegmaweydo. (Eeg garaafka III).

Tusaale 1:

Urur furfurista habdhiska isle'egyadan wada jira, ku soosaar garaaf:

$$3x - 2y + 5 = 0 \quad (1)$$

$$3y - x - 11 = 0 \quad (2)$$

Furfuris :

$$3x - 2y + 5 = 0 \quad (1)$$

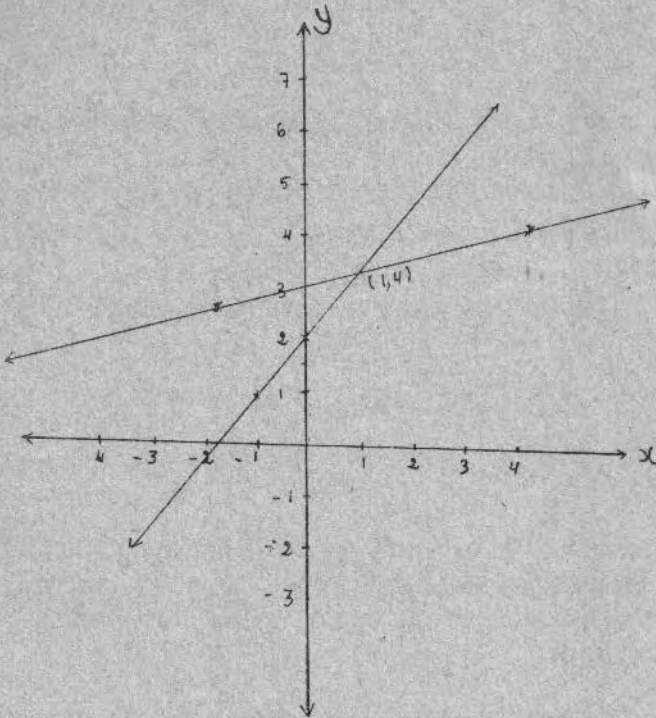
$$y = \frac{3x + 5}{2}$$

$$\begin{array}{r|l|l} x & -1 & 3 \\ \hline y & 1 & 7 \end{array}$$

$$3y - x - 11 = 0 \quad (2)$$

$$y = \frac{11 + x}{3}$$

$$\begin{array}{r|l|l} x & -2 & 4 \\ \hline y & 3 & 5 \end{array}$$



Baraha dhexyaalka u ah labada xarriiqood waa $(1, 4)$.
 Furfurista ay wadaagaan labada isle'eg waa $x = 1, y = 4$.
 Markaa, urur furfuristu waa $\{(1, 4)\}$.

Layli :

1) Ku furfur garaaf habdhiska isle'egyadan wada jira ee soo socda:

- | | |
|------------------|-------------------|
| 1. $x + y = 5$ | 2. $x + 2y = -4$ |
| $x - y = 7$ | $3x + y = 3$ |
| 3. $6x - y = 1$ | 4. $2x + 3y = 0$ |
| $y = x + 4$ | $x - y = -5$ |
| 5. $y = 4$ | 6. $x = 0$ |
| $3x + 2y = -1$ | 7. $5x - 2y = -4$ |
| 7. $2x + y = 10$ | 8. $y = 2x$ |
| $y - x = 1$ | $x - y = 2$ |
| 9. $x = 3$ | |
| $y = 5$ | |

2) Sawir garaafka habdhiska isle'egyadan wada jira ee soo socda. Adoo adeegsanaaya garaafka, sheeg kuwa Sarmaseegto ah, kuwa Siyaab ah iyo kuwa Seegmaweydo ah.

- | | |
|-----------------|------------------|
| 1. $2x + y = 1$ | 2. $x - y = 5$ |
| $4x + 2y = 2y$ | $3y = 2x - 15$ |
| 3. $2x = 5 - y$ | 4. $4x - 3y = 6$ |
| $3x - 4 = 2y$ | $x + 5y = 15$ |
| 5. $y = 3x + 3$ | 6. $y = 8$ |
| $6x - 2y = 4$ | $y = -3$ |

3) Raadi tiirada isle'eg kasta oo ku jirta layliga 2aad. Maxaad ka sheegi kartaa tiirooyinka labada xarriiq ee isle'egyadoodu sarmaseegto yihiin iyo kuwa ay siyaab yihiin?

4) Maxaad ka oran kartaa tiirada kutirsanayaasha dhexyaalka ururro furfurisyada laba isle'eg haddii ay:
 (a) Seegmaweydu; (b) Sarmaseegto; ama (c) Siyaab yihiin.

CUTUB 7

ISLEEGYO KU LUG LEH QIIME SUGAN

Qeex :

Qiimaha sugan ee b waa fogaanta « b » halbeeg u jirto unugga 0 , iyada con togaan iyo tabnaan loo kala eegin.

Mar haddii b iyo $-b$ ay fogaan isku mid ah u wada jiraan unugga 0 , markaa b iyo $-b$ qiimahooda sugani waa isku mid. Xisaab ahaan qeexda qiima sugani waa sidan:

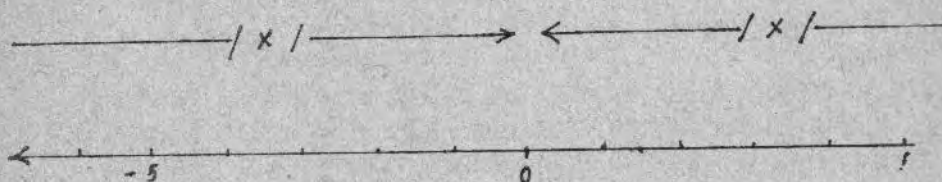
Haddii b tahay tiro maangal ah, markaa qiimaha sugan ee b loona qoro $|b|$ waa:

$$|b| = \begin{cases} b, & \text{haddii } b \geq 0 \\ -b, & \text{haddii } b < 0 \end{cases}$$

Garaafka b iyo $-b$ ee xarriiqda tiradu waa baro fogaan isle'eg u wada jira barta 0 , laakiin midba dhinac ku taal. Marka aan ka hadlayno fogaanta, garaafka tiro u jirto unugga, ayay habboon tahay in la isticmaalo qiimaha sugan ee tirada.

Tusaale :

Sida qeexidu oggoshahay $|-5| = 5$, waliba tirada 5 waxay astaynaysaa fogaanta garaafka -5 ay u jirto unugga, fiiri sawirka hoose:



Layli (Akhris) :

1) Kala sheeg hawraarahan kuwa runta ah iyo kuw kale.

1. $|-3| = 0$
2. $|-5| \neq 5$
3. $|7| + |-7| = 0$
4. $|-6| = 6$
5. $|8| = 8$
6. $|-8| \neq 8$
7. $|4| + |-4| + |-2| \neq 10$
8. $|4| - |4| = 4$
9. $|-4| - |4| = 4$
10. $|4| - |4| = 0$

2) Sheeg urur furfurista isle'eg kasta oo soo socota haddii urur tixraacu yahay dhammaan ururka tirooyinka maangalka ah.

1. $|B| = 6$
2. $|G| = 0$
3. $1 = |-T|$
4. $|-N| = 5$
5. $|x| + 1 = 3$
6. $|y| + |-2| = 2$
7. $5|-y| = 5$

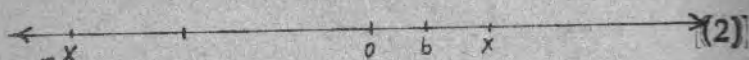
Waxaan ognahay, baraha leh kulannada 9 iyo 12 ee ku yaal xarriiqda tiradu in ay isu jiraan fogaan 'le'eg 3. Taasna waxaan hellaa markaan qaadanno faraqa $12 - 9$. Haddiise aan qaadanno $9 - 12$, waxan heleynaa -3 . Laakiinse isticmaalka qiimaha sugan ee $9 - 12$ ayaa ina siinaya fogaanta labada barood u dhexaysa.

Guud ahaan $|b - t|$ waa fogaanta u dhexaysa baraha ku-lannada b iyo t leh. Si ka sii habsan aan u qorro:

$$|x - b| = \begin{cases} (x - b) & \text{haddii } (x - b) \geq 0 \text{ ama haddii } \\ & x \geq b \text{ oo u dhiganta} \\ -(x - b) & \text{haddii } (x - b) < 0 \text{ ama haddii } \\ & x < b \text{ oo u dhiganta} \end{cases}$$

Garaaf ahaan, haddaan ku muujinno, waa:

$$|x - b| \xrightarrow{\hspace{10em}} \xleftarrow{\hspace{10em}} |x - b|$$



Tusaale :

Raadi urur furfurista $|x - 3| = 5$.

Furfuris :

Urur furfurista waan goobi karraa, mar haddii $(x - 3)$ tahay fogaanta x garaafkeedu u jiro 3. garaafkeeda oo we-liba fogaantaasu 5 tahay. Labada furfur ee isleegtu waa $3 + 5$ ama 8 iyo $3 - 5$ ama -2 . Sidaan aragno urur furfuristu waa $\{-2, 8\}$.

Furfuris II:

Ceex ahaan, $|x - 3| = 5$ waxay sheegaysaa in $(x - 3) = 5$ marka $x - 3 \geq 0$ ama in $-(x - 3) = 5$ marka $x - 3 < 0$. Haddaba aan furfurro isle'egta hore, $x - 3 = 5$ ama $x = 8$. Isle'egta labaadna; $-(x - 3) = 5$, $-x + 3 = 5$, $x = -2$

\therefore Urur furfuristu waa $\{-2, 8\}$.

Layli :

1) Raadi urur furfurista weedhahan soo socda:

$$\begin{array}{ll} \text{b) } |6 - x| = 1 & \text{t) } |6 - x| = 3 \\ \text{j) } |3 - x| = 1 & \text{x) } |2 - x| = 5 \end{array}$$

2) Urur furfurista weedh kasta ku muuji xarriiqda tirada:

$$\begin{array}{ll} \text{b) } |5-x| = 3 & \text{t) } |3-x| = 5 \\ \text{j) } |-3-x| = 2 & \text{x) } |x-(-2)| = 2 \\ \text{kh) } |x-4| = 5 & \text{d) } |-2-x| = 4 \end{array}$$

3) Isle'egyadan soo socda mid kasta u qor sansaan xi-didshe dabadeedna furfur:

Raad raac:

$$\text{Qeexda xisaabeed ee } |x| = \begin{cases} \sqrt{x^2} & \text{Haddii } x \geq 0 \\ -\sqrt{x^2} & \text{Haddii } x < 0 \end{cases}$$

aan sii balbalaarinnee tixgeli tusaalaha soo socda:

$$\text{Furfur } |x+5| = 8.$$

Furfuris :

$$\begin{aligned} \sqrt{(x+5)^2} &= 8 \\ (x+5)^2 &= 64 \\ x^2 + 10x + 25 &= 64 \\ x^2 + 10x - 39 &= 0 \end{aligned}$$

$$\therefore (x+13)(x-3) = 0$$

\therefore Urur furfurisu waa $\{-13, 3\}$.

$$\begin{array}{ll} \text{b) } |2x+5| = 2 & \text{t) } |3x+7| = 1 \\ \quad \quad \quad \frac{1}{2} \quad \quad \quad \frac{3}{4} & \quad \quad \quad \frac{3x}{2} \quad \quad \quad \frac{1}{2} \\ \text{j) } |1-\frac{1}{2}x| = \frac{3}{4} & \text{x) } |1+\frac{3x}{2}| = \frac{1}{2} \\ \quad \quad \quad \frac{3}{4} & \quad \quad \quad \frac{2x}{3} \\ \text{kh) } |\frac{3}{4}x+2| = 6 & \text{dh) } |\frac{2x}{3}-1| = 3 \end{array}$$

QIIMAHA SUGAN EE TARAN

Aan qaadanno dhowr tusaale oo ku saabsan xiriirka ka dhexeeya $|b \cdot t|$ iyo $|b| \cdot |t|$.

1. Haddii $b = 3$ $t = 2$
Markaa:

$$|b| = 3, |t| = 2 \quad |b \cdot t| = 6, |b| \cdot |t| = 6.$$

Waxaan aragnaa in $|b \cdot t| = |b| \cdot |t|$

2. Haddii $b = -3 \quad t = 2$

Markaa $|b \cdot t| = 6, |b| \cdot |t| = 6$

Markaana $|b \cdot t| = |b| \cdot |t|$

3. Haddii $b = 3 \quad t = 0$

Markaa $|b \cdot t| = |0| = 0, |b| \cdot |t| = 0$

Markaana $|b \cdot t| = |b| \cdot |t|$

Ugu dambayn:

4. Haddii $b = 3, t = -2$

Markaa $|b \cdot t| = |3 \cdot (-2)| = 6$

Markaana $|b| \cdot |t| = 2 \times 3$

Haddaba aan ku soo gooyanno in $|b| \cdot |t| = |b \cdot t|$
rooyinka maangalka oo idil.

