vè;k; 13

?kkrkd vkj ?kkr

13.1 Hkfedk

D;k vki tkur g fd iFoh dk n0;eku (mass) D;k g\ ;g 5,970,000,000,000,000,000,000,000 kg g!

D;k vki bl l[;k dk i< ldr g\

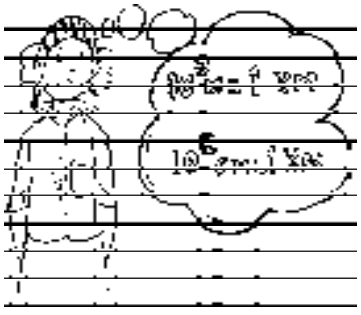
;jul xg (Uranus) dk n0;eku 86,800,000,000,000,000,000,000,000 kg gA

fdldk n0;eku vf/d gµiFoh ;k ;jul xg\

l; (Sun) vkj 'kfu (Saturn) oQ chp dh njh 1,433,500,000,000 m g rFkk 'kfu vkj ;jul xg oQ chp dh njh 1,439,000,000,000 m gA D;k vki bu l[;kvk dk i< ldr g\ bue dku&lh njh de g\

,lh cgr cMh l[;kvk dk i<uk] le>uk vkj budh ryuk djuk dfBu gkrk gA bu l[;kvk dk ljyrk l i<u] le>u vkj budh ryuk dju oQ fy,] ge ?kkrkdk (exponents) dk i;kx djr gA bl vè;k; e] ge ?kkrkdk oQ ckj e lh[kx rFkk ;g Hkh lh[kx fd budk i;kx fdl idkj fd;k tkrk gA

13.2 ?kkrkd



ge cMh l[;kvk dk ?kkrkdk dk i;kx djoQ lf{kIr :i e fy[k ldr gA fuEufyf[kr dk nf[k, % 10, 000 = 10 × 10 × 10 × 10 = 10^4

lf{kIr loQru 10^4 x.kuiQy 10×10×10×10 dk 0;Dr djrk gA ;gk] ó10ô vk/kj **(base)** vkj ó4ô ?kkrkd dgykrk gA **10^4** dk **10** dh Åij ?kkr **(power) 4** ;k oQoy **10** dh pkFkh ?kkr i<k tkrk gA **10^4** dk 10000 dk ?kkrkdh; :i **(exponential form)** dgk tkrk gA

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ge blh idkj 1000 dk Hkh 10 dh ?kkr oQ :i e 0;Dr dj ldr gA pfd 1000 l[;k 10 dk Lo; l rhu ckj x.kk g] blfy,

$$1000 = 10 \times 10 \times 10 = 10^3$$ gA

;gk] iu% 10^3 l[;k 1000 dk ?kkrkdh; :i gA

blh idkj] $1,00,000 = 10 \times 10 \times 10 \times 10 \times 10 = 10^5$ gA

vFkkr] 10^5 l[;k 1,00,000 dk ?kkrkdh; :i gA

bu nkuk mnkgj.kk e] vk/kj 10 gA 10^3 e ?kkrkd 3 g rFkk 10^5 e ?kkrkd 5 gA

ge l[;kvk dk foLrkfjr ;k ilkfjr :i (expanded form) e fy[ku oQ fy, 10, 100, 1000 bR;kfn tl h l[;kvk dk i;kx dj poQ g A

mnkgj.kkFk] $47561 = 4 \times 10000 + 7 \times 1000 + 5 \times 100 + 6 \times 10 + 1$ gA

bl $4 \times 10^4 + 7 \times 10^3 + 5 \times 10^2 + 6 \times 10 + 1$ oQ :i e fy[kk tk ldrk gA

fuEufyf[kr l[;kvk dk blh idkj fy[ku dk i;Ru dhft, %

172, 5642, 6374

mijkDr lHkh mnkgj.kk e] geu o l[;k, n[kh g ftuoQ vk/kj 10 gA ijr vkèkkj dkb Hkh l[;k gk ldrh gA mnkgj.kkFk]

$81 = 3 \times 3 \times 3 \times 3 = 3^4$ oQ :i e fy[kk tk ldrk gA ;gk vk/kj 3 g vkj ?kkrkd 4 gA

oQN ?kkrk oQ fof'k"V uke gA mnkgj.kkFk %

10^2, tk 10 oQ Åij ?kkr 2 g] bl 10 dk ox (10 squared) Hkh i<k tkrk gA

10^3, tk 10 oQ Åij ?kkr 3 g] bl 10 dk ?ku (10 cubed) Hkh i<k tkrk gA

D;k vki crk ldr g fd 5^3 (5 oQ ?ku) dk D;k vFk g\

5^3 dk vFk 5 dk Lo; l rhu ckj x.kk fd;k tkuk g] vFkkr $5^3 = 5 \times 5 \times 5 = 125$

vr% ge dg ldr g fd 125 l[;k 5 dh rhljh ?kkr (third power) gA

5^3 e vk/kj rFkk ?kkrkd D;k g\

blh idkj $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$ g, tk 2 dh ikpoh ?kkr gA

2^5 e] 2 vk/kj g rFkk ?kkrkd 5 gA

i;kl dhft,

,l ikp vkj mnkgj.k nhft,] tgk ,d l[;k dk ?kkrkdh; :i e 0;Dr fd;k tkrk gA iR;d fLFkfr e] ?kkrkd o vk/kj dh igpku Hkh dhft,A

blh fof/ oQ vulkj] $243 = 3 \times 3 \times 3 \times 3 \times 3 = 3^5$,

$64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$

$625 = 5 \times 5 \times 5 \times 5 = 5^4$

vki lf{kr :i e fy[ku dh bl fof/ dk rc Hkh ykx dj ldr g] tc vk/kj ,d ½.kRed i.kd gkA

$(-2)^3$ dk D;k vFk g\

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;g $(ï 2)^3 = (ï 2) \times (ï 2) \times (ï 2) = ï 8$ gA
D;k $(ï 2)^4 = 16$ g\ bldh tkp dhft,A
dkb fuf'pr l[;k yu oQ LFkku ij] vkb, fdlh Hkh l[;k a dk vk/kj y rFkk l[;kvk dk fuEufyf[kr :i e fy[k %

$a \times a = a^2$ (bl óa dk oxô ;k óa oQ Åij ?kkr 2ô i<k tkrk g)

