Government Higher Secondary school,

GURUVOYAL-600052., TLR-Dt.

AY **2024-2025**

10TH STD MATHEMATICS – E/M

NEW SYLLABUS IMPORTANT

FORMULAS, 8 MARKS,

5 MARKS, 2 MARKS AND 1 MARKS

(Questions & Answers)

Preparation by©

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(1) Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{3}{5}$ of the corresponding sides of the triangle PQR (scale factor $\frac{3}{5} < 1$)

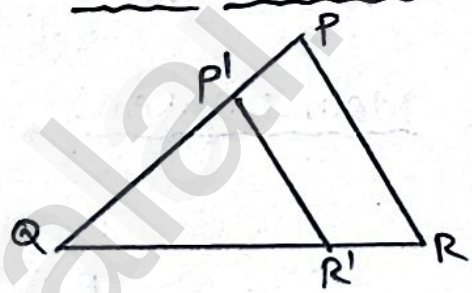
8 marks

NOTE: (i) Proper fraction → Inner Line → P'R'
(ii) Improper fraction → Outer Line → P'R'

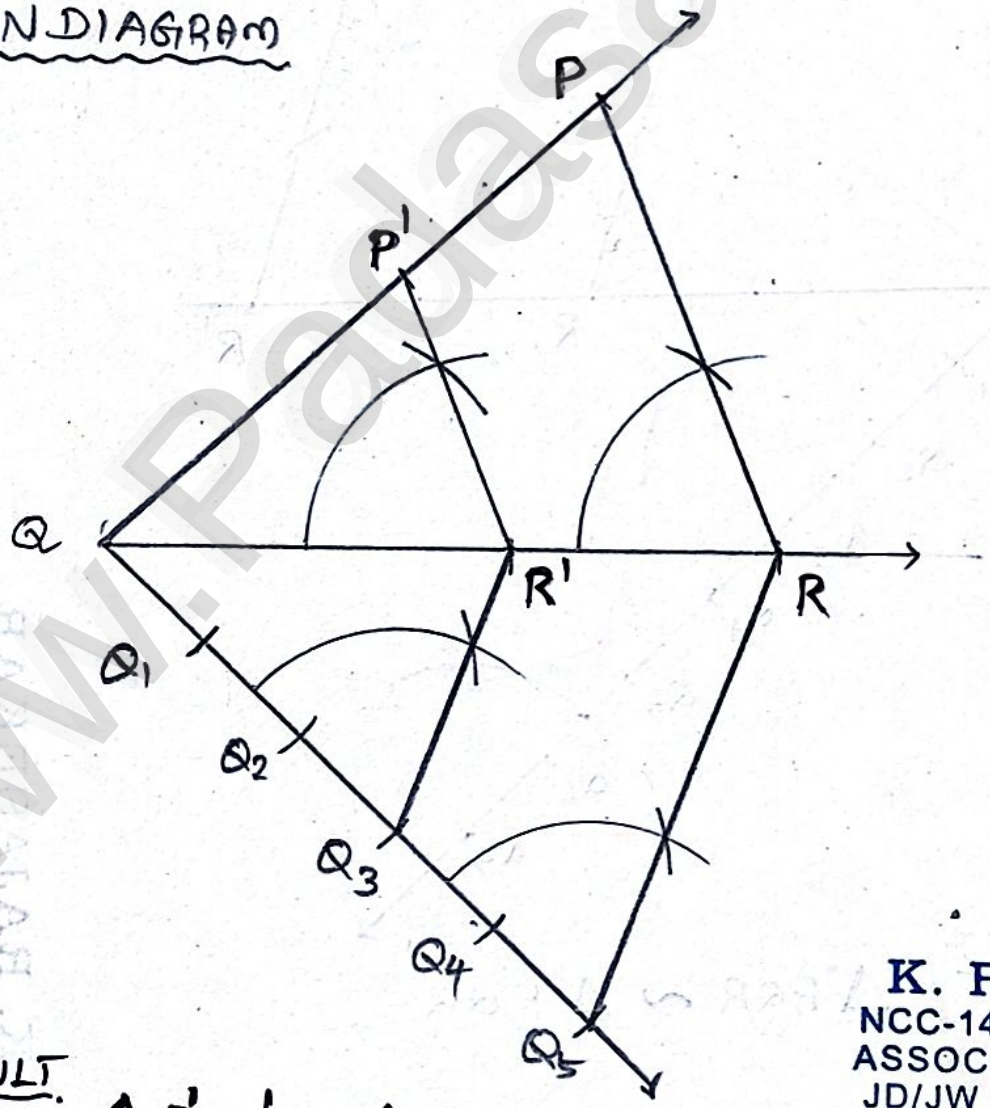
SOLUTION:

Given: Scale factor $\frac{3}{5}$

ROUGH DIAGRAM



MAIN DIAGRAM



RESULT

$\Delta P'QR' \sim \Delta PQR$.

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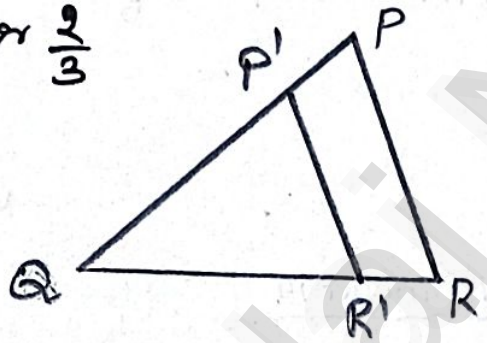
2. Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{2}{3}$ of the corresponding sides of the triangle PQR (scale factor $\frac{2}{3} < 1$).

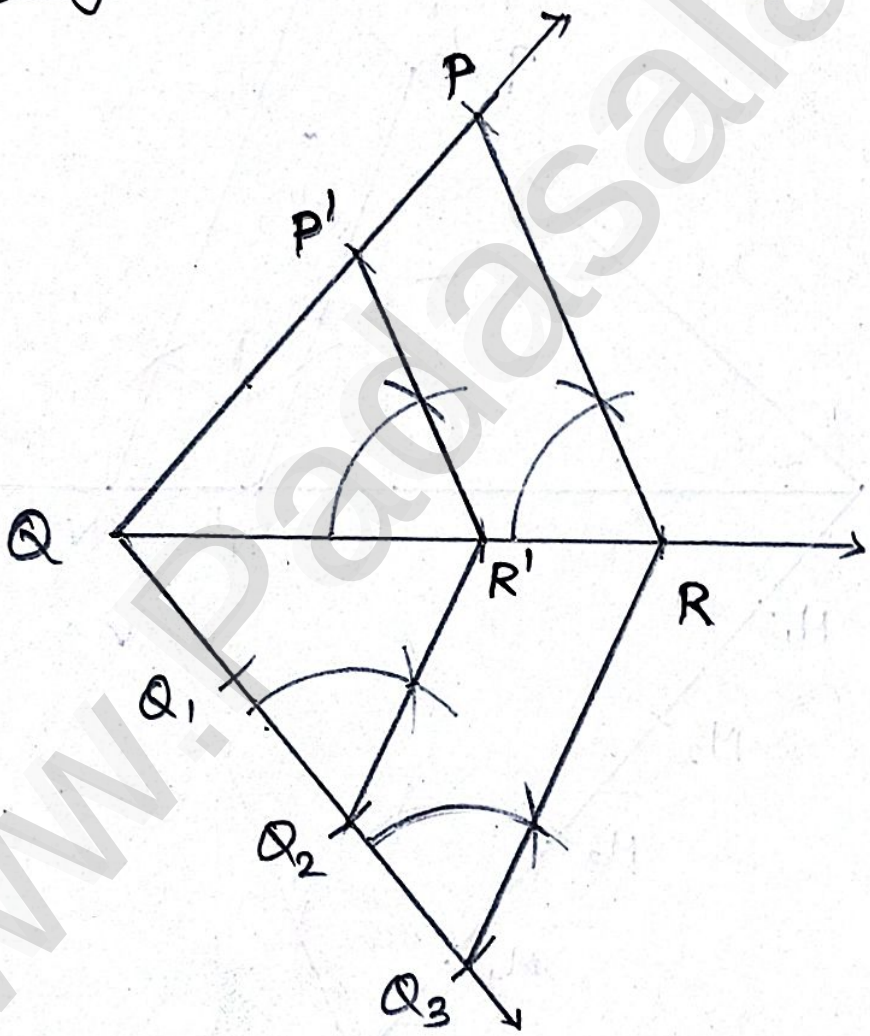
SOLUTION

Given: Scale factor $\frac{2}{3}$

ROUGH DIAGRAM



Main Diagram



RESULT:

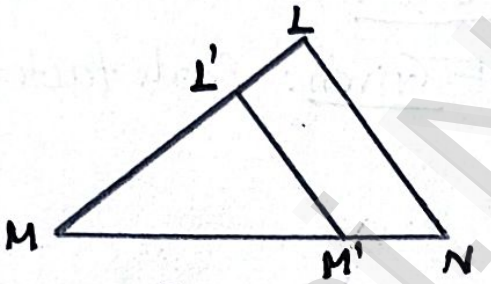
$\Delta P'QR' \sim \Delta PQR$.

(3) Construct a triangle similar to a given triangle LMN with its sides equal to $\frac{4}{5}$ of the corresponding sides of the triangle LMN (scale factor $\frac{4}{5} < 1$).

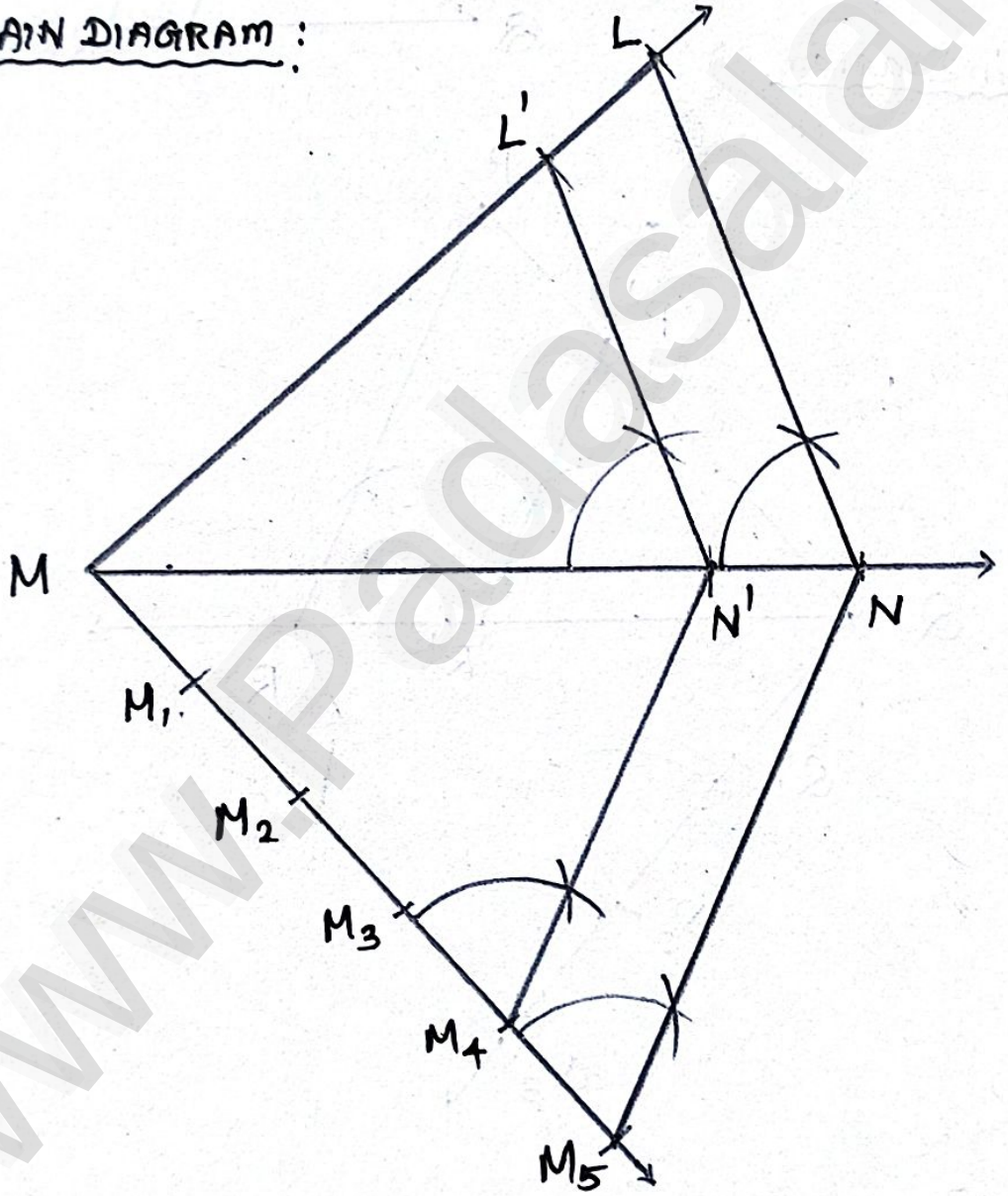
SOLUTION :

Given : Scal factor $\frac{4}{5}$

ROUGH DIAGRAM :



MAIN DIAGRAM :



RESULT :

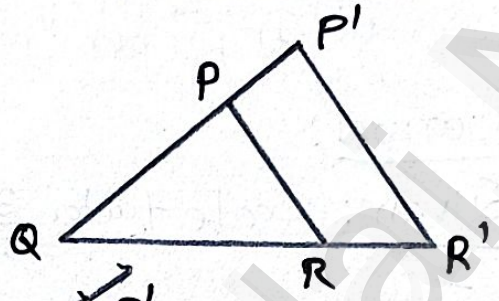
$\Delta L'MN' \sim \Delta LMN$

(4) Cons Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{7}{4}$ of the corresponding sides of the triangle PQR (scale factor $\frac{7}{4} > 1$)

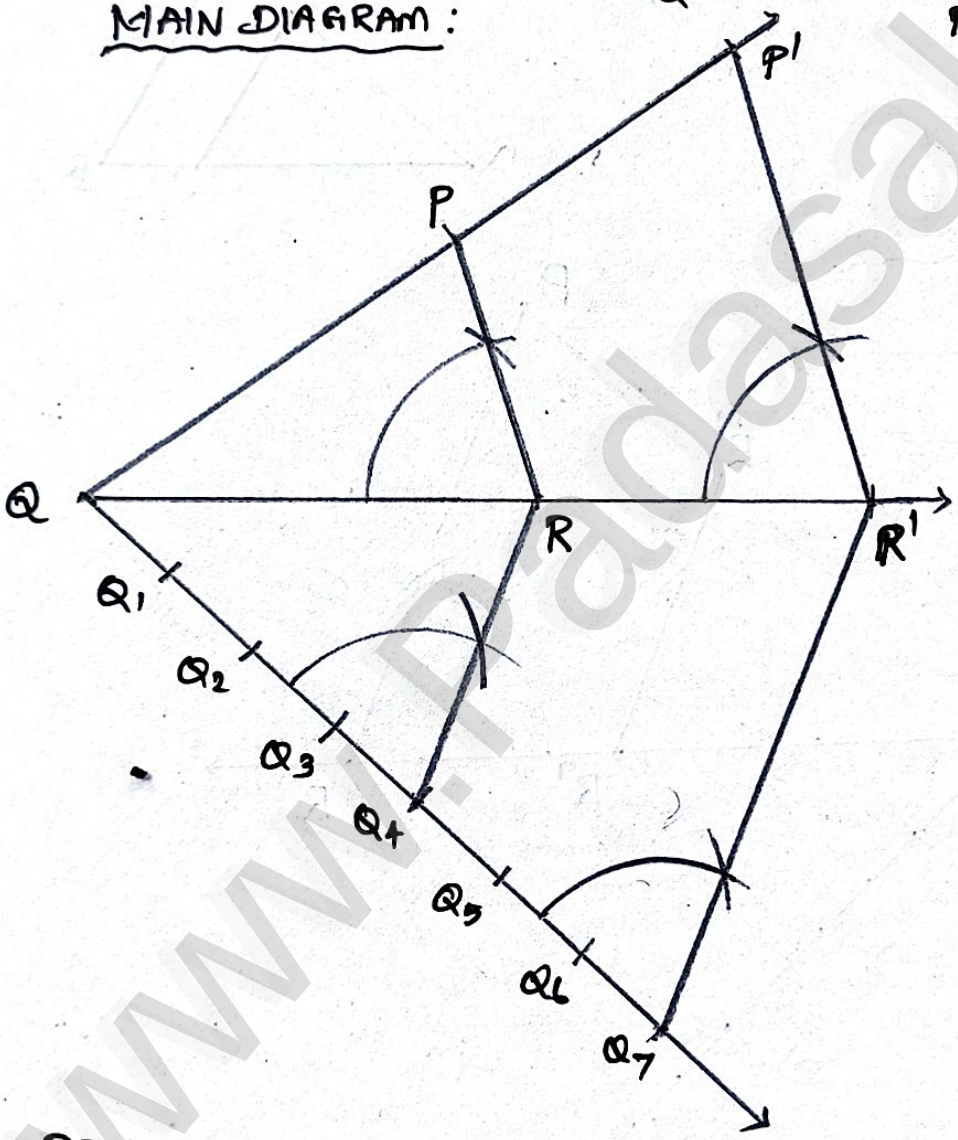
SOLUTION :

Given: Scale factor $\frac{7}{4}$

ROUGH DIAGRAM :



MAIN DIAGRAM :



RESULT

$\Delta PQR \sim \Delta P'QR'$

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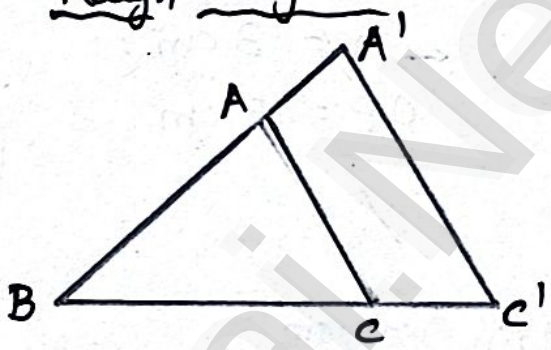
(5) Construct a triangle similar to a given triangle ABC with its sides equal to $\frac{6}{5}$ of the corresponding sides of the triangle ABC (scale factor $\frac{6}{5} > 1$).