QIIMAHA SUGAN EE WADAR

Sida sare aan qaadanno dhowr tusaale oo ku saabsan riirka ka dhexeeya $|b + t|$ iyo $|b| + |t|$.

1. Haddii $b = 3, t = -1$

Markaa $|b+t| = 2$ halka $|b| + |t| = 4$

Waxaan aragnaa in $|b+t|$ ka yar tahay $|b| + |t|$.

2. Haddii $b = -3, t = -1$

Markaa $|b+t| = |-3 + -1| = |-4| = 4,$

Waxaan aragnaa in $|b+t| = |b| + |t|$.

halka $|b| + |t| = |-3| + |-1| = 3+1 =$

Sii wad marka $b = 3, t = -1$ iyo marka $b =$
 $t = 1$, iskuna day inaad go'aan guud gaarto.

Waxtar bay inoo yeelan haddii aan tusaalooyinka 1 iyo 2, ku muujinno xarriiqda tirada.

Tusaale 1:

B iyo T waxay barta 0 ka xigaan laba dhinac oo iska horjeeda, kulannadooduna waa b iyo t .

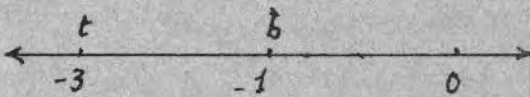


(3)

Fogaanta $b + t$ iyo 0 u dhexaysa waa in ay ka yar tahay fogaanta b iyo 0 u dhexaysa oo lagu daray fogaanta t iyo 0 u dhexaysa. Taasi waxay ina tusaysaa in $|b + t| < |b| + |t|$.

Tusaale 2:

B iyo T isla dhinac bay 0 ka wada jiraan barabixidyo ah -1 iyo -3 siday u kala horreeyaan.



(4)

Wadartooduna isla dhinacii bay u jirtaa 0 fogaan ah 4.

Markaa $|b + t| = |b| + |t|$.

Haddaan tixgelinno xaaladda guud waxaan arki karnaa laba arrimood miduun.

1. Haddii b iyo t ay dhinac ka wada xigaan unugga ama midkood eber yahay, markaa $|b + t| = |b| + |t|$.
2. Haddii b iyo t ay laba dhinac oo kala geddisan kaga kala yaalliin unugga, markaa $|b + t| < |b| + |t|$. Summadda $<$ waxa loo akhriyaa «ka yar»). Haddaba labada arrimood aan weedh kali ah isugu keenno:

Tirooyin kasta oo b iyo t ah, $|b + t| \leq |b| + |t|$.

Layli :

1. Bayaami in $|b \cdot t| = |b| \cdot |t|$ marka:

i. $b = \frac{-1}{2}$, $t = -\frac{1}{4}$

ii. $b = \sqrt{3}$ $t = -\sqrt{2}$

iii. $b = 1 + \sqrt{3}$ $t = 1 - \sqrt{-3}$

2) Waa maxay sida fudud ee $|2|^2$ loo dhigi karaa?
 $|-2|^2$ loo dhigi karaa?

Tus in $|b|^2 = b^2$, ha tabnaato, hase toгнаato amase 0 ha ahaatee. Kaddibna tus in $|b| = (\sqrt{b})^2$

(ogow marka aan qorro \sqrt{a} in ujeeddadu tahay in la qaadanayo xidid doorka labajibbaarka).

3) Bayaami in $|b| = (\sqrt{b})^2$ marka $b = -5$,
 $b = \frac{1}{4}$, $b = \frac{-1}{9}$.

4) Waa maxay furfurista:

i. $\sqrt{x^2} = |x|$

ii. $\sqrt[4]{x^2} = x$

iii. $\sqrt{x^2} = -x$.

5) Gargaarso $|x| = \sqrt{x^2}$ si aad u caddayso in
 $|b \cdot t| = |b| \cdot |t|$, raadraac:

$$\sqrt{(b \cdot t)^2} = \sqrt{b^2} \cdot \sqrt{t^2}$$

U fiirso weedhahan furan:

$$\begin{aligned}x + 3 &\leq 10 & (1) \\ -2y - 3 &< 5 & (2)\end{aligned}$$

Weedhahaa waxa la yiraa: **dheelliyo.**

Qiime habboon marka doorsoomaha dheelli la siiyo, tibaaxda bidixda ee dheelligu waa tiro maangal ah oo ka yar ($<$), ka yar ama le'eg (\leq), ka weyn ($>$), ka weyn ama le'eg (\geq), tibaaxda kale oo ah tiro maangal ah.

Dheelliyada ku runta ah urur tixraaca kutirsanayaashiisa oo idil waxa la yiraa dheelli shardi la'. Dheelliyada aan kutirsane kasta ku run ahayna waxa la yiraa dheelliyo shardiile ah.

Bil metel, dheelliyada sare ee (1) iyo (2) waa kuwo shardiilayaal ah.

Astaamaha soo socda ayaa dheelliyada sal u ah.

1. Tibaax kali ah waa loo geyn ama laga gooyn karaa dheelli labadiisa dhinacba.
2. Tiro togan waa lagu dhufan karaa dheelli labadiisa dhinacba.
3. Haddii tiro taban lagu dhufto dheelli labadiisa dhinacba markaa dheelligu waa is geddiyaa.

Tusaale :

Soo saar urur furfurista: $\frac{x - 3}{4} < \frac{2}{3}$, marka x tahay tiro maangal ah.

Furfuris :

Dhinac kasta ku dhufo 12:

$$3(x - 3) < 8 \text{ ama } 3x - 9 < 8.$$

Dhinac kasta ku dar 9:

$$3x < 17.$$

Ugu dambayn, dhinac kasta u qaybi 3:

$$x < \frac{17}{3}$$

Urur furfuristu waa: $S = \left\{ x \mid x < \frac{17}{3} \right\}$ S garaafkee-

ku waa ka hoos ku muujisan:



Xarriiqda culusi waxay muujinaysaa baraha kutirsan urur furfurista. Waxa jirta marmar aad arki doonto dheelli caynkan $-6 < 3x < 15$ ah. Dheelligaa macnahiisu waa $-6 < 3x$ isla markaa $3x \leq 15$. Kuwaas oo kale waxa la yiraa dheelliyo labaaley ah, urur furfuristooduna sidii kuwii aan soo falanqaynay ayaa lagu helaa.

Tusaale :

$$-6 < 3x \leq 15$$

Furfuris :

Dhinac kasta u qaybi 3, waxaad heleysaa $-2 < x \leq 5$, urur furfuristu waa $S = \{x \mid -2 < x \leq 5\}$. Garaafkeeduna waa kan hoos ku sawiran:



$$-2 < x \leq 5$$

U fiirso goobada yar barta -2 ku samaysan, waxa looga jeedaa in bartaasi aanay ku jirin urur furfurista.

Sidaan hore u soo aragnay urur furfurista $x > -5$ iyo $x < 1$ waxa loo soo gaabin karaa $S = \{x \mid -5 < x < 1\}$.

Si kale oo loo qori karaa waa:

$$S = \{x \mid x > -5\} \cap \{x \mid x < 1\}$$

Aan-u nimaadno dheelliyada leh tibaaxo jajabyo ah, fiiro dheerna siinno marka hooseeyuhu doorsoomo yahay.

Astaanta 3 ee dheelliyadu waxay sheegtay, haddii tiro taban lagu dhufto dheelli labadiisa dhinacba markaa dheelligu waa is geddiyaa. Sidaa awgeed marka x lagu dhufto dheelli labadiisa dhinacba, waa in aynan isku qaldin xaaladaha marka x togan tahay iyo marka ay taban tahay.

Tusaale :

$$\text{Raadi urur furfurista } \frac{6}{x} > 3.$$

Furfuris :

$$\text{i) Haddii } x > 0 \text{ markaa } x \times \frac{6}{x} > 3 \times x, 6 > 3x,$$

$x < 2$. Laakiin $x > 0$ baa afeef ahayd. Marka urur furfuristu waa $S_1 = \{x \mid 0 < x < 2\}$.

$$\text{ii) Haddii } x < 0 \text{ markaa } x \times \frac{6}{x} < 3 \times x, 6 < 3x,$$

$x > 2$. Laakiin $x < 0$ baa afeef ahayd.

$$\therefore \text{ Urur furfuristu waa } S_2 = \{x \mid x < 0 \text{ iyo } x > 2\} = \phi$$

$$\therefore \text{ Urur furfuristu } \frac{6}{x} > 3, \text{ wuxu ku dhan yahay}$$

$$S_1 \cup S_2 = \{x \mid 0 < x < 2\} \cup \phi = \{x \mid 0 < x < 2\}$$

Ogow, xaaladda marka $x = 0$ ma aynan tixgelin, sababtoo ah qiimaha $\frac{6}{0}$ ayaan qeexnayn. Si kale oon u furfuri karraa tusaalaha waa:

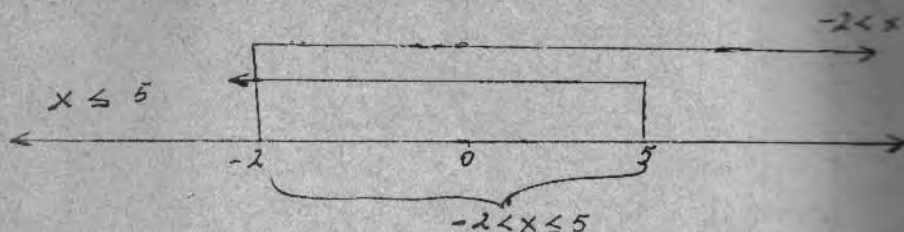
labada tibaaxood midba gooni u

furfur, dabadeedna soo saar dhexyaalkooda. Marka hore soo qaado $-6 > 3x$, dhinac kasta u qaybi 3.

\therefore Urur furfuristu waa $\{x \mid -2 < x\}$. Marka xiga soo qaado $3x \leq 15$, dhinac kasta u qaybi 3;

\therefore Urur furfuristu waa $\{x \mid x \leq 5\}$.

Aan isu keenno labadaa urur furfurisyo. Waxaan be-
leynaa urur furfurista dheelligii layna siiyay. Sidaa awgeed
garaafka urur furfuristu waa ka dhexyaalka u ah labada urur
furfurisyo (eeg shaxanka hoose)



Dheelliyada saabley si kale ayaa looga shaqeeyaa.

Tusaale ahaan, bal tixgeli dheelliga $x^2 + 4x < 5$, mar-
ka x tahay tiro maangal ah.

Aan raadinno qiimayaasha x ee raalli geliya dheelliga:
Dheelliga aan u sansazminno sidan $x^2 + 4x - 5 < 0$, oo u
dhiganta, dabadeedna aan isirinno. Waxaan hellaa:

dhiganta, dabadeedna aan isirinno.

Waxaan hellaa $(x + 5)(x - 1) < 0$.

Haddaba dheelligu wuxu ku run yahay afartan xaalla-
dood oo keliya.

$$x + 5 < 0 \text{ isla markaas } x - 1 > 0$$

ama

$$x + 5 > 0 \text{ isla markaas } x - 1 < 0$$

$$b \times t < 0 \longrightarrow$$

$$b < 0 \text{ isla markaas } t > 0$$

ama

$$b > 0 \text{ isla markaas } t < 0$$

\therefore Urur furfuristu waa

$$x > -5 \text{ iyo } x < 1 \text{ ama } \{-5 < x < 1\}.$$

Tusaale :

$$\frac{x}{x-2} \geq 5.$$

Furfuris :

Waxaan ognahay tiro kasta oo maangal ah b , in $b^2 \geq 0$.
Taas awgeed, $(x-2)^2$ haddaan ku dhufanno dheelliga laba-
diisa dhinacba.