$a \times a \times a = a^3$ (bl óa dk ?kuô ;k óa oQ Åij ?kkr 3ô i<k tkrk g)

$a \times a \times a \times a = a^4$ (bl a oQ Åij ?kkr 4 ;k óa dh pkFkh ?kkrô i<k tkrk g)

$a \times a \times a \times a \times a \times a \times a = a^7$ (bl 'a oQ Åij ?kkr 7ô ;k óa dh lkroh ?kkrô i<k tkrk g)

bR;kfnA

$a \times a \times a \times b \times b$ dk a^3b^2 oQ :i e 0;Dr fd;k tk ldrk g (bl a dk ?ku x.kk b dk ox i<k tkrk g)A

$a \times a \times b \times b \times b \times b$ dk a^2b^4 oQ :i e 0;Dr fd;k tk ldrk g (bl a dk ox x.kk b ij 4 ?kkr i<k tkrk g)A

i;kl dhft,

0;Dr dhft, %

(i) 729 dk 3 dh ?kkr oQ :i e

(ii) 128 dk 2 dh ?kkr oQ :i e

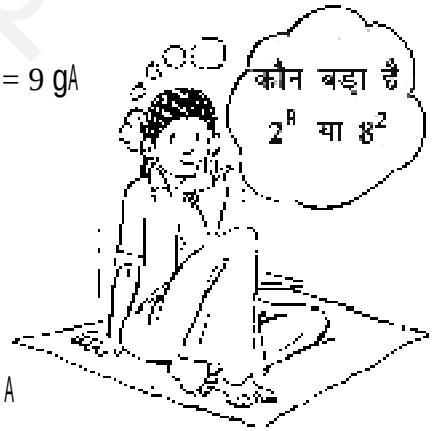
(iii) 343 dk 7 dh ?kkr oQ :i e

mnkgj.k 1 256 dk 2 dh ?kkr oQ :i e 0;Dr dhft,A

gy ge ikIr g $256 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
vr% ge dg ldr g fd $256 = 2^8$

mnkgj.k 2 2^3 vkj 3^2 e dku cMk g\

gy ge ikIr g fd $2^3 = 2 \times 2 \times 2 = 8$ g rFkk $3^2 = 3 \times 3 = 9$ gA
pfd $9 > 8$ g] blfy, 3^2 l[;k 2^3 l cMk gA



mnkgj.k 3 8^2 vkj 2^8 e dku cMk g\

gy $8^2 = 8 \times 8 = 64$ gA
$2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$ gA
Li"Vr;k] $2^8 > 8^2$

mnkgj.k 4 $a^3\,b^2$, $a^2\,b^3$, $b^2\,a^3$, vkj $b^3\,a^2$ dk ikfjr :i e fyf[k,A D;k ;s lHkh cjkcj g\

gy
$$a^3\,b^2 = a^3 \times b^2$$
$$= (a \times a \times a) \times (b \times b)$$
$$= a \times a \times a \times b \times b$$
$$a^2\,b^3 = a^2 \times b^3$$
$$= a \times a \times b \times b \times b$$
$$b^2\,a^3 = b^2 \times a^3$$
$$= b \times b \times a \times a \times a$$
$$b^3\,a^2 = b^3 \times a^2$$
$$= b \times b \times b \times a \times a$$

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è;ku nhft, fd in $a^3\ b^2$ vkj $a^2\ b^3$ dh fLFkfr e] a vkj b dh ?kkr fHkUu&fHkUu gA bl idkj] $a^3\ b^2$ vkj $a^2\ b^3$ fHkUu&fHkUu gA

bloQ foijhr] $a^3\ b^2$ vkj $b^2\ a^3$ cjkcj (,d gh) g] pfd bue a vkj b dh ?kkr ,d gh gA x.ku[kMk oQ Øe l dkb iHkko ugh iMrk gA

bl idkj] $a^3\ b^2 = a^3 \times b^2 = b^2 \times a^3$ gA

blh idkj $a^2\ b^3$ vkj $b^3\ a^2$ Hkh cjkcj gA

mnkgj.k 5 fuEufyf[kr l[;kvk dk vHkkT; x.ku[kMk dh ?kkrk oQ x.kuiQy oQ :i e 0;Dr dhft, %

(i) 72 (ii) 432 (iii) 1000 (iv) 16000

2	72
2	36
2	18
3	9
	3

gy

(i) $72 = 2 \times 36 = 2 \times 2 \times 18$
$= 2 \times 2 \times 2 \times 9$
$= 2 \times 2 \times 2 \times 3 \times 3 = 2^3 \times 3^2$

bl idkj $72 = 2^3 \times 3^2$ (okfNr vHkkT; x.ku[kMk dh ?kkrk oQ x.kuiQy okyk :i)

(ii) $432 = 2 \times 216 = 2 \times 2 \times 108 = 2 \times 2 \times 2 \times 54$
$= 2 \times 2 \times 2 \times 2 \times 27 = 2 \times 2 \times 2 \times 2 \times 3 \times 9$
$= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3$

;k $432 = 2^4 \times 3^3$ (okfNr :i)

(iii) $1000 = 2 \times 500 = 2 \times 2 \times 250 = 2 \times 2 \times 2 \times 125$
$= 2 \times 2 \times 2 \times 5 \times 25 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$

;k $1000 = 2^3 \times 5^3$

vry bl mnkgj.k dk fuEufyf[kr fof/ l gy djuk pkgrk g %

$1000 = 10 \times 100 = 10 \times 10 \times 10$
$= (2 \times 5) \times (2 \times 5) \times (2 \times 5)$ (pfd $10 = 2 \times 5$ g)
$= 2 \times 5 \times 2 \times 5 \times 2 \times 5 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$

;k $1000 = 2^3 \times 5^3$

D;k vry dh fof/ lgh g\

(iv) $16000 = 16 \times 1000 = (2 \times 2 \times 2 \times 2) \times 1000$ (pfd $16 = 2 \times 2 \times 2 \times 2$ gA)
$= (2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 5 \times 5 \times 5)$
(pfd $1000 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$ gA)
$= (2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2) \times (5 \times 5 \times 5)$

