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CH-1

Real Numbers

★ **Fundamental Theorem of Arthimatic (Prime Factorisation)**
Every composite number can be expressed as product of primes and this factorisation is unique, apart from order in which prime factors occur.

- Prime Numbers – have 2 factors
  - these are '1' & no. itself
  - ex. 2, 3, 5, 7......

- Composite Numbers – have more than 2 factors
  - ex. 4, 9, 16, 20.......

EX-1.1

Q1) Express each no. as product of its prime factors

Sol i) $140 = 2 \times 2 \times 5 \times 7$
$= 2^2 \times 5 \times 7$

ii) $156 = 2 \times 2 \times 3 \times 13$
$= 2^2 \times 3 \times 13$

iii) $3825 = 3 \times 3 \times 5 \times 5 \times 17$
$= 3^2 \times 5^2 \times 17$

iv) $5005 = 5 \times 7 \times 11 \times 13$

v) $7429 = 17 \times 19 \times 23$

Q2.) Find the LCM & HCF of the following pairs of integers and verify LCM X HCF = product of 2 no.s.

Sol i) 26 and 91

$26 = 2 \times 13$

$91 = 7 \times 13$

$HCF = 13$

$LCM = 13 \times 2 \times 7$

$= 182$

Verification

$LCM \times HCF = a \times b$

LHS	RHS
LCM X HCF	a X b
13 X 182	26 X 91
2366	2366

LHS = RHS

Hence verified

ii) 510 & 92

$92 = 2 \times 2 \times 23$

$510 = 2 \times 3 \times 5 \times 17$

$HCF = 2$

$LCM = 2 \times 3 \times 5 \times 17 \times 27$

$= 13770$

Verification

LHS	RHS
LCM X HCF	a X b
13770 X 2	510 X 92
27540	27540

LHS = RHS

Hence verified

iii) 336 & 54

$336 = 2^4 \times 3 \times 7$

$54 = 2 \times 3^3$

$HCF = 2 \times 3 = 6$

$LCM = 2^4 \times 3^3 \times 7$

$= 3024$

Verification

$LCM \times HCF = a \times b$

LHS	RHS
$LCM \times HCF$	$a \times b$
3024×6	336×54
18144	18144

LHS = RHS

Hence verified

Q3) Find LCM & HCF of following by prime factorisation method.

Sol i) 12, 15 & 21

$12 = 2 \times 2 \times 3$

$15 = 3 \times 5$

$21 = 3 \times 7$

$HCF = 3$

$LCM = 3 \times 2 \times 5 \times 7 \times 2$

$= 420$

ii) 17, 23, 29

$17 = 1 \times 17$

$23 = 1 \times 23$

$29 = 1 \times 29$

$HCF = 1$

$LCM = 17 \times 23 \times 29$

$= 11339$

iii) 8, 9, 25

$8 = 2 \times 2 \times 2$

$9 = 3 \times 3$

$25 = 5 \times 5$

HCF = 1

LCM = $8 \times 9 \times 25$

$= 1800$

Q4.) Given that HCF(306, 657) = 9, Find LCM.

Sol: We know that by Fundamental theorem of arthmatic

$$LCM \times HCF = a \times b$$

$$LCM \times 9 = 306 \times 657$$

$$LCM = \frac{\cancel{306}^{34} \times 657}{\cancel{9}}$$

$$LCM = 34 \times 657$$

$$= 22338$$

Q5.) Check whether 6^n can end with digit '0'.

Sol: If 6^n ends with digit zero it must contain 2 and 5 as prime factors.

Now, P.F of $6^n = (2 \times 3)^n = 2^n \times 3^n$

It contains 2's & 3's only.

$\therefore$ According to fundamental theorem of arthematic it never ends with digit zero.

Q6.) Explain why following no.s are composite.

Sol: i) $7 \times 11 \times 13 + 13$

$= 7 \times 11 \times 13 + 13$

$= 13[7 \times 11 + 1]$

$= 13 \times [77 + 1]$

$= 13 \times 78$

Since 13 is a prime factor of a given no.
$\therefore$ It is composite.

ii) $7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$
$= 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$
$= 5[7 \times 6 \times 4 \times 3 \times 2 \times 1 + 1]$
$= 5[1008 + 1]$
$= 5 \times 1009$

Since 5 is the prime factor of given no.
$\therefore$ It is composite.

Q7) There is a circular path around a sports feild. Sonia takes .... at the starting point?

Sol Time taken by Sonia = 18 minutes
" " " Ravi = 12 minutes
Minimum time taken by both -
to meet at starting point = LCM (18, 12)
$= 6 \times 6$
$= 36$ min

$$\begin{array}{r|l} 2 & 18-12 \\ \hline 3 & 9-6 \\ \hline & 3-2 \end{array}$$

Ex 3 Find HCF(96, 404) and then LCM.
Sol $96 = 2^5 \times 3$
$404 = 2^2 \times 101$
HCF = 4
$LCM = \frac{96 \times \cancel{404}^{101}}{\cancel{4}} = 9696$ $\left\{ \because LCM \times HCF = a \times b \right\}$

Ex - 1.2

Q1) Prove that $\sqrt{5}$ is irrational.

Sol. Proof:- Let us suppose that $\sqrt{5}$ is rational.

$\therefore \frac{\sqrt{5}}{1} = \frac{p}{q}$ where p & q are co-prime.

$q \times \sqrt{5} = p$

Squaring both sides

$(q \times \sqrt{5})^2 = p^2$

$5q^2 = p^2$ — ①

$q^2 = \frac{p^2}{5}$

5 divides p^2

5 divides p also

$\therefore p = 5x$ — ②

Putting ② in ①

$5q^2 = (5x)^2$

$\cancel{5}q^2 = \cancel{25}^{5} x^2$

$q^2 = 5x^2$

$\frac{q^2}{5} = x^2$

5 divides by q^2

5 divides by q also.

$\therefore q = 5y$ — ③

From ② & ③

HCF of P and q is 5

$\therefore$ Our supposition is wrong

Hence $\sqrt{5}$ is irrational.

Clearly $\frac{1-R^2}{-2R}$ is rational but $\sqrt{2}$ is irrational.

$\therefore \sqrt{2}+\sqrt{3}$ is irrational.

Q2:) Prove that $\sqrt{3}+\sqrt{5}$ is irrational

Sol Let us suppose that $\sqrt{3}+\sqrt{5}$ is rational.

$\therefore \sqrt{3}+\sqrt{5} = R$ [where R is rational no.]

$\sqrt{3} = R-\sqrt{5}$

Squaring Both Sides

$(\sqrt{3})^2 = (R-\sqrt{5})^2$

$3 = R^2+5-2\sqrt{5}R$

$3-R^2-5 = -2\sqrt{5}R$

$-2-R^2 = -2\sqrt{5}R$

$\frac{-2-R^2}{-2R} = \sqrt{5}$

Clearly $\frac{-2-R^2}{-2R}$ is rational no. but $\sqrt{5}$ is irrational.

$\therefore \sqrt{3}+\sqrt{5}$ is irrational.

Q3:) Find the largest no. which divides 70 & 125, leaving remainder 5 & 8 in each case.

Sol $70-5 = 65$, $125-8 = 117$

Largest Number = HCF (65, 117)

$65 = 13 \times 5$

$117 = 3 \times 3 \times 13$

HCF = 13

ii) $7\sqrt{5}$

let us suppose $7\sqrt{5}$ as rational.

$\therefore 7\sqrt{5} = R$ [where R is a rational no.]

$\sqrt{5} = \frac{R}{7}$

Clearly $\frac{R}{7}$ is rational and $\sqrt{5}$ is irrational.

$\therefore 7\sqrt{5}$ is irrational.

iii) $6+\sqrt{2}$

let us suppose $6+\sqrt{2}$ as rational.

$\therefore 6+\sqrt{2} = R$ [where R is a rational no.]

$\sqrt{2} = R-6$

Clearly $R-6$ is rational but $\sqrt{2}$ is irrational.

$\therefore 6+\sqrt{2}$ is irrational

EXTRA QUESTIONS

Q1) Prove that $\sqrt{2}+\sqrt{3}$ is irrational

Sol let us suppose that $\sqrt{2}+\sqrt{3}$ is rational

$\therefore \sqrt{2}+\sqrt{3} = R$ [Where R is rational no.]

$\sqrt{3} = R-\sqrt{2}$

Squaring both sides

$$(\sqrt{3})^2 = (R-\sqrt{2})^2$$

$$3 = R^2+(\sqrt{2})^2 - 2\times\sqrt{2}\times R$$

$$3 = R^2+2-2\sqrt{2}R$$

$$3-R^2-2 = -2\sqrt{2}R$$

$$1-R^2 = -2\sqrt{2}R$$

$$\frac{1-R^2}{-2R} = \sqrt{2}$$

Clearly $\frac{1-R^2}{-2R}$ is rational but $\sqrt{2}$ is irrational.

$\therefore \sqrt{2}+\sqrt{3}$ is irrational.

Q2.) Prove that $\sqrt{3}+\sqrt{5}$ is irrational

Sol Let us suppose that $\sqrt{3}+\sqrt{5}$ is rational.

$\therefore \sqrt{3}+\sqrt{5} = R$ [where R is rational no.]

$\sqrt{3} = R-\sqrt{5}$

Squaring Both Sides

$(\sqrt{3})^2 = (R-\sqrt{5})^2$

$3 = R^2+5-2\sqrt{5}R$

$3-R^2-5 = -2\sqrt{5}R$

$-2R^2 = -2\sqrt{5}R$

$\frac{-2-R^2}{-2R} = \sqrt{5}$

Clearly $\frac{-2-R^2}{-2R}$ is rational no. but $\sqrt{5}$ is irrational.

$\therefore \sqrt{3}+\sqrt{5}$ is irrational.

Q3.) Find the largest no which divides 70 & 125, leaving remainder 5 & 8 in each case.

Sol $70-5=65$, $125-8=117$

Largest Number = HCF (65, 117)

$65 = 13\times5$

$117 = 3\times3\times13$

HCF = 13

Q 4:) Find the least no. divisible by all natural no. from 1-10.

Sol Required no. is LCM(1,2,3,4,5,6,7,8,9,10)

$LCM = 2 \times 2 \times 3 \times 3 \times 5 \times 7 \times 2$

$= 2520$

Q5:) If LCM (72,120) = 24, Find LCM.

Sol $HCF \times LCM = a \times b$

$24 \times LCM = 72 \times 120$

$LCM = \frac{72 \times \cancel{120}^{5}}{\cancel{24}}$

$LCM = 360$

Q 6:) If LCM(91,26) = 182, Find HCF.

Sol $HCF \times LCM = a \times b$

$HCF = \frac{\cancel{91} \times \cancel{26}^{13}}{\cancel{182}_{91}}$

$HCF = 13$

Q 7:) If the HCF & LCM of two natural no.s are 12 and 180 and one of the no. is 36. Find other.

Sol $HCF = 12$

$LCM = 180$

$a = 36$

$b = ?$

$HCF \times LCM = a \times b$

$\frac{\cancel{12} \times \cancel{180}^{60}}{\cancel{36}_{3}} = b$

$b = 60$

Q8.) If $HCF(a, 8) = 4$ & $LCM(a, 8) = 24$. Find a.

Sol

$HCF \times LCM = a \times b$

$4 \times 24 = a \times 8$

$\frac{4 \times \cancel{24}^{3}}{\cancel{8}} = a$

$a = 12.$

Q9.) Given that $HCF(2520, 6600) = 120$. $LCM = 252k$. Find k

Sol

$HCF \times LCM = a \times b$

$120 \times 252k = 2520 \times 6600$

$k = \frac{\cancel{2520}^{10} \times \cancel{6600}^{550}}{\cancel{252} \times \cancel{120}}$

$k = 550.$

Q10.) If $HCF(65, 117)$ is expressible in form of $65m - 117$. Find m.

Sol

$HCF = 13$

$65 = 13 \times 5$

$117 = 3 \times 3 \times 13$

$HCF = 13$

ATQ

$65m - 117 = 13$

$65m = 13 + 117$

$m = \frac{\cancel{130}^{2}}{\cancel{65}}$

$m = 2.$

Q11.) 3 bells toll at intervals of 9, 12, 15 minutes. If they start tolling together, after what time will they toll together

Ans Time taken by bells to toll together again = LCM(9, 12, 15)

$LCM(9, 12, 15) = 3 \times 3 \times 4 \times 5$

$= 180$ mins

$= \frac{180}{60} = 3$ hrs.