Waxaan heleynaa:

$$(x-2)^2 \times \frac{x}{x-2} \geq 5 \times (x-2)^2$$

$$x^2 - 2x \geq 5x^2 - 20x + 20$$

$$4x^2 - 18x \leq 20$$

$$2x^2 - 9x + 10 \leq 0$$

$$(2x-5)(x-2) \leq 0$$

$$2x-5 \leq 0 \text{ isla markaa } x-2 \geq 0$$

$$\therefore x \geq 2 \text{ isla markaa } x \leq \frac{5}{2} \longrightarrow \left\{ x \mid 2 \leq x \leq \frac{5}{2} \right\}$$

$$\text{ama } 2x-5 \geq 0 \text{ isla markaa } x-2 \leq 0 \longrightarrow \phi$$

$$\therefore \text{Urur furfuristu waa } S = \left\{ x \mid 2 \leq x \leq \frac{5}{2} \right\}$$

Layli :

Furfur dheelli kasta, sawir garaafka urur furfuris kasta:

1) $x + 7 > 8$

2) $x + 5 \leq 7$

3) $3x - 2 > 1 - 2x$

4) $2x + 3 \leq x + 1$

$$5) \frac{2x - 3}{2} \leq 5$$

$$6) \frac{3x - 4}{3} > 12$$

$$7) \{x \mid x - 2 < 3\} \cap \{x \mid x + 4 > 2\}$$

$$8) \left\{x \mid \frac{1 + 3x}{2} \leq 3\right\} \cap \left\{x \mid \frac{2x}{3} > 6\right\}$$

$$9) (x + 1)(x - 2) > 0$$

$$10) 2 - 3x - 4x - 4x^2 > 0$$

$$11) x(x - 2) \leq 0$$

$$12) x^2 < 5$$

$$13) x^2 > -5$$

$$14) \frac{x}{x - 2} > \frac{4}{x}$$

Dheelliyada ku lug leh qiime sugan aan isla falanqayno, tusaale ahaan, bal tixgeli dheelligan:

$$|x + 1| < 3 \quad (1)$$

Haddaynu qeexdii qiime sugan ugu qiil samaynno, dheelliga sare wuxuu u dhigmaa:

$$x + 1 < 3 \text{ marka } x + 1 \geq 0$$

$$\text{ama } \longrightarrow (x + 1) < 3 \text{ marka } x + 1 < 0$$

Sansaanta labadaa weedhood isku xidhaa waa sidan:

$$-3 < x + 1 < 3 \quad (2)$$

Haddaba dheelli kasta oo sansaanka ka (1) ah, waxa loo dhigi karaa sansaanka dheelliga (2) intaan la qaadin talaabooyinka lagu gaaro furfurista.

Aan u soo noqonno furfurista dheelliga (2) tibix ka-sta oo dheelliga (2) ku dar -1 ; waxaan heleynaa $-4 < x < 2$. Taas oo ina siisa $S = \{x \mid -4 < x < 2\}$. S waa urur furfuristii la rabey, garaafka S waa ka hoos ku tusan:

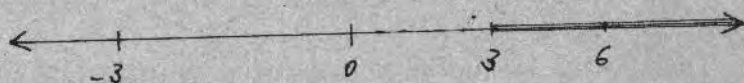
Ogow :

$$S = \{x \mid x > -4\} \cap \{x \mid x < 2\} = \{x \mid -4 < x < 2\}$$



Sida runta ah, garaafka, $\{x \mid -4 < x < 2\}$ waxay sifaynaysaa isgoyska garaafka labada urur ee $\{x \mid x > -4\}$ iyo $\{x \mid x < 2\}$.

Qiimaha sugan ee doorsoomaha ka weyn tiro b oo madoorsanta ah, waxa aan uga jeednaa «qiimayaasha x yeelan karto waxay midigta ka xigaan b, haddii $x > 0$ ». Bilmetel $|x| > 3$ fiiri garaafkeeda (Shaxanka hoose) marxa muujinaysa goobada dhexda madhan, «O».



Ogow :

Madoorsoomaha 3 laftiisu kuma jiro qiimayaasha x, waxa muujinaysa goobada dhexda madhan, «O».

Layli :

Furfur oo sawir garaafka urur furfurista.

Tuɣaale :

$$|2x - 11| \leq 7$$

Furfuris :

Dib u qor, kana tag summadda qiimaha sugan; waxaad heli:

$$(2x - 1) \leq 7 \text{ marka } 2x - 1 \geq 0 \quad (1)$$

$$-(2x - 1) \leq 7 \text{ marka } 2x - 1 < 0 \quad (2)$$

$$2x - 1 \leq 7 \longrightarrow 2x < 8 \longrightarrow x \leq 4$$

$$-(2x - 1) \leq 7 \longrightarrow 2x - 1 \geq -7 \longrightarrow 2x \geq -6 \longrightarrow x \geq -3$$

$$\therefore S = \{x \mid -3 \leq x \leq 4\}$$



$$\{x \mid -3 \leq x \leq 4\}$$

- 1) $|x| < 2$
- 2) $|x - 1| > 2$
- 3) $|x + 3| \leq 4$
- 4) $2|x + 1| \leq 8$
- 5) $|2x - 5| < -3$
- 6) $|2x + 4| < -1$

Dheelliyadan soo socda mid kasta u dhig sansaan xidid-she ka dibna furfur.

- 7) $|x - 4| > 4$
- 8) $|2x + 4| > 2$
- 9) $|2x + 1| \geq 5$
- 10) $|3x - 5| \geq 4$

CUTUB 8

SAHANKA

Araar:

Sahanku wuxu yahay sidii loo cabbiri lahaa dhulka iyo wixii kale ee ku dul yaalla ee ay ka mid yihiin buuraha, we-biyada, iwm. Taas ka sokow waxa lagu isticmaali karaa cabbiridda waxyaalaha ku dul dhisan dhulka oo ay ka mid yihiin aqallada, waddooyinka, iwm.

Haddaba, marka la cabbiro waxyaalahaas oo dhan waa in loo sawiro si ay khariidad u noqdaan.

Sahankuna wuxu ka mid yahay maaddooyinka aan si fudud loo baran karin haddii aan xisaabta wax laga aqoonin. Sidaas awgeed ayaa waxa buuggan loogu soo daray sahanka si faa'iidada xisaabta wax looga arko.

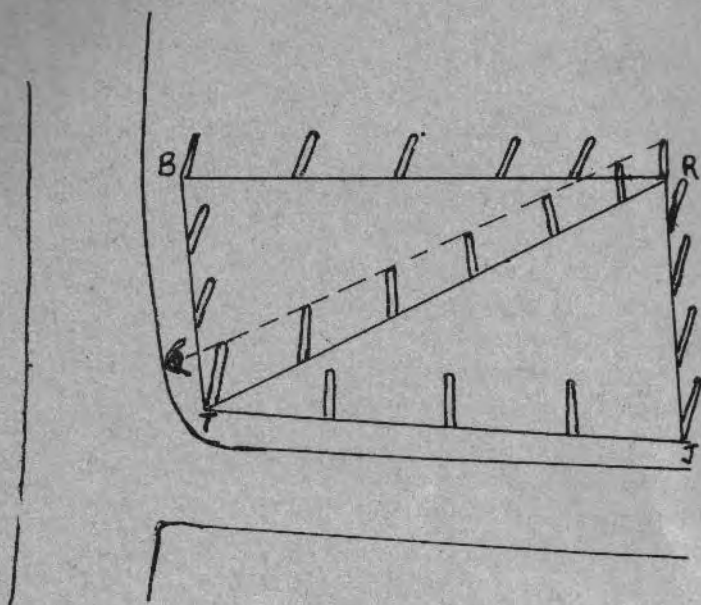
Haddaba, waxa jirta in sahanku uu u baahan yahay qalab gaar ah. Qalabkaasina waa mid aad u qaali ah. Hase ahaatee waxa suuragal ah in qalab la sameysan karo lagaga maarmo kaa qaaliga ah. Sida loo sameysanayaana waxa ay ku jirtaa duruusta soo socota.

Cutubkani waxan ku dhigan doonnaa labada dariiqo ee ugu fudud sahminta, kuwaas oo ah, (b) sahan ku dhisan saddexagal iyo (t) mid ku dhisan xarriiq isa suran iyo too-biye.

SAHANKA KU DHISAN SADDEXAGALKA

Dariiqadani waxay ku dhisan tahay in marka ugu horreysa loo qaybsho meesha la cabbiraayo saddexagal. Qalabka loo baahan yahayna waa qoryo iyo mulaax. Markaas si loo cab-

biro meesha hoos ku tilmaaman waa in la raaco tallaabooyinka hoos ku muujisan:



Marka ugu horreysa qoryo ha lagu joojiyo geesaha dhulka la doonayo in la cabbiro. Geesaha halkanina waa B, T, J iyo R. Dabadeedna qoryo isku toosan oo inta ay isku jiraan ka badnayn dhererka mulaaxda ha lagu taxo inta u dhexeysa T iyo R. Markaas xarriiqdaas TR waxay meesha u qaybinaysaa laba saddexagal oo ah BTR iyo TJR.

Marka la cabbiro dhererka xarriiqda TR waxa lagu xigiinayaa cabbirka BT, TJ, iyo RB oo ayana mid walba lagu taxay qoryo isku toosan si cabbir hagaagsan u soo baxo.

Haddaba markii la cabbiray waxay noqdeen sida hoos ku qoran:

- TJ = 75 mitir
- JR = 87 »
- RB = 93 »
- BT = 54 »
- TR = 109 »

Markaas, mar haddii la haysto cabbirrada kor ku qoran waxa suuragelaysa in lagu sawiro warqad ama la sameeyo khaarriidad. Dhibaataada halkan ka muuqata waxay tahay in aan la helayn warqad inoo qaadda cabbirradaa. Sidaas awgeed waxa lagama maarmaan ah in la sameeyo qiyaas-sawirkeeda. Tusaale ahaan 20kii mitir ee cabbirka dhulka ahiba warqadda waxay ku noqonayaan hal (1) sm.

Haddii aynu warqad ku sawirro xarriijin dhererkeedu yahay 100 mitir markaa, qiyaas sawirkeedu waa 5 sm. Markaas waa la deeqsiin karaa warqadda 5 sentimitir.

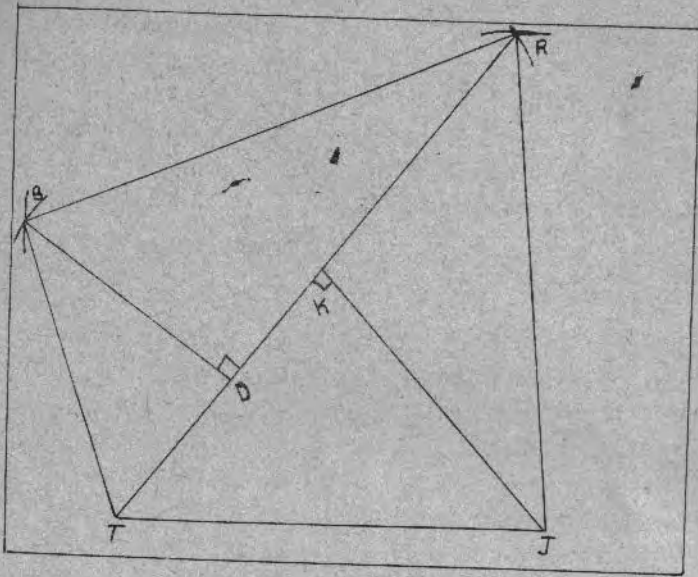
Haddaba, imminka waa in aynu sawirno meeshii, innaga oo u qaadanay halkii sentimitirba in uu u taagan yahay 10 mitir (1 sm. = 10 mitir).

Haddii aynu dib ugu noqonno jibaytadeenni sida hoos ku taalla ayay noqon.

Xarriiqda	Cabbirka-Dhulka	Qiyaas-sawirka
TJ	75 m.	7.5 sm.
JR	87 »	8.7 »
RB	93 »	9.3 »
BT	54 »	5.4 »
TR	109 »	10.9 »

Markaa, cabbirrada warqadda lagu sawirayaa waa 7.5 sm., 8.7 sm., 9.3 sm., 5.4 sm. iyo 10.9 sm. Meeshiina sida aynu

hore u soo sheegnay waxa ay kolba tahay laba saddexagal oo kala ah BTR iyo TJR. Markaas waxa la sawiri labada saddexagal, iyadoo la isticmaalayo mastarad iyo goobeeye.



Marka sidan loo sawiro dabadeed waxa loo baahan yahay in la soo saaro inta m^2 . ee dhulkani ku fadhiyo. Si taasi loo helo waa in la haystaa saddexagallo mid waliba leeyahay xagal 90° . Markaas taasi awgeed waa in xarriijin laga soo jeexo B oo lagu qotomiyo xarriiqda gudban ee RT; halkaas ay ku kulmaan waxa aynu ku magacaabi D. Xarriijin kalana waa in laga soo jeexo J oo lagaga qotomiyo RT barta K.

Marka ay intaasi inno dhammaato waxa aynu soo saari karnaa bedka saddexagal kastaa ku fadhiyo, marka la isku geeyana waxa inoo soo baxaya inta m^2 . ee dhulku ku fadhiyo.

$$\begin{aligned} \text{Cabbirka } BD &= 4.6 \text{ sm.} = 46 \text{ m.} \\ \text{» } JK &= 6 \text{ sm.} = 60 \text{ m.} \end{aligned}$$

$$\begin{aligned} \text{Bedka } \triangle BTR &= \frac{1}{2} \text{ sal} \times \text{jooq} \\ &= \frac{1}{2} \times \frac{109}{1} \times \frac{46}{1} \\ &= 2507 \text{ m}^2. \end{aligned}$$

$$\begin{aligned} \text{Bedka } \triangle TJR &= \frac{1}{2} \text{ sal} \times \text{jooq} \\ &= \frac{1}{2} \times \frac{109}{1} \times \frac{60}{1} \\ &= 3207 \text{ m}^2. \end{aligned}$$

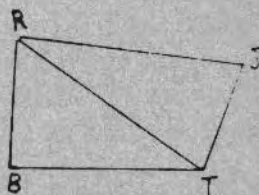
$$\begin{aligned} \text{Bedka } BTJR &= 2507 + 3207 \\ &= 5777 \text{ m}^2. \end{aligned}$$

Markaas meeshii la sahanshay waxay ku fadhidaa dhul ah 5777 m^2 .