;k] $16000 = 2^7 \times 5^3$

mnkgj.k 6 fuEufyf[kr oQ eku Kkr dhft,A

$(1)^5, (ï 1)^3, (ï 1)^4, (ï 10)^3$ vkj $(ï 5)^4$:

gy

(i) ge ikIr g] $(1)^5 = 1 \times 1 \times 1 \times 1 \times 1 = 1$
okLro e] 1 dh dkb Hkh ?kkr 1 oQ cjkcj gkrh gA

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(ii) $(-1)^3 = (-1) \times (-1) \times (-1) = 1 \times (-1) = -1$

(iii) $(-1)^4 = (-1) \times (-1) \times (-1) \times (-1) = 1 \times 1 = 1$

vki bldh tkp dj ldrs g fd (-1) dh dkb Hkh fo"ke ?kkr (-1) oQ cjkcj gkrh g rFkk (-1) dh dkb Hkh le ?kkr $(+1)$ oQ cjkcj gkrh gA

$(-1)^{\text{fo"ke l[;k}}$	$= -1$
$(-1)^{\text{le l[;k}}$	$= +1$

(iv) $(-10)^3 = (-10) \times (-10) \times (-10) = 100 \times (-10) = -1000$

(v) $(-5)^4 = (-5) \times (-5) \times (-5) \times (-5) = 25 \times 25 = 625$

i'ukoyh 13.1

1. fuEufyf[kr oQ eku Kkr dhft, %

(i) 2^6 (ii) 9^3 (iii) 11^2 (iv) 5^4

2. fuEufyf[kr dk ?kkrkdh; :i e 0;Dr dhft, %

(i) $6 \times 6 \times 6 \times 6$ (ii) $t \times t$ (iii) $b \times b \times b \times b$

(iv) $5 \times 5 \times 7 \times 7 \times 7$ (v) $2 \times 2 \times a \times a$ (vi) $a \times a \times a \times c \times c \times c \times c \times d$

3. fuEufyf[kr l[;kvk e l iR;d dk ?kkrkdh; loQru e 0;Dr dhft, %

(i) 512 (ii) 343 (iii) 729 (iv) 3125

4. fuEufyf[kr e l iR;d Hkkx e] tgk Hkh lHko gk] cMh l[;k dk igpkfu,%

(i) 4^3 ;k 3^4 (ii) 5^3 ;k 3^5 (iii) 2^8 ;k 8^2

(iv) 100^2 ;k 2^{100} (v) 2^{10} ;k 10^2

5. fuEufyf[kr e l iR;d dk muoQ vHkkT; x.ku[kMk dh ?kkrk oQ x.kuiQy oQ :i e 0;Dr dhft,A

(i) 648 (ii) 405 (iii) 540 (iv) 3600

6. ljy dhft, %

(i) 2×10^3 (ii) $7^2 \times 2^2$ (iii) $2^3 \times 5$ (iv) 3×4^4

(v) 0×10^2 (vi) $5^2 \times 3^3$ (vii) $2^4 \times 3^2$ (viii) $3^2 \times 10^4$

7. ljy dhft, %

(i) $(-4)^3$ (ii) $(-3) \times (-2)^3$ (iii) $(-3)^2 \times (-5)^2$

(iv) $(-2)^3 \times (-10)^3$

8. fuEufyf[kr l[;kvk dh ryuk dhft, %

(i) $2.7 \times 10^{12}; 1.5 \times 10^8$ (ii) $4 \times 10^{14}; 3 \times 10^{17}$

13.3 ?kkrkdk oQ fu;e

13.3.1 ,d gh vk/kj okyh ?kkrk dk x.ku

(i) vkb, $2^2 \times 2^3$ dk ifjdfyr djA

$$2^2 \times 2^3 = (2 \times 2) \times (2 \times 2 \times 2)$$
$$= 2 \times 2 \times 2 \times 2 \times 2 = 2^5 = 2^{2+3}$$

è;ku nhft, fd 2^2 vkj 2^3 e vk/kj ,d gh (leku) g rFkk ?kkrkdk dk ;kx] vFkkr 2 vkj 3 dk ;kx 5 gA

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(ii) $(-3)^4 \times (-3)^3 = [(-3) \times (-3) \times (-3) \times (-3)] \times [(-3) \times (-3) \times (-3)]$
$= (-3) \times (-3) \times (-3) \times (-3) \times (-3) \times (-3) \times (-3)$
$= (-3)^7$
$= (-3)^{4+3}$

iu% è;ku nhft, fd vk/kj ,d gh g rFkk ?kkrkdk dk ;kx 4 + 3 = 7 gA

(iii) $a^2 \times a^4 = (a \times a) \times (a \times a \times a \times a)$
$= a \times a \times a \times a \times a \times a = a^6$

(fVli.kh% vk/kj ,d gh g rFkk ?kkrkdk dk ;kx 2 + 4 = 6 g)

blh idkj] lR;kfir dhft, fd

$4^2 \times 4^2 = 4^{2+2}$

rFkk $3^2 \times 3^3 = 3^{2+3}$ gA

i;kl dhft,

ljy djo% ?kkrkdh; :i e fyf[k, %

(i) $2^5 \times 2^3$

(ii) $p^3 \times p^2$

(iii) $4^3 \times 4^2$

(iv) $a^3 \times a^2 \times a^7$

(v) $5^3 \times 5^7 \times 5^{12}$

(vi) $(-4)^{100} \times (-4)^{20}$

D;k vki ckDl e mi;Dr l[;k fy[k ldr g\

$(-11)^2 \times (-11)^6 = 11^{\square}$

$b^2 \times b^3 = b^{\square}$ (;kn jf[k,] vk/kj ,d gh g] b dks Hkh 'kU;rj i.kkd g)A

$c^3 \times c^4 = c^{\square}$ (c dks Hkh 'kU;rj i.kkd g)A

$d^{10} \times d^{20} = d^{\square}$

;gk l ge 0;kid :i l ;g dg ldr g fd ,d 'kU;rj i.kkd a, oQ fy,] $a^m \times a^n = a^{m+n}$

gkrk g] tgk m vkj n i.k l[;k, gA

lko/kuh!
$2^3 \times 3^2$ ij fopkj dhft,A
D;k vki ?kkrkdk dk tkM ldr g\ ugh! D;k vki crk ldr g ^D;k*\
2^3 dk vk/kj 2 g vkj 3^2 dk vk/kj 3 gA vk/kj ,d leku ugh gA