Q12.) Traffic lights at 3 road crossings change after every 72s - 96s - 120s. If they changed together at 9:00AM, After what time they will change together again?

Sol Next instance of together change = LCM(72, 96, 120).

$LCM = 8 \times 9 \times 20$

$= \frac{1440}{60} = 24$ minutes

Time required = 9:24AM.

Q13.) ~~If HCF(65, 117)~~ The length, breadth and height of a room are 8m 50cm, 6m 25cm and 4m 75cm. Find length of longest rod that can measure dimensions of room exactly.

Sol length of room = 8m 50cm = 850cm

Breadth " " = 6m 25cm = 625cm

Height " " = 4m 75cm = 475cm

length of longest rod = HCF(850, 625, 475)

= 25cm

Q14.) A circular track around a sports ground has circumference 1080m. 2 cyclists Sonia & Ravi starts together and cycled at constant speed of 6m/s & 9m/s around the track. After how many minutes will they meet again at the starting point.

L-13

Statistics

Central Tendencies of statistics :-
i) Mean
ii) Median
iii) Mode

Emperical relation :- 3 Median = Mode + 2 Mean

Class size = upper limit - lower limit
Class marks = $\frac{\text{Upper limit} + \text{lower limit}}{2}$

Mean 3 methods :-
i) Direct method → $\bar{x} = \frac{\sum fx}{\sum f}$

ii) Assume Mean method → $\bar{x} = A + \frac{\sum fu}{\sum f} \times h$ $\{d = x - A\}$

iii) Step deviation → $\bar{x} = A + \frac{\sum fd}{\sum f}$ $\left\{ U = \frac{x-A}{h} \right\}$ $\left\{ h = \text{class size} \right\}$

EX-13.1

Q1) A survey - - - - - - -

Sol

C/I	X	$U = \frac{x-A}{h}$	f	FU
0-2	1	-3	1	-3
2-4	3	-2	2	-4
4-6	5	-1	1	-1
6-8	7 A	0	5	0
8-10	9	1	6	6
10-12	11	2	2	4
12-14	13	3	3	9
			$\sum f = 20$	$\sum fU = 11$

h = ~~72~~

No. of boys = $\frac{372}{12} = 31$

" " girls = $\frac{449}{15} = 31$

Q17.) Milkman has 2 vessels containing 720 ml and 405 ml of milk. Milk from these containers is poured into glasses of equal capacity to their full brim. Find minimum no. of glasses that can be filled.

Sol ~~Minimum no. of glasses that can be filled = HCF(720, 405)~~
~~$= 3 \times 3 \times 5$~~
~~$= 9 \times 5 = 45$~~
~~$\therefore$ These 2 vessels can fill minimum of 45 glasses.~~

HCF of $(720, 405) = 45 = 3^2 \times 5$

No. of glasses of Type I = $\frac{720}{45} = 16$

" " " " " II = $\frac{405}{45} = 9$

Total glasses required = $16 + 9 = 25$

11/04

L-13

Statistics

Central Tendencies of Statistics :-

i) Mean
ii) Median
iii) Mode

Emperical relation :- 3 Median = Mode + 2 Mean

Class size = upper limit - lower limit

Class marks = $\frac{\text{Upper limit} + \text{lower limit}}{2}$

Mean 3 methods :-

i) Direct method → $\bar{x} = \frac{\Sigma fx}{\Sigma f}$

ii) Assume Mean method → $\bar{x} = A + \frac{\Sigma fu}{\Sigma f} \times h$ $\{d = x - A\}$

iii) Step deviation → $\bar{x} = A + \frac{\Sigma fd}{\Sigma f}$ $\left\{ U = \frac{x-A}{h} \right\}$ $\{h = \text{class size}\}$

EX-13.1

Q1) A survey - - - - - - - - -

Sol

C/I	X	$U = \frac{x-A}{h}$	f	FU
0-2	1	-3	1	-3
2-4	3	-2	2	-4
4-6	5	-1	1	-1
6-8	7 A	0	5	0
8-10	9	1	6	6
10-12	11	2	2	4
12-14	13	3	3	9
			$\Sigma f = 20$	$\Sigma fU = 11$

h = ~~72~~

$$\bar{x} = A + \frac{\sum fU}{\sum f} \times h = 7 + \frac{11}{\cancel{20}\,10} \times \cancel{2} = \frac{70+11}{10} = \frac{81}{10} = 8.1$$

We used step deviation method ∵ it is easy and convenient.

Q3.) Consider — — — — —.

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU
500-520	510	-2	12	-24
520-540	530	-1	14	-14
540-560	550 A	0	8	0
560-580	570	1	6	6
580-600	590	2	10	20

$-24 + (-14) = -38$, $6 + 20 = 26$

$h = 20$ | $\sum f = 50$ | $\sum fU = -12$

$$\bar{x} = A + \frac{\sum fU}{\sum f} \times h$$

$$= 550 + \frac{(-12)}{50} \times 20$$

$$= 550 - \frac{24}{5}$$

$$= 550 - 4.8$$

$$= 545.2$$

Q4.) Thirty — — — — — — — —

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU
65-68	66.5	-3	2	-6
68-71	69.5	-2	4	-8
71-74	72.5	-1	3	-3
74-77	75.5 A	0	8	0
77-80	78.5	1	7	7
80-83	81.5	2	4	8
83-86	84.5	3	2	6

$-6 + (-8) + (-3) = -17$, $7 + 8 + 6 = 21$

$h = 3$ | $\sum f = 30$ | $\sum fU = 4$

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$

$$= 75.5 + \frac{\cancel{4}^{2}}{\cancel{10}_{5}} \times \cancel{2}$$

$$= 75.5 + \frac{2}{5}$$

$$= 75.5 + 0.4$$

$$= 75.9$$

Q5.) In a — — — — — — — —

Sol

C/I	X	$U = \frac{X-A}{h}$	f	fU
50-52	51	-2	15	-30
53-55	54	-1	110	-110
56-58	57 A	0	135	0
59-61	60	1	115	115
62-64	63	2	25	50
			$\Sigma f = 400$	$\Sigma fU = 25$

$-30, -110 \rightarrow -140$

$115, 50 \rightarrow 165$

$h = 2$

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$

$$= 57 + \frac{\cancel{25}^{1}}{\cancel{400}_{\cancel{16}\,8}} \times \cancel{2}$$

$$= \cancel{65}\ 57 + \frac{1}{8}$$

$$= 57 + 0.125$$

$$= 57.125$$

Q6.) The - - - - - - - - - -

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU
100-150	125	-2	4	-8
150-200	175	-1	5	-5
200-250	225 A	0	12	0
250-300	275	1	2	2
300-350	325	2	2	4
			$\Sigma f = 25$	$\Sigma fU = -7$

$-8, -5 \rightarrow -13$; $2, 4 \rightarrow 6$

$h = 50$

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$

$$= 225 + \frac{(-7)}{\cancel{25}} \times \cancel{50}\,2$$

$$= 225 - 14$$

$$= 211$$

Q7.) To find - - - - - - - - - -

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU
0.00-0.04	0.02	-2	4	-8
0.04-0.08	0.06	-1	9	-9
0.08-0.12	0.10	0	9	0
0.12-0.16	0.14	1	2	2
0.16-0.20	0.18	2	4	8
0.20-0.24	0.22	3	2	6
			$\Sigma f = 30$	$\Sigma fU = -1$

$-8, -9 \rightarrow -17$; $2, 8, 6 \rightarrow 16$

$h = 0.04$

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h = 0.10 + \frac{-1}{30} \times 0.04 = \cancel{0.10} + \frac{\cancel{4}\,1}{3\cancel{000}\,750}$$

$= \cancel{0.10 \frac{1}{750}} = 0.10 + 0.13 = 0.23$

$0.10 - \frac{.4}{3000}$

$= \frac{10}{100} - \frac{4}{3000}$

$= \frac{300-4}{3000} = \frac{296}{3000}$

$= \frac{0.296}{3}$

$= 0.98666$

$= 0.99$

Q9.) The following ------

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU	
45-55	50	-2	3	-6	-16
55-65	60	-1	10	-10	
65-75	70 A	0	11	0	
75-85	80	1	8	8	14
85-95	90	2	3	6	
h = 10			$\Sigma f = 35$	$\Sigma fU = -2$	

$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h = 70 + \frac{(-2)}{\cancel{35}\,7} \times \cancel{10}\,2 = 70 - \frac{4}{7} = \frac{490-4}{7} = \frac{486}{7}$

$= 69.42$

Q8.) A class - - - - - - - - -.

Sol

C/I	X	f	fX
0-6	3	11	33
6-10	8	10	80
10-14	12	7	84
14-20	17	4	68
20-28	24	4	96
28-38	33	3	99
38-40	39	1	39
		$\Sigma f = 40$	$\Sigma fX = 499$

$$\bar{x} = \frac{\Sigma fX}{\Sigma f} = \frac{\cancel{499}^{12.475}}{\cancel{40}} = 12.475$$

Q3.) The - - - - - - - - -

Sol

C/I	X	$U = \frac{X-A}{h}$	f	fU
11-13	12	-3	7	-21
13-15	14	-2	6	-12
15-17	16	-1	9	-9
17-19	18	0	13	0
19-21	20	1	f	f
21-23	22	2	5	10
23-25	24	3	4	12
			$\Sigma f = 44+f$	$\Sigma fU = -20+f$

-42

$-22+f$

$h = 2$

Mean = 18

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$

$$18 = 18 + \frac{(-20+f)}{44+f} \times 2$$

$$18 - 18 = \frac{-20 + f}{44 + f} \times 2$$

$$0 = \frac{-40 + 2f}{44 + f}$$

$$0 \times (44 + f) = -40 + 2f$$

$$0 = -40 + 2f$$

$$2f = 40$$

$$f = \frac{\cancel{40}^{20}}{\cancel{2}}$$

$$f = 20$$

Ex - 13.2

$$\text{Mode} = L + \frac{[f_1 - f_0]}{2f_1 - f_0 - f_2} \times h$$

L = lower limit of modal class
f_0 = frequency of class preceding the modal class.
f_1 = " " " "
f_2 = " " " succeeding " ".
h = class size.

Q1) The - - - - - - - -

Sol

C/I	frequency		
5-15	6		
15-25	11		
25-35	21		f_0
35-45	23	]- Modal class	f_1
45-55	14		f_2
55-65	5		

$h = 10$

$$\text{Mode} = L + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$$

$$= L + \frac{23-21}{2\times23 - 21 - 14} \times h$$

$$= L + \frac{2}{11} \times h$$

$$= 35 + \frac{2}{11} \times 10$$

$$= 35 + \frac{20}{11} = 35 + 1.81 = 36.81$$

Q2.) The following — — — — — — — .

Sol

C/I	frequency	
0 – 20	10	
20 – 40	35	
40 – 60	52	f_0
60 – 80	61] - Modal class	f_1
80 – 100	38	f_2
100 – 120	29	

$h = 20$

$$\text{Mode} = L + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$$

$$= 60 + \frac{61 - 52}{2 \times 61 - 52 - 38} \times 20$$

$$= 60 + \frac{9}{122 - 90} \times 20$$

$$= 60 + \frac{9}{\cancel{32}_{8}} \times \cancel{20}^{5}$$

$$= 60 + \frac{45}{8}$$

$$= 60 + 5.625$$

$$= 65.625$$

Q3) The following ——...