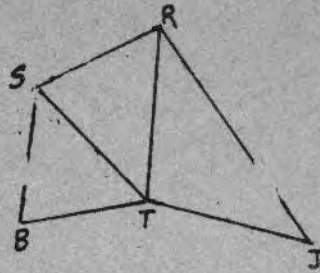
Layli:

Sawirrada hoos ku muujisani waxa weeye dhul la sahamiyay. Haddaba, marka hore qiyaas ku sawir, dabadeedna waxad soo saartaa inta ay dhul ku fadhiyaan (bed).

- $BJ = 250 \text{ m.}$
 $JR = 175 \text{ m.}$
 $RB = 151 \text{ m.}$
 $BT = 210 \text{ m.}$
 $TJ = 170 \text{ m.}$



2. $BT = 135 \text{ m.}$
- $TJ = 210 \text{ m.}$
- $JR = 270 \text{ m.}$
- $RS = 140 \text{ m.}$
- $ST = 135 \text{ m.}$
- $TR = 120 \text{ m.}$
- $BS = 162 \text{ m.}$

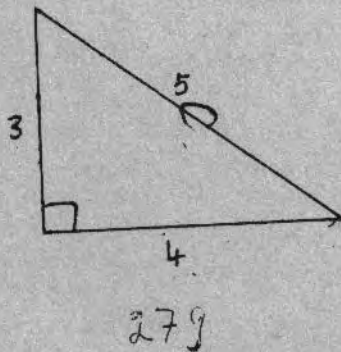


Sahamin ku dhisan Xarriiq-Isasuran iyo Toobiye.

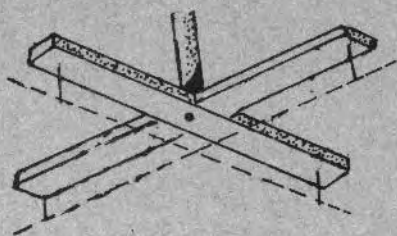
Dariiqdani waxay tahay saddexagalkii oo wax lagu sii kordhiyey. Alaabta ama qalabka la isticmaalayaana waa kuwii oo kale. Waxase ku kordhaya mid aynaan hore ugu baahan kaasoo ah mid wax calaamadin kara ama cabbiri kara xagal ah 90° .

Taasina in kasta oo ay alaab qaali ah tahay oo wax lagu cabbiro haddana waxa jirta siyaabo kale oo loo cabbiri karo xaglaha qumman oo ay ka mid yihiin kuwa hcos ku qorani.

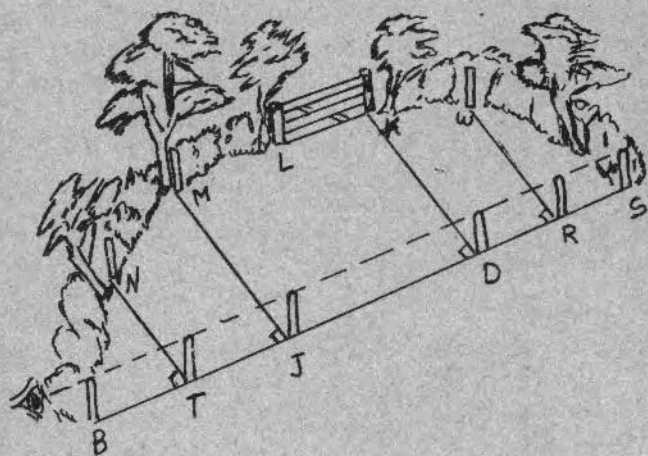
1. Dariiqada 3, 4 iyo 5 (taasi oo ah haddii dhinacyada Δ yihiin 3 m., 4 m. iyo 5 m., waa in uu yeeshaa xagal qumman).



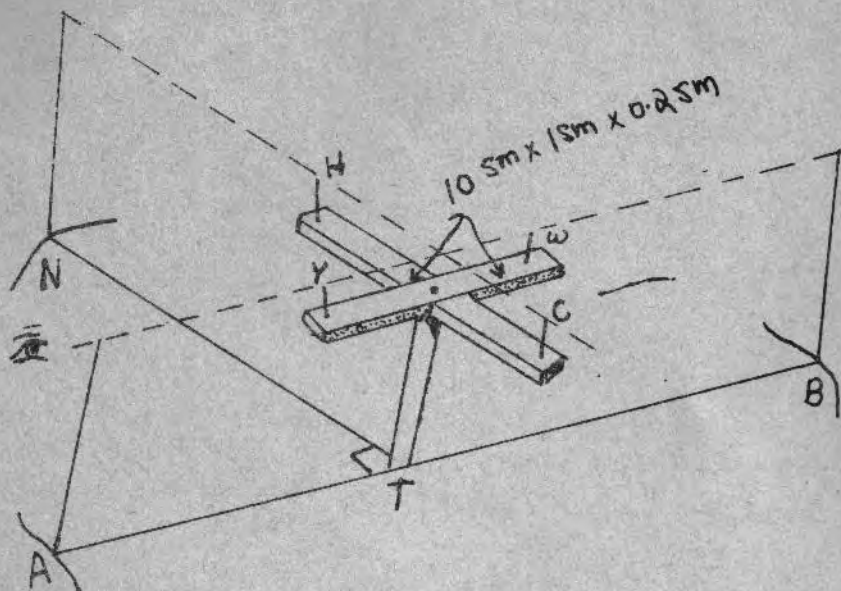
2. Ayada oo la isticmaalo qori yar oo ah ka halkan ku sawiran qorigaana waa mid la sameysan karo.



Haddaba aan tusaale ka qaadanno sida loo sahaminayo meesha hoos ku sawiran iyada oo la isticmaalayo dariiqadan. «Sahmin ku dhisan xarriiq isusaran iyo toobiye».

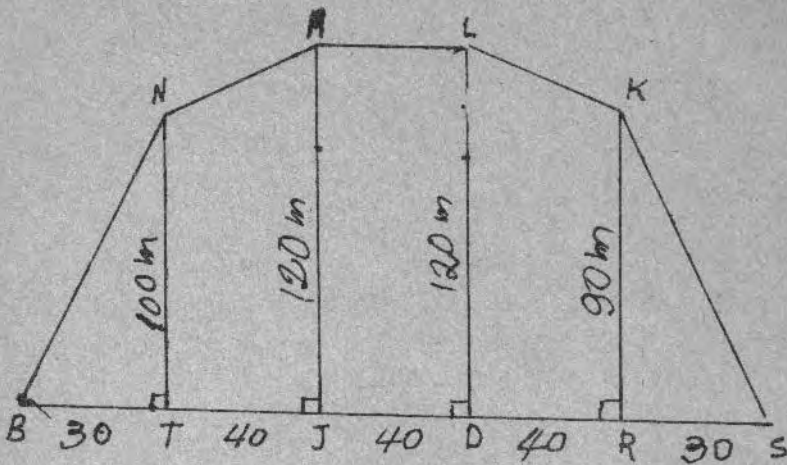


Marka ugu horreysa waxa lagu taxaya qoryo isku toosan inta u dhexaysa labada gees B iyo S. Marka taas la dhammeeyana waxa T, J, D iyo R laga jeexayaa xarriijimo ku qotoma xarriiqda AB. Xagashaas 90° ahna waxa loo sameynayaa sida shaxanka ka muuqata:



Marka ugu horreysa qof ayaa ka taagaya qori barta N. Dabadeedna qof kale ayaa ka taagaya qori barta T oo ku taal xarriiqda u dhexaysa A iyo B. Qorigaas waxa la dul saarayaa «sighting square» oo ah xagal cabbiraha. Markaas haddana waxa la eegayaa in ay isku toosan yihiin A, Y, W iyo B. Markaas haddana waxa la eegayaa in ay N, H iyo C isku toosan yihiin. Haddii ay isku toosan yihiin xagasha ATN waa 90° (digrii), haddii kale waa in la dhaqdhaqaaajo qoriga ku taagan kobta N, ilaa ay isku toosaan baraha N, H iyo C.

Haddaba aan u noqonaa soo saar inta m^2 . ee dhulkani ku fadhiyo.



$$\text{Bedka} = \frac{1}{2} \times \text{sal} \times \text{joog}$$

$$\text{Bedka } \triangle \text{BTN} = \frac{1}{2} \times \frac{30}{1} \times \frac{100}{1} = 1500 \text{ m}^2.$$

$$\text{Bedka Koorta} = \frac{1}{2} \text{ (isugenya labada dhinac ee barbarra- da ah) (joog u dhexeeya).}$$

$$\text{Bedka TNMJ} = \frac{1}{2} \times (120 + 100) \times 40.$$

$$= \frac{1}{2} \times \frac{220}{1} \times \frac{40}{1}$$

$$= 2820$$

$$= 4400 \text{ m}^2.$$

$$\begin{aligned} \text{Bedka JMLD} &= \frac{1}{2} (120 + 130) \times 40 = \frac{1}{2} \times 250 \times 40 \\ &= 5,000 \text{ m}^2. \end{aligned}$$

$$\begin{aligned} \text{Bedka DLKR} &= \frac{1}{2} \times (130 + 90) \times 40 \\ &= \frac{1}{2} \times \frac{220}{1} \times \frac{40}{1} = 4400 \text{ m}^2. \end{aligned}$$

$$\text{Bedka } \Delta \text{ RKS} = \frac{1}{2} \times \frac{30}{1} \times \frac{90}{1} = 1350 \text{ m}^2.$$

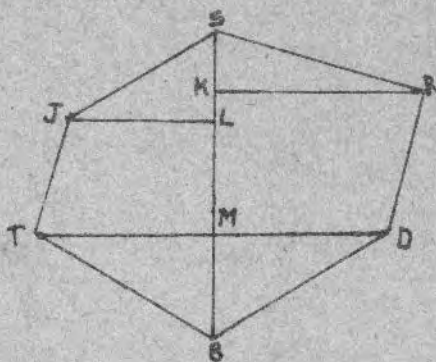
$$\begin{aligned} \text{Bedka Dhulku} &= 1500 + 4400 + 5000 + 4400 + 1350 \\ &= 16,650 \text{ m}^2. \end{aligned}$$

Layli :

Waxa aad soo saartaa inta m^2 . ee meelaha la soo saha-miyay ee hoos ku sawirani ku fadhiyaan waxaanad ku sawirtaa warqad adiga oo isticmaalaya qiyaas:

1. J 120 m.
- Ilaa S 105 m. R 135 m.
- Ilaa D 60 m. 75 ilaa T
- laga bilaabo
- kobta B

2. S 95 m.
 K 80 m. R 60 m.
 J 45 m. L 65 m.
 T 55 m. M 33 m. B 50 m.
 laga bi-
 laabo
 kobta B

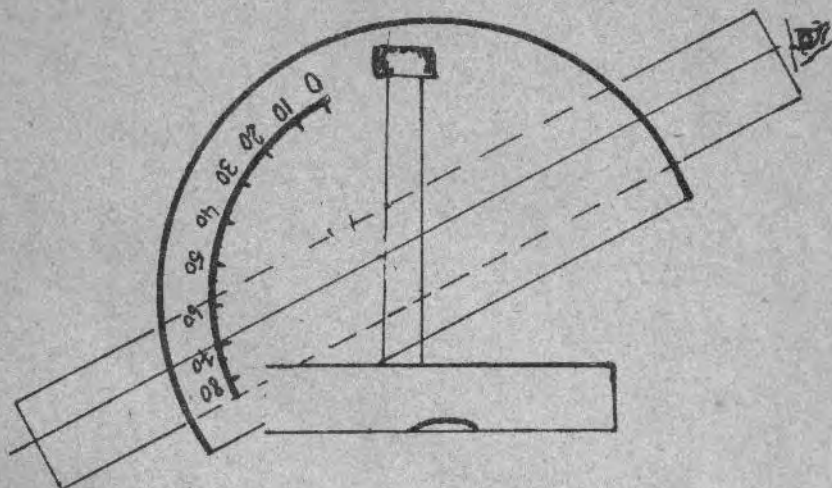


3. Adiga oo isticmaalaya qalabkii sahaminta waxa aad sahamisaa dhowr meelood oo haddii ay suuragal tahay dug-siga ku dhow. Marka aad sahamisidna ku sawir warqad.

Cabbiridda meelaha dhaadheer ama meelaha ballaadhan; qalabka wax lagu cabbiro.