13.3.2 ,d gh vk/kj okyh ?kkrk dk foHkktu

vkb, $3^7 \div 3^4$ dk ljy djA

$$3^7 \div 3^4 = \frac{3^7}{3^4} = \frac{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3}{3 \times 3 \times 3 \times 3}$$

$= 3 \times 3 \times 3 = 3^3 = 3^{7-4}$

bl idkj] $3^7 \div 3^4 = 3^{7-4}$ gA

¼è;ku nhft, fd 3^7 vkj 3^4 oQ vk/kj ,d gh g vkj $3^7 \times 3^4 = 3^{7+4}$ gk tkrk gA½

bl idkj] $5^6 \div 5^2 = \frac{5^6}{5^2} = \frac{5 \times 5 \times 5 \times 5 \times 5 \times 5}{5 \times 5}$

$= 5 \times 5 \times 5 \times 5 = 5^4 = 5^{6-2}$

;k] $5^6 \div 5^2 = 5^{6-2}$ gA

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eku yhft, fd a dkb 'kU;rj i.kkd gA rc]

$$a^4 \quad a^2 = \frac{a^4}{a^2} \quad \frac{a \quad a \quad a \quad a}{a \quad a} \quad a \quad a \quad a^2 \quad a^{4-2}$$

;k $a^4 \quad a^2 = a^{4-2}$ gA

D;k vc vki rjr mÙkj n ldr g\

$10^8 \div 10^3 = 10^{8-3} = 10^5$

$7^9 \div 7^6 = 7^{\square}$

$a^8 \div a^5 = a^{\square}$

'kU;rj i.kkd b vkj c oQ fy,

$b^{10} \div b^5 = b^{\square}$

$c^{100} \div c^{90} = c^{\square}$

0;kid :i e] fdlh Hkh 'kU;rj i.kkd a oQ fy,]

$$a^m \div a^n = a^{m-n}$$

gkrk g] tgk m vkj n i.k l[;k, g rFkk $m > n$ gA

13.3.3 ,d ?kkr dh ?kkr yuk

fuEufyf[kr ij fopkj dhft, %

2^3 ^{2} vkj 3^2 ^{4} dk ljy dhft,A

vc] 2^3 ^{2} dk vFk g 2^3 dk Lo; l nk ckj x.kk fd;k x;k gA

2^3 ^{2} $= 2^3 \times 2^3$

$= 2^{3+3}$ (pfd $a^m \times a^n = a^{m+n}$ gA)

$= 2^6 = 2^{3\times 2}$

vFkkr 2^3 ^{2} $= 2^{3\times 2}$

blh idkj] 3^2 ^{4} $= 3^2 \times 3^2 \times 3^2 \times 3^2$

$= 3^{2+2+2+2}$

$= 3^8$ (nf[k, fd 2 vkj 4 dk x.kuiQy 8 gA)

$= 3^{2\times 4}$

D;k vki crk ldr g fd 7^2 ^{10} fdloQ cjkcj g\

vr%] 2^3 ^{2} $= 2^{3\times 2} = 2^6$

3^2 ^{4} $= 3^{2\times 4} = 3^8$

i;kl dhft,

ljy djoQ ?kkrkdh; :i e fyf[k,% (mnkgj.k oQ fy,] $11^6 \div 11^2 = 11^4$)

(i) $2^9 \div 2^3$ (ii) $10^8 \div 10^4$

(iii) $9^{11} \div 9^7$ (iv) $20^{15} \div 20^{13}$

(v) $7^{13} \div 7^{10}$

i;kl dhft,

ljy djoQ] mÙkj dk ?kkrkdh; :i e 0;Dr dhft,A

(i) 6^2 ^{4} (ii) 2^2 ^{100}

(iii) 7^{50} ^{2} (iv) 5^3 ^{7}

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$7^{2^{10}} = 7^{2 \times 10} = 7^{20}$

$a^{2^3} = a^{2 \times 3} = a^6$

$(a^m)^3 = a^{m \times 3} = a^{3m}$

mijkDr l]ge 0;kid :i l dg ldr g fd fdlh 'kU;rj i.kkd áaôoQ fy,]

$$a^{m^n} = a^{mn}$$

gkrk g] tgk m vkj n i.k l[;k, gA

mnkgj.k 7 D;k vki crk ldr g fd $(5^2) \times 3$ vkj 5^{2^3} e l dku cMk g\

gy $(5^2) \times 3$ dk vFk g fd 5^2 dk 3 l x.kk fd;k x;k g] vFkkr ;g $5 \times 5 \times 3 = 75$

ijr 5^{2^3} dk vFk g fd 5^2 dk Lo; l rhu ckj x.kk fd;k x;k g] vFkkr ;g

$5^2 \times 5^2 \times 5^2 = 5^6 = 15625$ gA

vr%] $(5^2)^3 > (5^2) \times 3$ gA

13.3.4 leku ?kkrdk okyh ?kkrk dk x.ku

D;k vki $2^3 \times 3^3$ dk ljy dj ldr g\ è;ku nhft, fd ;gk nkuk ink 2^3 vkj 3^3 oQ vk/kj fHkUu&fHkUu gA ijr buoQ ?kkrkd leku gA

vc $2^3 \times 3^3 = (2 \times 2 \times 2) \times (3 \times 3 \times 3)$

$= (2 \times 3) \times (2 \times 3) \times (2 \times 3)$

$= 6 \times 6 \times 6$

$= 6^3$ (nf[k, 6 vk/kjk 2 vkj 3 dk x.kuiQy g)

nf[k, $4^4 \times 3^4 = (4 \times 4 \times 4 \times 4) \times (3 \times 3 \times 3 \times 3)$

$= (4 \times 3) \times (4 \times 3) \times (4 \times 3) \times (4 \times 3)$

$= 12 \times 12 \times 12 \times 12$

$= 12^4$

lkFk gh] nf[k, $3^2 \times a^2 = (3 \times 3) \times (a \times a)$

$= (3 \times a) \times (3 \times a)$

$= (3 \times a)^2$

$= (3a)^2$ (è;ku nhft, %$3 \times a = 3a$)

blh idkj $a^4 \times b^4$ $= (a \times a \times a \times a) \times (b \times b \times b \times b)$

$= (a \times b) \times (a \times b) \times (a \times b) \times (a \times b)$

$= (a \times b)^4$

$= (ab)^4$ (è;ku nhft, fd $a \times b = ab$ g)