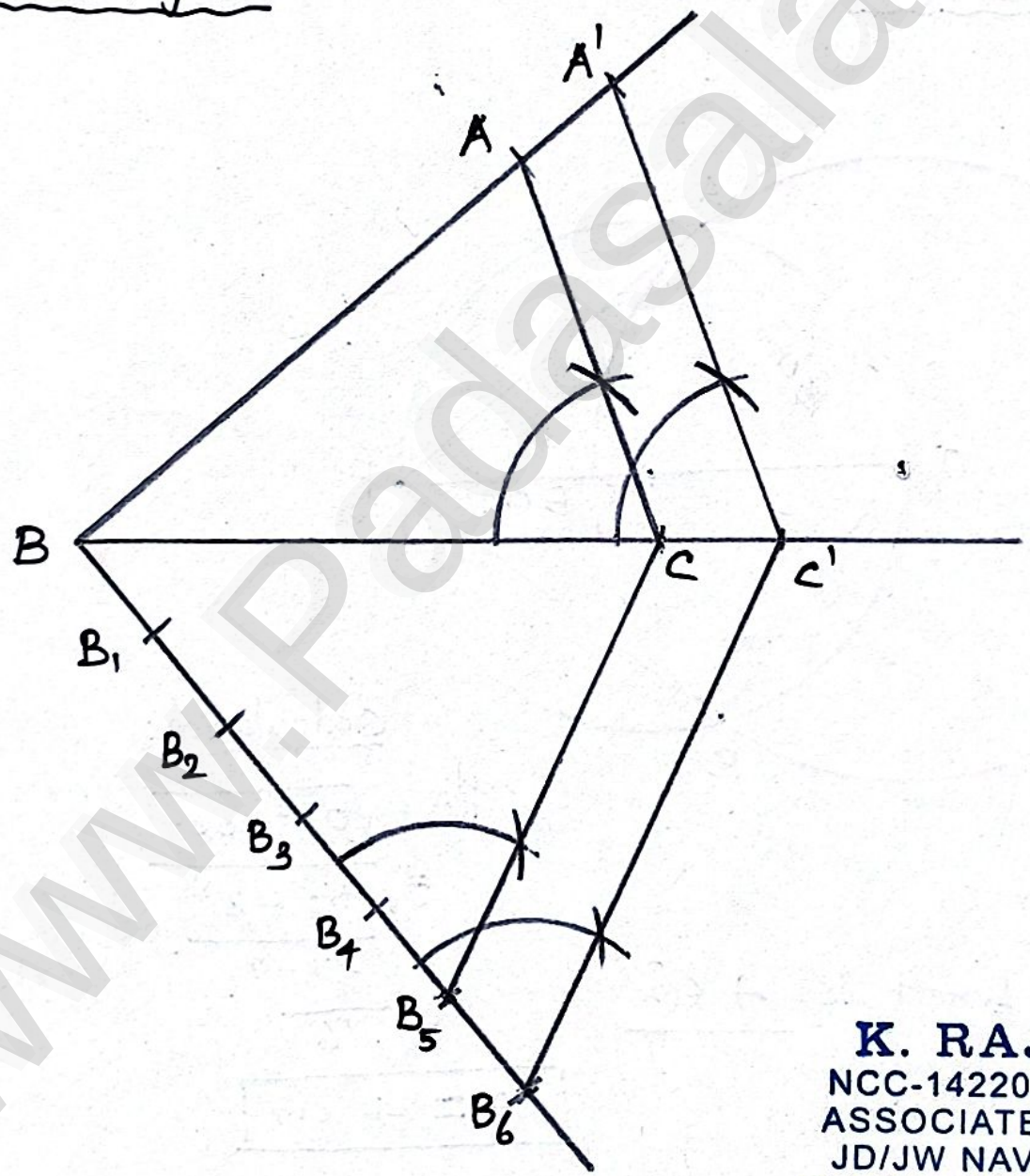
Solution

Given: Scale factor $\frac{6}{5}$

Rough Diagram



Main Diagram



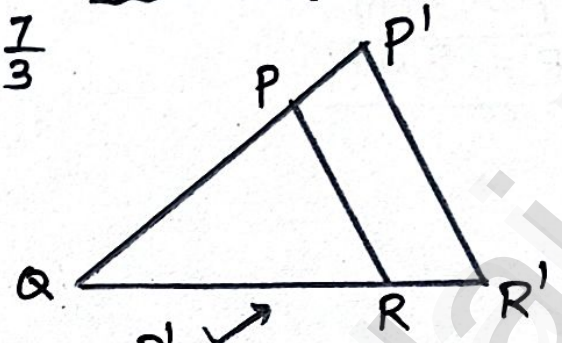
Result: $\Delta ABC \sim \Delta A'BC'$

6 Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{7}{3}$ of the corresponding sides of the triangle PQR (scale factor $\frac{7}{3} > 1$).

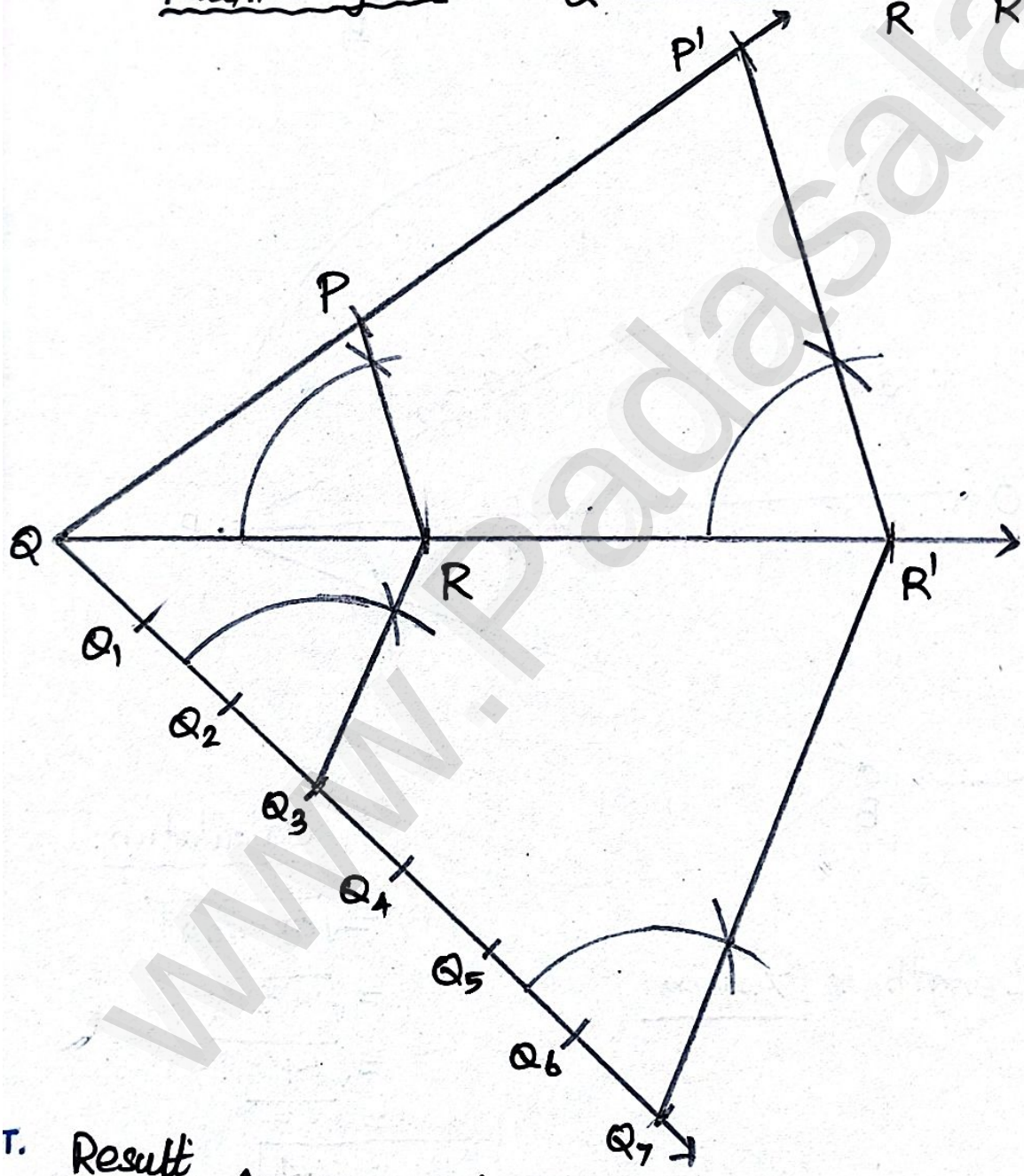
Solution

Given: Scale factor $\frac{7}{3}$

Rough Diagram:



Main Diagram:



Result: $\Delta PQR \sim \Delta P'QR'$

7. Draw a circle of diameter 6 cm from a point P, which is 8 cm away from its centre. Draw the two tangents PA and PB to the circle and measure their lengths. (7)

Solution

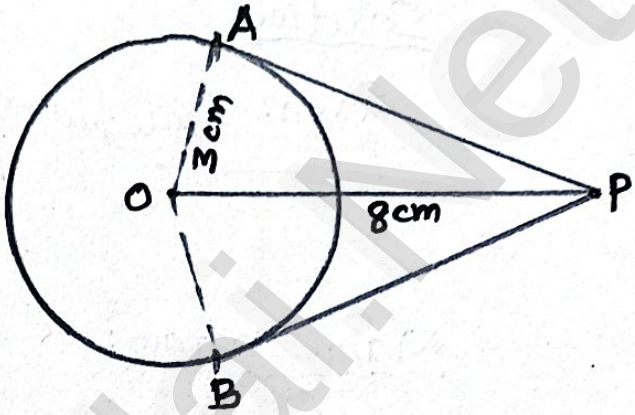
$r = \frac{D}{2}$

Given : $D = 6$ cm

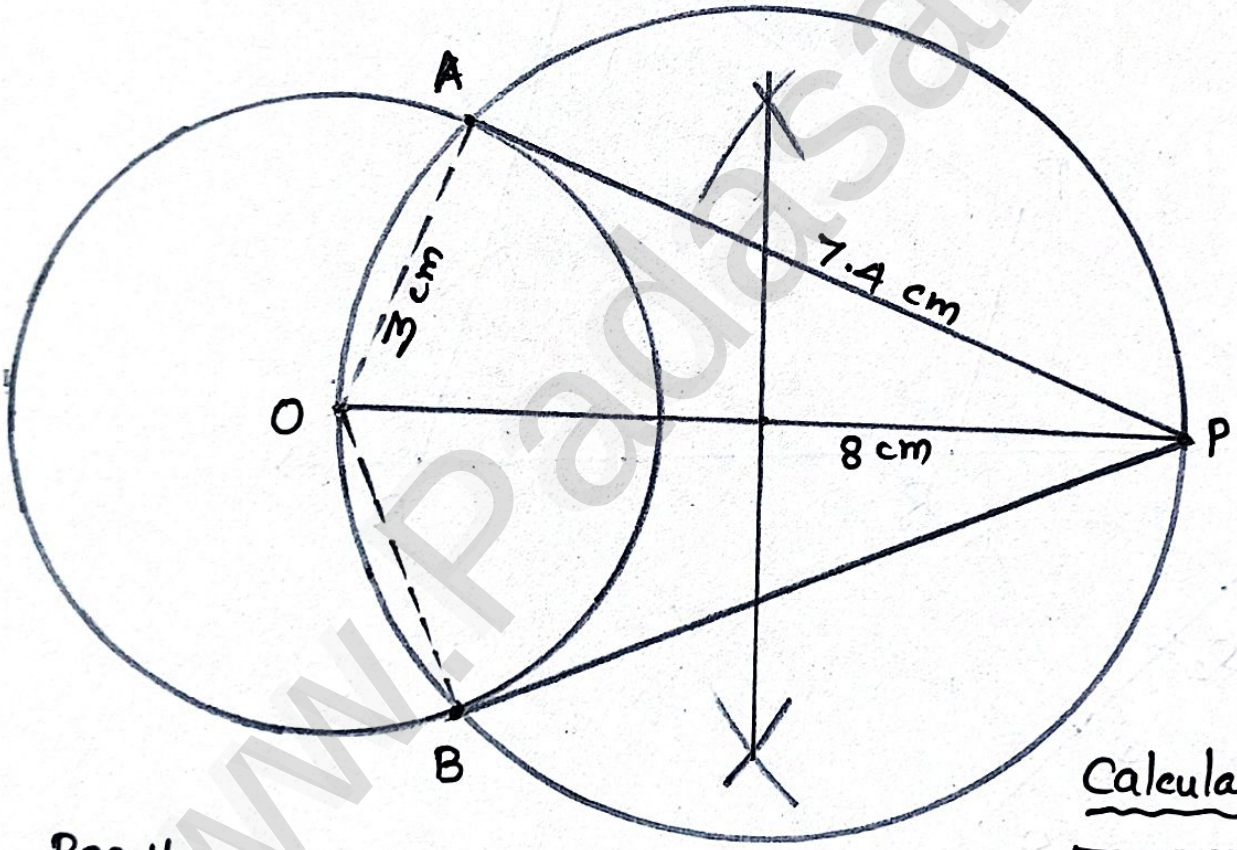
$r = 3$ cm

$OP = 8$ cm

Rough Diagram



Main Diagram



Calculation:

$PA = \sqrt{OP^2 - OA^2}$

$= \sqrt{8^2 - 3^2}$

$= \sqrt{64 - 9}$

$= \sqrt{55}$

$PA \simeq 7.4$

Result:

Tangent Length is 7.4 cm

(8). Draw the two tangents from a point which is 5 cm away from the centre of a circle of diameter 6 cm. Also, measure the lengths of the tangents. (8)

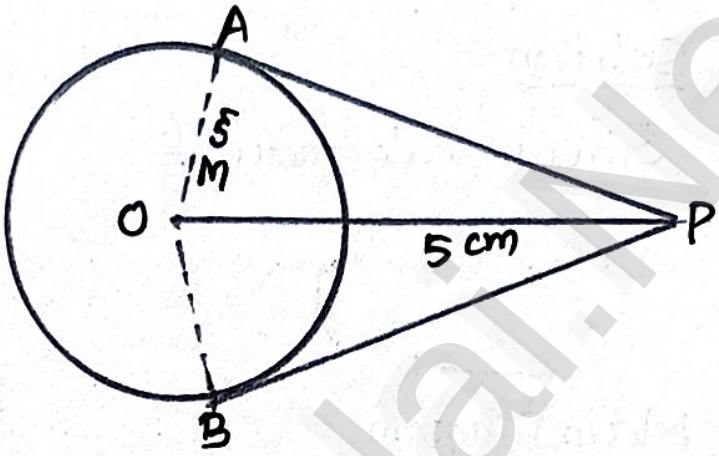
Solution

Given : $D = 6$ cm

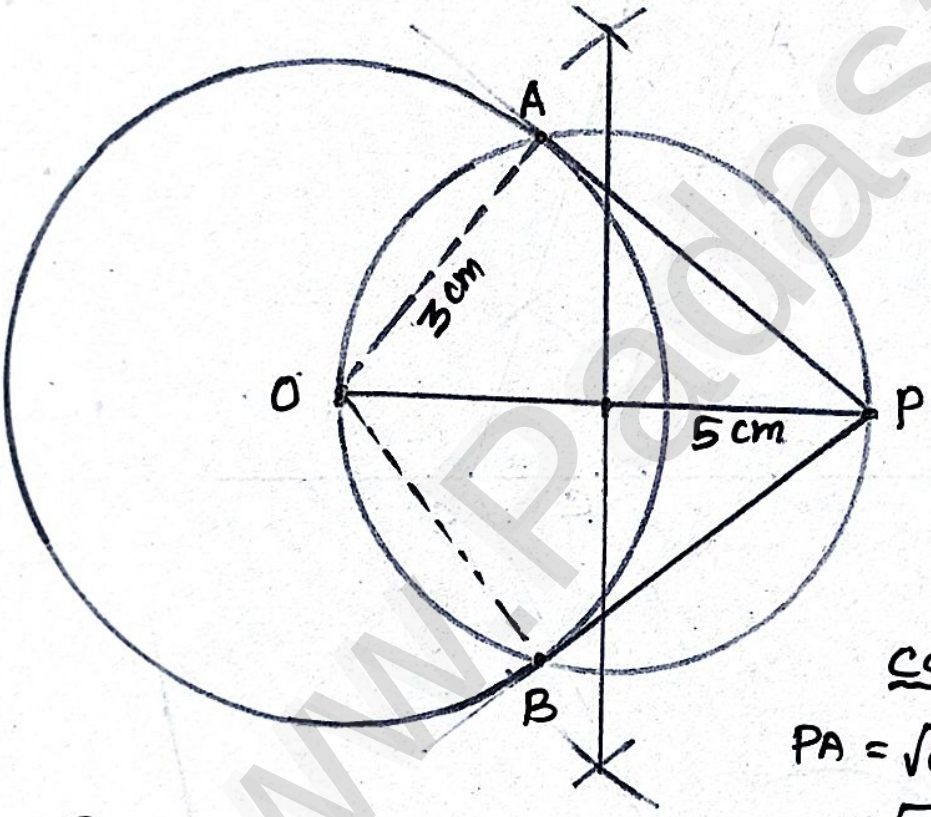
$r = 3$ cm

$OP = 5$ cm

Rough Diagram :