Sol

C/I	frequency
1000 - 1500	24
1500 - 2000	40] Modal class
2000 - 2500	33
2500 - 3000	28
3000 - 3500	30
3500 - 4000	22
4000 - 4500	16
4500 - 5000	7

f_0
f_1
f_2

$h = 500$

$$Mode = L + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$$

$$= 1500 + \frac{40-24}{2\times40-24-33} \times 500$$

$$= 1500 + \frac{16}{80-57} \times 500$$

$$= 1500 + \frac{16}{23} \times 500$$

$$= 1500 + \frac{8000}{23}$$

$$= 1500 + 347.82$$

$$= 1847.82$$

Q4.) The following - - - - - - - -

Sol

C.I	frequency
15-20	3
20-25	8
25-30	9
30-35	10] Modal Class
35-40	3
40-45	0
45-50	0
50-55	2

f_0
f_1
f_2

$h = 5$

$$\text{Mode} = L + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$$

$$= 30 + \frac{10-9}{2\times10-9-3} \times 5$$

$$= 30 + \frac{1}{8} \times 5$$

$$= 30 + \frac{5}{8}$$

$$= 30 + 0.625$$

$$= \cancel{30.38}\ 30.625$$

Q5) The given ------

Sol

C/I	frequency
3000 - 4000	4
4000 - 5000	18] Modal Class
5000 - 6000	9
6000 - 7000	7
7000 - 8000	6
8000 - 9000	3
9000 - 10000	1
10000 - 11000	1

f_0

f_1

f_2

$h = 1000$

$$\text{Mode} = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$= 4000 + \frac{18-4}{2\times18-4-9} \times 1000$$

$$= 4000 + \frac{14}{\cancel{23}\,23} \times 1000$$

$$= 4000 + \frac{14000}{23}$$

$$= 4000 + \cancel{666.66}\ 608.7$$

$$= \cancel{4666.66}\ 4608.7$$

Q6.) A student — — — — — — — — — —

Sol

C/I	frequency	
0 - 10	7	
10 - 20	14	
20 - 30	13	
30 - 40	12	f_0
40 - 50	20	] Modal Class f_1
50 - 60	11	f_2
60 - 70	15	
70 - 80	8	

$h = 10$

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$= 40 + \frac{20-12}{2\times20-12-11} \times 10$$

$$= 40 + \frac{8}{40-23} \times 10$$

$$= 40 + \frac{8}{17} \times 10$$

$$= 40 + \frac{80}{17}$$

$$= 40 + 4.705$$

$$= 44.705$$

Ex - 13.3

Median – $L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$ $\quad (\Sigma f = N)$

L – lower limit of median class.
$N = \Sigma f \rightarrow$ Sum of frequencies
Cf = Cummutative frequency of class preceding median class
h = class size
f = class size

Q1) The — — — — — — —

Sol

C/I	f	Cf
65–85	4	4
85–105	5	9
105–125	13	22 C.f
125–145	20	42] Median Class f
145–165	14	56
165–185	8	64
185–205	4	68
$h = 20$	$N = 68$	

$\frac{N}{2} = \frac{\cancel{68}}{\cancel{2}} = 34$

Median $= L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$

$= 125 + \frac{34 - 22}{\cancel{20}} \times \cancel{20}$

$= 125 + 12$
$= 137$

Mode $= 135.7$

3Mean = 3 Median – Mode $\quad$ {By relation}

$= 3 \times 137 - 135.7$
$= 411 - 135.7 = \cancel{275.3} = 137.6$

Q6.) 100 surnames — — — —

Sol

C/I	f	C.f
1-4	6	6
4-7	30	36
7-10	40	76
10-13	16	92
13-16	4	96
16-19	4	100
h = 3	N=100	

] Median class

C.f

f

$$\frac{N}{2} = \frac{\cancel{100}}{\cancel{2}} = 50$$

$$\text{Median} = L + \left[\frac{\boxed{\frac{N}{2} - C.f}}{f}\right] \times h$$

$$= 7 + \frac{50 - 36}{40} \times 3$$

$$= 7 + \frac{\cancel{14}^{7}}{\cancel{40}_{20}} \times 3$$

$$= 7 + \frac{21}{20}$$

$$= 7 + 1.05$$

$$= 8.05$$

Q 7:) The distribution — ——— ———

Sol

C.I.	f	C.f
40-45	2	2
45-50	3	5
50-55	8	13
55-60	6	19] Median class
60-65	6	25
65-70	3	28
70-75	2	30
$h = 5$	$N = 30$	

$\frac{C.f}{f}$

$$\frac{N}{2} = \frac{30}{\cancel{2}} = 15$$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$= 55 + \frac{15 - 13}{6} \times 5$$

$$= 55 + \frac{\cancel{2}^{1}}{\cancel{6}_{3}} \times 5$$

$$= 55 + \frac{5}{3}$$

$$= 55 + 1.66\ldots$$

$$= 56.66\ldots$$

$$= 56.67$$

Q5.) The following ---

Sol

C/I	f	C.f
1500 - 2000	14	14
2000 - 2500	56	70
2500 - 3000	60	130
3000 - 3500	86	216] Median Class
3500 - 4000	74	290
4000 - 4500	62	352
4500 - 5000	48	400
h = 500	N = 400	

C f

f

$\frac{N}{2} = \cancel{\frac{300}{2}} = \cancel{150}$ $\frac{400}{2} = 200$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$= 3000 + \frac{200 - 130}{86} \times 500$$

$$= 3000 + \frac{\cancel{70}}{\cancel{86}_{43}} \times 500$$

$$= 3000 + \frac{35000}{43}$$

$$= 3000 + 116.2$$

$$= 3116.2$$

Q4) The lengths ———

Sol

117.5 − 126.5	3	3
126.5 − 135.5	5	8
135.5 − 144.5	9	17
144.5 − 153.5	12	29] Median class
153.5 − 162.5	5	34
162.5 − 171.5	4	38
171.5 − 180.5	2	40
$h = 9$	$N = 40$	

C.f
f

$$\frac{N}{2} = \frac{\cancel{40}}{\cancel{2}} = 20$$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$= 144.5 + \frac{20 - 17}{12} \times 9$$

$$= 144.5 + \frac{3 \times \cancel{9}3}{\cancel{12}4}$$

$$= 144.5 + \frac{9}{4}$$

$$= 144.5 + 2.25$$

$$= 146.75$$

Q8.) The life ― ― ― ― ― ―

Sol

C/I	C/I	f	C.f
below 20	15-20	2	2
" 25	20 - 25	6-2= 4	6
" 30	25 - 30	24-6=18	24
" 35	30 - 35	45 - 24 = 21	45
" 40	35 - 40	78 - 45 = 33	78] Median Class
" 45	40 - 45	11	89
" 50	45 - 50	3	92
" 55	50 - 55	6	98
" 60	55 - 60	2	100.
$h=5$		$N = 100$	

C.f
f

$\frac{N}{2} = \frac{100}{2} = 50$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$= 35 + \frac{50 - 45}{33} \times 5$$

$$= 35 + \frac{5}{33} \times 5$$

$$= 35 + \frac{25}{33}$$

$$= 35 + 0.75$$

$$= 35.75$$

Q2:) If - - - - - - - - - - .

Sol

C.I	f	C.f
0-10	5	5
10-20	x	$5+x$
L 20-30	20	$25+x$
30-40	15	$40+x$
40-50	y	$40+x+y$
50-60	5	$45+x+y$
$h=10$	$N=60$	

C.f] Median Class f

$$\text{Median} = 28.5 \quad , \frac{N}{2} = \frac{60}{2} = 30$$

$$5+x+20+15+y+5 = 60$$

$$45+x+y = 60$$

$$x+y = 60-45 = 15 \quad - (1)$$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$28.5 = 20 + \frac{30-(5+x)}{20_2} \times 10$$

$$28.5 - 20 = \frac{30-5-x}{2}$$

$$8.5 = \frac{25-x}{2}$$

$$8.5 \times 2 = 25 - x$$

$$17 = 25 - x$$

$$x = 25 - 17$$

$$x = 8$$

Putting $x=8$ in ①

$x+y=15$

$8+y=15$

$y=15-8$

$y=7$

EXTRA QUESTIONS

Q1) The median of data is 14.4, find x & y if total frequency is 20.

Sol

C/I	f	C.f
0-6	4	4
6-12	x	$4+x$
L (12)-18	5	$9+x$
18-24	y	$9+x+y$
24-30	1	$10+x+y$
$h=6$	$N=20$	

C.f] Median class f

Median $= 14.4$

$\frac{N}{2} = \frac{20}{2} = 10$

$4+x+5+y+1=20$

$10+x+y=20$

$x+y=20-10$

$x+y=10$ — ①

$$\text{Median} = L+\left[\frac{\frac{N}{2}-C.f}{f}\right]\times h$$

$$14.4 = 12+\left(\frac{10-(9+x)}{5}\right)\times 6$$

$$14.4 - 12 = \frac{10 - 4 - x}{5} \times 6$$

$$2.4 = \frac{6 - x}{5} \times 6$$

$$2.4 = \frac{36 - 6x}{5}$$

$$2.4 \times 5 = 36 - 6x$$

$$6x = 36 - 12$$

$$x = \frac{\cancel{24}^{4}}{\cancel{6}}$$

$$x = 4 \quad \text{— (2)}$$

Putting (2) in (1)

$$x + y = 10$$
$$4 + y = 10$$
$$y = 10 - 4$$
$$y = 6$$
$$\therefore x = 4, y = 6$$

Q2.) Find value of x & y if median of data is 31 & sum of frequencies is 40.

Sol

C.I.	f	C.f
0-10	5	5
10-20	x	5+x
20-30	6	11+x
L 30-40	y	11+x+y
40-50	6	17+x+y
50-60	5	22+x+y
h = 10	N = 40	

] Median Class

C.f

f

Median = 31, $\frac{N}{2} = \frac{\cancel{40}}{\cancel{2}} = 20$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$31 = 30 + \frac{20 - 11 - x}{y} \times 10$$

$$31 - 30 = \frac{9 - x}{y} \times 10$$

$$y = 90 - 10x$$

$$10x + y = 90 \quad - (2)$$

$$5 + x + 6 + y + 6 + 5 = 40$$

$$22 + x + y = 40$$

$$x + y = 40 - 22$$

$$x + y = 18 \quad - (1)$$

$$x = 18 - y \quad - (3)$$

Putting (3) in (2)

$$10(18 - y) + y = 90$$

$$180 - 10y + y = 90$$

$$-9y = 90 - 180$$

$$y = \frac{\cancel{+90}^{10}}{\cancel{+9}}$$

$$y = 10 \quad - (4)$$

Putting (4) in (1)

$$x + y = 18$$

$$x + 10 = 18$$

$$x = 18 - 10$$

$$x = 8$$

$$\therefore x = 8 \;,\; y = 10$$

Q3.) Median of the data is 50. Find p & q if N = 90.

Sol

C.I	f	C.f
20-30	p	p
30-40	15	15+p
40-50	25	40+p
L 50-60	20	60+p] Median Class
60-70	q	60+p+q
70-80	8	68+p+q
80-90	10	78+p+q
h = 10	N = 90	

C.f
f

Median = 50 , $\frac{N}{2} = \frac{90}{\cancel{2}} = 45$

$$\text{Median} = L + \left[\frac{\frac{N}{2} - C.f}{f}\right] \times h$$

$$50 = 50 + \frac{45 - 40 - p}{\cancel{20}_2} \times \cancel{10}$$

$$50 - 50 = 5 - p$$

$$p = 5 \quad -(2)$$

$$p + 15 + 25 + 20 + q + 8 + 10 = 90$$

$$78 + p + q = 90$$

$$p + q = 90 - 78$$

$$p + q = 12 \quad -(1)$$

Putting (2) in (1)

$$5 + q = 12$$

$$q = 12 - 5 = 7$$

$$\therefore p = 5 , q = 7$$

Q4) Find the value of x & y if mode of data is 55 & sum of frequencies is 51.

Sol

C.I	f
0-15	6
15-30	7
30-45	x f_0
45-60	15] Modal Class f_1
60-75	10 f_2
75-90	y
$h=15$	51

$6+7+x+15+10+y = 51$

$38+x+y = 51$

$x+y = 51-38$

$x+y = 13$ — (1)

$$\text{Mode} = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$55 = 45 + \frac{15-x}{30-x-10} \times 15$$

$$55-45 = \frac{15-x}{20-x} \times 15$$

$$10 = \frac{225-15x}{20-x}$$

$200 - 10x = 225 - 15x$

$200 = 225 - 15x + 10x$

$200 - 225 = -5x$

$$x = \frac{\cancel{25}\,5}{\cancel{5}}$$

$x = 5$

Putting ② in ①

$5 + y = 13$

$y = 13 - 5$

$y = 8$

$\therefore x = 5, \; y = 8$

Q5) The mode of the data is 65. Find x & y if sum of frequencies is 70.