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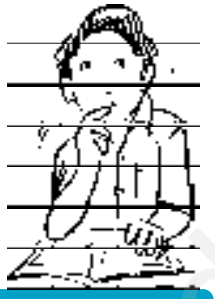
0;kid :i e] fdlh Hkh 'kU;rj i.kkd oQ fy,]

$a^m \times b^m = (ab)^m$ gkrk g tgk] m ,d i.k l[;k g



mnkgj.k 8 fuEufy[kr ink dk ?kkrkdh; :i e 0;Dr dhft, %

(i) $(2 \times 3)^5$ (ii) $(2a)^4$ (iii) $(ï\ 4m)^3$

gy

(i) $(2 \times 3)^5 = (2 \times 3) \times (2 \times 3) \times (2 \times 3) \times (2 \times 3) \times (2 \times 3)$
$= (2 \times 2 \times 2 \times 2 \times 2) \times (3 \times 3 \times 3 \times 3 \times 3)$
$= 2^5 \times 3^5$

(ii) $(2a)^4 = 2a \times 2a \times 2a \times 2a$
$= (2 \times 2 \times 2 \times 2) \times (a \times a \times a \times a)$
$= 2^4 \times a^4$

(iii) $(ï\ 4m)^3 = (ï\ 4 \times m)^3$
$= (ï\ 4 \times m) \times (ï\ 4 \times m) \times (ï\ 4 \times m)$
$= (ï\ 4) \times (ï\ 4) \times (ï\ 4) \times (m \times m \times m) = (ï\ 4)^3 \times (m)^3$

i;kl dhft,

$a^m \times b^m = (ab)^m$ dk i;kx djo]

vU; :i e cnfy, %

(i) $4^3 \times 2^3$ (ii) $2^5 \times b^5$

(iii) $a^2 \times t^2$ (iv) $5^6 \times (ï\ 2)^6$

(v) $(ï\ 2)^4 \times (ï\ 3)^4$

13.3.5 leku ?kkrkdk okyh ?kkrk l foHkktu

fuEufyf[kr ljyhdj.kk dk nf[k, %

(i) $\frac{2^4}{3^4} \quad \frac{2}{3}\frac{2}{3}\frac{2}{3}\frac{2}{3} \quad \frac{2}{3}\frac{2}{3}\frac{2}{3}\frac{2}{3} \quad \frac{2}{3}^4$

(ii) $\frac{a^3}{b^3} \quad \frac{a}{b}\frac{a}{b}\frac{a}{b} \quad \frac{a}{b}\frac{a}{b}\frac{a}{b} \quad \frac{a}{b}^3$

bu mnkgj.kk l] ge dg ldr g fd 0;kid :i e]

$a^m \quad b^m \quad \frac{a^m}{b^m} \quad \frac{a}{b}^m$ tgk] a vkj b dkb nk 'kU;rj i.kkd g rFkk m ,d i.k l[;k gA

i;kl dhft,

$a^m \quad b^m \quad \frac{a}{b}^m$ dk i;kx djo] vU; :i e cnfy, %

(i) $4^5 \div 3^5$

(ii) $2^5 \div b^5$

(iii) $(ï\ 2)^3 \div b^3$

(iv) $p^4 \div q^4$

(v) $5^6 \div (ï\ 2)^6$

mnkgj.k 9 ilkj dhft, % (i) $\frac{3}{5}^4$ (ii) $\frac{ï\ 4}{7}^5$

gy

(i) $\frac{3}{5}^4 = \frac{3^4}{5^4} = \frac{3}{5}\frac{3}{5}\frac{3}{5}\frac{3}{5}$

(ii) $\frac{ï\ 4}{7}^5 = \frac{(\ 4)^5}{7^5} = \frac{ï\ 4 \times ï\ 4 \times ï\ 4 \times ï\ 4 \times ï\ 4}{7 \times 7 \times 7 \times 7 \times 7}$

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- 'kU; ?kkrkd okyh l[;k,

D;k vki crk ldr g fd $\frac{3^5}{3^5}$ fdlo Q cjkcj g\

$$\frac{3^5}{3^5} = \frac{3\ 3\ 3\ 3\ 3}{3\ 3\ 3\ 3\ 3} \quad 1 \text{ gA}$$

?kkrkdk oQ fu;ek dk i;kx djr g,]

$3^5 \quad 3^5 = 3^{5-5} = 3^0$ gA

vr% $3^0 = 1$ gA

D;k vki crk ldr g fd 7^0 fdlo Q cjkcj g\

$7^3 \quad 7^3 = 7^{3-3} = 7^0$

lkFk gh] $\frac{7^3}{7^3} = \frac{7\times7\times7}{7\times7\times7} \quad 1$ gA

vr% $7^0 = 1$

blh idkj] $a^3 \quad a^3 = a^{3-3} = a^0$ gA

lkFk gh $a^3 \quad a^3 = \frac{a^3}{a^3} \quad \frac{a\times a\times a}{a\times a\times a} \quad 1$ gA

vr%] $a^0 = 1$ (fdlh Hkh 'kU;rj i.kkd a oQ fy,)

vr%] ge dg ldr g fd fdlh Hkh l[;k ('kU; oQ vfrfjDr) ij ?kkr (;k ?kkrkd) o dk eku 1 gkrk gA

a^o D;k g\
fuEufyf[kr iVu dk nf[k,%
$2^6 = 64$
$2^5 = 32$
$2^4 = 16$
$2^3 = 8$
$2^2 = ?$
$2^1 = ?$
$2^o = ?$
vki oQoy iVu n[k dj gh 2^o oQ eku dk vueku yxk ldr gA
vki n[k ldr g fd $2^o = 1$ gA
;fn $3^6 = 729$, l ikjHk dj] rk Åij n'kkb fof/ l $3^5, 3^4, 3^3, \ldots$ bR;kfn Kkr djr g,] D;k vki 3^o dk eku crk ldr g\

13.4 ?kkrkdk oQ fu;ek dk fofo/ mnkgj.kk e i;kx

vkb, Åij fodflr fd, x, ?kkrkdk oQ fu;ek dk i;kx djoQ] oQN mnkgj.k gy djA

mnkgj.k 10 $8\times8\times8\times8$ oQ fy,] vk/kj 2 yr g,] bl ?kkrkdh; :i e fyf[k,A

gy Kkr g fd] $8\times8\times8\times8 = 8^4$

ijr ge tkur g fd $8 = 2\times2\times2 = 2^3$ gA

vr%] $8^4 = (2^3)^4 = 2^3\times2^3\times2^3\times2^3$

$= 2^{3\times4}$ (vki $(a^m)^n = a^{mn}$ dk Hkh i;kx dj ldr gA)