Main Diagram



Calculation :

$PA = \sqrt{OP^2 - OA^2}$

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

$= \sqrt{25 - 9}$

$= \sqrt{16}$

$\boxed{PA = 4 \text{ cm}}$

Result

Tangent Length is 4 cm

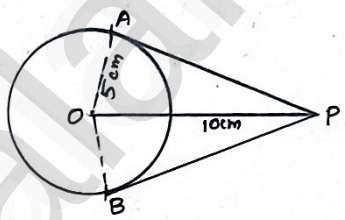
9. Draw the two tangents from a point which is 10 cm away from the centre of a circle of radius 5 cm. Also, measure the lengths of the tangents. 9

Solution

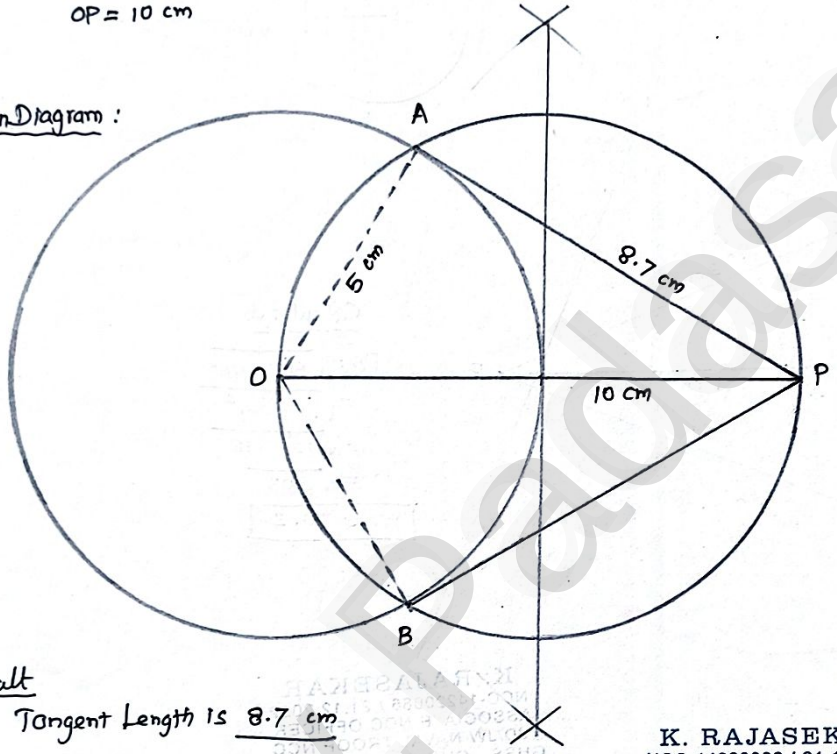
Given : $r = 5$ cm

$OP = 10$ cm

ROUGH DIAGRAM



Main Diagram :



Calculation

$PA = \sqrt{OP^2 - OA^2}$

$= \sqrt{10^2 - 5^2}$

$= \sqrt{100 - 25}$

$= \sqrt{75}$

$\boxed{PA \simeq 8.7 \text{ cm}}$

Result

Tangent Length is 8.7 cm

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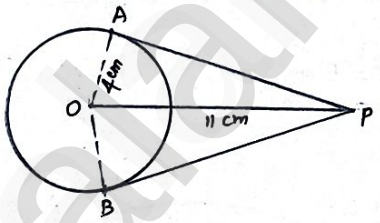
(10) Take a point which is 11 cm away from the centre of a circle of radius 4 cm and draw the two tangents to the circle from that point.

Solution:

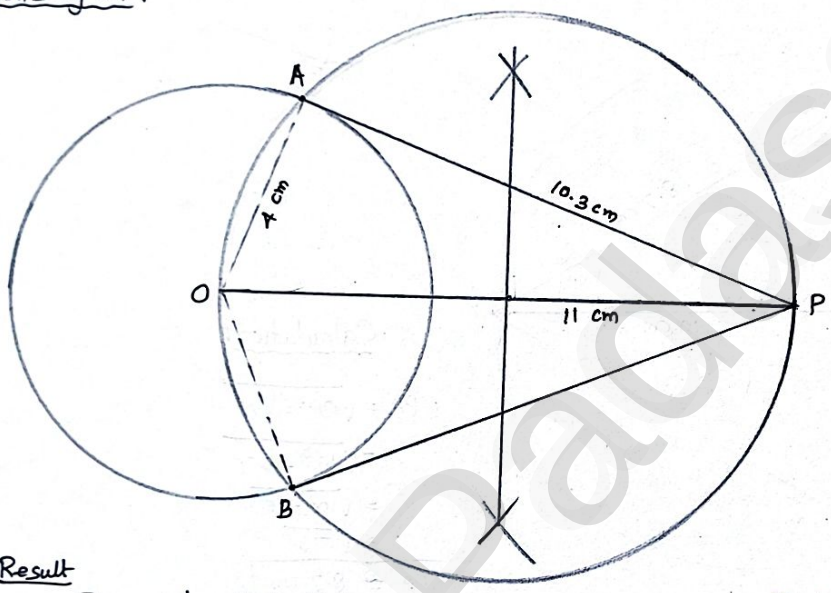
Given: $r = 4$ cm

$OP = 11$ cm

Rough Diagram



Main Diagram :



Calculation

$PA = \sqrt{OP^2 - OA^2}$

$= \sqrt{11^2 - 4^2}$

$= \sqrt{121 - 16}$

$= \sqrt{105}$

$\boxed{PA \simeq 10.3}$

Result

Tangent Length is 10.3 cm

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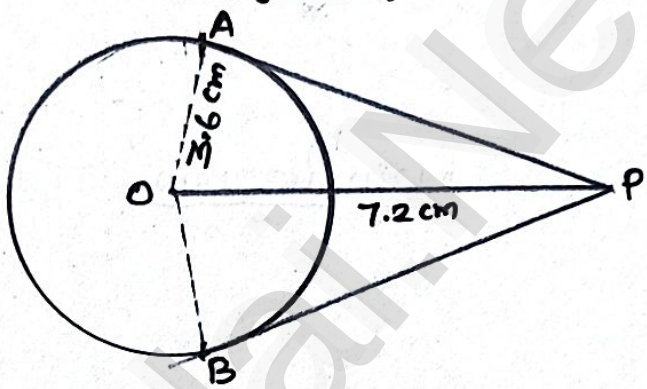
(11) Draw a tangent to the circle from the point P having radius 3.6cm, and centre at O. Point P is at a distance 7.2 cm from the centre.

Solution

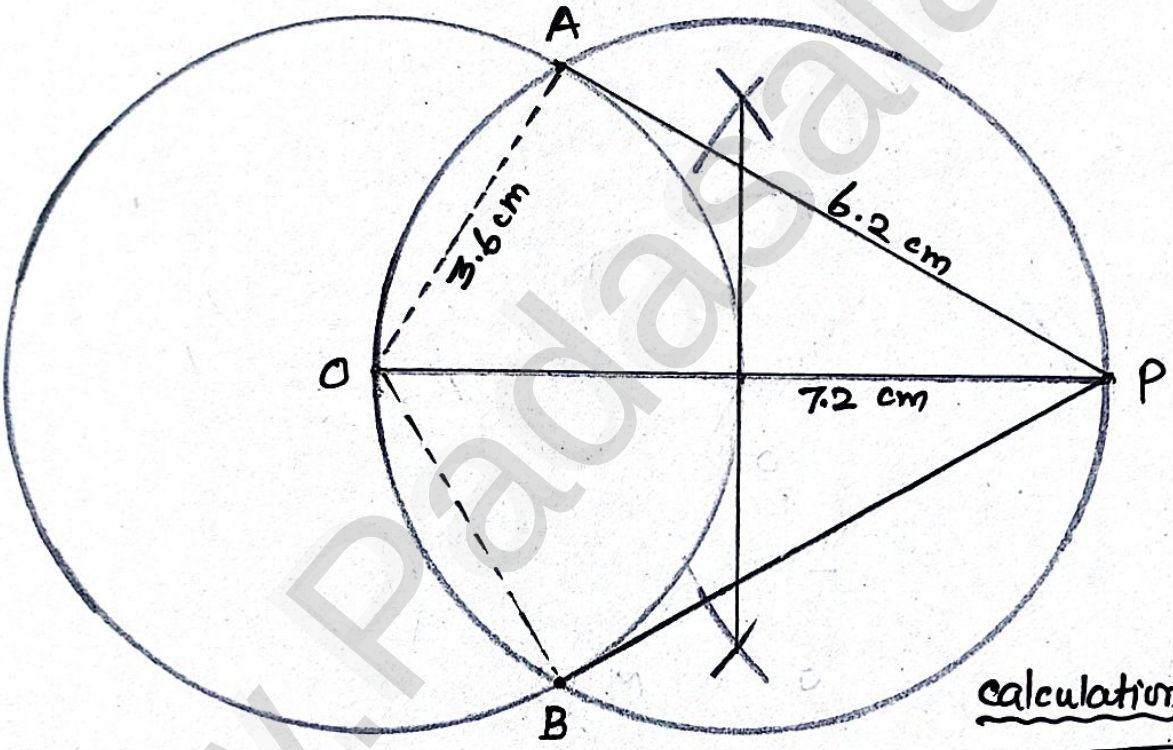
Given : $r = 3.6$ cm

$OP = 7.2$ cm

Rough Diagram



Main Diagram :



Calculation :

$PA = \sqrt{OP^2 - OA^2}$

$= \sqrt{7.2^2 - 3.6^2}$

$= \sqrt{51.84 - 12.96}$

$= \sqrt{38.88}$

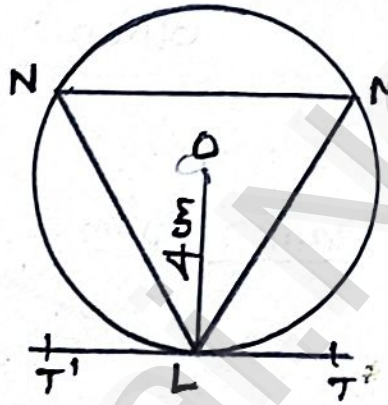
$\boxed{PA \simeq 6.2 \text{ cm}}$

Result:

Tangent Length is 6.2 cm

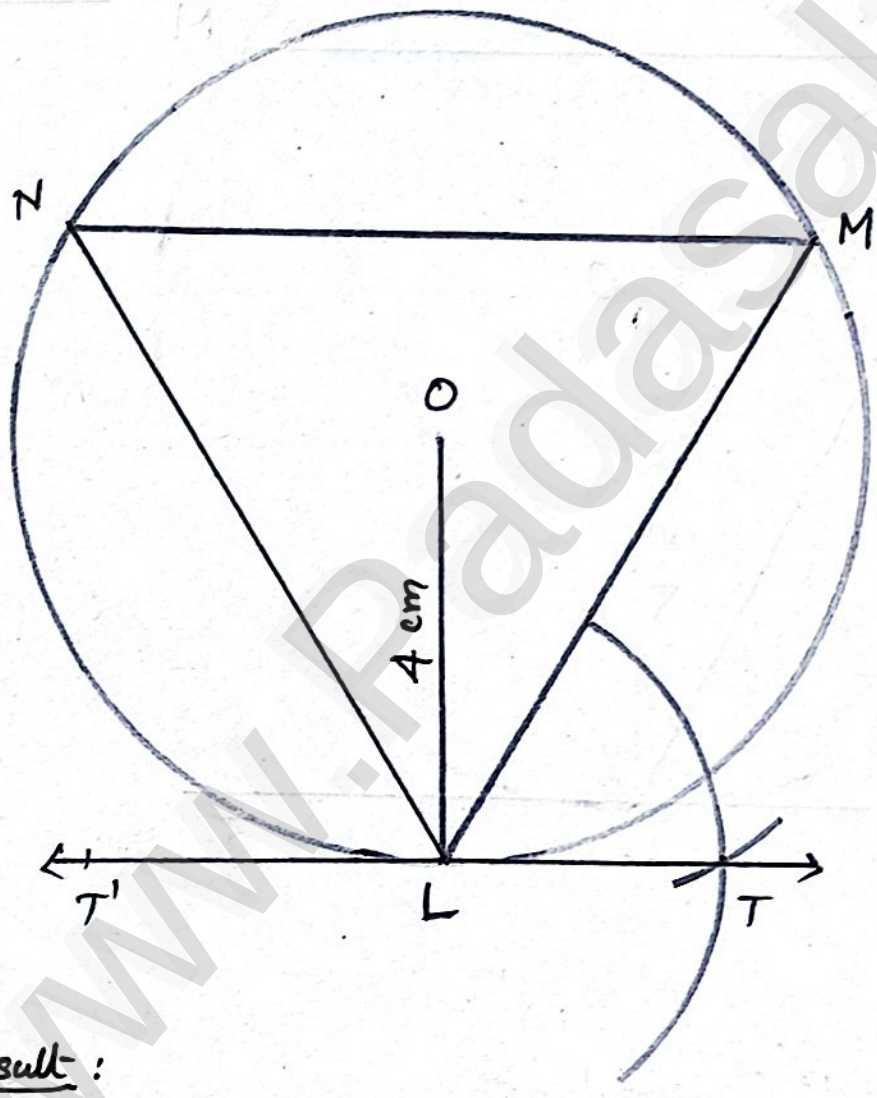
12 Draw a circle of radius 4 cm. At a point L on it draw a tangent to the circle using the alternate segment.

Rough Diagram.



Solution:

Given: $r = 4$ cm



Result:

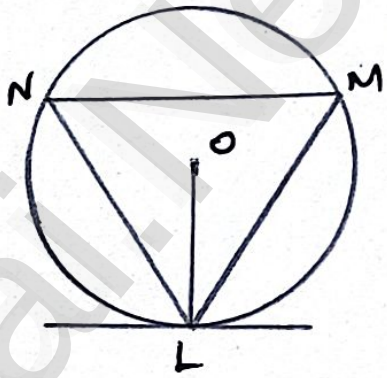
TT' is Tangent Line

(13) Draw a circle of radius 4.5 cm. Take a point on the circle. Draw the tangent at that point using the alternate segment theorem.