Sol

C/I	f	
0-20	8	
20-40	11	
40-60	x	f_0
L 60-80	12	] Modal Class f_1
80-100	y	f_2
100-120	9	
120-140	9	
140-160	5	
h = 20	70	

Mode = 65

$8 + 11 + x + 12 + y + 9 + 9 + 5 = 70$

$54 + x + y = 70$

$x + y = 70 - 54$

$x + y = 16 \quad -①$

$x = 16 - y \quad -②$

$$\text{Mode} = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$65 = 60 + \frac{12-x}{24-x-y} \times 20$$

$$65-60 = \frac{240-20x}{24-x-y}$$

$$5(24-x-y) = 240-20x$$

$$120-5x-5y = 240-20x$$

$$-5y = 240-120-20x+5x$$

$$-5y = 120-15x$$

$$15x-5y = 120 \quad -③$$

Putting ② in ③

$$15(16-y)-5y = 120$$

$$240-15y-5y = 120$$

$$-20y = 120-240$$

$$y = \frac{-\cancel{120}\,6}{-\cancel{20}}$$

$$y = 6 \quad -④$$

Putting ④ in ①

$$x+y = 16$$

$$x+6 = 16$$

$$x = 16-6$$

$$x = 10$$

$\therefore x = 10, y = 6$

Q6.) The ~~mode~~ mean of the data is 62.8 and the sum of frequencies is 50. Find f_1 and f_2.

Sol

C/I	x	$U=\frac{x-A}{h}$	f	fU
0-20	10	-2	5	-10
20-40	30	-1	f_1	$-f_1$
40-60	50 A	0	10	0
60-80	70	1	f_2	f_2
80-100	90	2	7	14
100-120	110	3	8	24

$-10-f_1$

$38+f_2$

$h=20$ $\quad \Sigma f = 30+f_1+f_2$ $\quad \Sigma fU = 28 - f_1 + f_2$

$$5+f_1+10+f_2+7+8 = 50$$
$$30+f_1+f_2 = 50$$
$$f_1+f_2 = 50-30$$
$$f_1+f_2 = 20 \quad -①$$
$$f_1 = 20-f_2 \quad -②$$

$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$

$$62.8 = 50 + \frac{28-f_1+f_2}{30+f_1+f_2} \times 20$$

$$62.8-50 = \frac{560-20f_1+20f_2}{30+f_1+f_2}$$

$$12.8 = \frac{560-20f_1+20f_2}{30+f_1+f_2}$$

$$12.8(30+f_1+f_2) = 560-20f_1+20f_2$$
$$38.4 + 12.8f_1 + 12.8f_2 = 560 - 20f_1 + 20f_2$$

$$12.8f_1 + 12.8f_2 = 560 - 38.4 - 20f_1 + 20f_2$$

$$12.8f_1 + 20f_1 + 12.8f_2 - 20f_2 = 521.6$$

$$32.8f_1 - 7.2f_2 = 521.6 \quad -(3)$$

Putting (2) in (3)

$$32.8(20 - f_2) - 7.2f_2 = 521.6$$

$$656.0 - 32.8f_2 - 7.2f_2 = 521.6$$

$$-40f_2 = 521.6 - 656$$

$$f_2 = \frac{\cancel{-134.4}^{12}}{\cancel{-40}}$$

$$f_2 = 12 \quad -(4)$$

Putting (4) in (1)

$$f_1 + f_2 = 20$$

$$f_1 + 12 = 20$$

$$f_1 = 20 - 12$$

$$f_1 = 8$$

$$\therefore f_1 = 8,\ f_2 = 12$$

Q 7:) The daily expenditure of 100 families are given below. Calculate f_1 & f_2 if mean daily expenditure is 188 Rs.

Sol

C/I	X	$U = \frac{x-A}{h}$	f	fU
140-160	150	-2	5	-10
160-180	170	-1	25	-25
180-200	190 A	0	f_1	0
200-220	210	1	f_2	f_2
220-240	230	2	5	10
h = 20			$35 + f_1 + f_2$	$\Sigma fU = -25 + f_2$

$-10 - 25 = -35$; $f_2 + 10 = 10 + f_2$

$$5 + 25 + f_1 + f_2 + 5 = 100$$
$$35 + f_1 + f_2 = 100$$
$$f_1 + f_2 = 100 - 35$$
$$f_1 + f_2 = 65 \quad -(1)$$
$$f_1 = 65 - f_2 \quad -(2)$$
$$\bar{x} = A + \frac{\Sigma fU}{\Sigma f} \times h$$
$$188 = 190 + \frac{(-25 + f_2)}{35 + f_1 + f_2} \times 20$$
$$188 - 190 = \frac{-25 + f_2}{35 + f_1 + f_2} \times 20$$
$$-2(35 + f_1 + f_2) = -500 + 20f_2$$
$$-70 - 2f_1 - 2f_2 = -500 + 20f_2$$
$$-2f_1 - 2f_2 - 20f_2 = -500 + 70$$
$$-2f_1 - 22f_2 = 430$$
$$-2[f_1 + 11f_2] = 430$$
$$f_1 + 11f_2 = \frac{\cancel{430}^{215}}{\cancel{-2}}$$
$$f_1 + 11f_2 = 215 \quad -(3)$$

Putting ② in ③

$$65 - f_2 + 11f_2 = 215$$
$$10f_2 = 215 - 65$$
$$f_2 = \frac{15\cancel{0}}{1\cancel{0}}$$
$$f_2 = 15 \quad - ④$$

Putting ~~③~~ ④ in ①

$$f_1 + f_2 = 65$$
$$f_1 + 15 = 65$$
$$f_1 = 65 - 15$$
$$f_1 = 50$$

$$\therefore f_1 = 50, f_2 = 15$$

18/04

CH-14

Probability

$P(E) = \frac{\text{Fav. outcome}}{\text{Total outcomes}} = \frac{a}{b} = 0 - 1$

$P(E) + P(\text{not } E) = 1$

Ex - 14.1

Q1:) Complete the following:-

i) Probability of an event E + Probability of an event 'not E' = 1

ii) The probability of an event that cannot happen is 0. Such an event is called Impossible event.

iii) The probability of an event that is certain to happen is 1. Such an event is called Sure event.

iv) The sum of the probabilities of all the elementary events of an experiment is 1.

v) The probability of an event is greater than or equal to 0 and less than or equal to 1.

Q2:) Which of the following experiments have equally likely outcomes

i) A driver attempts to start a car. The car starts or doesn't start. False

ii) A player attempts to shoot a basketball. He shoots or misses the shot. False

iii) Trial is made to answer a True/False question. The answer is right or wrong. True.

iv) A child is born a boy or girl. True.

Q3) Why is tossing a coin considered to be a fair way of deciding?

Ans ∵ tossing a coin is a equally likely outcome.

Q4) Which of fallowing can't be probability of an event?

Sol a) $\frac{2}{3}$ b) -1.5 c) 15% d) 0.7

Q5) If $P(E) = 0.05$, what is probability of not E?

Sol $P(E) = 0.05$

$P(\text{not } E) = ?$

$P(E) + P(\text{not } E) = 1$

$0.05 + P(\text{not } E) = 1$

$P(\text{not } E) = 1 - 0.05$

$= 0.95$

Q6) A bag - - - - - - - - - - -

Sol i) 0

ii) 1

Q7) It is - - - - - - - - - - -

Sol $P(\text{not } E) = 0.992$

$P(E) = ?$

$P(E) + P(\text{not } E) = 1$

$P(E) = 1 - 0.992$

$= 0.008$

Q8:) A bag - - - - - - - - - -

Sol No. of Red balls = 3

" " Black " = 5

Total " = 8

i) P (Red)

Favourable Cases = 3

$P(E) = \frac{\text{Favourable Cases}}{\text{Total Cases}} = \frac{3}{8}$

ii) $P(\text{not Red}) = 1 - \frac{3}{8} = \frac{8-3}{8} = \frac{5}{8}$

Q9:) A box - - - - - - - - - -

Sol $T.C = 17 = 5 + 8 + 4$

$P(\text{Red}) = \frac{5}{17}$

$P(\text{White}) = \frac{8}{17}$

$P(\text{not green}) = \frac{5+8}{17} = \frac{13}{17}$

Q10:) A piggy - - - - - - - - - -

Sol 50p coins = 100

1 Rs " = 50

2 Rs " = 20

5 Rs " = 10

Total " = 180

i) $P(50_p) = \frac{\cancel{100}^{5}}{\cancel{180}_{9}} = \frac{5}{9}$

ii) $P(\text{not a 5 Rs coin}) = \frac{17\cancel{0}}{18\cancel{0}} = \frac{17}{18}$

Q12) Gopi - - - - - -

Sol Male fishs = 5

Female " = 8

Total " = 13

$P(\text{Male}) = \frac{5}{13}$

Q13) A game - - - - - - -

Sol Total Cases = 8

i) $P(8) = \frac{1}{8}$

ii) Odd Cases = 4

$P(\text{odd}) = \frac{\cancel{4}}{\cancel{8}} = \frac{1}{2}$

iii) No. greater than 2 = 6

$P(\text{no. greater than } 2) = \frac{\cancel{6}}{\cancel{8}} = \frac{3}{4}$

iv) No.s less Than 9 = 8

$P(\text{no. less than } 9) = \frac{\cancel{8}}{\cancel{8}} = 1$

Q13) A die - - - - - - - -

Sol T.C = 6

i) $P(\text{prime}) = \frac{\cancel{3}}{\cancel{6}} = \frac{1}{2}$

ii) $P(\text{b/w } 2 \,\&\, 6) = \frac{\cancel{3}}{\cancel{6}} = \frac{1}{2}$

iii) $P(\text{odd}) = \frac{3}{6} = \frac{1}{2}$

Q14.) One card ----------
Sol Composition of cards :-
Total = 52
Types = 4 { $\underbrace{\text{Spade ♠, Club ♣}}_{}$ Black, $\underbrace{\text{Heart ♡, Diamond ◇}}_{}$ Red }
All 4 cards have - Ace, 2 to 10 no.s and 3 face cards {J, Q, K}

i) P(Red king) = $\frac{\cancel{2}}{\cancel{52}} = \frac{1}{26}$

ii) P(Face Cards) = $\frac{\cancel{12}^{6\ 3}}{\cancel{52}_{26\ 13}} = \frac{3}{13}$

iii) P(Red Face Card) = $\frac{\cancel{6}}{\cancel{52}} = \frac{3}{26}$

iv) P(Jack of hearts) = $\frac{1}{52}$

v) P(Spade) = $\frac{\cancel{13}}{\cancel{52}} = \frac{1}{4}$

vi) P(queen of diamonds = $\frac{1}{52}$

Q15.) Five cards ----------------
Sol i) P(queen) = $\frac{1}{5}$

ii) a.) P(an ace) = $\frac{1}{4}$, b.) P(queen) = 0

Q16.) 12 defective ----------
Sol T.C = 144
P(Good pen) = $\frac{\cancel{132}^{11}}{\cancel{144}_{12}} = \frac{11}{12}$

Q17) i) A lot - - - - - - - - - -

Sol i) T.C = 20

F.C = 4

P(defective) = $\frac{\cancel{4}}{\cancel{20}} = \frac{1}{5}$

ii) T.C = 19

F.C = 15

P(good one) = $\frac{15}{19}$

Q18) A box - - - - -

Sol T.C = 90

i) F.C = 81

P(2 digit no.) = $\frac{\cancel{81}^{9}}{\cancel{90}_{10}} = \frac{9}{10}$

ii) F.C = 9

P(perfect square no.) = $\frac{\cancel{9}}{\cancel{90}} = \frac{1}{10}$

iii) F.C = 18

P(no. divisible by 5) = $\frac{\cancel{18}}{\cancel{90}} = \frac{1}{5}$

Q19) A child - - - - - - -

Sol T.C = 6

i) F.C = 2

P(A) = $\frac{\cancel{2}}{\cancel{6}} = \frac{1}{3}$

ii) F.C = 1

P(D) = $\frac{1}{6}$

Q20.) Suppose ---------------

Sol Area of rectangular sheet $= l \times b$
$= 3 \times 2 = 6\,m^2$

Diameter of circle = 1m
Radius " " $= \frac{1}{2}$

Area of circle $= \pi r^2 = \pi \times \frac{1}{2} \times \frac{1}{2} = \frac{\pi}{4}$

$T.C = 6\,m^2$
$F.C = \frac{\pi}{4}\,m^2$

P(die will land in circle) $= \frac{\frac{\pi}{4}}{6} = \frac{\pi}{24}$

Q21.) A lot ---------------

Sol Total Pens = 144
defective " = 20
Good " = 144 − 20 = 124

i) T.C = 144
F.C = 124
P(she will buy) $= \frac{\cancel{124}}{\cancel{144}} = \frac{31}{36}$

ii) T.C = 144
F.C = 20
P(she won't buy) $= \frac{\cancel{20}}{\cancel{144}} = \frac{5}{36}$

Q22) Refer — — — — — — — — — —

Sol $T.C = 6^n = 36$

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

i) Sum 2

$F.C = 1$

$P(\text{Sum } 2) = \frac{1}{36}$

ii) Sum 3

$F.C = 2$

$P(\text{Sum } 3) = \frac{\cancel{2}}{\cancel{36}} = \frac{1}{18}$

iii) Sum 4

$F.C = 3$

$P(\text{Sum } 4) = \frac{\cancel{3}}{\cancel{36}} = \frac{1}{12}$

iv) Sum 5

$F.C = 4$

$P(\text{Sum } 5) = \frac{\cancel{4}}{\cancel{36}} = \frac{1}{9}$

v) Sum 6
F.C = 5
P(Sum 6) = $\frac{5}{36}$

vi) Sum 7
F.C = 6
P(Sum 7) = $\frac{\cancel{6}}{\cancel{36}} = \frac{1}{6}$

vii) Sum 8
F.C = ~~6~~ 5
P(Sum 8) = $\frac{5}{36}$

viii) Sum 9
F.C = 4
P(Sum 9) = $\frac{\cancel{4}}{\cancel{36}} = \frac{1}{9}$

ix) Sum 10
F.C = 3
P(Sum 10) = $\frac{\cancel{3}}{\cancel{36}} = \frac{1}{12}$

x) Sum 11
F.C = 2
P(Sum 11) = $\frac{\cancel{2}}{\cancel{36}} = \frac{1}{18}$

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xi) Sum 12
F.C = 1
$P(\text{Sum } 12) = \frac{1}{36}$

ii) No, ∵ they are not no. but sum of 2 no.