$= 2^{12}$

mnkgj.k 11 ljy dhft, vkj mÙkj dk ?kkrkdh; :i e fyf[k,%

(i) $\frac{3^7}{3^2} \quad 3^5$ (ii) $2^3\times2^2\times5^5$ (iii) $(6^2\times6^4)\div6^3$

(iv) $((2^2)^3\times3^6)\times5^6$ (v) $8^2\div2^3$

gy (i) $\frac{3^7}{3^2} \quad 3^5 = 3^{7-2} \quad 3^5$

$= 3^5\times3^5 = 3^{5+5} = 3^{10}$

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(ii) $2^3 \times 2^2 \times 5^5 = 2^{3+2} \times 5^5$
$= 2^5 \times 5^5 = (2\times5)^5 = 10^5$

(iii) $6^2 \quad 6^4 \quad 6^3 = 6^{2\ 4} \quad 6^3$

$= \frac{6^6}{6^3} \quad 6^{6\ 3} \quad 6^3$

(iv) $2^{2\ 3} \quad 3^6 \quad 5^6 = [2^6 \times 3^6] \times 5^6$

$= 2 \quad 3^{\ 6} \quad 5^6$

$= 2 \quad 3 \quad 5^{\ 6} = 30^6$

(v) $8 = 2 \times 2 \times 2 = 2^3$

vr%] $8^2 \div 2^3 = (2^3)^2 \div 2^3$

$= 2^6 \div 2^3 = 2^{6-3} = 2^3$

mnkgj.k 12 ljy dhft, %

(i) $\frac{12^4 \quad 9^3 \quad 4}{6^3 \quad 8^2 \quad 27}$ (ii) $2^3 \times a^3 \times 5a^4$ (iii) $\frac{2\times3^4\times2^5}{9\times4^2}$

gy (i) ;gk

$$\frac{12^4 \quad 9^3 \quad 4}{6^3 \quad 8^2 \quad 27} = \frac{2^2 \quad 3^{\ 4} \quad 3^{2\ 3} \quad 2^2}{2 \quad 3^{\ 3} \quad 2^{3\ 2} \quad 3^3}$$

$$= \frac{2^{2\ 4} \times 3^{\ 4} \times 3^{2\ 3} \times 2^2}{2^3 \times 3^3 \times 2^{2\ 3} \times 3^3} \quad \frac{2^8 \cdot 2^2 \cdot 3^4 \cdot 3^6}{2^3 \cdot 2^6 \cdot 3^3 \cdot 3^3}$$

$$= \frac{2^{8\ 2} \quad 3^{4\ 6}}{2^{3\ 6} \quad 3^{3\ 3}} \quad \frac{2^{10} \quad 3^{10}}{2^9 \quad 3^6}$$

$= 2^{10-9} \times 3^{10-6} = 2^1 \times 3^4$

$= 2 \times 81 = 162$

(ii) $2^3 \times a^3 \times 5a^4 = 2^3 \times a^3 \times 5 \times a^4$

$= 2^3 \times 5 \times a^3 \times a^4 = 8 \times 5 \times a^{3+4}$

$= 40\, a^7$

(ii) $\frac{2\times3^4\times2^5}{9\times4^2} = \frac{2\times3^4\times2^5}{3^2\times \quad 2^{2\ 2}} = \frac{2\times2^5\times3^4}{3^2\times2^{2\ 2}}$

$= \frac{2^{1\ 5} \quad 3^4}{2^4 \quad 3^2} = \frac{2^6 \quad 3^4}{2^4 \quad 3^2} = 2^{6\ 4} \quad 3^{4\ 2}$

$= 2^2 \times 3^2 = 4 \times 9 = 36$

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fVIi.kh% bl vè;k; e] geu vf/dk'kr% ,l mnkgj.k fy, g ftue vk/kj i.kd gA ijr bl vè;k; oQ lHkh ifj.kke mu fLFkfr;k oQ fy, Hkh lR; g] tgk vk/kj ifje; l[;k, gA

i'ukoyh 13.2

1. ?kkrkdk oQ fu;ek dk i;kx djr g,] ljy dhft, vkj mÙkj dk ?kkrkdh; :i e fyf[k, %

(i) $3^2 \times 3^4 \times 3^8$ (ii) $6^{15} \quad 6^{10}$ (iii) $a^3 \times a^2$

(iv) $7^x \times 7^2$ (v) $5^{2\ 3} \quad 5^3$ (vi) $2^5 \times 5^5$

(vii) $a^4 \times b^4$ (viii) $3^{4\ 3}$ (ix) $2^{20} \quad 2^{15} \quad 2^3$

(x) $8^t \quad 8^2$

2. fuEufyf[kr e l iR;d dk ljy djoQ ?kkrkdh; :i e 0;Dr dhft, %

(i) $\dfrac{2^3 \times 3^4 \times 4}{3 \times 32}$ (ii) $5^{2\ 3} \quad 5^4 \quad 5^7$ (iii) $25^4 \quad 5^3$

(iv) $\dfrac{3 \quad 7^2 \quad 11^8}{21 \quad 11^3}$ (v) $\dfrac{3^7}{3^4 \quad 3^3}$ (vi) $2^0 + 3^0 + 4^0$

(vii) $2^0 \times 3^0 \times 4^0$ (viii) $(3^0 + 2^0) \times 5^0$ (ix) $\dfrac{2^8 \quad a^5}{4^3 \quad a^3}$

(x) $\dfrac{a^5}{a^3} \times a^8$ (xi) $\dfrac{4^5 \times a^8 b^3}{4^5 \times a^5 b^2}$ (xii) $2^3 \quad 2^{\ 2}$

3. crkb, fd fuEufyf[kr dFku lR; g ;k vlR; rFkk viu mÙkj dk dkj.k Hkh nhft, %

(i) $10 \times 10^{11} = 100^{11}$ (ii) $2^3 > 5^2$ (iii) $2^3 \times 3^2 = 6^5$

(iv) $3^0 = (1000)^0$

4. fuEufyf[kr e l iR;d dk oQoy vHkkT; x.ku[kMk dh ?kkrk oQ x.kuiQy oQ :i e 0;Dr dhft, %