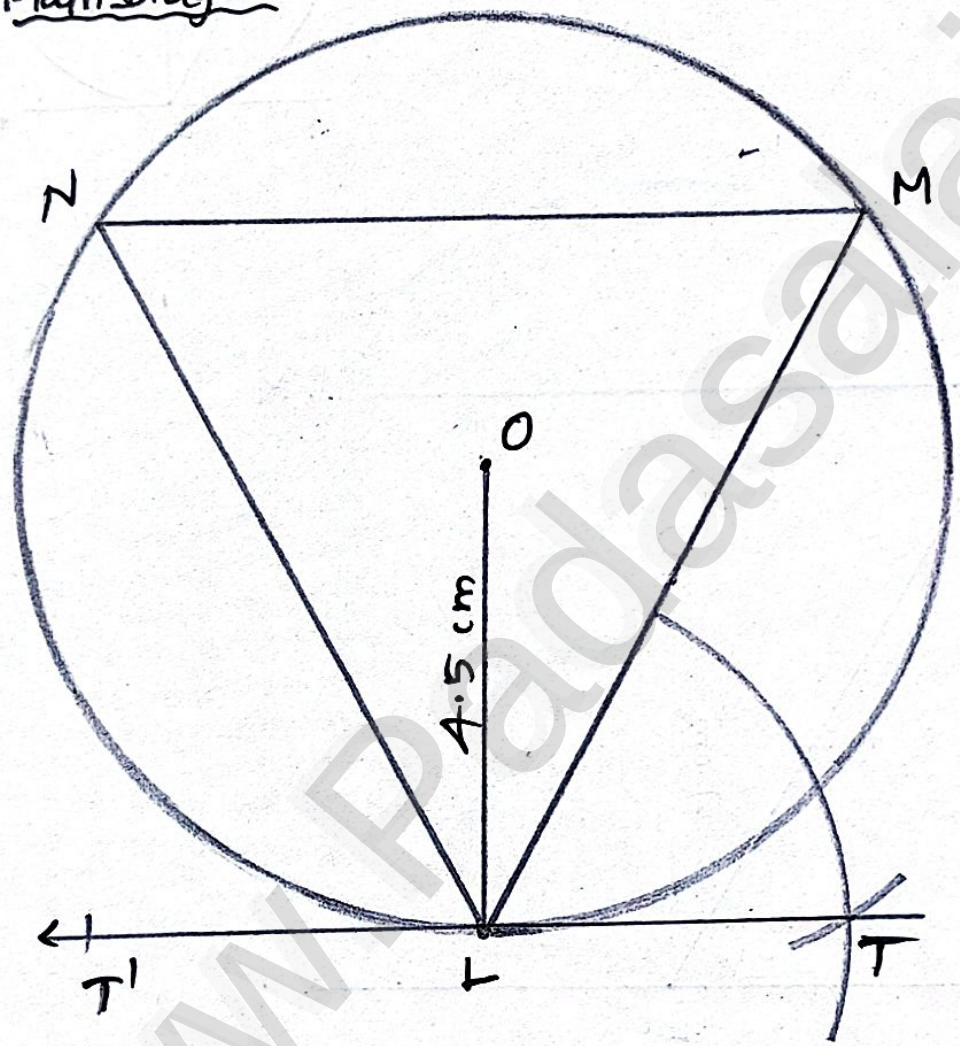
Solution

Given : Radius $r = 4.5$ cm

Rough Diagram



Main Diagram



Result

TT' is Tangent Length.

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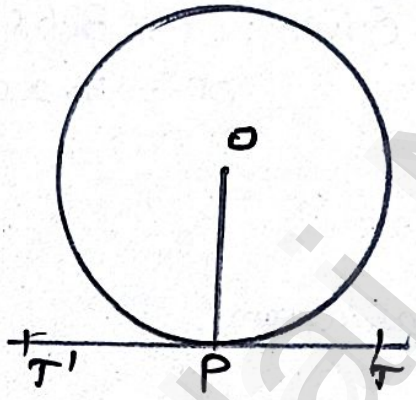
(14) Draw a circle of radius 3 cm. Take a point P on this circle and draw a tangent at P.

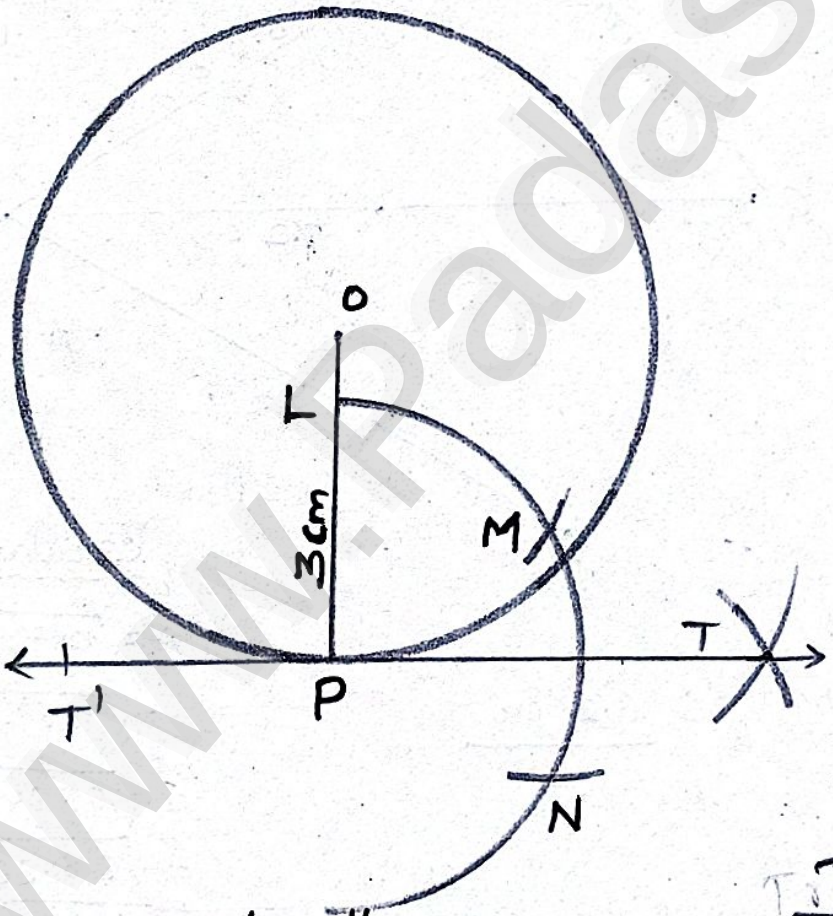
Solution:

Given : r = 3 cm

Rough Diagram



Main diagram.



Result

TT' is Tangent Length.

Try This H/W

HW (15) : radius 3.4 cm

(1) Varshika drew 6 circles with different sizes. Draw a graph for the relationship between the diameter and circumference of each circle as shown in the table and use it to find the circumference of a circle when its diameter is 6 cm.

Diameter (x) cm	1	2	3	4	5
Circumference (y) cm	3.1	6.2	9.3	12.4	15.5

Solution

(1) Table:

x	1	2	3	4	5	6
y	3.1	6.2	9.3	12.4	15.5	18.6

(2) Direct Variation

(3) Constant variation $k = \frac{y}{x} = \frac{3.1}{1}$

(4) Points (x, y):

(1, 3.1) (2, 6.2) (3, 9.3) (4, 12.4) (5, 15.5) (6, 18.6)

(5) Result:

If $x = 6$ then $y = 18.6$

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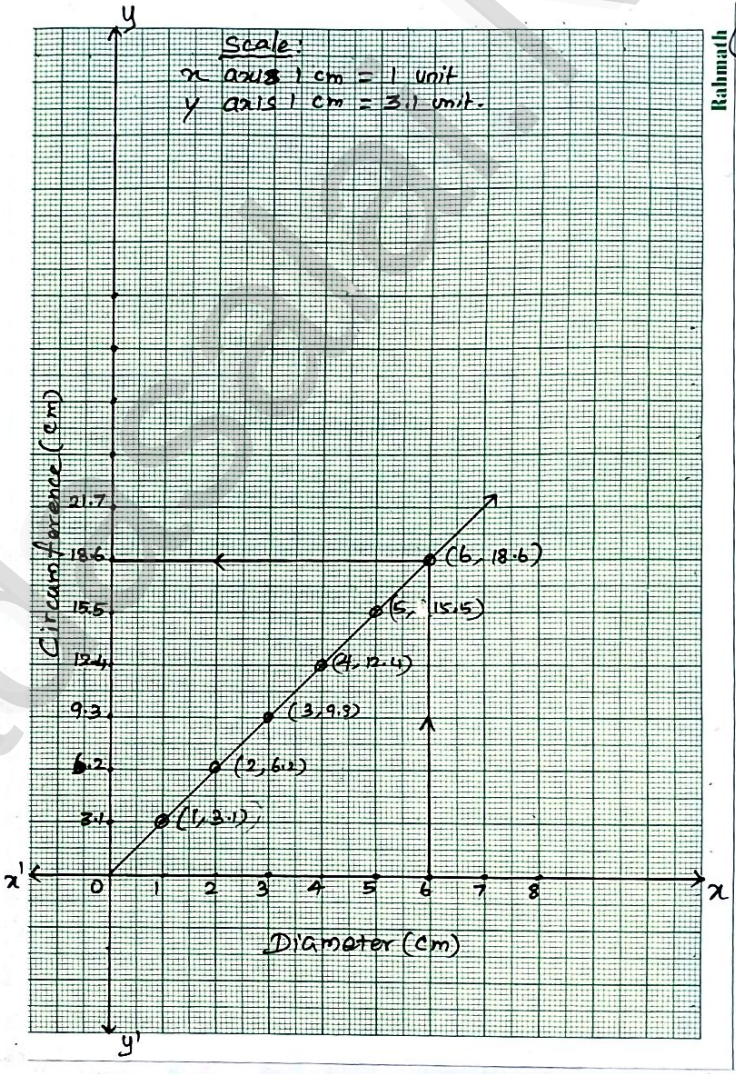


Rahmath (5)

(2) A company initially started with 40 workers to complete the work by 150 days. Later, it decided to fasten up the work increasing the number of workers as shown below.

Number of workers (x)	40	50	60	75
Number of days (y)	150	120	100	80

(i) Graph the above data and identify the type of variation.

(ii) From the graph, find the number of days required to complete the work if the company decides to opt for **120** workers?

(iii) If the work has to be completed by **200 days** how many workers are required?

$120 \times ? = 6000$

$200 \times ? = 6000$

Solution

(1) Table:

workers (x)	40	50	60	75	80	100	120
days (y)	150	120	100	80	75	60	50

(2) Indirect Variation

(3) Constant variation: $K = x \times y = 40 \times 150 = 6000$

(4) points (x, y):

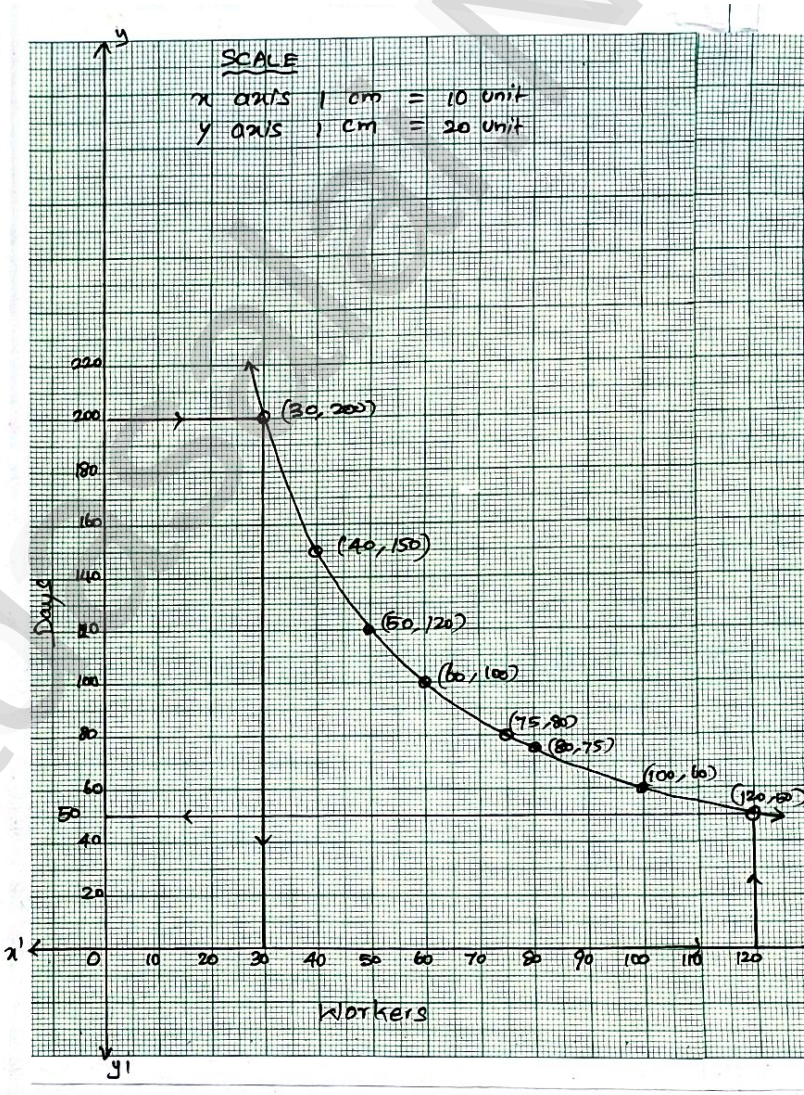
(40, 150) (50, 120) (60, 100) (75, 80) (80, 75) (100, 60) (120, 50)

(5) Result:

(i) Indirect Variation

(ii) If $x = 120$ then $y = 50$

(iii) If $y = 200$ then $x = 30$



(3) A two wheeler parking zone near bus stand charges as below.

Time (in hours) (x)	4	8	12	24
Amount ₹ (y)	60	120	180	360

Check if the amount charged are in direct variation or in inverse variation to the parking time. Graph the data. Also (i) find the amount to be paid when parking time is 6 hr; (ii) find the parking duration when the amount paid is ₹150.

Solution:

(1) Table :

x	4	8	12	24
y	60	120	180	360

(2) Direct variation

(3) Constant variation : $K = \frac{y}{x} = \frac{60}{4} = 15$

(4) points (x, y)

$(4, 60)$ $(8, 120)$ $(12, 180)$ $(24, 360)$

(5) Result :

(i) If $x = 6$ then $y = 90$

(ii) If $y = 150$ then $x = 10$

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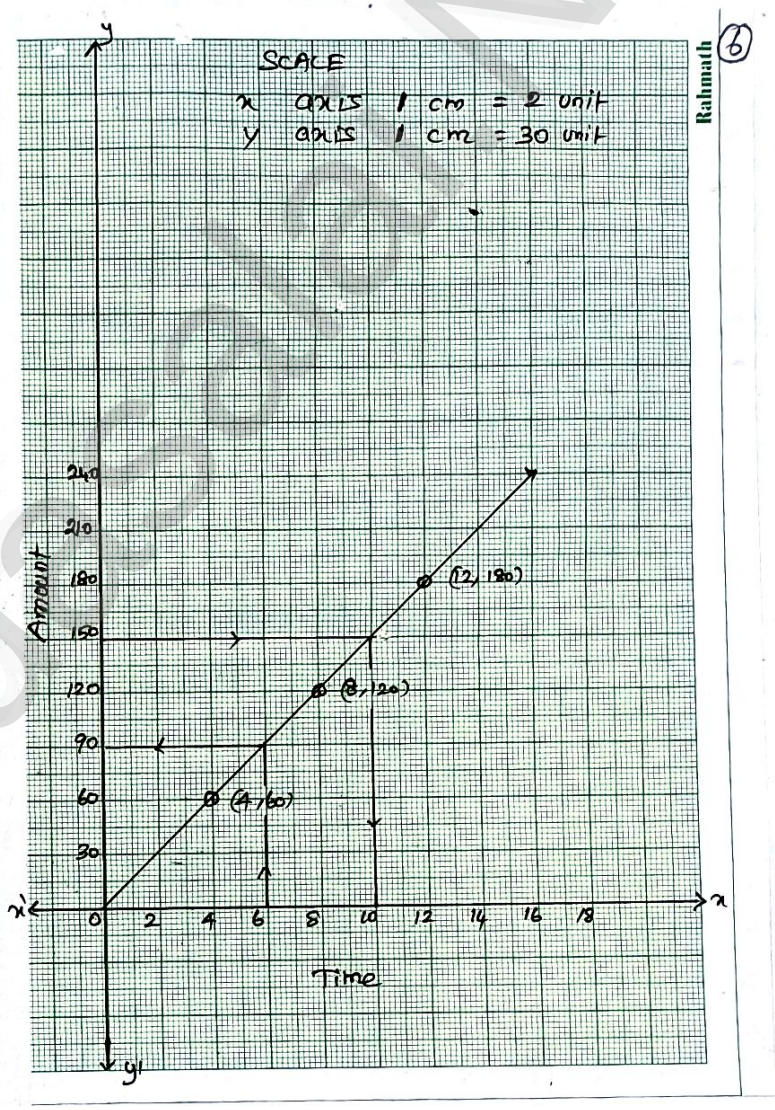


(6)

Rahmath

(4) A school announces that for a certain competitions, the cash price will be distributed for all the participants equally as show below

No. of participants (x)	2	4	6	8	10
Amount for each participant in ₹ (y)	180	90	60	45	36

(i) Find the constant of variation.

(ii) Graph the above data and hence, find how much will each participant get if the number of participants are 12.