Q23) A game ------------
Sol Note - Tossing coins general formula = 2^n {n is no. of times/coins}

$T.C = 2^n = 2^3 = 8$ {HHH, HHT, HTH, THH, TTH, THT, HTT, TTT}
F.C = 6
$P(\text{Hanif will lose}) = \frac{\cancel{6}}{\cancel{8}} = \frac{3}{4}$ {0, 1, 1, 1, 2, 2, 2, 3}

Q24) A die ------------
Sol i) T.C = 36
F.C = 36 − 11 = 25
$P(5 \text{ willn't come}) = \frac{25}{36}$

ii) T.C = 36
F.C = 11
$P(5 \text{ will come}) = \frac{11}{36}$

	1	2	3	4	5	6
1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)
2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)
3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
4	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)	(4,6)
5	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)	(5,6)
6	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)	(6,6)

Q25) Which ------
Sol i) False ∵ it has 4 possible outcomes.
ii) True ∵ it ~~has~~ is an equally likely outcome.

Extra Questions

Q1.) 3 coins are tossed simultaneously. Find probability of getting -

i) 1 Tail
ii) 2 heads
iii) 2 Tails
iv) No head
v) Exactly 3 tails
vi) At least 1 tail
vii) At least 2 heads
viii) At most 2 tails
ix) At most 1 tail

Sol: $T.C = 2^3 = 8$ $\{0, 1, 1, 1, 2, 2, 2, 3\}$

i) $F.C = 3$
$P(1\text{ tail}) = \frac{3}{8}$

ii) $F.C = 3$
$P(2\text{ heads}) = \frac{3}{8}$

iii) $F.C = 3$
$P(2\text{ tails}) = \frac{3}{8}$

iv) $F.C = 1$
$P(\text{No head}) = \frac{1}{8}$

v) $F.C = 1$
$P(3\text{ Tails}) = \frac{1}{8}$

vi) $F.C = 7$
$P(\text{At least 1 Tail}) = \frac{7}{8}$

vii) $F.C = 4$
$P(\text{At least 2 heads}) = \frac{\cancel{4}}{\cancel{8}} = \frac{1}{2}$

viii) F.C = 7

PC At most 2 tails = $\frac{7}{8}$

ix) F.C = 4

P(At most 1 tail) = $\frac{\cancel{4}}{\cancel{8}} = \frac{1}{2}$

Q2:) 2 dice are thrown simultaneously. Find the probability of getting doublet.

Sol T.C = 36

F.C = 6

P(Doublet) = $\frac{\cancel{6}}{\cancel{36}} = \frac{1}{6}$

Q3:) 3 dice are thrown simultaneously. Find the probability of getting a triplet.

Sol T.C = $6^n = 6^3 = 216$

F.C = 6

P(getting triplet) = $\frac{\cancel{6}}{\cancel{216}} = \frac{1}{36}$

Q4.) What is probability of getting 53 sundays in a non leap year?

Ans Total days in a year = 365

No. of week = $\frac{365}{7}$ = 52 weeks + 1 day

This 1 day can be arranged as

{S, M, Tue, W, Thu, Fri, Sat}

T.C = 7

F.C = 1

P(53 Sundays) = $\frac{1}{7}$

Q5:) What is the probability of getting 53 sundays in a leap year?

Sol Total Days in year = 366

" weeks " " = $\frac{366}{7}$ = 52 weeks + 2 days

These 2 days can be arranged as:-

(Sun, Mon) (Mon, Tue) (Tue, Wed) (Wed, Thu) (Thu, Fri) (Fri, Sat) (Sat, Sun)

T.C = 7

F.C = 2

P(53 sundays) = $\frac{2}{7}$

Q6:) Cards numbered from 1 to 30 are put in a bag. A card is drawn at random. What is probability of getting -

i) a prime no. bigger than 7

ii) not a perfect square

iii) Not divisible by 3.

Sol T.C = 30

i) F.C = 6

P(7+ prime) = $\frac{\cancel{6}}{\cancel{30}} = \frac{1}{5}$

ii) F.C = 30 - 5 = 25

P(not perfect square) = $\frac{\cancel{25}}{\cancel{30}} = \frac{5}{6}$

iii) F.C = 30 - 10 = 20

P(not divisible by 3) = $\frac{\cancel{20}}{\cancel{30}} = \frac{2}{3}$

Q7.) A letter of english alphabet is choosen at random. Determine the probability that the letter is –

i) consonant ii) Vowel

Sol T.C = 26

i) F.C = 26 − 5 = 21

$P(\text{Consonant}) = \frac{\cancel{21}\,21}{\cancel{26}\,26} = \frac{21}{26}$

ii) F.C = 5

$P(\text{Vowel}) = \frac{5}{26}$

Q8.) 2 dice are thrown simultaneously. Find the probability of no. appearing on top sum is –

i) 9 or 11
ii) 6 or 7
iii) a multiple of 3 is the sum
iv) At least 10
v) no. less than or equal to 10
vi) even

Sol TC = 36

i) F.C = 6

$P(9 \text{ or } 11) = \frac{\cancel{6}}{\cancel{36}} = \frac{1}{6}$

ii) F.C = 11

$P(6 \text{ or } 7) = \frac{11}{36}$

iii) F.C = 12

$P(\text{multiple of } 3) = \frac{\cancel{12}}{\cancel{36}} = \frac{1}{3}$

iv) F.C = 6

$P(\text{At least } 10) = \frac{\cancel{6}}{\cancel{36}} = \frac{1}{6}$

v) F.C = 33

$P(\text{no.} \leq 10) = \frac{\cancel{33}}{\cancel{36}} = \frac{11}{12}$

vi) F.C = 18

$P(\text{even}) = \frac{\cancel{18}}{\cancel{36}} = \frac{1}{2}$

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Q9) 2 different dice tossed together. Find probability that product of 2 no. at top are –
i) 6
ii) perfect square
iii) even
iv) less than 16

Sol T.C = 36

i) F.C = 4

$$P(6) = \frac{\cancel{4}}{\cancel{36}} = \frac{1}{9}$$

ii) F.C = 8

$$P(\text{perfect square}) = \frac{\cancel{8}}{\cancel{36}} = \frac{2}{9}$$

iii) F.C = 27

$$P(\text{even}) = \frac{\cancel{27}}{\cancel{36}} = \frac{3}{4}$$

iv) F.C = 26

$$P(<16) = \frac{\cancel{26}}{\cancel{36}} = \frac{13}{18}$$

Q10) A die is numbered in such a way that it's faces are 1, 2, 2, 3, 3, 6. It is thrown twice and total score in 2 throws is noted. Find the probability that total score is –
i) Even
ii) Six
iii) At least 6

Sol T.C = 36

i) F.C = 18

$$P(\text{Even}) = \frac{\cancel{18}}{\cancel{36}} = \frac{1}{2}$$

ii) F.C = 4

$$P(\text{six}) = \frac{4}{36} = \frac{1}{9}$$

iii) F.C = 15

$$P(\text{At least } 6) = \frac{15}{36} = \frac{5}{12}$$

Q11) 3 coins are tossed simultaneously find probability of getting -

i) 3 heads
ii) 2 heads
iii) 1 head
iv) No head
v) At least 1 head
vi) At least 2 heads
vii) At most 2 heads
viii) At most 1 tail

Sol T.C = 8

i) F.C = 1

$$P(3 \text{ heads}) = \frac{1}{8}$$

ii) F.C = 3

$$P(2 \text{ heads}) = \frac{3}{8}$$

iii) F.C = 3

$$P(1 \text{ head}) = \frac{3}{8}$$

iv) F.C = 1

$$P(\text{no head}) = \frac{1}{8}$$

v) F.C = 7

$$P(\text{At least } 1 \text{ head}) = \frac{7}{8}$$

vi) F.C = 4
P(At least 2 heads) = $\frac{4}{8} = \frac{1}{2}$

vii) F.C = 7
P(At most 2 heads) = $\frac{7}{8}$

viii) F.C = 4
P(At most 1 tail) = $\frac{4}{8} = \frac{1}{2}$

Q2) A card is drawn from a well shuffled deck of 52 cards. Find probability that -
i) Neither King nor ace
ii) Either King or ace
iii) Spade or King
iv) Spade and King
v) Neither Red nor queen
vi) 10 of hearts
vii) King or queen
viii) King and queen

Sol T.C = 52
i) F.C = 44
P(neither king nor ace) = $\frac{44}{52} = \frac{11}{13}$

ii) F.C = 8
P(Either King or ace) = $\frac{8}{52} = \frac{2}{13}$

iii) F.C = 16
P(spade or King) = $\frac{16}{52} = \frac{4}{13}$

iv) F.C = 1

P(spade & King) = $\frac{1}{52}$

v) F.C = 24

P(neither red nor queen) = $\frac{\cancel{24}}{\cancel{52}} = \frac{6}{13}$

vi) F.C = 1

P(10 of hearts) = $\frac{1}{52}$

vii) F.C = 8

P(King or queen) = $\frac{\cancel{8}}{\cancel{52}} = \frac{2}{13}$

viii) F.C = 0

P(King and queen) = $\frac{0}{52} = 0$

$\frac{24}{04}$

CH-2

Polynomials

Zero - A value of variable that makes polynomial 0.
Degree - highest power of variable
no. of zeroes = highest degree

Ex-2.1

Q1.) The ___________

Sol i) 0
ii) 1
iii) 3
iv) 2
v) 4
vi) 3

General form of quadratic polynomial - ax^2+bx+c

Relation b/w 2 zeroes and coff.:-
If α and β are zeroes of polynomial
i) Sum of 2 zeroes $\Rightarrow \alpha+\beta = \frac{-b}{a}$

ii) Product of 2 zeroes $\Rightarrow \alpha \times \beta = \frac{c}{a}$

iii) If α & β are the zeroes of the polynomial then
$P(x) = x^2 - Sx + P$
S = Sum of zeroes , P = Product of zeroes