(i) 108×192 (ii) 270 (iii) 729×64

(iv) 768

5. ljy dhft, %

(i) $\dfrac{2^5 \quad ^2 \quad 7^3}{8^3 \quad 7}$ (ii) $\dfrac{25 \quad 5^2 \quad t^8}{10^3 \quad t^4}$ (iii) $\dfrac{3^5 \quad 10^5 \quad 25}{5^7 \quad 6^5}$

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13.5 n'keyo l[;k i¼fr

vkb, 47561 oQ fuEufyf[kr ilkj dk n[k ftll ge igy l gh ifjfpr g %

$$47561 = 4 \times 10000 + 7 \times 1000 + 5 \times 100 + 6 \times 10 + 1$$

ge bl 10 dh ?kkrk dk i;kx djr g,] ?kkrkdh; :i e fuEufyf[kr idkj l 0;Dr dj ldr g %

$$47561 = 4 \times 10^4 + 7 \times 10^3 + 5 \times 10^2 + 6 \times 10^1 + 1 \times 10^0$$

[è;ku nhft, % $10000 = 10^4$, $1000 = 10^3$, $100 = 10^2$, $10 = 10^1$ and $1 = 10^0$ gA]

vkb, ,d vkj l[;k dk ilkfjr :i e fy[k %

$$104278 = 1 \times 100{,}000 + 0 \times 10000 + 4 \times 1000 + 2 \times 100 + 7 \times 10 + 8 \times 1$$
$$= 1 \times 10^5 + 0 \times 10^4 + 4 \times 10^3 + 2 \times 10^2 + 7 \times 10^1 + 8 \times 10^0$$
$$= 1 \times 10^5 + 4 \times 10^3 + 2 \times 10^2 + 7 \times 10^1 + 8 \times 10^0$$

è;ku nhft, fd fdl idkj 10 oQ ?kkrkd vf/dre eku 5 l ikjHk gkr g, ,d&,d djoQ ?kVr g,] ord vk tkr gA

13.6 cMh l[;kvk dk ekud :i e 0;Dr djuk

vkb,] bl vè;k; dh ikjfHkd fLFkfr ij okil vk tk,A geu dgk Fkk fd cMh l[;kvk dk] ?kkrkdk dk i;kx djoQ lfo/ktud :i l 0;Dr fd;k tk ldrk gA bl vHkh rd geu fn[kk;k ugh gA vc ge ,sk djxA

1. l; gekjh vkdk'kxxk (Milky Way Galaxy) oQ oQn l 300,000,000,000,000,000,000 m dh njh ij fLFkr gA
2. gekjh vkdk'kxxk e 100,000,000,000 rkj gA
3. iFoh dk n0;eku 5,976,000,000,000,000,000,000,000 kg gA

; l[;k, i<u vkj fy[ku dh nf"V l lfo/ktud ugh gA budk lfo/ktud cuku oQ fy,] ge ?kkrk (;k ?kkrkdk) dk i;kx djr gA fuEufyf[kr dk nf[k, %

$$59 = 5.9 \times 10 = 5.9 \times 10^1$$
$$590 = 5.9 \times 100 = 5.9 \times 10^2$$
$$5900 = 5.9 \times 1000 = 5.9 \times 10^3$$
$$59000 = 5.9 \times 10000 = 5.9 \times 10^4$$ bR;kfnA

geu bu lHkh l[;kvk dk ekud :i **(standard form)** e 0;Dr dj fn;k gA fdlh Hkh l[;k dk 1.0 vkj 10.0 oQ chp dh ,d n'keyo l[;k (ftle 1.0 lfEefyr g) vkj 10 dh fdlh ?kkr oQ x.kuiQy oQ :i e 0;Dr fd;k tk ldrk gA l[;k oQ bl :i dk mldk ekud :i dgr gA bl idkj]

$$5985 = 5.985 \times 1000 = 5.985 \times 10^3$$ l[;k 5985 dk ekud :i gA

i;kl dhft,

10 dh ?kkrk dk i;kx djr g,] ?kkrkdh; :i e ilkfjr dhft, %

(i) 172
(ii) 5643
(iii) 56439
(iv) 176428

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è;ku nhft, fd 5985 dk 59.85×100 ;k 59.85×10^2 oQ :i e Hkh 0;Dr fd;k tk ldrk gA ijr ;g 5985 dk ekud :i ugh gA blh idkj

$5985 = 0.5985 \times 10000 = 0.5985 \times 10^4$ Hkh 5985 dk ekud :i ugh gA

vc ge bl vè;k; oQ ikjHk e vkb gb l[;kvk dk bl ekud :i e 0;Dr dju e l{ke gk x, gA

gekjh vkdk'kxxk oQ oQn l l; dh njh vFkkr]

300,000,000,000,000,000,000 m dk

$3.0 \times 100,000,000,000,000,000,000$ m $= 3.0 \times 10^{20}$ m

oQ :i e fy[kk tk ldrk gA vc] D;k vki 40,000,000,000 dk blh :i e 0;Dr dj ldr g\ ble 'kU;k dh l[;k dk fxfu,A ;g 10 gA

vr% $40,000,000,000 = 4.0 \times 10^{10}$ gA

iFoh dk n0;eku = 5,976,000,000,000,000,000,000,000 kg

$= 5.976 \times 10^{24}$ kg gA

D;k vki bl ckr l lger g fd i<u] le>u vkj ryuk dju dh nf"V l ekud :i e fy[kh ;g l[;k ml 25 vdk dh l[;k dh vi{kk cgr vf/d ljy ;k lfo/ktud g\

vc] ;jul xg dk n0;eku = 86,800,000,000,000,000,000,000,000 kg

$= 8.68 \times 10^{25}$ kg gA

vc] mijkDr nkuk 0;tdk e oQoy 10 dh ?kkrk dh ryuk djoQ gh] vki ;g dg ldr g fd ;jul xg dk n0;eku iFoh l vf/d gA

l; vkj 'kfu oQ chp dh njh 1,433,500,000,000 m ;k 1.4335×10^{12} m gA 'kfu vkj ;jul oQ chp dh njh 1,439,000,000,000 m ;k 1.439×10^{12} m gA l; vkj iFoh oQ chp dh njh 149,600,000,000 m ;k 1.496×10^{11} m gA