$3 \times 12 = 36$

$30 \times 12 = 360$

Solution:

(1) Table:

x	2	4	6	8	10
y	180	90	60	45	36

(2) Indirect Variation

(3) Constant Variation $K = x \times y = 2 \times 180 = 360$

(4) Points (x, y):

$(2, 180)$ $(4, 90)$ $(6, 60)$ $(8, 45)$ $(10, 36)$

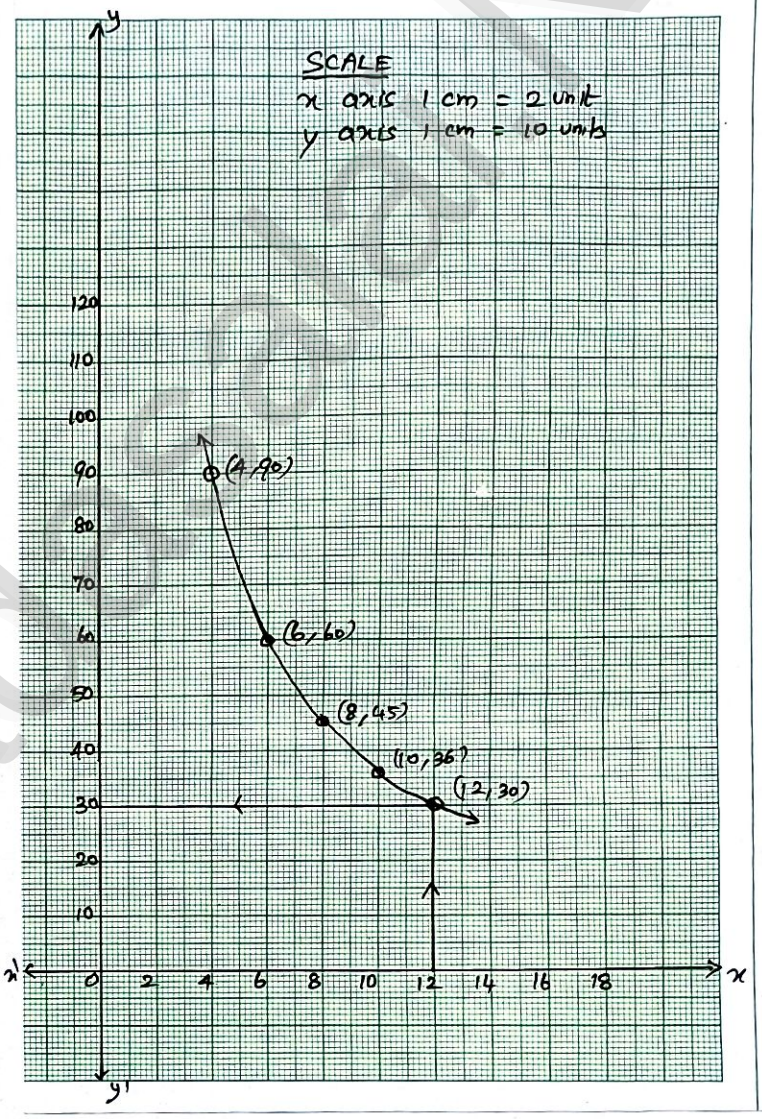
(5) Result: (i) $K = x \times y = 2 \times 180 = 360$.

(ii) If $x = 12$ then $y = 30$

Note:

$2 \times 180 = 360$

$12 \times 30 = 360$



(5) The following table shows the data about the number of pipes and the time taken to till the same tank.

No. of pipes (x)	2	3	6	9
Time Taken (in min) (y)	45	30	15	10

Draw the graph for the above data and hence

(i) Find the time taken to fill the tank when five pipes are used

(ii) Find the number of pipes when the time is 9 minutes.

Solution.

(1) Table :

Pipe	x	2	3	6	9	10
Time	y	45	30	15	10	9

(2) Indirect variation

(3) Constant variation : $K = xy = 2 \times 45 = 90$

(4) Points (x, y) :

$(2,45)$ $(3,30)$ $(6,15)$ $(9,10)$ $(10,9)$

(5) Result:

If $x = 5$ then $y = 18$

If $y = 9$ then $x = 10$

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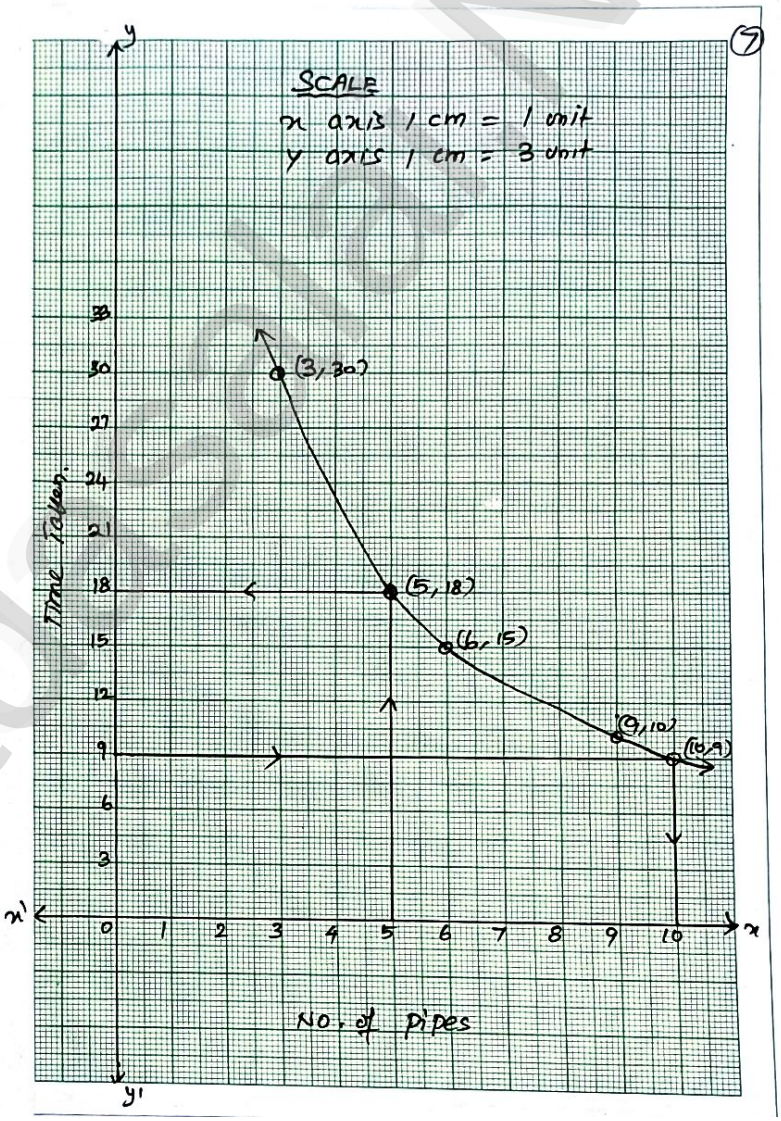
(7)



(b) A garment shop announces a flat 50% discount on every purchase of items for their customers. Draw the graph for the relation between the Marked Price and the Discount. Hence find
(i) the marked price when a customer gets a discount of ₹ 3250 (from graph)
(ii) the discount when the marked price is ₹ 2500

Solution.

(1) Table

x	1000	2000	3000	4000	5000	6000
y	500	1000	1500	2000	2500	3000

(2) Direct Variation

(3) $K = \frac{y}{x} = \frac{500}{1000} = \frac{5}{10} = \frac{1}{2}$

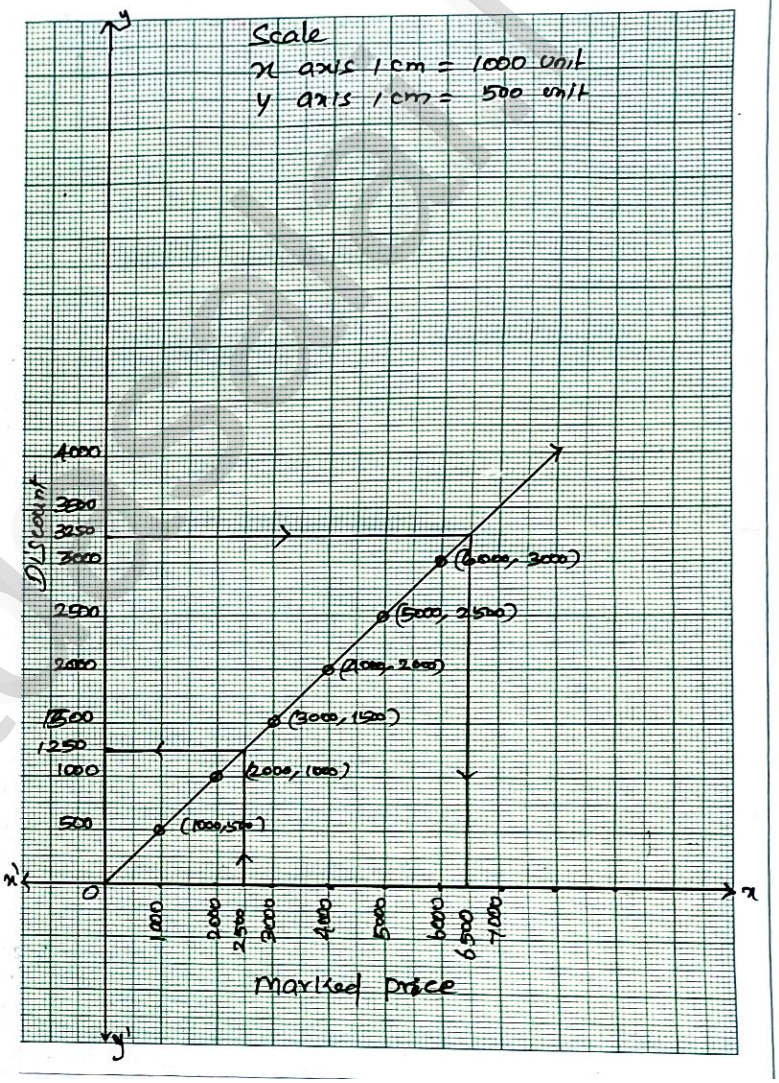
(4) Points (x, y):

(1000, 500) (2000, 1000) (3000, 1500) (4000, 2000) (5000, 2500) (6000, 3000)

(5) Result:

(i) If $y = 3250$ then $x = 6500$

(ii) If $x = 2500$ then $y = 1250$



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(7) A bus is travelling at a uniform speed of 50 km/hr. Draw the distance-time graph and hence find

(i) the constant of variation

(ii) how far will it travel in 1½ hr

(iii) the time required to cover a distance of 300 km from the graph.

Solution :

(1) Table:

x	1	2	3	4	5	6
y	50	100	150	200	250	300

(2) Direct variation

(3) Constant Variation: $k = \frac{y}{x} = \frac{50}{1}$

(4) points (x, y)

(1,50) (2,100) (3,150) (4,200) (5,250) (6,300)

(5) Result

(i) $k = \frac{y}{x} = \frac{50}{1} = 50$

(ii) If $x = 1\frac{1}{2}$ then $y = 75$

(iii) If $y = 300$ then $x = 6$

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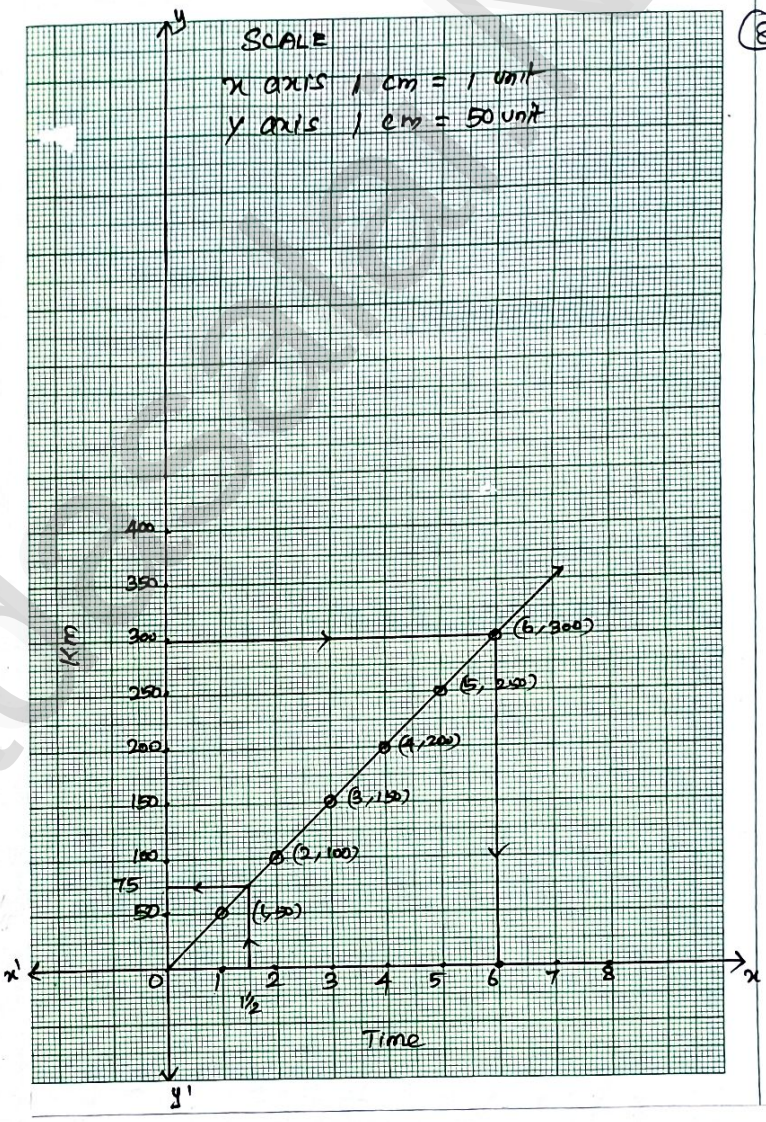
(8)



(8) Nishanth is the winner in a Marathon race of 12 km distance. He ran at the uniform speed of 12 km/hr and reached the destination in 1 hour. He was followed by Aradhana, Ponmozhi, Jeyanth, Sathya and Swetha with their respective speed of 6 km/hr, 4 km/hr, 3 km/hr and 2 km/hr. And, they covered the distance in 2 hrs, 3 hrs, 4 hrs and 6 hours respectively. Draw the speed-time graph and use it to find the time taken to Kaushik with his speed of 2.4 km/hr.

Solution:

(1) Table:

x	12	6	4	3	2
y	1	2	3	4	6

(2) Indirect Variation

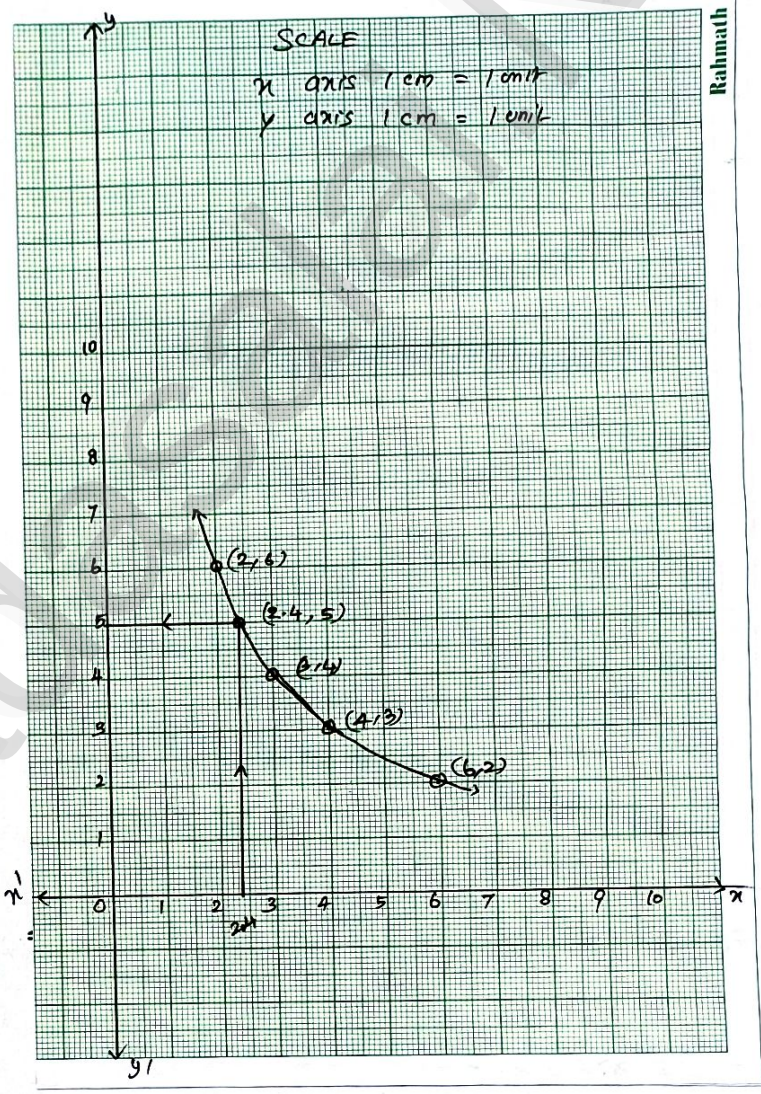
(3) Constant Variation $K = x \times y = 12 \times 1 = 12$

(4) points (x, y):

(12,1) (6,2) (4,3) (3,4) (2,6)

(5) Result:

If $x = 2.4$ then $y = 5$



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(9) Graph the following linear function $y = \frac{1}{2}x$.
Identify the constant of variation and verify it with the graph. Also (i) find y when $x = 9$
(ii) find x when $y = 7.5$.