Ex-2.2

Q1) Find ------ --- --

Sol i) x^2-2x-8

$=x^2-4x+2x-8$

$=x(x-4)+2(x-4)$

$=(x+2)(x-4)$

$x-4=0$	$x+2=0$
$x=4$	$x=-2$
$\alpha=4$	$\beta=-2$

Verification

$\alpha+\beta=\frac{-b}{a}$	$\alpha\beta=\frac{c}{a}$
$\alpha+\beta=4+(-2)$ $=4-2$ $=2$	$\alpha\beta=4\times-2=-8$
$\frac{-b}{a}=\frac{-(-2)}{1}$ $=2$	$\frac{c}{a}=\frac{-8}{1}=-8$
$\therefore\alpha+\beta=\frac{-b}{a}$	$\therefore\alpha\beta=\frac{c}{a}$
	Hence verified

ii) $4s^2 - 4s + 1$

$= 4s^2 - 2s - 2s + 1$

$= 2s(2s-1) - 1(2s-1)$

$= (2s-1)(2s-1)$

$2s - 1 = 0$

$2s = 1$

$s = \frac{1}{2}$

$\alpha = \frac{1}{2}$

$2s - 1 = 0$

$2s = 1$

$s = \frac{1}{2}$

$\beta = \frac{1}{2}$

Verification

$\alpha + \beta = \frac{-b}{a}$

$\alpha + \beta = \frac{1}{2} + \frac{1}{2}$

$= \cancel{\frac{2}{2}} = 1$

$\frac{-b}{a} = \frac{-(-4)}{4}$

$= \cancel{\frac{4}{4}} = 1$

$\therefore \alpha + \beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$

$\alpha\beta = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$\frac{c}{a} = \frac{1}{4}$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified

iii) $6x^2 - 3 - 7x$

$= 6x^2 - 7x - 3$

$= 6x^2 - 9x + 2x - 3$

$= 6x^2 + 2x - 9x - 3$

$= 2x(3x+1) - 3(3x+1)$

$= (2x-3)(3x+1)$

$2x - 3 = 0$

$2x = 3$

$x = \frac{3}{2}$

$\alpha = \frac{3}{2}$

$3x + 1 = 0$

$3x = -1$

$x = \frac{-1}{3}$

$\beta = \frac{-1}{3}$

Verification

$\alpha + \beta = \frac{-b}{a}$

$\alpha + \beta = \frac{3}{2} + \frac{(-1)}{3}$

$= \frac{9-2}{6}$

$= \frac{7}{6}$

$\frac{-b}{a} = -\frac{(-7)}{6}$

$= \frac{7}{6}$

$\therefore \alpha + \beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$

$\alpha\beta = \frac{\cancel{3}}{2} \times \frac{-1}{\cancel{3}} = \frac{-1}{2}$

$\frac{c}{a} = \frac{-\cancel{3}}{\cancel{6}} = \frac{-1}{2}$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified.

iv) $= 4u^2 + 8u$
$= 4u(u+2)$
$= (4u)(u+2)$

$4u = 0$	$u+2 = 0$
$u = \frac{0}{4}$	$u = -2$
$\alpha = 0$	$\beta = -2$

Verification

$\alpha + \beta = \frac{-b}{a}$	$\alpha\beta = \frac{-c}{a}$
$\alpha + \beta = 0 + (-2)$	$\alpha\beta = 0 \times -2$
$= -2$	$= 0$
$\frac{-b}{a} = \frac{-8}{4} = -2$	$\frac{-c}{a} = \frac{-0}{4} = 0$
$\therefore \alpha + \beta = \frac{-b}{a}$	$\therefore \alpha\beta = \frac{-c}{a}$

Hence verified.

v) $t^2 - 15$

$t^2 - 15 = 0$

$t^2 = 15$

$t = \pm\sqrt{15}$

$\alpha = \sqrt{15}$, $\beta = -\sqrt{15}$

Verification

$\alpha + \beta = \frac{-b}{a}$

$\alpha + \beta = \sqrt{15} - \sqrt{15}$
$= 0$

$\frac{-b}{a} = \frac{0}{1} = 0$

$\therefore \alpha + \beta = \frac{-b}{a}$

$\alpha\beta = \frac{-c}{a}$

$\alpha\beta = \sqrt{15} \times (-\sqrt{15}) = -15$

$\frac{c}{a} = \frac{-15}{1} = -15$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified

vi) $3x^2 - x - 4$

$= 3x^2 - 4x + 3x - 4$

$= 3x^2 + 3x - 4x - 4$

$= 3x(x+1) - 4(x+1)$

$= (3x-4)(x+1)$

$3x - 4 = 0$

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

$\alpha = \frac{4}{3}$

$x + 1 = 0$

$x = -1$

$\beta = -1$

Verification

$\alpha+\beta = \frac{-b}{a}$

$\alpha+\beta = \frac{4}{3} - 1 = \frac{1}{3}$

$\frac{-b}{a} = \frac{-(-1)}{3} = \frac{1}{3}$

$\therefore \alpha+\beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$

$\alpha\beta = \frac{4}{3} \times -1 = \frac{-4}{3}$

$\frac{c}{a} = \frac{-4}{3}$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified.

Q2.) Find - - - - - - - - .

Sol i) $\frac{1}{4}, -1$

$S = \frac{1}{4}, P = -1$

$P(x) = x^2 - Sx + P$

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

$= x^2 - \frac{1}{4}x - 1$

$= \frac{1}{4}\left[4x^2 - \cancel{4} \times \frac{1}{\cancel{4}}x - 4 \times 1\right]$

$= \frac{1}{4}\left[4x^2 - x - 4\right]$

$p(x) = 4x^2 - x - 4$

ii) $\sqrt{2}, \frac{1}{3}$

$S = \sqrt{2}, \quad P = \frac{1}{3}$

$p(x) = x^2 - Sx + P$

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

$= \frac{1}{3}\left[3x^2 - 3\sqrt{2}x + \cancel{3} \times \frac{1}{\cancel{3}}\right]$

$= \frac{1}{3}\left[3x^2 - 3\sqrt{2}x + 1\right]$

$p(x) = 3x^2 - 3\sqrt{2}x + 1$

iii) $0, \sqrt{5}$

$p(x) = x^2 - 0x + \sqrt{5}$

$= x^2 + \sqrt{5}$

iv) $1, 1$

$p(x) = x^2 - Sx + P$

$= x^2 - x + 1$

v) $\frac{-1}{4}, \frac{1}{4}$

$p(x) = x^2 - \left(\frac{-1}{4}\right)x + \frac{1}{4}$

$= x^2 + \frac{1}{4}x + \frac{1}{4}$

$= \frac{1}{4}\left[4x^2 + x + 1\right]$

$p(x) = 4x^2 + x + 1$

vi) 4, 1

$p(x) = x^2 - Sx + P$

$= x^2 - 4x + 1$

EXTRA QUESTIONS

Q1:) The quadratic polynomial whose zeroes are $\left(2, \frac{-3}{2}\right)$

Sol $P = \cancel{2} \times \frac{-3}{\cancel{2}} = -3$

$S = 2 + \frac{-3}{2} = \frac{4-3}{2} = \frac{1}{2}$

$p(x) = x^2 - Sx + P$

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

$= \frac{1}{2}\left[2x^2 - x - 6\right]$

$p(x) = 2x^2 - x - 6$

Q2:) The quadratic polynomial whose zeroes are $(-3, 4)$.

Sol $P = -3 \times 4 = -12$

$S = -3 + 4 = 1$

$p(x) = x^2 - 1x + 12$

$= x^2 - x - 12$

$= x^2 - x - 12$

$= \frac{x^2}{2} - \frac{x}{2} - \frac{\cancel{12}\,6}{\cancel{2}}$

$= \frac{x^2}{2} - \frac{x}{2} - 6$

Q3:) Find the zeroes of polynomial and verify the relation between zeroes & coefficient.

i) $2x^2 + \frac{7}{2}x + \frac{3}{4}$.

ii) $4x^2 + 5\sqrt{2}x - 3$

iii) $y^2 + \frac{3}{2}\sqrt{5}y - 5$

iv) $4x^2 + 4x - 3$

v) $x^2 + \frac{1}{6}x - 2$

vi) $v^2 + 4\sqrt{3}v - 15$

Sol i) $2x^2 + \frac{7}{2}x + \frac{3}{4}$

$= \frac{1}{4}\left[8x^2 + 14x + 3\right]$

$= 8x^2 + 14x + 3$

$= 8x^2 + 12x + 2x + 3$

$= 8x^2 + 2x + 12x + 3$

$= 2x(4x+1) + 3(4x+1)$

$= (2x+3)(4x+1)$

$2x + 3 = 0$

$x = \frac{-3}{2}$

$\alpha = \frac{-3}{2}$

$4x + 1 = 0$

$x = \frac{-1}{4}$

$\beta = \frac{-1}{4}$

Verification

$\alpha + \beta = \frac{-3}{2} - \frac{1}{4} = \frac{-6-1}{4}$

$= \frac{-7}{4}$

$\frac{-b}{a} = \frac{-14}{8} = \frac{-7}{4}$

$\therefore \alpha + \beta = \frac{-b}{a}$

$\alpha\beta = \frac{-3}{2} \times \frac{-1}{4} = \frac{3}{8}$

$\frac{c}{a} = \frac{3}{8}$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified

ii) $4x^2 + 5\sqrt{2}x - 3$

$= 4x^2 + 6\sqrt{2}x - \sqrt{2}x - 3$

$\cancel{= 4x^2 - \sqrt{2}x + 6\sqrt{2}x - 3}$

$\cancel{= 2\sqrt{2}x(\sqrt{2}x + 3) - 1(}$

$= 2\sqrt{2}x(\sqrt{2}x + 3) - 1(\sqrt{2}x + 3)$

$= (2\sqrt{2}x - 1)(\sqrt{2}x + 3)$

$2\sqrt{2}x - 1 = 0$

$2\sqrt{2}x = 1$

$x = \dfrac{1}{2\sqrt{2}} = \dfrac{1}{2\sqrt{2}} \times \dfrac{2\sqrt{2}}{2\sqrt{2}}$

$= \dfrac{2\sqrt{2}}{4 \times 2} = \dfrac{\cancel{2}\sqrt{2}}{\cancel{8}\,4}$

$\alpha = \dfrac{\sqrt{2}}{4}$

$\sqrt{2}x + 3 = 0$

$\sqrt{2}x = -3$

$x = \dfrac{-3}{\sqrt{2}} \times \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{-3\sqrt{2}}{2}$

$\beta = \dfrac{-3\sqrt{2}}{2}$

Verification:-

$\alpha + \beta = \dfrac{-b}{a}$

$\alpha + \beta = \dfrac{\sqrt{2}}{4} + \left(\dfrac{-3\sqrt{2}}{2}\right)$

$= \dfrac{\sqrt{2} - 6\sqrt{2}}{4}$

$= \dfrac{-5\sqrt{2}}{4}$

$\dfrac{-b}{a} = \dfrac{-5\sqrt{2}}{4}$

$\therefore \alpha + \beta = \dfrac{-b}{a}$

$\alpha\beta = \dfrac{c}{a}$

$\alpha\beta = \dfrac{\sqrt{2}}{4} \times \dfrac{-3\sqrt{2}}{2}$

$= \dfrac{-3 \times \cancel{2}}{\cancel{8}\,4}$

$= \dfrac{-3}{4}$

$\dfrac{c}{a} = \dfrac{-3}{4}$

$\therefore \alpha\beta = \dfrac{c}{a}$

Hence verified

iii) $y^2 + \frac{3}{2}\sqrt{5}y - 5$

$= \frac{1}{2}\left[2y^2 + 3\sqrt{5}y - 10\right]$

$= 2y^2 + 3\sqrt{5}y - 10$

$= 2y^2 + 4\sqrt{5}y - \sqrt{5}y - 10$

$= 2y(y + 2\sqrt{5}) - \sqrt{5}(y + 2\sqrt{5})$

$= (y + 2\sqrt{5})(2y - \sqrt{5})$

$y + 2\sqrt{5} = 0$	$2y - \sqrt{5} = 0$
$y = -2\sqrt{5}$	$2y = \sqrt{5}$
	$y = \frac{\sqrt{5}}{2}$
$\alpha = -2\sqrt{5}$	$\beta = \frac{\sqrt{5}}{2}$