Waxa jira sida aynu wada ognahay waxyaabo aad u dheer oo ay ka mid yihiin aqallada qaarkood iyo dhirta oo marka loo baahdo in la helo joogooda ay dhibaato badani ka iman karto haddii qalab lagu cabbiro aan la hayn oo kuu soo saara xaglaha qaarkood. Haddii xaglahaas la helana way suuroobi in dheererkii la soo saaro iyada oo xisaabtaynu hore u soo dhiganay lagu shaqaynayo. Haddaba qalabka xagasha

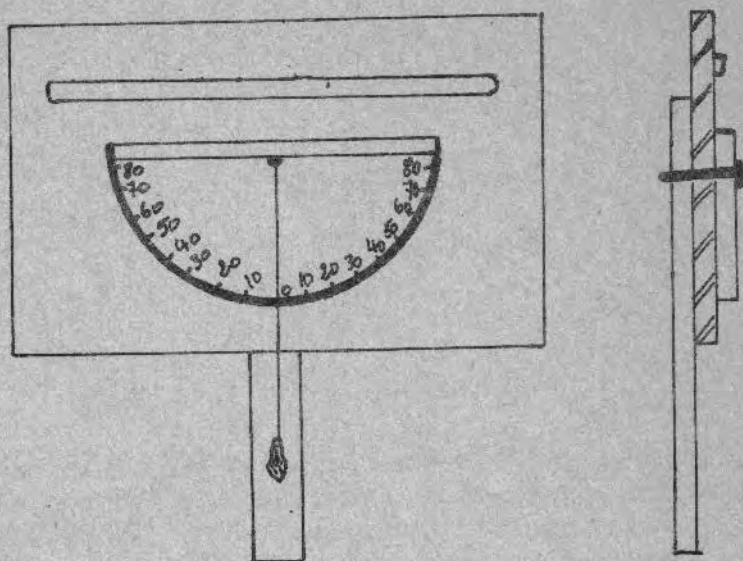
lagu soo saarayaa waa mid aad u qaali ah, waxaana ka mid ah qalabkaas «Tiyoodilayd», kiloonometer iyo «Ab level» oo loo isticmaalo kiloonometer ahaan, waana kan hoos ku sawiran.



Waxa aan wada ogsoon nahay in ay aad u adag tahay in la helo qalabkan lacagtiisu badan tahay. Sidaas awgeed waxa lagama maarmaan ah in la sameeyo alaab rakhiis ah oo lagaga maarmo kuwaas qaaliga ah. Haddaba halkan waxa aan ku sheegeynaa sidii loo sameyn lahaa kiiloonometer oo ah qalab lagu cabbiro xagasha. Sida loo sameynayaana waxay tahay in qori «Loox» ah 15 mm. × 75 mm. lagu dhejiyo xagalbeeg iyada oo la isticmaalayo xabag aad u adag. Marka la isku dhejiyo waxa laga daloolinayaa meel xagga sare ku dhow qoriga iyo xagal beeggaba. Markaas waxa kale oo lagu dhejinayaa xagal beegga korkiisa qori dhuun ah oo la barbaro ah guudka qorigii «looxii» hore.

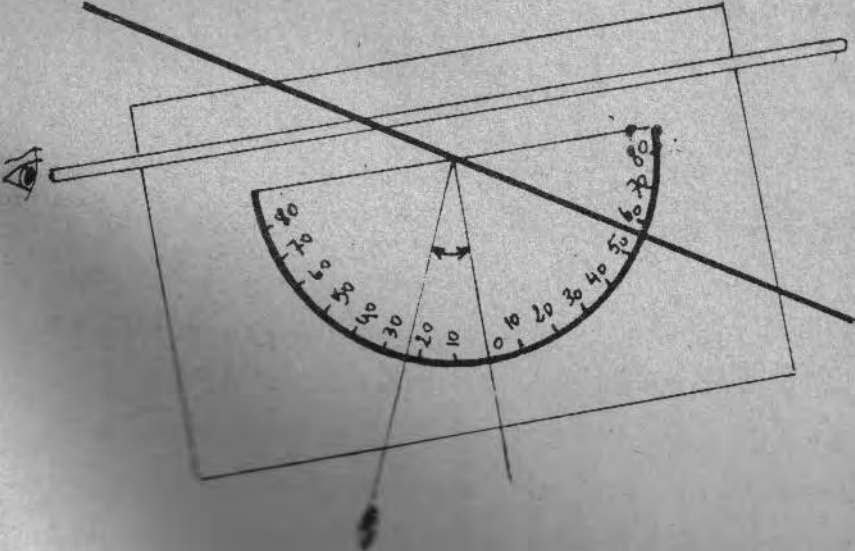
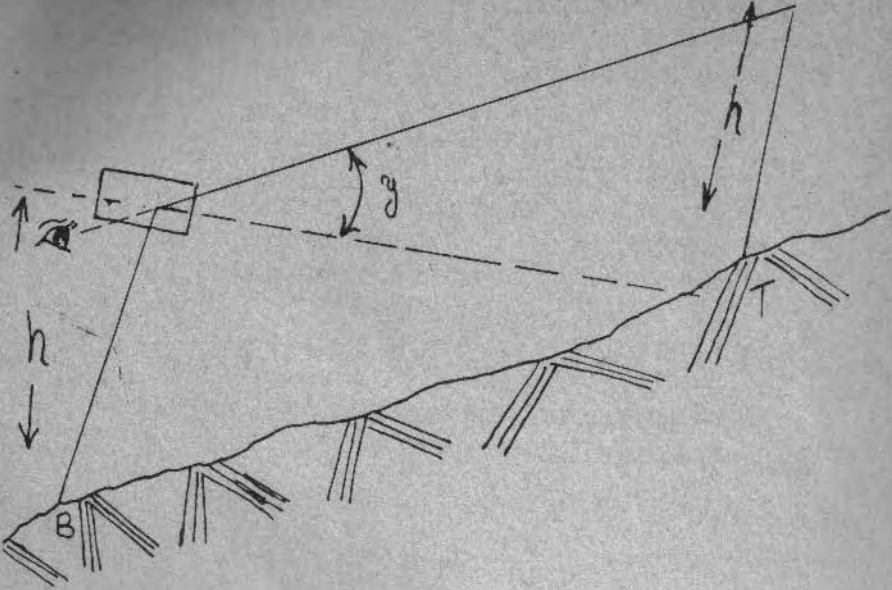
Intaasi marka ay dhammaato waxa daloolkii la gelinayaa musmaar. Xagga dambana waxa ka qabanaya musmaarka

qori dheer oo ah 1 mitir ilaa 1.50 mitir. Qorigaanina waa ka kiiloonomitirka haya marka wax lagu cabbirayo. Sida sawirka hoose sheegayana waxa musmaarka laga lulayaa xarig bir yar oo culusi kaga xiran tahay xagga hoose.



Haddaba marka la sameeyo kiiloonomitirka kor ku sawiran waxa lagu isticmaali soo saaridda xaglaha. Tusaale ahaan haddii la doono in la ogaado inta laba meelood oo dhulka ku yaalli kala sarreeyaan waxa loo heli karayaa sida hoos

ku muujisa.



Hadda sida kor ku muujisan waxa la cabbirayaa inta ay kala sarreeyaan B iyo T oo ah meelo dhul kala sarreeya ku yaal. Markaas, marka ugu horreysa waxa lagu joojinayaa rugta B qoriga kiloonomitirku ku dul sameysan yahay. Waxa kale oo qori lagu joojinayaa rugta T. Qorigaasina waa in uu noqdo mid dheerer le'eg ka B ka taagan.

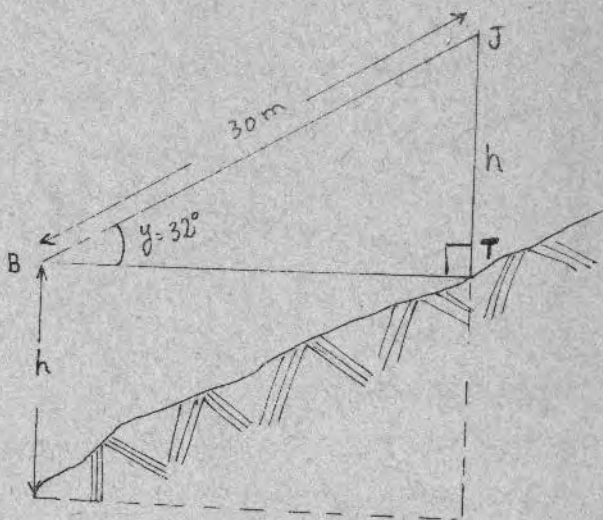
Dabadeedna halka daloosha ayaa isha la saaraya, kiloonomitirkana waa la wareejinayaa ilaa ay muuqato halka ugu sarreeysa qoriga ka taagan rugta T. Markaas xagasha kacsani waxay noqonaysaa «y». Markaas marka «y» sidaasi loo helo waxa kale oo la cabbirayaa inta u dhexaysa B iyo T.

Tusaale 1:

Markaas marka aynu qaadanno saddexagal BTJ:

$$BJ = 30 \text{ m.}$$

$$\angle TBJ = 32^\circ$$



Muxuu markaas noqonayaa BT oo ah dheererka runta ah ee BJ? Markaas innaga oo ka faa'iideysanayna trigonooma-trigii aynu hore u soo dhiganay waxannu u shaqayn sidan:

$$\frac{TJ}{JB} = \text{Saynka } \angle TJB$$

$$\frac{TJ}{30} = 0.5295$$

$$\therefore TJ = 30 \times 0.5299 = 15.8970 \text{ m.}$$

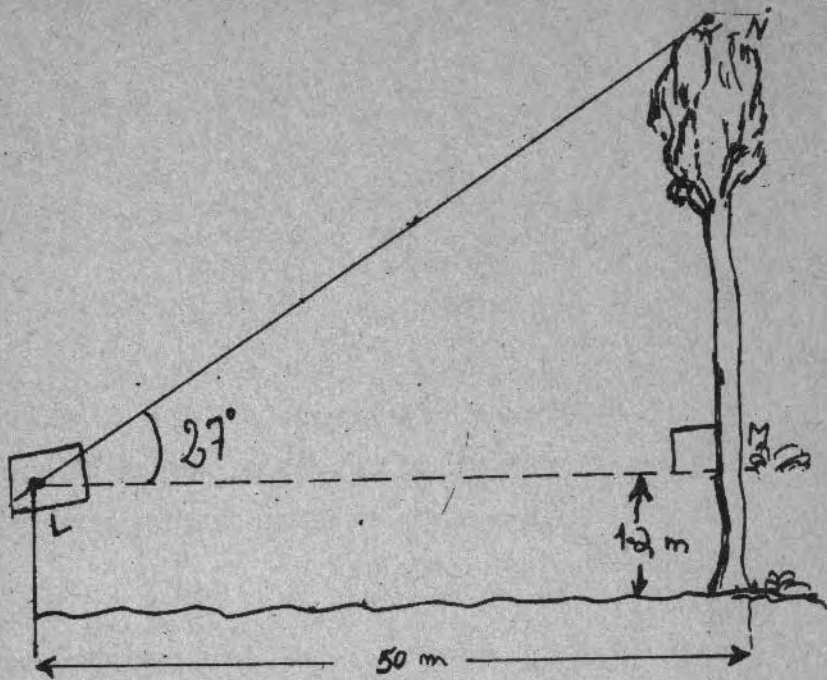
Markaas halkani waxa ka muuqata haddii la doonayo in la cabbiro dhul kala joog dheer dabadeedna warqad lagu muujiyo oo khariidad laga sameeyo ay lagama maarmaan tahay in fogaanta runta ah ee jiifta la soo saaro.

Hadda fogaanta jiifta ee B iyo T u dhexaysa waa 15.8970 m.