Solution:

(1) Table:

put $x = 2$, $y = \frac{1}{2}(2) = 1$

put $x = 4$, $y = \frac{1}{2}(4) = 2$

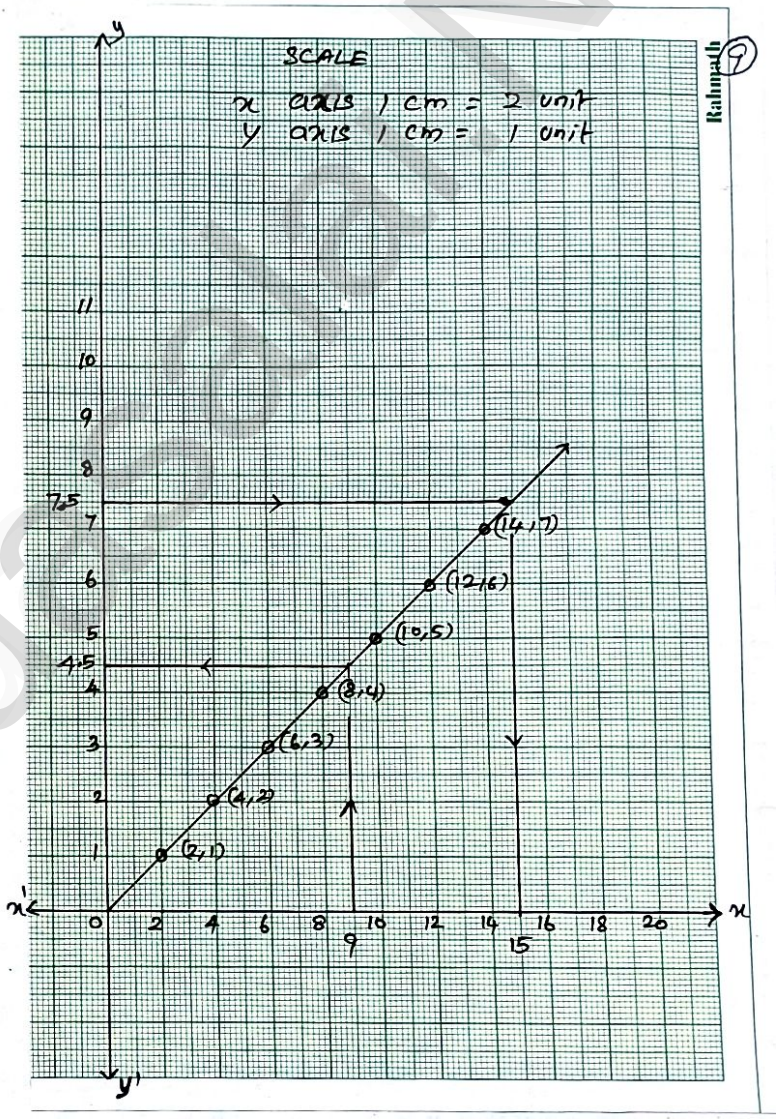
x	2	4	6	8	10	12	14
y	1	2	3	4	5	6	7

(2) Direct variation

(3) Constant variation : $K = \frac{y}{x} = \frac{1}{2}$

(4) points (x, y):
(2,1) (4,2) (6,3) (8,4) (10,5) (12,6) (14,7)

(5) Result:
(i) If $x = 9$ then $y = 4.5$
(ii) If $y = 7.5$ then $x = 15$



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(10) Draw the graph of $xy = 24$, $x, y > 0$. Using the graph find,
(i) y when $x = 3$ and (ii) x when $y = 6$.

Solution:

$1 \times 24 = 24$
$2 \times 12 = 24$
$3 \times 8 = 24$
$4 \times 6 = 24$
$6 \times 4 = 24$

(1) Table:

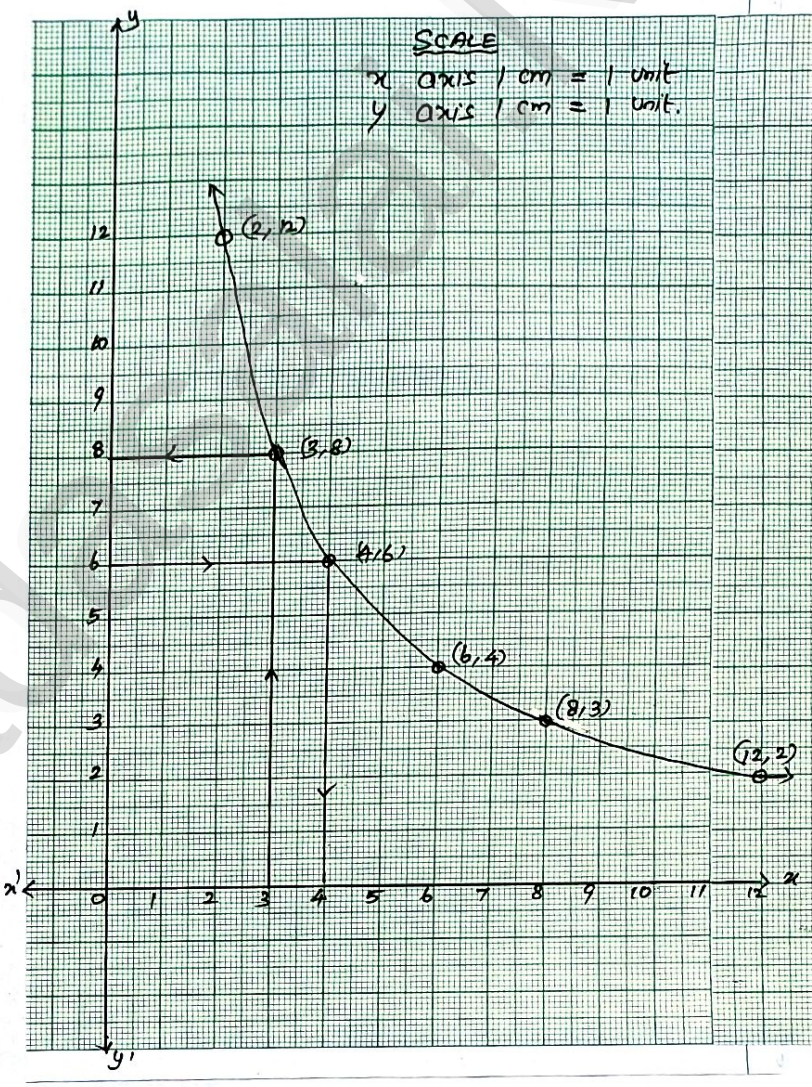
x	1	2	3	4	6	8	12	24
y	24	12	8	6	4	3	2	1

(2) Indirect variation

(3) Constant variation $K = x \times y = 1 \times 24 = 24$.

(4) points (x, y):
$(1,24)$ $(2,12)$ $(3,8)$ $(4,6)$ $(6,4)$ $(8,3)$ $(12,2)$ $(24,1)$

(5) Result:
If $x = 3$ then $y = 8$
If $y = 6$ then $x = 4$



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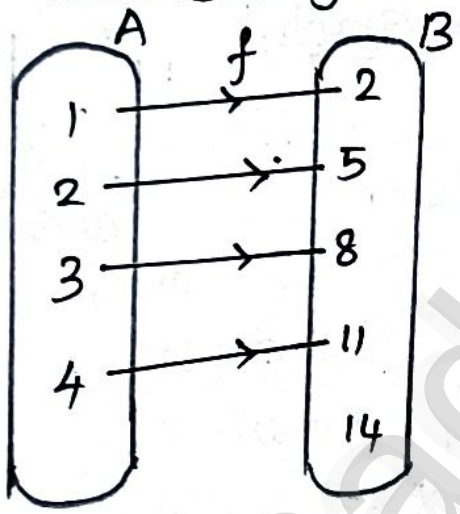
FIVE MARKS.

(1) Let A = {1, 2, 3, 4} and B = {2, 5, 8, 11, 14} be two sets. Let $f : A \to B$ be a function given by $f(x) = 3x - 1$. Represent this function
(i) by arrow diagram
(ii) in a table form
(iii) as a set of ordered pairs
(iv) in a graphical form

Solution:

Given $A = \{1, 2, 3, 4\}$, $B = \{2, 5, 8, 11, 14\}$

(i) Arrow diagram:

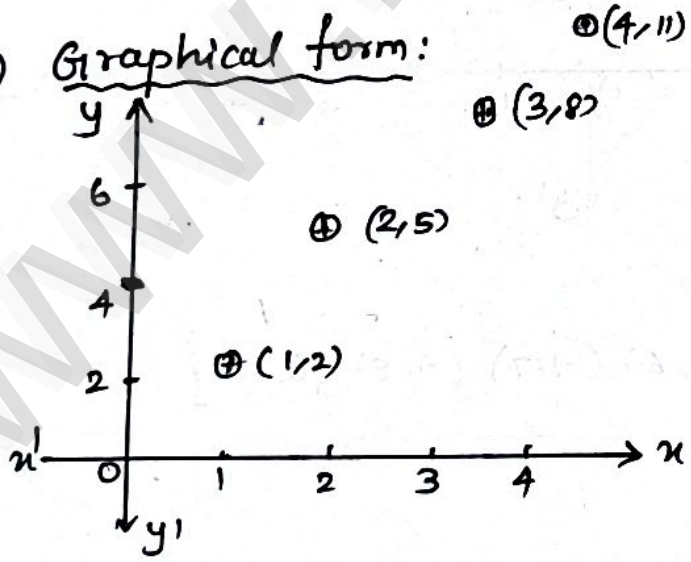


(ii) Table form:

x	1	2	3	4
$f(x)$	2	5	8	11

(iii) Ordered pair: $f = \{(1,2)\ (2,5)\ (3,8)\ (4,11)\}$

(iv) Graphical form:



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(2) Let $f : A \to B$ be a function defined by $f(x) = \frac{x}{2} - 1$ where $A = \{2, 4, 6, 10, 12\}$, $B = \{0, 1, 2, 4, 5, 9\}$. Represent f by (10)

i) set of ordered pairs ii) a table

iii) an arrow diagram iv) a graph

Solution: Given $A = \{2, 4, 6, 10, 12\}$

$B = \{0, 1, 2, 4, 5, 9\}$

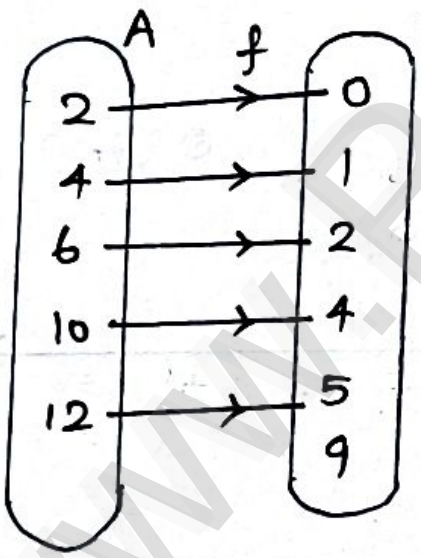
(i) Ordered pairs

$f = \{(2,1)\ (4,1)\ (6,2)\ (10,4)\ (12,5)\}$

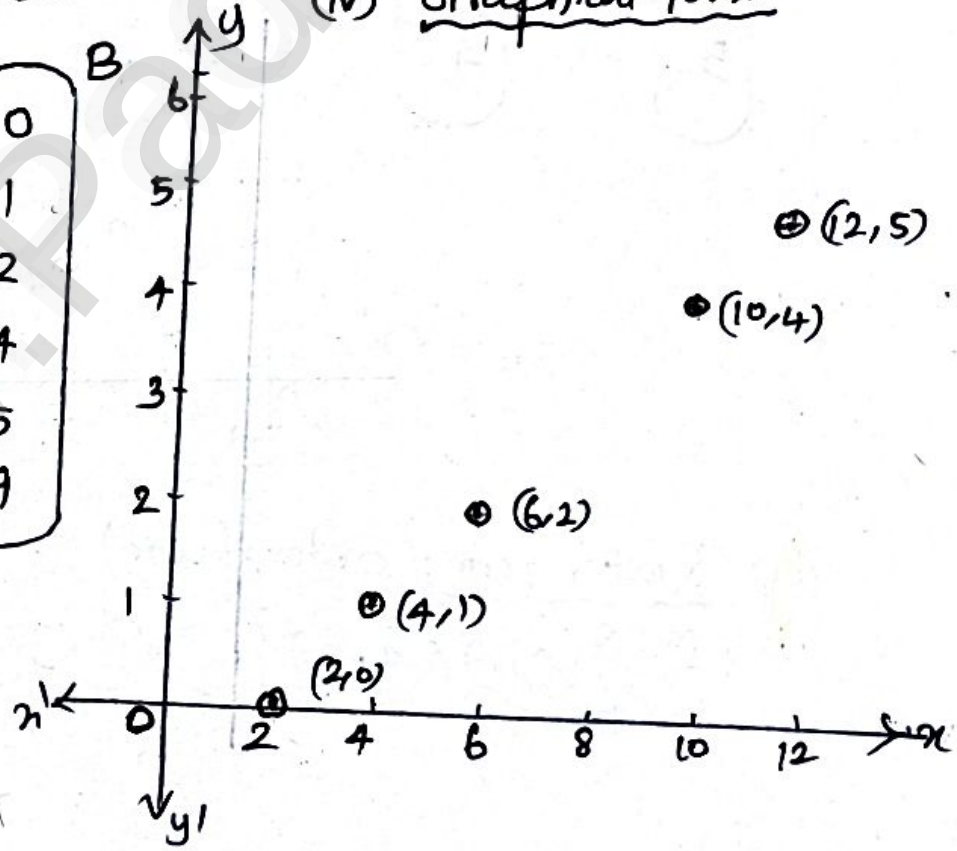
(ii) Table:

x	2	4	6	10	12
$f(x)$	0	1	2	4	5

(iii) Arrow diagram:



(iv) Graphical form:



(3) Represent each of the given relations by (a) an arrow diagram, (b) a graph and (c) a set in roster form, wherever possible.

$\{(x, y) | x = 2y, x \in \{2, 3, 4, 5\}, y \in \{1, 2, 3, 4\}$

Solution

Given $x = 2y \Rightarrow 2y = x$

$y = x/2 \Rightarrow \boxed{f(x) = \frac{x}{2}}$

If $x \in \{2, 3, 4, 5\}$ then

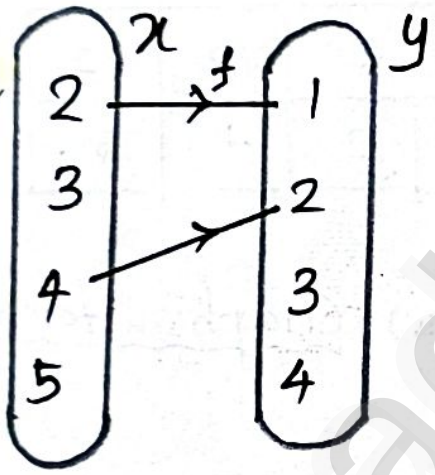
put $x = 2$, $f(2) = \frac{2}{2} = 1$ ✓

put $x = 3$, $f(3) = \frac{3}{2} = 1.5$

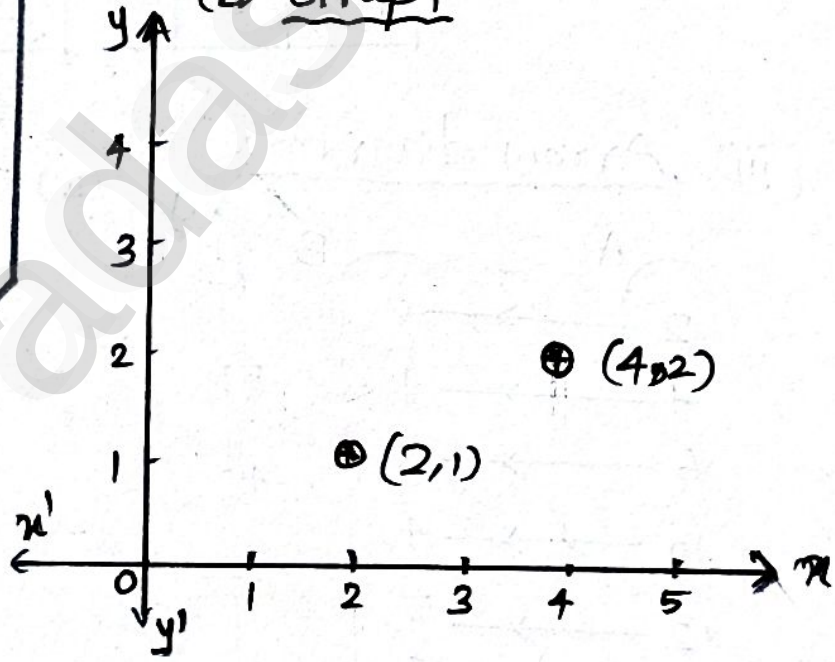
put $x = 4$, $f(4) = \frac{4}{2} = 2$ ✓

put $x = 5$, $f(5) = \frac{5}{2} = 2.5$

(a) Arrow Diagram



(b) Graph



(c) Roster form: (ordered pair)

$f = \{(2,1)(4,2)\}$

(4) Represent each of the given relation by (a) an arrow diagram (b) a graph (c) set in roster form wherever possible