D;k vki crk ldr g fd bu rhuk nfj;k e dku&lh njh U;ure g\

mnkgj.k 13 fuEufyf[kr l[;kvk dk ekud :i e 0;Dr dhft, %

(i) 5985.3 (ii) 65950

(iii) 3,430,000 (iv) 70,040,000,000

gy

(i) $5985.3 = 5.9853 \times 1000 = 5.9853 \times 10^3$

(ii) $65950 = 6.595 \times 10000 = 6.595 \times 10^4$

(iii) $3,430,000 = 3.43 \times 1000,000 = 3.43 \times 10^6$

(iv) $70,040,000,000 = 7.004 \times 10,000,000,000 = 7.004 \times 10^{10}$

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;gk è;ku j[ku ;kX; ckr ;g g fd n'keyo fcn l ckb vkj oQ (vdk dh l[;k) fxudj] mle l 1 ?kVk dj tk ikIr gkrk g] ogh 10 dk ?kkrkd gkrk g] ftl ekud :i e i;kx fd;k tkrk gA ge bl fcn dh dYiuk] l[;k oQ (nk,) flj ij dj yr gA ;gk l ckb vkj vdk dh (l[;k) 11 gA blfy,] ekud :i e 0;Dr dju oQ fy,] 10 dk ?kkrkd 11 ï 1 = 10 gA blfy, bloQ ekud :i e 10 dk ?kkrkd 4 ï 1 = 3 gA

i'ukoyh 13.3

1. fuEufyf[kr l[;kvk dk ilkfjr :i e fyf[k, %

279404, 3006194, 2806196, 120719, 20068

2. fuEufyf[kr ilkfjr :ik e l iR;d oQ fy, l[;k Kkr dhft, %

(a) $8 \times 10^4 + 6 \times 10^3 + 0 \times 10^2 + 4 \times 10^1 + 5 \times 10^0$

(b) $4 \times 10^5 + 5 \times 10^3 + 3 \times 10^2 + 2 \times 10^0$

(c) $3 \times 10^4 + 7 \times 10^2 + 5 \times 10^0$

(d) $9 \times 10^5 + 2 \times 10^2 + 3 \times 10^1$

3. fuEufyf[kr l[;kvk dk ekud :i e 0;Dr dhft, %

(i) 5,00,00,000 (ii) 70,00,000 (iii) 3,18,65,00,000

(iv) 3,90,878 (v) 39087.8 (vi) 3908.78

4. fuEufyf[kr dFkuk e idV gku okyh (vku okyh) l[;kvk dk ekud :i e 0;Dr dhft,A

(a) iFoh vkj pnek oQ chp dh njh 384,000,000 m gA

(b) fuokr LFkku e idk'k dh pky (;k ox) 300,000,000 m/sec. gA

(c) iFoh dk 0;kl 12756000 m gA

(d) l; dk 0;kl 1,400,000,000 m gA

(e) ,d vkdk'kxxk e vklru 100,000,000,000 rkj gA

(f) fo'o eMy (;k lkj eMy) 12,000,000,000 o"k ijkuk vkdfyr fd;k x;k gA

(g) vkdk'kxxk oQ eè; l l; dh njh 300,000,000,000,000,000,000 m vkdfyr dh xb gA

(h) 1.8 g Hkkj okyh ikuh dh ,d cn e 60,230,000,000,000,000,000,000 v.k (molecules) gkr gA

(i) iFoh e 1,353,000,000 km^3 len ty gA

(j) ekp 2001 e Hkkjr dh tul[;k 1,027,000,000 FkhA

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geu D;k ppk dh\

1. cgr cMh l[;k, i<u] le>u] ryuk dju vkj mu ij lfØ;k, dju dh nf"V l dfBu gkrh gA budk ljy cuku oQ fy,] ge bu vf/dk'k cMh l[;kvk dk ?kkrkdk dk i;kx djoQ lf{kIr :i e fy[kr gA
2. oQN l[;kvk oQ ?kkrkdh; :i fuEufyf[kr g %

   $10000 = 10^4$ (bl 10 oQ Åij ?kkr 4 i<k tkrk g)

   $243 = 3^5$, $128 = 2^7$.

   ;gk] 10, 3 vkj 2 vk/kj g rFkk 4, 5 vkj 7 Øe'k% buoQ ?kkrkd gA ge ;g Hkh dgr g fd 10 dh pkFkh ?kkr 10000 g] 3 dh ikpoh ?kkr 243 g] bR;kfnA
3. ?kkrkdh; :i e l[;k, oQN fu;ek dk ikyu djrh g] tk bl idkj g % fdUgh 'kU;rj i.kkdk a vkj b rFkk i.k l[;kvk m vkj n oQ fy,]

   (a) $a^m \times a^n = a^{m+n}$

   (b) $a^m \quad a^n = a^{m-n}$, $m > n$

   (c) $(a^m)^n = a^{mn}$

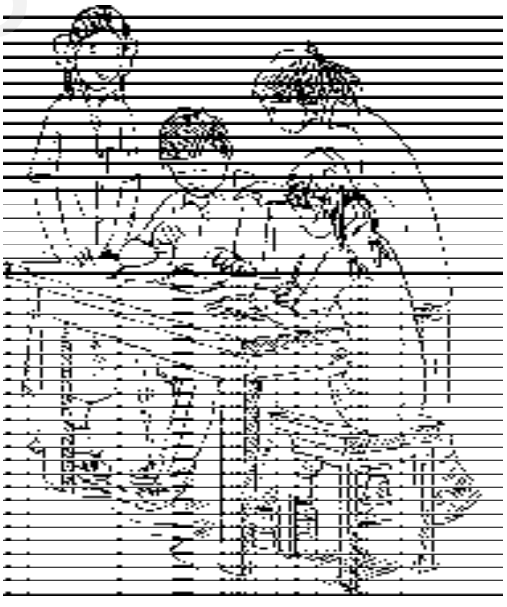
   (d) $a^m \times b^m = (ab)^m$

   (e) $a^m \quad b^m = \left(\frac{a}{b}\right)^m$

   (f) $a^\circ = 1$

   (g) $(-1)^{\text{le } l[;k} = 1$

   $(-1)^{\text{fo"ke } l[;k} = -1$



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