Tusaale 2:

Halkan waxa ku yaalla geed aad u dheer aadna ay u adag tahay, qodax awgeed, in la koro oo jooggiisa la cabbiro. Si-daas awgeed ayada oo la isticmaalayo kiloonomitir waxa suu-ragal ah in la helo jooggiisa runta ah. Kiloonomitirka ayaa la dul saaraya qori jooggiisu yahay 1.20 mitir. Markaas in-too kiloonomitirka daloolkiisa isha la saaro ayaa kiloonomitir-ka la wareejinayaa ilaa geedka halka u sarreysa la arko. Markaas waxa laga akhriyayaa xagal-beegga cabbirka xagasha

oo halkan ah 27° .



$$\text{Markaas } \frac{NM}{LM} = \tan 27^\circ$$

$$\frac{NM}{50} = \tan 27^\circ$$

$$NM = 50 \times 0.5095$$

$$= 25.475 \text{ M}$$

$$\begin{array}{r} \text{Geedka jooggiisu waa} = 25.475 \text{ mitir} \\ + 1.200 \text{ mitir} \\ \hline 26.675 \text{ mitir} \end{array}$$

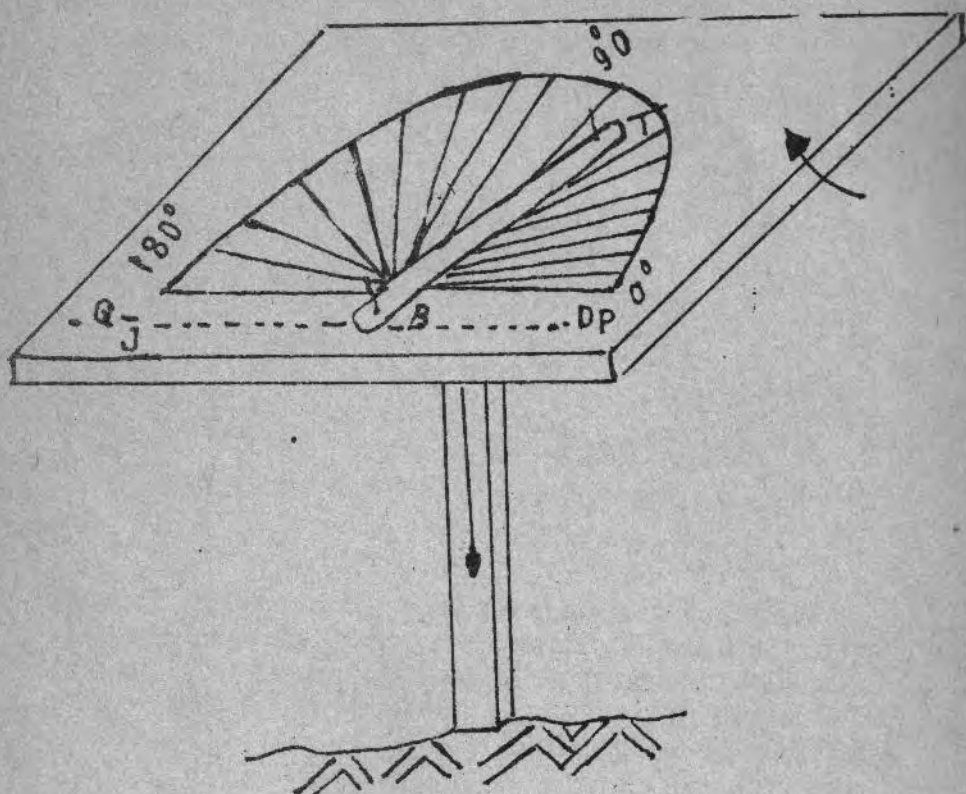
Layli :

- 1) Waxa aad soo saartaa adoo ku shaqeynaya kiloonomitir dheererka aqalka ugu dheer dugsiga aad wax ka dhigatid.

(XUSUUSI ardayda in ay sameystaan qalabkan ay ku soc shaqeysanayaan oo uu ka mid yahay kiloonomitirku).

CABBIRKA XAGASHA JIIFTA

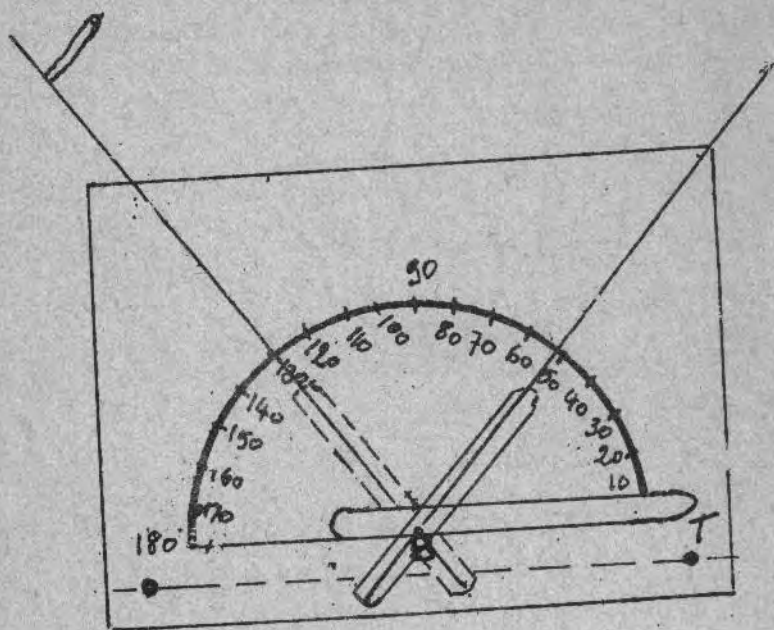
Waxa hadda inoo suuragalay in xagasha taagan aan ku cabbirro kiloonomitir. Hase yeeshee waxa loo baahan yahay in la cabbiri karo xagasha jiipta. Markaas tani waxa lagu cabbiri karayaa «tiyoodilayd» oo aad u lacag badan. Markaas ayada oo la ogsoon yahay in ay adag tahay in la helo taasi qaaliga ah waa in la sameysto mid raqiis ah oo shaqadana inoo qaban karta. Taasina waa midda hoos ku sawiran:



Haddaba sida loo sameynayaa xagal jiifta waxay tahay in la helo qori ah 250 mm. × 250 mm. ama mid ku dhow. Markaas qoriga waxa lagu dhejinayaa xagal-beeg ku sameysan warqad adag. Xagal-beegga guudkiisana waxa lagu dhejinayaa qori dhuuban «BT» sida sawirka ku muujisan.

Qorigan halka B waxa ka haya musmaar waxaana loog talagalay in uu halkaas ku wareego. Labada meelood ee J iyo D-na waxa laga taagayaa laba musmaar si ay uga ceshaan qoriga BT in uu jabo.

Haddaba bal aan eegno sidii loogu cabbiri lahaa xagal iyadoo la isticmaalayo xagal jiifta cabbiraha. Xagasha jiifta ee halkan lagu cabbiray waa tan hoos ku sawiran ee ah JBT.

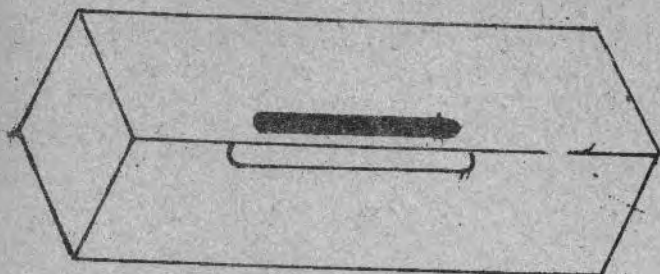


Sawirkani waa ayada oo xagal jiifta cabbirihii kor laga eegayo. Sida sawirka ka muuqata xagal jiifta cabbiraha waxa lagu qotominayaa rugta B; markaas inta aan weli wax lagu cabbirin waa in la hubsho in qoriga guudkiisu siman yahay uuna dhinacyada u qalloocin.

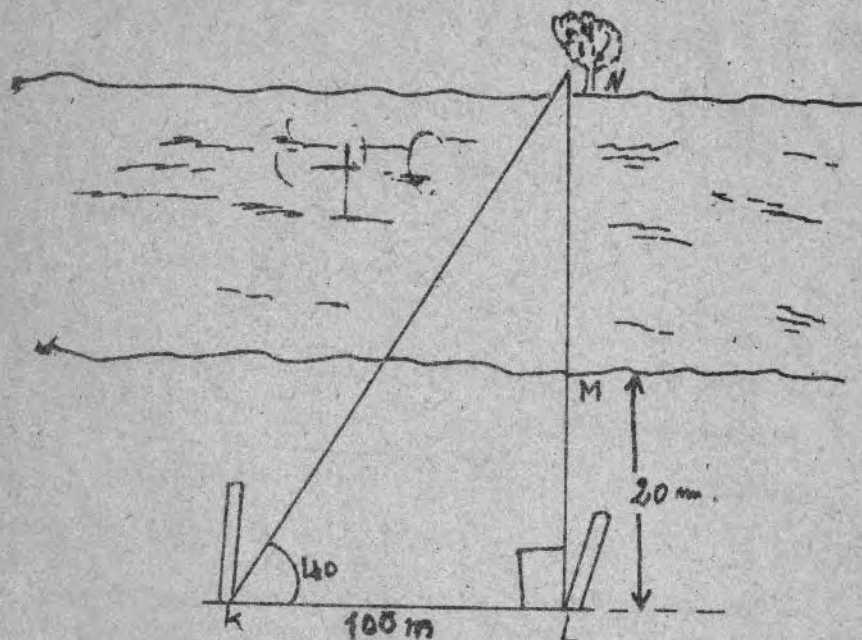
Taasina waxa lagu habsan karaa ayada oo la dhul saaro «isku sime», lana habsado in xarigga lusha ee birtu ku xiran tahay ku toosan yahay qoriga taagan bartamihisa.

Marka taasi la dhammeeyo waxa la eegayaa in labada musmaar ee yar-yari ku toosan yihiin rugta «T». Marka sidaas la isugu beego ayaa qorigan gacanta lagu wareejiyaa ilaa lagu beego «J».

Markaas waxa kuu soo baxaya xagasna «J B T».



Sidii loo cabbiri lahaa ballaca webiga iyada oo aan la tallaabin:



Marka ugu horreysa waxa qori laga taagaya rugta L oo ku toosan rugta N oo geed ku yaallo. Geedkaasi ama wixii kale ee halkaas lagu calaamadsanayaa waa inay saaraadaan qarka webiga.

Markaas marka xagashaas lagu cabbiro xagal jiipta cab-biraha oo lagu joojiyay rugta L, waxa qori kale laga teega-
yaa rugta K. Dabadeedna waxa la cabbirayaa xagasha NKL
iyo xarriiqda KL. Markaas marka labadaas cabbir la helo
waxa suuragal noqonaaya in la soo saaro xarriiqda NL. Mar-
kaas waxa halkan ka muuqata in ballaca webigu ka yar yahay
NL oo uu yahay NM.

Haddaba si taasi loo helo waa in marka la soo saaro NL
la cabbiro ML. Markaas, marka NL laga gooyo ML waxa
soo baxa ballacii webiga oo ah NM.

Tusaale :

$$KL = 50 \text{ mitir}$$

$$NKL = 50^\circ$$

$$NL = ?$$

$$\text{Taanjant } 40^\circ = \frac{NL}{100}$$

$$NL = \frac{1}{4} \times 100 \times 0.8391$$

$$= 83.91$$

Markaas webiga

$$\text{ballaciisu waa} = 83.91 - 20 = 63.91 \text{ mitir.}$$

Layli :

Adiga oo isticmaalaya xagal jiipta cabbiraha waxa aad
soo saartaa ballaca waddooyinka baabuurta ee dugsigaaga ku
dhow?

LOGARDAM

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12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
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15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
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21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
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27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
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34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
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37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
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47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
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53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
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LOGARDAM

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56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	I	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	I	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	I	I	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	I	I	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	I	I	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	I	I	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	I	I	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	I	I	2	3	3	4	5	5	6
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65	8129	8136	8142	8149	8156	8162	8169	8176	8181	8189	I	I	2	3	3	4	5	5	6
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67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	I	I	2	3	3	4	5	5	6
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73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	I	I	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	I	I	2	2	3	4	4	5	5
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77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	I	I	2	2	3	3	4	4	5
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92	9633	9643	9647	9652	9657	9661	9666	9671	9675	9680	O	I	I	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	O	I	I	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	O	I	I	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	O	I	I	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	O	I	I	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	O	I	I	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	O	I	I	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	O	I	I	2	2	3	3	4	4
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

LIDLOGARDAM

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01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
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08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	2
09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	3
10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	2	2	3
12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2	2	2	2	3
13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2	2	2	3	3
15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	3	3
16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2	2	2	3	3
17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2	2	2	3	3
19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	2	2	2	3	3	3
22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2	2	3	3	3
23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2	2	3	3	4
24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	4	5
40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	4	5	6
46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	4	5	6
47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	4	5	6
48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	4	5	6
49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	4	5	6
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

LIDLOGARDAM

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
59	3890	3899	3908	3917	3926	3935	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4255	1	2	3	4	5	6	7	8	9
63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