$\{(x,y) \mid y = x+3,\ x, y \text{ are natural number} < 10\}$

Solution

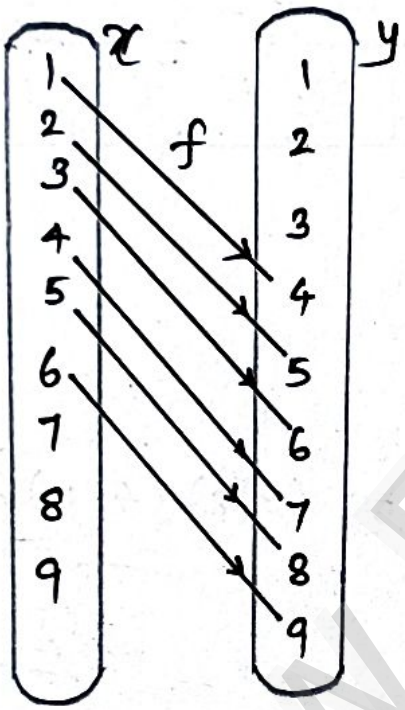
Given $y = x+3$, $x = \{1,2,3,4,5,6,7,8,9\}$

Let $f(x) = x+3$ $y = \{1,2,3,4,5,6,7,8,9\}$

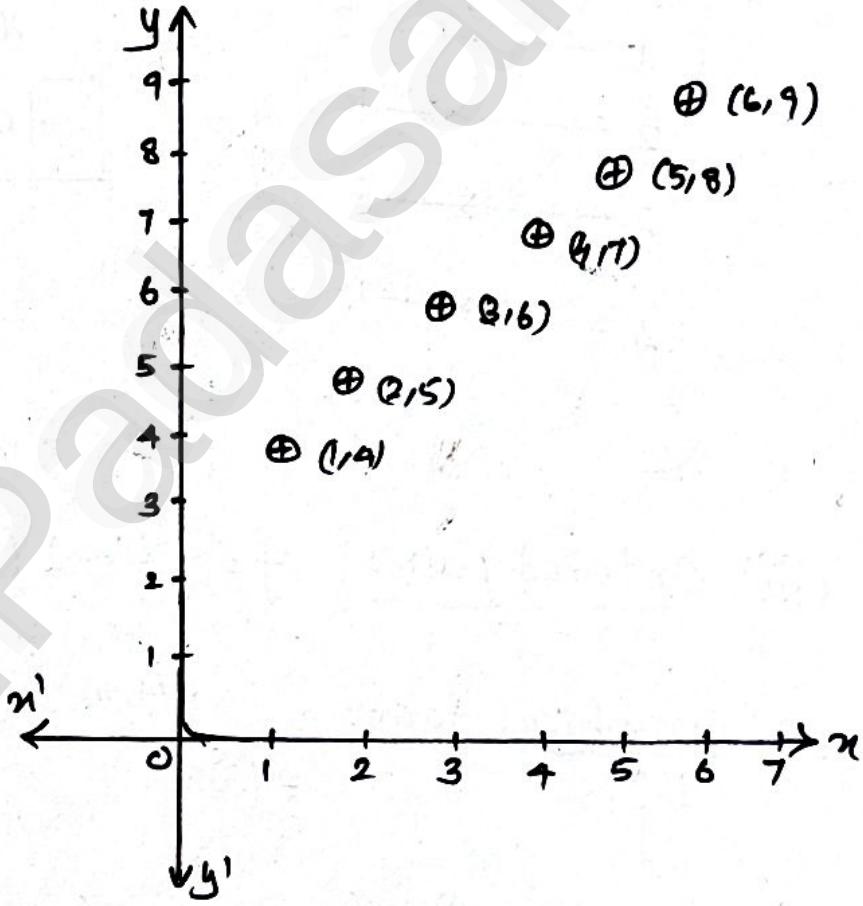
$f(1) = 1+3 = 4$, $f(2) = 2+3 = 5$, $f(3) = 3+3 = 6$

$f(4) = 4+3 = 7$, $f(5) = 5+3 = 8$ $f(6) = 6+3 = 9$

(a) Arrow Diagram:



(b) Graph:



(c) Roster form:

$f = \{(1,4)\ (2,5)\ (3,6)\ (4,7)\ (5,8)\ (6,9)\}$

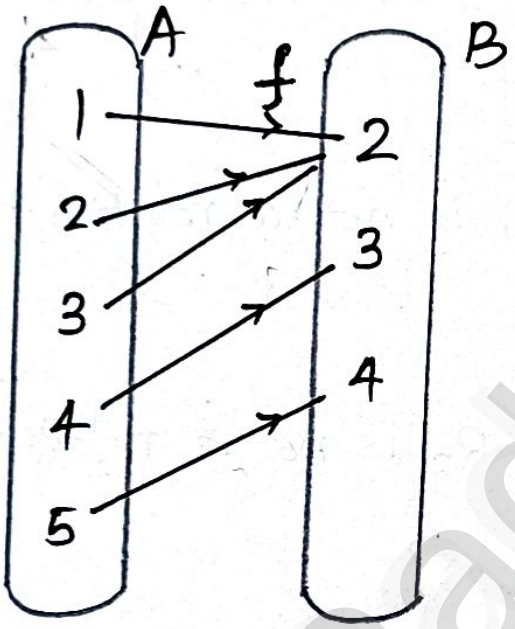
5. Represent the function
f = {(1, 2), (2, 2), (3, 2), (4, 3), (5, 4)} through
(i) an arrow diagram
(ii) a table form
(iii) a graph

(3)

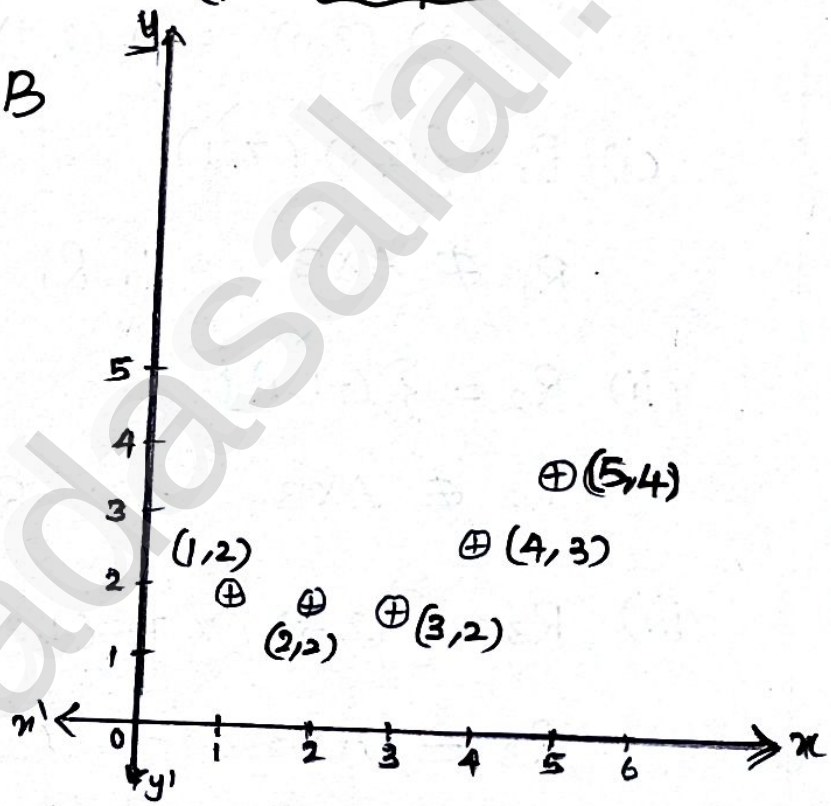
Solution:

Given $f = \{(1,2)\ (2,2)\ (3,2)\ (4,3)\ (5,4)\}$

(i) Arrow diagram:



(iii) Graph:



(ii) Table form:

x	1	2	3	4	5
$f(x)$	2	2	2	3	4

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(6) Let A = {3, 4, 7, 8} and B = {1, 7, 10}. Which of the following sets are relations from A to B?

(i) $R_1 = \{(3, 7), (4, 7), (7, 10), (8, 1)\}$

(ii) $R_2 = \{(3, 1), (4, 12)\}$

(iii) $R_3 = \{(3, 7), (4, 10), (7, 7), (7, 8), (8, 11), (8, 7), (8, 10)\}$

(11)

Solution: Given: $A = \{3, 4, 7, 8\}$, $B = \{1, 7, 10\}$

$A \times B = \{(3,1)\ (3,7)\ (3,10)\ (4,1)\ (4,7)\ (4,10)\ (7,1)\ (7,7)\ (7,10)\ (8,1)\ (8,7)\ (8,10)\}$

(i) $R_1 = \{(3,7)\ (4,7)\ (7,10)\ (8,1)\}$

$R_1 \in A \times B$

$\therefore R_1$ is a relation

(ii) $R_2 = \{(3,1)\ (4,12)\}$ ×

$R_2 \notin A \times B$

$\therefore R_2$ is not a relation

(iii) $R_3 = \{(3,7)\ (4,10)\ (7,7)\ (7,8)\ (8,11)\ (8,7)\ (8,10)\}$ × ×

$R_3 \notin A \times B$

$\therefore R_3$ is not a relation.

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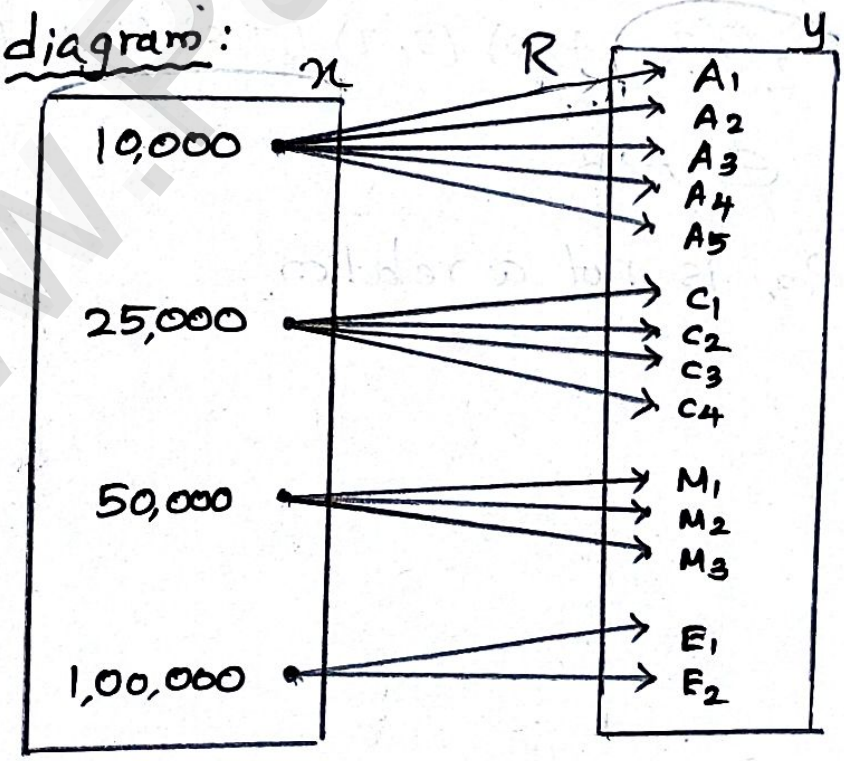
(7) A company has four categories of employees given by Assistants (A), Clerks (C), Managers (M) and an Executive Officer (E). The company provide ₹ 10,000, ₹ 25,000, ₹ 50,000 and ₹ 1,00,000 as salaries to the people who work in the categories A, C, M and E respectively. If A_1, A_2, A_3, A_4 and A_5 were Assistants; C_1, C_2, C_3, C_4 were Clerks; M_1, M_2, M_3 were managers and E_1, E_2 were Executive officers and if the relation R is defined by xRy, where x is the salary given to person y, express the relation R through an ordered pair and an arrow diagram.

Solution:

(i) Ordered pair:

$f = \{(10000, A_1), (10000, A_2), (10000, A_3), (10000, A_4), (10000, A_5),$
$(25000, C_1), (25000, C_2), (25000, C_3), (25000, C_4).$
$(50000, M_1), (50000, M_2), (50000, M_3),$
$(100000, E_1), (100000, E_2)\}$

(ii) Arrow diagram:



(8) Let A = {1, 2, 3, 7} and B = {3, 0, –1, 7}, which of the following are relation from A to B ?
(i) $R_1 = \{(2, 1), (7, 1)\}$ (ii) $R_2 = \{(-1, 1)\}$
(iii) $R_3 = \{(2, -1), (7, 7), (1, 3)\}$
(iv) $R_4 = \{(7, -1), (0, 3), (3, 3), (0, 7)\}$

Solution :

Given: $A = \{1, 2, 3, 7\}$, $B = \{3, 0, -1, 7\}$

$A \times B = \{(1,3)\ (1,0)\ (1,-1)\ (1,7)\ (2,3)\ (2,0)\ (2,-1)\ (2,7)$
$(3,3)\ (3,0)\ (3,-1)\ (3,7)\ (7,3)\ (7,0)\ (7,-1)\ (7,7)\}$

(i) $R_1 = \{(2,1)\ (7,1)\}$

$R_1 \notin A \times B$ $\therefore R_1$ is not a relation

(ii) $R_2 = \{(-1,1)\}$

$R_2 \notin A \times B$ $\therefore R_2$ is not a relation

(iii) $R_3 = \{(2,-1)\ (7,7)\ (1,3)\}$

$R_3 \in A \times B$

$\therefore R_3$ is a relation

(iv) $R_4 = \{(7,-1)\ (0,3)\ (3,3)\ (0,7)\}$

$R_4 \notin A \times B$

R_4 is not a relation.

(9) Let A = The set of all natural numbers less than 8, B = The set of all prime numbers less than 8, C = The set of even prime number. Verify that

$$(A \cap B) \times C = (A \times C) \cap (B \times C)$$

Sep 2020
May 2022

Solution

Given: $A = \{1, 2, 3, 4, 5, 6, 7\}$, $B = \{2, 3, 5, 7\}$, $C = \{2\}$

Steps
① $A \cap B$
LHS ② $(A \cap B) \times C$
③ $(A \times C)$
④ $(B \times C)$
RHS ⑤ $(A \times C) \cap (B \times C)$

(i) $A \cap B = \{1, 2, 3, 4, 5, 6, 7\} \cap \{2, 3, 5, 7\}$

$= \{2, 3, 5, 7\}$ —— ①

(ii) $(A \times B) \times C = \{2, 3, 5, 7\} \times \{2\}$

$= \{(2,2)\ (3,2)\ (5,2)\ (7,2)\}$ —— ②

(iii) $(A \times C) = \{1, 2, 3, 4, 5, 6, 7\} \times \{2\}$

$= \{(1,2)\ (2,2)\ (3,2)\ (4,2)\ (5,2)\ (6,2)\ (7,2)\}$ —— ③

(iv) $(B \times C) = \{2, 3, 5, 7\} \times \{2\}$

$= \{(2,2)\ (3,2)\ (5,2)\ (7,2)\}$ —— ④

(v) $(A \times C) \cap (B \times C) = \{(2,2)\ (3,2)\ (5,2)\ (7,2)\}$ —— ⑤

LHS = RHS,

$(A \cap B) \times C = (A \times C) \cap (B \times C)$ is Verified

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(10) Let A = The set of all natural numbers less then 8 (12)

B = The set of all prime numbers less then 8

C = The set of even prime number. verify that

$A \times (B-C) = (A \times B) - (A \times C)$

Solution:

Given: $A = \{1,2,3,4,5,6,7\}$ $B = \{2,3,5,7\}$, $C = \{2\}$

Steps	
	(1) B−C
LHS	(2) A×(B−C)
	(3) A×B
	(4) A×C
RHS	(5) (A×B)−(A×C)

(i) $B - C = \{\cancel{2},3,5,7\} - \{\cancel{2}\}$

$= \{3,5,7\}$ —— (1)

(ii) $A \times (B-C) = \{1,2,3,4,5,6,7\} \times \{3,5,7\}$

$= \{(1,3)(1,5)(1,7)(2,3)(2,5)(2,7)(3,3)(3,5)(3,7)$
$(4,3)(4,5)(4,7)(5,3)(5,5)(5,7)(6,3)(6,5)(6,7)$
$(7,3)(7,5)(7,7)\}$ —— (2)

(iii) $A \times B = \{1,2,3,4,5,6,7\} \times \{2,3,5,7\}$

$= \{(1,2)(1,3)(1,5)(1,7)(2,2)(2,3)(2,5)(2,7)$
$(3,2)(2,3)(3,5)(3,7)(4,2)(4,3)(4,5)(4,7)$
$(5,2)(5,3)(5,5)(5,7)(6,2)(6,3)(6,5)(6,7)$
$(7,2)(7,3)(7,5)(7,7)\}$ —— (3)

(iv) $(A \times C) = \{1,2,3,4,5,6,7\} \times \{2\}$

$= \{(1,2)(2,2)(3,2)(4,2)(5,2)(6,2)(7,2)\}$ —— (4)

(v) $(A \times B) - (A \times C) =$

$= \{(1,3)(1,5)(1,7)(2,3)(2,5)(2,7)(3,3)(3,5)(3,7)$
$(4,3)(4,5)(4,7)(5,3)(5,5)(5,7)(6,3)(6,5)(6,7)$
$(7,3)(7,5)(7,7)\}$ —— (5)

LHS = RHS

$A \times (B-C) = (A \times B) - (A \times C)$ is verified.