Verification :-

$\alpha + \beta = \frac{-b}{a}$	$\alpha\beta = \frac{c}{a}$
$\alpha + \beta = -2\sqrt{5} + \frac{\sqrt{5}}{2}$	$\alpha\beta = -\cancel{2}\sqrt{5} \times \frac{\sqrt{5}}{\cancel{2}}$
$= \frac{-4\sqrt{5} + \sqrt{5}}{2}$	$= \frac{-5}{1}$
$= \frac{-3\sqrt{5}}{2}$	$\frac{c}{a} = \frac{-5}{1}$
$\frac{-b}{a} = \frac{-3\sqrt{5}}{2 \times 1}$	$\therefore \alpha\beta = \frac{c}{a}$
$= \frac{-3\sqrt{5}}{2}$	Hence Verified
$\therefore \alpha + \beta = \frac{-b}{a}$	

iv) $4x^2 + 4x - 3$

$= 4x^2 - 2x + 6x - 3$

$= 2x(2x-1) + 3(2x-1)$

$= (2x+3)(2x-1)$

$2x+3=0$

$2x=-3$

$x=\frac{-3}{2}$

$\alpha=\frac{-3}{2}$

$2x-1=0$

$2x=1$

$x=\frac{1}{2}$

$\beta=\frac{1}{2}$

Verification:-

$\alpha+\beta=\frac{-b}{a}$

$\alpha+\beta=\frac{-3}{2}+\frac{1}{2}$

$=\frac{-3+1}{2}$

$=\frac{-\cancel{2}}{\cancel{2}}=-1$

$\frac{-b}{a}=\frac{-\cancel{4}}{\cancel{4}}=-1$

$\therefore \alpha+\beta=\frac{-b}{a}$

$\alpha\beta=\frac{c}{a}$

$\alpha\beta=\frac{-3}{2}\times\frac{1}{2}$

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

$\frac{c}{a}=\frac{-3}{4}$

$\therefore \alpha\beta=\frac{c}{a}$

Hence verified

v) $x^2 + \frac{1}{6}x - 2$

$= \frac{1}{6}[6x^2 + x - 12]$

$= 6x^2 + x - 12$

$= 6x^2 + 9x - 8x - 12$

$= 3x(2x-3) - 4(2x-3)$

$= (3x-4)(2x-3)$

$3x - 4 = 0$

$3x = 4$

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

$\alpha = \frac{4}{3}$

$2x - 3 = 0$

$2x = 3$

$x = \frac{3}{2}$

$\beta = \frac{3}{2}$

Verification :-

$\alpha + \beta = \frac{-b}{a}$

$\alpha + \beta = \frac{4}{3} + \frac{3}{2}$

$= \frac{8 - 9}{6}$

$= \frac{-1}{6}$

$\frac{-b}{a} = \frac{-1}{6}$

$\therefore \alpha + \beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$

$\alpha\beta = \frac{\cancel{4}^{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{2}} = 2$

$\frac{c}{a} = \frac{\cancel{12}^{2}}{\cancel{6}} = 2$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified.

vi) $v^2 + 4\sqrt{3}v - 15$

$= v^2 + 5\sqrt{3}v - \sqrt{3}v - 15$

$= v(v+5\sqrt{3}) - \sqrt{3}(v+5\sqrt{3})$

$= (v-\sqrt{3})(v+5\sqrt{3})$

$v-\sqrt{3}=0$	$v+5\sqrt{3}=0$
$v=\sqrt{3}$	$v=-5\sqrt{3}$
$\alpha=\sqrt{3}$	$\beta=-5\sqrt{3}$

<u>Verification:-</u>

$\alpha+\beta = \frac{-b}{a}$

$\alpha+\beta = \sqrt{3}+(-5\sqrt{3})$

$= \sqrt{3}-5\sqrt{3}$

$= -4\sqrt{3}$

$\frac{-b}{a} = \frac{-4\sqrt{3}}{1}$

$= -4\sqrt{3}$

$\therefore \alpha+\beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$

$\alpha\beta = \sqrt{3}\times(-5\sqrt{3})$

$= -5\times 3$

$= -15$

$\frac{c}{a} = \frac{-15}{1} = -15$

$\therefore \alpha\beta = \frac{c}{a}$

Hence verified

Q 4.) If α and $\frac{1}{\alpha}$ are the zeroes of the polynomial $6x^2+11x-(k-2)$ then find the value of k.

Sol $p(x) = 6x^2+11x-(k-2)$

$a = 6,\ b = 11,\ c = -(k-2)$

Since zeroes are reciprocal of each other

$\therefore \alpha\beta = \frac{c}{a}$

$\cancel{\alpha} \times \frac{1}{\cancel{\alpha}} = \frac{-(k-2)}{6}$

$1 = \frac{-k+2}{6}$

$6 = -k+2$

$k = 2-6$

$= -4$

Q5.) If one zero of $p(x) = (a^2+9)x^2+13x+6a$ is reciprocal of other find 'a'

Sol $p(x) = (a^2+9)x^2+13x+6a$

$a = a^2+9,\ b = 13,\ c = 6$

Since zeroes are reciprocal of each other

$\therefore \alpha\beta = \frac{c}{a}$

$\cancel{\alpha} \times \frac{1}{\cancel{\alpha}} = \frac{6a}{a^2+9}$

$a^2+9 = 6a$

$a^2 - 6a + 9 = 0$

$a^2 - 3a - 3a + 9$

$a(a-3) - 3(a-3) = 0$

$(a-3)(a-3) = 0$

$a - 3 = 0$

$a = 3$

Q6:) If the zeroes of $p(x) = x^2 - 5x + k$ are reciprocal of each other find k.

Sol

$p(x) = x^2 - 5x + k$

$a = 1, \ b = -5, \ c = k$

Since zeroes are reciprocal of each other,

$\therefore \alpha\beta = \frac{c}{a}$

$\cancel{\alpha} \times \frac{1}{\cancel{\alpha}} = \frac{k}{1}$

$k = 1$

Q7:) If one zero of the polynomial $3x^2 - 8x + 2k + 1$ is seven times the other, then find k.

Sol

$a = 3, \ b = -8, \ c = 2k + 1$

let $\alpha = x$, $\beta = 7x$

$\alpha + \beta = \frac{-b}{a}$

$x + 7x = \frac{-(-8)}{3}$

$8x = \frac{8}{3}$

$x = \frac{\cancel{8}}{3} \times \frac{1}{\cancel{8}}$

$x = \frac{1}{3}$

$\alpha\beta = \frac{c}{a}$

$x \times 7x = \frac{2k+1}{3}$

$7x^2 = \frac{2k+1}{3}$

$7\left(\frac{1}{3}\right)^2 = \frac{2k+1}{3}$

$\frac{7}{9} = \frac{2k+1}{3}$

$21 = 18k + 9$

$18k = 21 - 9$

$18k = 12$

$k = \frac{\cancel{12}^{2}}{\cancel{18}_{3}}$

$k = \frac{2}{3}$

Q8:) If sum of zeroes of $p(x) = 3x^2 - kx + 6$ is 3 find k.

Sol $a = 3,\ b = -k,\ c = 6$

$\alpha + \beta = 3$

$\frac{-b}{a} = 3$

$\frac{-(-k)}{3} = 3$

$k = 3 \times 3$

$k = 9$

Q9:) -3 is the zero of $p(x) = (k-1)x^2 + kx - 3$. Find k.

Sol Given $x = -3$

$0 = (k-1)(-3)^2 + k(-3) - 3$

$0 = 9k - 9 - 3k - 3$

$0 = 6k - 12$

$6k = 12$

$k = \frac{\cancel{12}^{2}}{\cancel{6}}$

$k = 2$

Identities :- i) $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$

ii) $\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$

iii) $(\alpha-\beta)^2=(\alpha+\beta)^2-4\alpha\beta$

iv) $\alpha-\beta=\sqrt{(\alpha+\beta)^2-4\alpha\beta}$

Q6) If α & β are zeroes of $p(x)=2x^2+3x-6$. Find value of i) α^2+b^2 ii) $\frac{1}{\alpha}+\frac{1}{\beta}$ iii) $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}$ iv) $\alpha^2+\beta^2-\alpha\beta$

v) $\alpha^2\beta+\beta^2\alpha$ vi) $\alpha^3+\beta^3$ vii) $\frac{\alpha^2}{\beta}+\frac{\beta^2}{\alpha}$ viii) $\alpha-\beta$

Sol $a=2,\ b=3,\ c=-6$

$\alpha+\beta=\frac{-b}{a}=\frac{-3}{2}$, $\alpha\beta=\frac{\cancel{-6}}{\cancel{2}}=-3$

i) $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$

$=\left(\frac{-3}{2}\right)^2-2\times-3$

$=\frac{9}{4}+6=\frac{33}{4}$

ii) $\frac{1}{\alpha}+\frac{1}{\beta}=\frac{\alpha+\beta}{\alpha\beta}=\frac{\frac{-3}{2}}{-3}=\frac{-\cancel{3}}{2}\times\frac{-1}{\cancel{3}}=\frac{1}{2}$

iii) $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}=\frac{\alpha^2+\beta^2}{\alpha\beta}=\frac{\frac{33}{4}}{-3}=\frac{\cancel{33}^{11}}{4}\times\frac{-1}{\cancel{3}}=\frac{-11}{4}$

iv) $\alpha^2+\beta^2-\alpha\beta=\frac{33}{4}-(-3)=\frac{33}{4}+3=\frac{33+12}{4}=\frac{45}{4}$

v) $\alpha^2\beta + \beta^2\alpha = \alpha\beta(\alpha+\beta)$

$= -3\left(\frac{-3}{2}\right)$

$= \frac{-9}{2}$

vi) $\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$= \left(\frac{33}{4}\right)^3 - 3\times -3\left(\frac{33}{4}\right)$

$= \frac{35937}{64} + 9\times\frac{33}{4}$

$= \frac{35937}{64} + \frac{297}{4}$

$= \frac{35937+4752}{64} = \frac{40689}{64}$

vi) $\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$= \left(\frac{-3}{2}\right)^2 - 3(-3)\left(\frac{-3}{2}\right)$

$= \frac{-27}{8} - \frac{27}{2}$

$= \frac{-27-108}{8} = \frac{-135}{8}$

vii) $\frac{\alpha^2}{\beta} + \frac{\beta^2}{\alpha} = \frac{\alpha^3+\beta^3}{\alpha\beta} = \frac{\frac{-135}{8}}{-3} = \frac{\cancel{-135}}{8} \times \frac{1}{\cancel{-3}} = \frac{45}{8}$

viii) $\alpha-\beta = \left(\frac{-3}{2}\right)^2 - 4\times -3$

$= \frac{9}{4} + 12 = \frac{9+48}{4} = \sqrt{\frac{57}{4}} = \frac{\sqrt{57}}{4}$

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Q11.) If α & β are the zeroes of $p(x) = x^2 - x - 6$, Find
i) $\alpha^2+\beta^2$ ii) $\frac{1}{\alpha}+\frac{1}{\beta}$ iii) $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}$ iv) $\alpha^2+\beta^2-\alpha\beta$
v) $\alpha^2\beta+\beta^2\alpha$ vi) $\alpha^3+\beta^3$ vii) $\frac{\alpha^2}{\beta}+\frac{\beta^2}{\alpha}$ viii) $\alpha-\beta$

Sol

$p(x) = x^2 - x - 6$

$a = 1,\ b = -1,\ c = -6$

$\alpha+\beta = \frac{-b}{a} = \frac{-(-1)}{1} = \frac{1}{1} = 1$

$\alpha\beta = \frac{c}{a} = \frac{-6}{1} = -6$

i) $\alpha^2+\beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$

$= 1^2 - 2 \times -6$

$= 1 + 12 = 13$

ii) $\frac{1}{\alpha}+\frac{1}{\beta} = \frac{\alpha+\beta}{\alpha\beta} = \frac{1}{-6} = \frac{-1}{6}$

iii) $\frac{\alpha}{\beta}+\frac{\beta}{\alpha} = \frac{\alpha^2+\beta^2}{\alpha\beta} = \frac{13}{-6} = \frac{-13}{6}$

iv) $\alpha^2+\beta^2-\alpha\beta = 13-(-6) = 13+6 = 19$

v) $\alpha^2\beta+\beta^2\alpha = \alpha\beta(\alpha+\beta) = -6(1) = -6$

vi) $\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$= 1^3 - 3 \times -6 \times 1$

$= 1 + 18$

$= 19$

vii) $\frac{\alpha^2}{\beta} + \frac{\beta^2}{\alpha} = \frac{\alpha^3+\beta^3}{\alpha\beta} = \frac{-19}{6}$.

viii) $\alpha - \beta = \sqrt{(\alpha+\beta)^2 - 4\alpha\beta}$

$= \sqrt{1^2 - 4 \times -6}$

$= \sqrt{1+24}$

$= \sqrt{25}$

$= 5$

Q12) If α & β are the zeroes of the $p(x) = 2x^2+5x+k$ satisfying the relation $\alpha^2+\beta^2+\alpha\beta = \frac{21}{4}$, find value of k.