SAYN

x°	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	Δm	UGEE*				
	0°0	0°1	0°2	0°3	0°4	0°5	0°6	0°7	0°8	0°9		+	1	2	3	4
0°	0-0000	0017	0035	0052	0070	0087	0105	0122	0140	0157	18½	3	6	9	12	15
1	0-0175	0192	0209	0227	0244	0262	0279	0297	0314	0332	17½	3	6	9	11	14
2	0-0349	0366	0384	0401	0419	0436	0454	0471	0488	0506	17½	3	6	9	11	14
3	0-0523	0541	0558	0576	0593	0610	0628	0645	0663	0680	17½	3	6	9	11	14
4	0-0698	0715	0732	0750	0767	0785	0802	0819	0837	0854	17½	3	6	9	11	14
5	0-0872	0889	0906	0924	0941	0958	0976	0993	1011	1028	17½	3	6	9	11	14
6	0-1045	1063	1080	1097	1115	1132	1149	1167	1184	1201	17	3	6	9	11	14
7	0-1219	1236	1253	1271	1288	1305	1323	1340	1357	1374	17	3	6	9	11	14
8	0-1392	1409	1426	1444	1461	1478	1495	1513	1530	1547	17	3	6	9	11	14
9	0-1564	1582	1599	1616	1633	1650	1668	1685	1702	1719	17	3	6	9	11	14
10	0-1736	1754	1771	1788	1805	1822	1840	1857	1874	1891	17	3	6	9	11	14
11	0-1908	1925	1942	1959	1977	1994	2011	2028	2045	2062	17	3	6	9	11	14
12	0-2079	2096	2113	2130	2147	2164	2181	2198	2215	2233	17	3	6	9	11	14
13	0-2250	2267	2284	2300	2317	2334	2351	2368	2385	2402	17	3	6	8	11	14
14	0-2419	2436	2453	2470	2487	2504	2521	2538	2554	2571	17	3	6	8	11	14
15	0-2588	2605	2622	2639	2656	2672	2689	2706	2723	2740	17	3	6	8	11	14
16	0-2756	2773	2790	2807	2823	2840	2857	2874	2890	2907	17	3	6	8	11	14
17	0-2924	2940	2957	2974	2990	3007	3024	3040	3057	3074	17	3	6	8	11	14
18	0-3090	3107	3123	3140	3156	3173	3190	3206	3223	3239	17	3	6	8	11	14
19	0-3256	3272	3289	3305	3322	3338	3355	3371	3387	3404	16	3	5	8	11	13
20	0-3420	3437	3453	3469	3486	3502	3518	3535	3551	3567	16	3	5	8	11	13
21	0-3584	3600	3616	3633	3649	3665	3681	3697	3714	3730	16	3	5	8	11	13
22	0-3746	3762	3778	3795	3811	3827	3843	3859	3875	3891	16	3	5	8	11	13
23	0-3907	3923	3939	3955	3971	3987	4003	4019	4035	4051	16	3	5	8	11	13
24	0-4067	4083	4099	4115	4131	4147	4163	4179	4195	4210	16	3	5	8	11	13
25	0-4226	4242	4258	4274	4289	4305	4321	4337	4352	4368	16	3	5	8	11	13
26	0-4384	4399	4415	4431	4446	4462	4478	4493	4509	4524	16	3	5	8	11	13
27	0-4540	4555	4571	4586	4602	4617	4633	4648	4664	4679	16	3	5	8	11	13
28	0-4695	4710	4726	4741	4756	4772	4787	4802	4818	4833	15	3	5	8	10	13
29	0-4848	4863	4879	4894	4909	4924	4939	4955	4970	4985	15	3	5	8	10	13
30	0-5000	5015	5030	5045	5060	5075	5090	5105	5120	5135	15	3	5	8	10	13
31	0-5150	5165	5180	5195	5210	5225	5240	5255	5270	5284	15	2	5	7	10	12
32	0-5299	5314	5329	5344	5358	5373	5388	5402	5417	5432	15	2	5	7	10	12
33	0-5446	5461	5476	5490	5505	5519	5534	5548	5563	5577	15	2	5	7	10	12
34	0-5592	5606	5621	5635	5650	5664	5678	5693	5707	5721	14	2	5	7	9	12
35	0-5736	5750	5764	5779	5793	5807	5821	5835	5850	5864	14	2	5	7	9	12
36	0-5878	5892	5906	5920	5934	5948	5962	5976	5990	6004	14	2	5	7	9	12
37	0-6018	6032	6046	6060	6074	6088	6101	6115	6129	6143	14	2	5	7	9	12
38	0-6157	6170	6184	6198	6211	6225	6239	6252	6266	6280	14	2	5	7	9	12
39	0-6293	6307	6320	6334	6347	6361	6374	6388	6401	6414	14	2	5	7	9	12
40	0-6428	6441	6455	6468	6481	6494	6508	6521	6534	6547	13	2	4	7	9	11
41	0-6561	6574	6587	6600	6613	6626	6639	6652	6665	6678	13	2	4	7	9	11
42	0-6691	6704	6717	6730	6743	6756	6769	6782	6794	6807	13	2	4	6	9	11
43	0-6820	6833	6845	6858	6871	6884	6896	6909	6921	6934	13	2	4	6	9	11
44	0-6947	6959	6972	6984	6997	7009	7022	7034	7046	7059	12	2	4	6	8	10
45	0-7071	7083	7096	7108	7120	7133	7145	7157	7169	7181	12	2	4	6	8	10
46	0-7193	7206	7218	7230	7242	7254	7266	7278	7290	7302	12	2	4	6	8	10
47	0-7314	7325	7337	7349	7361	7373	7385	7396	7408	7420	12	2	4	6	8	10
48	0-7431	7443	7455	7466	7478	7490	7501	7513	7524	7536	12	2	4	6	8	10
49	0-7547	7559	7570	7581	7593	7604	7615	7627	7638	7649	11	2	4	6	7	9

SAYN

x°	0	6	12	18	24	30	36	42	48	54	Δ _m	UGEE*				
	0° 0	0° 1	0° 2	0° 3	0° 4	0° 5	0° 6	0° 7	0° 8	0° 9		+	1	2	3	4
50°	0-7660	7672	7683	7694	7705	7716	7727	7738	7749	7760	11	2	4	6	7	9
51	0-7771	7782	7793	7804	7815	7826	7837	7848	7859	7869	11	2	4	5	7	9
52	0-7880	7891	7902	7912	7923	7934	7944	7955	7965	7976	11	2	4	5	7	9
53	0-7986	7997	8007	8018	8028	8039	8049	8059	8070	8080	10	2	3	5	7	8
54	0-8090	8100	8111	8121	8131	8141	8151	8161	8171	8181	10	2	3	5	7	8
55	0-8192	8202	8211	8221	8231	8241	8251	8261	8271	8281	10	2	3	5	7	8
56	0-8290	8300	8310	8320	8329	8339	8348	8358	8368	8377	10	2	3	5	7	8
57	0-8387	8396	8406	8415	8425	8434	8443	8453	8462	8471	9	2	3	5	6	8
58	0-8480	8490	8499	8508	8517	8526	8536	8545	8554	8563	9	2	3	5	6	8
59	0-8572	8581	8590	8599	8607	8616	8625	8634	8643	8652	9	1	3	4	6	7
60	0-8660	8669	8678	8686	8695	8704	8712	8721	8729	8738	9	1	3	4	6	7
61	0-8746	8755	8763	8771	8780	8788	8796	8805	8813	8821	8	1	3	4	5	7
62	0-8829	8838	8846	8854	8862	8870	8878	8886	8894	8902	8	1	3	4	5	7
63	0-8910	8918	8926	8934	8942	8949	8957	8965	8973	8980	8	1	3	4	5	7
64	0-8988	8996	9003	9011	9018	9026	9033	9041	9048	9056	8	1	3	4	5	7
65	0-9063	9070	9078	9085	9092	9100	9107	9114	9121	9128	7	1	2	4	5	6
66	0-9135	9143	9150	9157	9164	9171	9178	9184	9191	9198	7	1	2	4	5	6
67	0-9205	9212	9219	9225	9232	9239	9245	9252	9259	9265	7	1	2	3	5	6
68	0-9272	9278	9285	9291	9298	9304	9311	9317	9323	9330	6	1	2	3	4	5
69	0-9336	9342	9348	9354	9361	9367	9373	9379	9385	9391	6	1	2	3	4	5
70	0-9397	9403	9409	9415	9421	9426	9432	9438	9444	9449	6	1	2	3	4	5
71	0-9455	9461	9466	9472	9478	9483	9489	9494	9500	9505	6	1	2	3	4	5
72	0-9511	9516	9521	9527	9532	9537	9542	9548	9553	9558	5	1	2	3	3	4
73	0-9563	9568	9573	9578	9583	9588	9593	9598	9603	9608	5	1	2	3	3	4
74	0-9613	9617	9622	9627	9632	9636	9641	9646	9650	9655	5	1	2	2	3	4
75	0-9659	9664	9668	9673	9677	9681	9686	9690	9694	9699	4	1	1	2	3	3
76	0-9703	9707	9711	9715	9720	9724	9728	9732	9736	9740	4	1	1	2	3	3
77	0-9744	9748	9751	9755	9759	9763	9767	9770	9774	9778	4	1	1	2	3	3
78	0-9781	9785	9789	9792	9796	9799	9803	9806	9810	9813	4	1	1	2	3	3
79	0-9816	9820	9823	9826	9829	9833	9836	9839	9842	9845	3	1	1	2	2	3
80	0-9848	9851	9854	9857	9860	9863	9866	9869	9871	9874	3	0	1	1	2	2
81	0-9877	9880	9882	9885	9888	9890	9893	9895	9898	9900	3	0	1	1	2	2
82	0-9903	9905	9907	9910	9912	9914	9917	9919	9921	9923	2	0	1	1	1	2
83	0-9925	9928	9930	9932	9934	9936	9938	9940	9942	9943	2	0	1	1	1	2
84	0-9945	9947	9949	9951	9952	9954	9956	9957	9959	9960	2	0	1	1	1	2
85	0-9962	9963	9965	9966	9968	9969	9971	9972	9973	9974						
86	0-9976	9977	9978	9979	9980	9981	9982	9983	9984	9985						
87	0-9986	9987	9988	9989	9990	9990	9991	9992	9993	9993						
88	0-9994	9995	9995	9996	9996	9997	9997	9997	9998	9998						
89	0-9998	9999	9999	9999	9999	1-000	1-000	1-000	1-000	1-000						

KOSAYN

x ^o	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	Δ _m	1'	2'	3'	4'	5'
	0°·0	0°·1	0°·2	0°·3	0°·4	0°·5	0°·6	0°·7	0°·8	0°·9		-	KA GOO			
0 ^o	1·0000	1·000	1·000	1·000	1·000	1·000	9999	9999	9999	9999						
1	0·9998	9998	9998	9997	9997	9997	9996	9996	9995	9995						
2	0·9994	9993	9993	9992	9991	9990	9990	9989	9988	9987						
3	0·9986	9985	9984	9983	9982	9981	9980	9979	9978	9977						
4	0·9976	9974	9973	9972	9971	9969	9968	9966	9965	9963						
5	0·9962	9960	9959	9957	9956	9954	9952	9951	9949	9947	2	0	1	1	1	2
6	0·9945	9943	9942	9940	9938	9936	9934	9932	9930	9928	2	0	1	1	1	2
7	0·9925	9923	9921	9919	9917	9914	9912	9910	9907	9905	2	0	1	1	1	2
8	0·9903	9900	9898	9895	9893	9890	9888	9885	9882	9880	3	0	1	1	2	2
9	0·9877	9874	9871	9869	9866	9863	9860	9857	9854	9851	3	0	1	1	2	2
10	0·9848	9845	9842	9839	9836	9833	9829	9826	9823	9820	3	1	1	2	2	3
11	0·9816	9813	9810	9806	9803	9799	9796	9792	9789	9785	4	1	1	2	3	3
12	0·9781	9778	9774	9770	9767	9763	9759	9755	9751	9748	4	1	1	2	3	3
13	0·9744	9740	9736	9732	9728	9724	9720	9715	9711	9707	4	1	1	2	3	3
14	0·9703	9699	9694	9690	9686	9681	9677	9673	9668	9664	4	1	1	2	3	3
15	0·9659	9655	9650	9646	9641	9636	9632	9627	9622	9617	5	1	2	2	3	4
16	0·9613	9608	9603	9598	9593	9588	9583	9578	9573	9568	5	1	2	3	3	4
17	0·9563	9558	9553	9548	9542	9537	9532	9527	9521	9516	5	1	2	3	3	4
18	0·9511	9505	9500	9494	9489	9483	9478	9472	9466	9461	6	1	2	3	4	5
19	0·9455	9449	9444	9438	9432	9426	9421	9415	9409	9403	6	1	2	3	4	5
20	0·9397	9391	9385	9379	9373	9367	9361	9354	9348	9342	6	1	2	3	4	5
21	0·9336	9330	9323	9317	9311	9304	9298	9291	9285	9278	6	1	2	3	4	5
22	0·9272	9265	9259	9252	9245	9239	9232	9225	9219	9212	7	1	2	3	5	6
23	0·9205	9198	9191	9184	9178	9171	9164	9157	9150	9143	7	1	2	4	5	6
24	0·9135	9128	9121	9114	9107	9100	9092	9085	9078	9070	7	1	2	4	5	6
25	0·9063	9056	9048	9041	9033	9026	9018	9011	9003	8996	8	1	3	4	5	7
26	0·8988	8980	8973	8965	8957	8949	8942	8934	8926	8918	8	1	3	4	5	7
27	0·8910	8902	8894	8886	8878	8870	8862	8854	8846	8838	8	1	3	4	5	7
28	0·8829	8821	8813	8805	8796	8788	8780	8771	8763	8755	8	1	3	4	5	7
29	0·8746	8738	8729	8721	8712	8704	8695	8686	8678	8669	9	1	3	4	6	7
30	0·8660	8652	8643	8634	8625	8616	8607	8599	8590	8581	9	1	3	4	6	7
31	0·8572	8563	8554	8545	8536	8526	8517	8508	8499	8490	9	2	3	5	6	8
32	0·8480	8471	8462	8453	8443	8434	8425	8415	8406	8396	9	2	3	5	6	8
33	0·8387	8377	8368	8358	8348	8339	8329	8320	8310	8300	10	2	3	5	7	8
34	0·8290	8281	8271	8261	8251	8241	8231	8221	8211	8202	10	2	3	5	7	8
35	0·8192	8181	8171	8161	8151	8141	8131	8121	8111	8100	10	2	3	5	7	8
36	0·8090	8080	8070	8059	8049	8039	8028	8018	8007	7997	10	2	3	5	7	8
37	0·7986	7976	7965	7955	7944	7934	7923	7912	7902	7891	11	2	4	5	7	9
38	0·7880	7869	7859	7848	7837	7826	7815	7804	7793	7782	11	2	4	5	7	9
39	0·7771	7760	7749	7738	7727	7716	7705	7694	7683	7672	11	2	4	6	7	9
40	0·7660	7649	7638	7627	7615	7604	7593	7581	7570	7559	11	2	4	6	7	9
41	0·7547	7536	7524	7513	7501	7490	7478	7466	7455	7443	12	2	4	6	8	10
42	0·7431	7420	7408	7396	7385	7373	7361	7349	7337	7325	12	2	4	6	8	10
43	0·7314	7302	7290	7278	7266	7254	7242	7230	7218	7206	12	2	4	6	8	10
44	0·7193	7181	7169	7157	7145	7133	7120	7108	7096	7083	12	2	4	6	8	10
45	0·7071	7059	7046	7034	7022	7009	6997	6984	6972	6959	12	2	4	6	8	10
46	0·6947	6934	6921	6909	6896	6884	6871	6858	6845	6833	13	2	4	6	9	11
47	0·6820	6807	6794	6782	6769	6756	6743	6730	6717	6704	13	2	4	6	9	11
48	0·6691	6678	6665	6652	6639	6626	6613	6600	6587	6574	13	2	4	7	9	11
49	0·6561	6547	6534	6521	6508	6494	6481	6468	6455	6441	13	2	4	7	9	11

KOSAYN

x°	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	Δm	1'	2'	3'	4'	5'
	0°·0	0°·1	0°·2	0°·3	0°·4	0°·5	0°·6	0°·7	0°·8	0°·9		—	KA GOO			
50°	0·6428	6414	6401	6388	6374	6361	6347	6334	6320	6307	14	2	5	7	9	12
51	0·6293	6280	6266	6252	6239	6225	6211	6198	6184	6170	14	2	5	7	9	12
52	0·6157	6143	6129	6115	6101	6088	6074	6060	6046	6032	14	2	5	7	9	12
53	0·6018	6004	5990	5976	5962	5948	5934	5920	5906	5892	14	2	5	7	9	12
54	0·5878	5864	5850	5835	5821	5807	5793	5779	5764	5750	14	2	5	7	9	12
55	0·5736	5721	5707	5693	5678	5664	5650	5635	5621	5606	14	2	5	7	9	12
56	0·5592	5577	5563	5548	5534	5519	5505	5490	5476	5461	15	2	5	7	10	12
57	0·5446	5432	5417	5402	5388	5373	5358	5344	5329	5314	15	2	5	7	10	12
58	0·5299	5284	5270	5255	5240	5225	5210	5195	5180	5165	15	2	5	7	10	12
59	0·5150	5135	5120	5105	5090	5075	5060	5045	5030	5015	15	3	5	8	10	13
60	0·5000	4985	4970	4955	4939	4924	4909	4894	4879	4863	15	3	5	8	10	13
61	0·4848	4833	4818	4802	4787	4772	4756	4741	4726	4710	15	3	5	8	10	13
62	0·4695	4679	4664	4648	4633	4617	4602	4586	4571	4555	16	3	5	8	11	13
63	0·4540	4524	4509	4493	4478	4462	4446	4431	4415	4399	16	3	5	8	11	13
64	0·4384	4368	4352	4337	4321	4305	4289	4274	4258	4242	16	3	5	8	11	13
65	0·4226	4210	4195	4179	4163	4147	4131	4115	4099	4083	16	3	5	8	11	13
66	0·4067	4051	4035	4019	4003	3987	3971	3955	3939	3923	16	3	5	8	11	13
67	0·3907	3891	3875	3859	3843	3827	3811	3795	3778	3762	16	3	5	8	11	13
68	0·3746	3730	3714	3697	3681	3665	3649	3633	3616	3600	16	3	5	8	11	13
69	0·3584	3567	3551	3535	3518	3502	3486	3469	3453	3437	16	3	5	8	11	13
70	0·3420	3404	3387	3371	3355	3338	3322	3305	3289	3272	16	3	5	8	11	13
71	0·3256	3239	3223	3206	3190	3173	3156	3140	3123	3107	17	3	6	8	11	14
72	0·3090	3074	3057	3040	3024	3007	2990	2974	2957	2940	17	3	6	8	11	14
73	0·2924	2907	2890	2874	2857	2840	2823	2807	2790	2773	17	3	6	8	11	14
74	0·2756	2740	2723	2706	2689	2672	2656	2639	2622	2605	17	3	6	8	11	14
75	0·2588	2571	2554	2538	2521	2504	2487	2470	2453	2436	17	3	6	8	11	14
76	0·2419	2402	2385	2368	2351	2334	2317	2300	2284	2267	17	3	6	8	11	14
77	0·2250	2233	2215	2198	2181	2164	2147	2130	2113	2096	17	3	6	9	11	14
78	0·2079	2062	2045	2028	2011	1994	1977	1959	1942	1925	17	3	6	9	11	14
79	0·1908	1891	1874	1857	1840	1822	1805	1788	1771	1754	17	3	6	9	11	14
80	0·1736	1719	1702	1685	1668	1650	1633	1616	1599	1582	17	3	6	9	11	14
81	0·1564	1547	1530	1513	1495	1478	1461	1444	1426	1409	17	3	6	9	11	14
82	0·1392	1374	1357	1340	1323	1305	1288	1271	1253	1236	17	3	6	9	11	14
83	0·1219	1201	1184	1167	1149	1132	1115	1097	1080	1063	17	3	6	9	11	14
84	0·1045	1028	1011	0993	0976	0958	0941	0924	0906	0889	17½	3	6	9	11	14
85	0·0872	0854	0837	0819	0802	0785	0767	0750	0732	0715	17½	3	6	9	11	14
86	0·0698	0680	0663	0645	0628	0610	0593	0576	0558	0541	17½	3	6	9	11	14
87	0·0523	0506	0488	0471	0454	0436	0419	0401	0384	0366	17½	3	6	9	11	14
88	0·0349	0332	0314	0297	0279	0262	0244	0227	0209	0192	17½	3	6	9	11	14
89	0·0175	0157	0140	0122	0105	0087	0070	0052	0035	0017	18½	3	6	9	12	15

TAANJENT

°	0	6	12	18	24	30	36	42	48	54	Δ _m	1	2	3	4	5
	0°-0	0°-1	0°-2	0°-3	0°-4	0°-5	0°-6	0°-7	0°-8	0°-9		+	U GEE *			
0°	0-0000	0017	0035	0052	0070	0087	0105	0122	0140	0157	178	3	6	9	11	14
1	0-0175	0192	0209	0227	0244	0262	0279	0297	0314	0332	178	3	6	9	11	14
2	0-0349	0367	0384	0402	0419	0437	0454	0472	0489	0507	188	3	6	9	12	15
3	0-0524	0542	0559	0577	0594	0612	0629	0647	0664	0682	188	3	6	9	12	15
4	0-0699	0717	0734	0752	0769	0787	0805	0822	0840	0857	188	3	6	9	12	15
5	0-0875	0892	0910	0928	0945	0963	0981	0998	1016	1033	188	3	6	9	12	15
6	0-1051	1069	1086	1104	1122	1139	1157	1175	1192	1210	18	3	6	9	12	15
7	0-1228	1246	1263	1281	1299	1317	1334	1352	1370	1388	18	3	6	9	12	15
8	0-1405	1423	1441	1459	1477	1495	1512	1530	1548	1566	18	3	6	9	12	15
9	0-1584	1602	1620	1638	1655	1673	1691	1709	1727	1745	18	3	6	9	12	15
10	0-1763	1781	1799	1817	1835	1853	1871	1890	1908	1926	18	3	6	9	12	15
11	0-1944	1962	1980	1998	2016	2035	2053	2071	2089	2107	18	3	6	9	12	15
12	0-2126	2144	2162	2180	2199	2217	2235	2254	2272	2290	18	3	6	9	12	15
13	0-2309	2327	2345	2364	2382	2401	2419	2438	2456	2475	18	3	6	9	12	15
14	0-2493	2512	2530	2549	2568	2586	2605	2623	2642	2661	19	3	6	9	13	16
15	0-2679	2698	2717	2736	2754	2773	2792	2811	2830	2849	19	3	6	9	13	16
16	0-2867	2886	2905	2924	2943	2962	2981	3000	3019	3038	19	3	6	9	13	16
17	0-3057	3076	3096	3115	3134	3153	3172	3191	3211	3230	19	3	6	10	13	16
18	0-3249	3269	3288	3307	3327	3346	3365	3385	3404	3424	19	3	6	10	13	16
19	0-3443	3463	3482	3502	3522	3541	3561	3581	3600	3620	20	3	7	10	13	17
20	0-3640	3659	3679	3699	3719	3739	3759	3779	3799	3819	20	3	7	10	13	17
21	0-3839	3859	3879	3899	3919	3939	3959	3979	4000	4020	20	3	7	10	13	17
22	0-4040	4061	4081	4101	4122	4142	4163	4183	4204	4224	20	3	7	10	13	17
23	0-4245	4265	4286	4307	4327	4348	4369	4390	4411	4431	21	3	7	10	14	17
24	0-4452	4473	4494	4515	4536	4557	4578	4599	4621	4642	21	4	7	11	14	18
25	0-4663	4684	4706	4727	4748	4770	4791	4813	4834	4856	21	4	7	11	14	18
26	0-4877	4899	4921	4942	4964	4986	5008	5029	5051	5073	22	4	7	11	15	18
27	0-5095	5117	5139	5161	5184	5206	5228	5250	5272	5295	22	4	7	11	15	18
28	0-5317	5340	5362	5384	5407	5430	5452	5475	5498	5520	23	4	8	11	15	19
29	0-5543	5566	5589	5612	5635	5658	5681	5704	5727	5750	23	4	8	12	15	19
30	0-5774	5797	5820	5844	5867	5890	5914	5938	5961	5985	24	4	8	12	16	20
31	0-6009	6032	6056	6080	6104	6128	6152	6176	6200	6224	24	4	8	12	16	20
32	0-6249	6273	6297	6322	6346	6371	6395	6420	6445	6469	25	4	8	12	17	21
33	0-6494	6519	6544	6569	6594	6619	6644	6669	6694	6720	25	4	8	13	17	21
34	0-6745	6771	6796	6822	6847	6873	6899	6924	6950	6976	26	4	9	13	17	22
35	0-7002	7028	7054	7080	7107	7133	7159	7186	7212	7239	26	4	9	13	17	22
36	0-7265	7292	7319	7346	7373	7400	7427	7454	7481	7508	27	5	9	14	18	23
37	0-7536	7563	7590	7618	7646	7673	7701	7729	7757	7785	28	5	9	14	19	23
38	0-7813	7841	7869	7898	7926	7954	7983	8012	8040	8069	28	5	9	14	19	23
39	0-8098	8127	8156	8185	8214	8243	8273	8302	8332	8361	29	5	10	15	19	24
40	0-8391	8421	8451	8481	8511	8541	8571	8601	8632	8662	30	5	10	15	20	25
41	0-8693	8724	8754	8785	8816	8847	8878	8910	8941	8972	31	5	10	16	21	26
42	0-9004	9036	9067	9099	9131	9163	9195	9228	9260	9293	32	5	11	16	21	27
43	0-9325	9358	9391	9424	9457	9490	9523	9556	9590	9623	33	6	11	17	22	28
44	0-9657	9691	9725	9759	9793	9827	9861	9896	9930	9965	34	6	11	17	23	28
45	1-0000	0035	0070	0105	0141	0176	0212	0247	0283	0319	36	6	12	18	24	30
46	1-0355	0392	0428	0464	0501	0538	0575	0612	0649	0686	37	6	12	18	25	31
47	1-0724	0761	0799	0837	0875	0913	0951	0990	1028	1067	38	6	13	19	25	32
48	1-1106	1145	1184	1224	1263	1303	1343	1383	1423	1463	40	7	13	20	27	33
49	1-1504	1544	1585	1626	1667	1708	1750	1792	1833	1875	41	7	14	21	27	34