Sol $a=2$, $b=5$, $c=k$

$\alpha+\beta = \frac{-b}{a} = \frac{-5}{a}$, $\alpha\beta = \frac{c}{a} = \frac{k}{2}$

$\alpha^2+\beta^2+\cancel{2}\alpha\beta = 21$

$(\alpha+\beta)^2 - 2\alpha\beta + \alpha\beta = 21$

$(\alpha+\beta)^2 - \alpha\beta = \frac{21}{4}$

$\left(\frac{-5}{2}\right)^2 - \frac{k}{2} = \frac{21}{4}$

$\frac{25}{4} - \frac{k}{2} = \frac{21}{4}$

$\frac{25}{4} - \frac{21}{4} = \frac{k}{2}$

$\frac{25-21}{\cancel{4}\,2} \times \cancel{2} = k$

$\frac{\cancel{4}}{\cancel{2}}\,2 = k$

$k = 2$

Q13) If α & β are zeroes of $p(x) = kx^2 + 4x + 4$ satisfying the relation $\alpha^2 + \beta^2 = 24$. Find k.

Sol

$a = k$, $b = 4$, $c = 4$

$\alpha + \beta = \frac{-b}{a} = \frac{-4}{k}$, $\alpha\beta = \frac{c}{a} = \frac{4}{k}$.

$\alpha^2 + \beta^2 = 24$

$(\alpha+\beta)^2 - 2\alpha\beta = 24$

$\left(\frac{-4}{k}\right)^2 - 2 \times \frac{4}{k} = 24$

$\frac{16}{k^2} - \frac{8}{k} = 24$

$\frac{16 - 8k}{k^2} = 24$

$16 - 8k = 24k^2$

$24k^2 + 8k - 16 = 0$

$3k^2 + k - 2 = 0$

$3k^2 + 3k - 2k - 2 = 0$

$3k(k+1) - 2(k+1) = 0$

$(3k-3)(k+1) = 0$

$3k - 2 = 0$	$k + 1 = 0$
$3k = 2$	$k = -1$
$k = \frac{2}{3}$	

Q14) Find the quadratic p(x) whose sum & product of zeroes is $-2\sqrt{3}$ and -9. Also find zeroes of p(x)

Sol $p(x) = x^2 - Sx + P$
$= x^2 - (-2\sqrt{3})x + -9$
$= x^2 + 2\sqrt{3}x - 9$

$= x^2 + 2\sqrt{3}x - 9$
$= x^2 + 3\sqrt{3}x - \sqrt{3}x - 9$
$= x^2 - \sqrt{3}x + 3\sqrt{3}x - 9$
~~$= x(x-\sqrt{3}) + 3(\sqrt{3}x - 3)$~~
$= x^2 + 3\sqrt{3}x - \sqrt{3}x - 9$
$= x(x + 3\sqrt{3}) - \sqrt{3}(x + 3\sqrt{3})$
$= (x - \sqrt{3})(x + 3\sqrt{3})$

$x - \sqrt{3} = 0$
$x = \sqrt{3}$
$\alpha = \sqrt{3}$

$x + 3\sqrt{3} = 0$
$x = -3\sqrt{3}$
$\beta = -3\sqrt{3}$

Q15) Find the quadratic p(x) whose zeroes are $\frac{3-\sqrt{5}}{5}$, $\frac{3+\sqrt{5}}{5}$.

Sol $\alpha = \frac{3-\sqrt{5}}{5}$, $\beta = \frac{3+\sqrt{5}}{5}$

$\alpha + \beta = \frac{3-\sqrt{5}}{5} + \frac{3+\sqrt{5}}{5} = \frac{3+3-\sqrt{5}+\sqrt{5}}{5} = \frac{6}{5}$

$\alpha\beta = \frac{3-\sqrt{5}}{5} \times \frac{3+\sqrt{5}}{5} = \frac{3^2 - \sqrt{5}^2}{25} = \frac{9-5}{25} = \frac{4}{25}$

$p(x) = x^2 - \frac{6}{5}x + \frac{4}{25}$

$= 25x^2 - 30x + 4$

CH-4

Quadratic Equations

Nature of Roots ÷
Discriminent :- (D)

$$D = b^2 - 4ac$$

$D>0$	$D=0$	$D<0$
Real & Distinct	Real & Equal	Imaginary roots / no real roots

To find roots if $D>0$, $D=0$

$$x = \frac{-b + \sqrt{D}}{2a}$$

$\boxed{\text{EX-4.1}}$

Q1:) Check – – – –

Sol i) $(x+1)^2 = 2(x-3)$

$x^2+1^2+2\times1\times x = 2x-6$

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

$x^2+1+6=0$

$x^2+7=0$

$\therefore$ Yes

ii) $x^2 - 2x = -2(3-x)$

$x^2 - 2x = -6 + 2x$

$x^2 - 2x - 2x + 6 = 0$

$x^2 - 4x + 6 = 0$

$\therefore$ Yes

iii) $(x-2)(x+1) = (x-1)(x+3)$

$x^2 + x - 2x - 2 = x^2 + 3x - x - 3$

$x^2 - x^2 + x + x - 2x + 3x - 2 + 3 = 0$

$3x + 2 = 0$

$\therefore$ No

iv) $(x-3)(2x+1) = x(x+5)$

$2x^2 + x - 6x - 3 = x^2 + 5x$

$2x^2 - x^2 + x - 5x - 6x - 3 = 0$

$x^2 - 10x - 3 = 0$

$\therefore$ Yes

v) $(2x-1)(x-3) = (x+5)(x-1)$

$2x^2 - 6x - x + 3 = x^2 - x + 5x - 5$

$2x^2 - x^2 - 6x - 5x - x + 3 + 5 = 0$

$x^2 - 12x + 8 = 0$

$\therefore$ Yes

vi) $x^2+3x+1=(x-2)^2$

$x^2+3x+1 = x^2+4-4x$

$x^2-x^2+3x-4x+1-4=0$

$-x-3=0$

$\therefore$ No

vii) $(x+2)^3 = 2x(x^2-1)$

$x^3+8+6x(x+2) = 2x^3-2x$

$x^3+8+6x^2+12x = 2x^3-2x$

$x^3-2x^3+8+6x^2+12x+2x=0$

$-x^3+8+6x^2+14x=0$

$\therefore$ No

viii) $x^3-4x^2-x+1=(x-2)^3$

$x^3-4x^2-x+1 = x^3-8-6x(x-2)$

$x^3-4x^2-x+1 = x^3-8-6x^2+12x$

$x^3-x^3-4x^2+6x^2-x-12x+1+8=0$

$2x^2-13x+9=0$

$\therefore$ Yes

Q2.) Represent ---------

Sol i) let $B = x\,m$

$L = (1+2x)m$

$A = 528\,m^2$

$L \times B = A$

$(1+2x) \times x = 528$

$2x^2+x=528$

$2x^2+x-528=0$

$a=2, b=1, c=-528$

$D=b^2-4ac$
$=1^2-4\times2\times-528$
$=1+4224$
$=4225$

$x=\frac{-b\pm\sqrt{D}}{2a}$
$=\frac{-1\pm\sqrt{4225}}{2\times2}$

$x=\frac{-1+65}{4}$
$=\frac{\cancel{64}\,16}{\cancel{4}}$
$x=16$

$x=\frac{-1-65}{4}$
$=\frac{-66}{4}$
Not possible

$B=16\text{cm}$
$L=1+2x$
$=1+32$
$=33\text{cm}$

ii) let first no. $= x$
second " $= x+1$
Product $= 306$

$x(x+1) = 306$
$x^2 + x - 306 = 0$

$a = 1, b = 1, c = -306$

$D = b^2 - 4ac$
$= 1^2 - 4 \times 1 \times -306$
$= 1 + 1224$
$= 1225$

$x = \frac{-b \pm \sqrt{D}}{2a}$
$= \frac{-1 \pm \sqrt{1225}}{2 \times 1}$
$= \frac{-1 \pm 35}{2}$

$x = \frac{-1+35}{2}$
$= \frac{34}{2} = 17$

$x = \frac{-1-35}{2}$
$= \frac{-36}{2} = -18$
Not possible

$x = 17$
First no. $= 17$
Second " $= 17+1$
$= 18$

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(iii) let present age of Rohan = x
" " " mother = $x+26$
3 years later age of Rohan = $x+3$
" " " " mother = $x+26+3 = x+29$
Product = 360

$(x+3)(x+29) = 360$
$x^2+29x+3x+87 = 360$
$x^2+32x+87=0$
$x^2+32x-273=0$
~~$x^2+39x-7x-273=0$~~
~~$x(x+39)$~~

$D = b^2-4ac$
$= 32^2 - 4\times1\times-273$
$= 1024+1092$
$= 2116$

$x = \frac{-b \pm \sqrt{D}}{2a}$

$x = \frac{-32 \pm 46}{2\times1}$

$x = \frac{-32+46}{2}$
$= \frac{14}{2} = 7$
$x = 7$

$x = \frac{-32-46}{2}$
$= \frac{-78}{2} = -39$
not feasible

Rohan Age = 7
Mother age = $7+26 = 33$

iv) Let speed = x km/h

Distance = 480 km

$T_1 = \frac{480}{x}$ - ①

New speed = $(x-8)$ km/h

$T_2 = \frac{480}{x-8}$ - ②

Difference = 3 hrs

$T_2 - T_1 = 3$

$\frac{480}{x-8} - \frac{480}{x} = 3$

$\frac{480x - 480(x-8)}{x(x-8)} = 3$

$\frac{480x - 480x + 3840}{x^2 - 8x} = 3$

$\frac{3840}{x^2-8x} = 3$

$(x^2-8x)3 = 3840$

$3x^2 - 24x - 3840 = 0$

$x^2 - 8x - 1280 = 0$

$D = b^2 - 4ac$

$= (-8)^2 - 4 \times 1 \times -1280$

$= 64 + 5120$

$= 5184$

$x = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-8) \pm \sqrt{5184}}{2 \times 1} = \frac{8 \pm 72}{2}$

$x = \frac{8+72}{2}$ | $x = \frac{8-72}{2}$

$= \frac{80}{2} = 40$ | $= \frac{-64}{2} = -32$

Not possible

$\therefore$ Speed of train $= 40$ km/h

Q11) A train travels 360 km at a uniform speed. If the speed had been 5 km/h more. It would have taken one hr less for same journey find speed of train.

Sol let speed $= x$ km/h

Distance $= 360$ km

$T_1 = \frac{360}{x}$ — (1)

New speed $= (x+5)$ km/h

$T_2 = \frac{360}{x+5}$ — (2)

Difference $= 1$ hr

$T_1 - T_2 = 1$

$\frac{360}{x} - \frac{360}{x+5} = 1$

$\frac{360x + 1800 - 360x}{x(x+5)} = 1$

$\frac{1800}{x^2+5x} = 1$

$1800 = x^2 + 5x$

$$x^2+5x-1800=0$$

$D = b^2-4ac$
$= 25-4\times1\times-1800$
$= 25+7200$
$= 7225$

$$x = \frac{-b \pm \sqrt{D}}{2a}$$
$$= \frac{-5 \pm \sqrt{7225}}{2\times1}$$
$$= \frac{-5 \pm 85}{2}$$

$x = \frac{-5+85}{2}$
$= \frac{\cancel{80}}{\cancel{2}} = 40$

$x = \frac{-5-85}{2}$
$= \frac{-\cancel{90}}{\cancel{2}} = -45$
Not possible

$\therefore$ Speed of Train $= 40$ km/h

Q12) An express train takes 1 hr less than a passenger train to travel 132 km b/w Mysore and Banglore. If average speed of express is 11 km/h more than passenger train. Find avg. speed of both trains.

Sol let speed of express train $= x$ km/h
Distance $= 132$ Km
$T_1 = \frac{132}{x}$ — ①
Speed of Passenger train $= (x-11)$ km/h
$T_2 = \frac{132}{x-11}$ — ②

Difference = 1 hr

$$T_2 - T_1 = 1$$

$$\frac{132}{x-11} - \frac{132}{x} = 1$$

$$\frac{132x - 132x + 1452}{x(x-11)} = 1$$

$$1452 = x^2 - 11x$$

$$x^2 - 11x - 1452 = 0$$

$$D = b^2 - 4ac$$
$$= -11^2 - 4 \times 1 \times -1452$$
$$= 121 + 5808$$
$$= 5929$$

$$x = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-11) \pm \sqrt{5929}}{2} = \frac{11 \pm 77}{2}$$

$$x = \frac{11 + 77}{2} = \frac{88}{2} = 44$$

$$x = \frac{11 - 77}{2} = \frac{-66}{2} = 33$$

Not possible

Speed of express train = 44 km/h
" " passenger " = 33 km/h