(11) Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \le 4\}$ and $C = \{3, 5\}$. Verify that

$$A \times (B \cup C) = (A \times B) \cup (A \times C)$$

(12)

Solution. Given: $A = \{0, 1\}$, $B = \{2, 3, 4\}$, $C = \{3, 5\}$

(i) $B \cup C = \{2, 3, 4, 5\}$ —— (1)

(ii) $A \times (B \cup C) = \{0, 1\} \times \{2, 3, 4, 5\}$

$= \{(0,2)\ (0,3)\ (0,4)\ (0,5)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\}$ —— (2)

(iii) $A \times B = \{0, 1\} \times \{2, 3, 4\}$

$= \{(0,2), (0,3), (0,4), (1,2), (1,3), (1,4)\}$ —— (3)

(iv) $A \times C = \{0, 1\} \times \{3, 5\}$

$= \{(0,3)\ (0,5)\ (1,3)\ (1,5)\}$ —— (4)

(v) $(A \times B) \cup (A \times C) = \{(0,2)\ (0,3)\ (0,4)\ (0,5)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\}$ —— (5)

LHR = RHS

$A \times (B \cup C) = (A \times B) \cup (A \times C)$ is verified.

Steps
1. $B \cup C$
2. $A \times (B \cup C)$
3. $A \times B$
4. $A \times C$
5. $(A \times B) \cup (A \times C)$

(12) Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \leq 4\}$ and $C = \{3, 5\}$. Verify that

$$A \times (B \cap C) = (A \times B) \cap (A \times C)$$

Steps

1. $B \cap C$
2. $A \times B \cap C$
3. $A \times B$
4. $A \times C$
5. $(A \times B) \cap (A \times C)$

Solution

Given: $A = \{0, 1\}$, $B = \{2, 3, 4\}$, $C = \{3, 5\}$

(i) $B \cap C = \{2, 3, 4\} \cap \{3, 5\}$

$= \{3\}$ —— (1)

(ii) $A \times (B \cap C) = \{0, 1\} \times \{3\}$

$= \{(0, 3), (1, 3)\}$ —— (2)

(iii) $(A \times B) = \{0, 1\} \times \{2, 3, 4\}$

$= \{(0,2)\ (0,3)\ (0,4)\ (1,2)\ (1,3)\ (1,4)\}$ —— (3)

(iv) $(A \times C) = \{0, 1\} \times \{3, 5\}$

$= \{(0,3)\ (0,5)\ (1,3)\ (1,5)\}$ —— (4)

(v) $(A \times B) \cap (A \times C) = \{(0,3)\ (1,3)\}$ —— (5)

LHS = RHS

$A \times (B \cap C) = (A \times B)\ (A \times C)$ is verified.

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(13) Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \leq 4\}$ and $C = \{3, 5\}$. Verify that

$$(A \cup B) \times C = (A \times C) \cup (B \times C)$$

Solution

Steps
1. $A \cup B$
2. $(A \cup B) \times C$
3. $A \times C$
4. $B \times C$
5. $(A \times C) \cup (B \times C)$

Given: $A = \{0, 1\}$, $B = \{2, 3, 4\}$, $C = \{3, 5\}$

(i) $A \cup B = \{0, 1, 2, 3, 4\}$ —— (1)

(ii) $(A \cup B) \times C = \{0, 1, 2, 3, 4\} \times \{3, 5\}$

$= \{(0,3)\ (0,5)\ (1,3)\ (1,5)\ (2,3)\ (2,5)\ (3,3)\ (3,5)\ (4,3)\ (4,5)\}$ —— (2)

(iii) $A \times C = \{0, 1\} \times \{3, 5\}$

$= \{(0,3)\ (0,5)\ (1,3)\ (1,5)\}$ —— (3)

(iv) $B \times C = \{2, 3, 4\} \times \{3, 5\}$

$= \{(2,3)\ (2,5)\ (3,3)\ (3,5)\ (4,3)\ (4,5)\}$ —— (4)

(v) $(A \times C) \cup (B \times C) = \{(0,3)\ (0,5)\ (1,3)\ (1,5)\ (2,3)\ (2,5)\ (3,3)\ (3,5)\ (4,3)\ (4,5)\}$ —— (5)

LHS = RHS

$(A \cup B) \times C = (A \times C) \cup (B \times C)$ is verified.

(14) Given A = {1, 2, 3}, B = {2, 3, 5}, C = {3, 4} and D = {1, 3, 5}, check if $(A \cap C) \times (B \cap D) = (A \times B) \cap (C \times D)$ is true?

(13)

Solution: Given $A = \{1, 2, 3\}$, $B = \{2, 3, 5\}$

$C = \{3, 4\}$, $D = \{1, 3, 5\}$

Steps
1. $A \cap C$
2. $B \cap C$
3. $(A \cap C) \times (B \cap D)$
4. $A \times B$
5. $C \times D$
6. $(A \times B) \cap (C \times D)$

(i) $(A \cap C) = \{1, 2, 3\} \cap \{3, 4\} = \{3\}$ — (1)

(ii) $B \cap D = \{2, 3, 5\} \cap \{1, 3, 5\} = \{3, 5\}$ — (2)

(iii) $(A \cap C) \times (B \cap D) = \{3\} \times \{3, 5\}$

$= \{(3, 3)\ (3, 5)\}$ — (3)

(iv) $(A \times B) = \{1, 2, 3\} \times \{2, 3, 5\}$

$= \{(1,2)\ (1,3)\ (1,5)\ (2,2)\ (2,3)\ (2,5)\ (3,2)\ (3,3)\ (3,5)\}$ — (4)

(v) $(C \times D) = \{3, 4\} \times \{1, 3, 5\}$

$= \{(3,1)\ (3,3)\ (3,5)\ (4,1)\ (4,3)\ (4,5)\}$ — (5)

(vi) $(A \times B) \cap (C \times D) = \{(3, 3)\ (3, 5)\}$ — (6)

LHS = RHS

$(A \cap C) \times (B \cap D) = (A \times B) \cap (C \times D)$ is True.

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15 Let $A = \{x \in N \mid 1 < x < 4\}$, $B = \{x \in W \mid 0 \le x < 2\}$ and $C = \{x \in N \mid x < 3\}$. Then verify that

$$A \times (B \cup C) = (A \times B) \cup (A \times C)$$

Solution:

Given: $A = \{2, 3\}$, $B = \{0, 1\}$, $C = \{1, 2\}$

(i) $B \cup C = \{0, 1, 2\}$ —— ①

(ii) $A \times (B \cup C) = \{2, 3\} \times \{0, 1, 2\}$

$= \{(2,0)\ (2,1)\ (2,2)\ (3,0)\ (3,1)\ (3,2)\}$ —— ②

(iii) $A \times B = \{2, 3\} \times \{0, 1\}$

$= \{(2,0), (2,1), (3,0), (3,1)\}$ —— ③

(iv) $A \times C = \{2, 3\} \times \{1, 2\}$

$= \{(2,1)\ (2,2)\ (3,1)\ (3,2)\}$ —— ④

(v) $(A \times B) \cup (A \times C) = \{(2,0)\ (2,1)\ (2,2)\ (3,0)\ (3,1)\ (3,2)\}$ —— ⑤

Steps
① $B \cup C$
② $A \times (B \cup C)$
③ $A \times B$
④ $A \times C$
⑤ $(A \times B) \cup (A \times C)$

LHS = RHS

$A \times (B \cup C) = (A \times B) \cup (A \times C)$ is verified.

(16) Let $A = \{x \in N \mid 1 < x < 4\}$, $B = \{x \in W \mid 0 \le x < 2\}$ and $C = \{x \in N \mid x < 3\}$. then verified that

$$A \times (B \cap C) = (A \times B) \cap (A \times C)$$

Solution

Given: $A = \{2, 3\}$, $B = \{0, 1\}$, $C = \{1, 2\}$

STEPS
1. $B \cap C$
2. $A \times (B \cap C)$
3. $A \times B$
4. $A \times C$
5. $(A \times B) \cap (A \times C)$

(i) $B \cap C = \{0, 1\} \cap \{1, 2\} = \{1\}$ — (1)

(ii) $A \times (B \cap C) = \{2, 3\} \times \{1\}$

$= \{(2, 1)(3, 1)\}$ — (2)

(iii) $A \times B = \{2, 3\} \times \{0, 1\}$

$= \{(2, 0)(2, 1)(3, 0)(3, 1)\}$ — (3)

(iv) $A \times C = \{2, 3\} \times \{1, 2\}$

$= \{(2, 1)(2, 2)(3, 1)(3, 2)\}$ — (4)

(v) $(A \times B) \cap (A \times C) = \{(2, 1), (3, 1)\}$ — (5)

LHS = RHS

$A \times (B \cap C) = (A \times B) \cap (A \times C)$ is verified.

(17) If A = {5, 6}, B = {4, 5, 6}, C = {5, 6, 7}, Show that A × A = (B × B) ∩ (C × C).

Solution:

Given: $A = \{5,6\}$, $B = \{4,5,6\}$, $C = \{5,6,7\}$

Steps
(1) A×A
(2) B×B
(3) C×C
(4) (B×B) ∩ (C×C)

(i) $A \times A = \{5,6\} \times \{5,6\}$

$= \{(5,5)\ (5,6)\ (6,5)\ (6,6)\}$ —— (1)

(ii) $B \times B = \{4,5,6\} \times \{4,5,6\}$

$= \{(4,4)\ (4,5)\ (4,6)\ (5,4)\ (5,5)\ (5,6)\ (6,4)\ (6,5)\ (6,6)\}$ —— (2)

(iii) $C \times C = \{5,6,7\} \times \{5,6,7\}$

$= \{(5,5)\ (5,6)\ (5,7)\ (6,5)\ (6,6)\ (6,7)\ (7,5)\ (5,6)\ (7,7)\}$ —— (3)

(iv) $(B \times B) \cap (C \times C) = \{(5,5)\ (5,6)\ (6,5)\ (6,6)\}$ —— (4)

LHS = RHS

$\therefore$ $A \times A = (B \times B) \cap (C \times C)$ is verified.

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(18) If A = {1, 3, 5} and B = {2, 3} then
(i) Find A×B and B×A.
(ii) Is A×B = B×A? If not why?
(iii) Show that n(A×B) = n(B×A) = n(A)× n(B)

(14)

Solution: Given: $A = \{1, 3, 5\}$, $B = \{2, 3\}$

Let, $\boxed{n(A) = 3}$, $\boxed{n(B) = 2}$

(i) $A \times B = \{1, 3, 5\} \times \{2, 3\}$

$A \times B = \{(1,2), (1,3), (3,2), (3,3), (5,2), (5,3)\}$

$\boxed{n(A \times B) = 6}$

$B \times A = \{2, 3\} \times \{1, 3, 5\}$

$B \times A = \{(2,1)\ (2,3)\ (2,5)\ (3,1)\ (3,3)\ (3,5)\}$

$\boxed{n(B \times A) = 6}$

(ii) $A \times B \neq B \times A = \{(1,2) \neq (2,1), (1,3) \neq (2,3), \ldots\}$

(iii) $n(A \times B) = n(B \times A) = n(A) \times n(B)$

$6 = 6 = 3 \times 2$

$6 = 6 = 6$

$\therefore$ verified.

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(19) Let f be a function $f : N \to N$ be defined by $f(x) = 3x + 2, x \in N$

(i) Find the images of 1, 2, 3

(ii) Find the pre-images of 29, 53

(iii) Identify the type of function

Solution: given: $f(x) = 3x+2, \quad x \in N.$

(i)

$x = 1, \quad f(1) = 3(1)+2 = 3+2 = 5$

$x = 2, \quad f(2) = 3(2)+2 = 6+2 = 8$

$x = 3, \quad f(3) = 3(3)+2 = 9+2 = 11$

$\therefore$ The Images are 5, 8, 11

(ii)

$f(x) = 29, \quad 3x+2 = 29$

$3x = 29-2$

$x = \frac{\cancel{27}\,9}{\cancel{3}}$

$\boxed{x = 9}$

$f(x) = 53, \quad 3x+2 = 53$

$3x = 53-2$

$x = \frac{\cancel{51}\,17}{\cancel{3}}$

$\boxed{x = 17}$

$\therefore$ The Pre-images are 9, 17

(iii) f is one-one and into function

(20) If $p_1^{x_1} \times p_2^{x_2} \times p_3^{x_3} \times p_4^{x_4} = 113400$ where p_1, p_2, p_3, p_4 are primes in ascending order and x_1, x_2, x_3, x_4 are integers, find the value of p_1, p_2, p_3, p_4 and x_1, x_2, x_3, x_4

Solution

2	113400
2	56700
2	28350
3	14175
3	4725
3	1575
3	525
5	175
5	35
7	7
	1

$\therefore$ $2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 5 \times 5 \times 7 = 113400$

$2^3 \times 3^4 \times 5^2 \times 7^1 = 113400$

Given: $\boxed{P_1^{x_1} \times P_2^{x_2} \times P_3^{x_3} \times P_4^{x_4} = 113400}$

$\therefore$ $P_1 = 2$, $P_2 = 3$, $P_3 = 5$, $P_4 = 7$

$x_1 = 3$, $x_2 = 4$, $x_3 = 2$, $x_4 = 1$

(21) Find the sum to n terms of the series
5 + 55 + 555 + ...

Solution:

$S_n = 5 + 55 + 555 + \cdots + n$ terms

$5[1 + 11 + 111 + \cdots + n]$

$\frac{5}{9}[9 + 99 + 999 + \cdots + n]$

$\frac{5}{9}[(10-1) + (100-1) + (1000-1) + \cdots + n]$

$\frac{5}{9}[(10 + 100 + 1000 + \cdots n) - (1 + 1 + 1 + \cdots n)]$

$\frac{5}{9}\left[\frac{10(10^n - 1)}{9} - n\right]$

$\frac{50}{81}\left[10^n - 1\right] - \frac{5}{9}n$

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(22) Find the sum to n terms of the series.

3 + 33 + 333 + ... to n terms

(15)

Solution:

$$S_n = 3 + 33 + 333 + \cdots + n \text{ terms}$$

$$3[1 + 11 + 111 + \cdots + n]$$

$$\frac{3}{9}[9 + 99 + 999 + \cdots + n]$$

$$\frac{3}{9}[(10-1) + (100-1) + (1000-1) + \cdots + n]$$

$$\frac{3}{9}[(10 + 100 + 1000 + \cdots n) - (1 + 11 + 111 + \cdots n)]$$

$$\frac{3}{9}\left[\frac{10(10^n - 1)}{9} - n\right]$$

$$\frac{30}{81}[10^n - 1] - \frac{3}{9}n$$

(23) Find the sum to n terms of the series

(i) 0.4 + 0.44 + 0.444 + ... to n terms

Solution: Given: $0.4 = \frac{4}{10}$, $0.44 = \frac{44}{100}$

$$\frac{4}{10} + \frac{44}{100} + \frac{444}{1000} + \cdots + n \text{ terms}$$

$$4\left[\frac{1}{10} + \frac{11}{100} + \frac{111}{1000} + \cdots + n\right]$$

$$\frac{4}{9}\left[\frac{9}{10} + \frac{99}{100} + \frac{999}{1000} + \cdots n\right]$$

$$\frac{4}{9}\left[\left(1 - \frac{1}{10}\right) + \left(1 - \frac{1}{100}\right) + \cdots + n\right]$$

$$\frac{4}{9}\left[(1 + 1 + 1 + \cdots n) - \left(\frac{1}{10} + \frac{11}{100} + \cdots n\right)\right]$$

$$\frac{4}{9}\left[n - \frac{1}{10}\left[\frac{1 - \left(\frac{1}{10}\right)^n}{1 - \frac{1}{10}}\right]\right]$$

$$\frac{4}{9}\left[n - \frac{1}{9}\left[1 - \left(\frac{1}{10}\right)^n\right]\right]$$

(24) Find the value of 16 + 17 + 18 + ... + 75

Solution

Given: $16+17+18+\cdots+75 =$

$= (1+2+3+\cdots+75) - (1+2+3+\cdots+15)$

$n=75$ $n=15$

$= \frac{n(n+1)}{2} - \frac{n(n+1)}{2}$

$= \frac{75(75+1)}{2} - \frac{15(15+1)}{2}$

$= \frac{75 \times \cancel{76}^{38}}{\cancel{2}} - \frac{15 \times \cancel{16}^{8}}{\cancel{2}}$

$= (75 \times 38) - (15 \times 8)$

$= 2850 - 120$

$= 2730$

25 Find the sum of the following series

(i) $6^2 + 7^2 + 8^2 + \ldots\ldots + 21^2$

Solution.

$$6^2+7^2+8^2+\cdots+21^2 = (1^2+2^2+\cdots 21^2) - (1^2+2^2+\cdots 5^2)$$

$\boxed{n=21}$ $\boxed{n=5}$

$$= \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)(2n+1)}{6}$$

$$= \frac{21(21+1)(2\times 21+1)}{6} - \frac{5(5+1)(2\times 5+1)}{6}$$

$$= \frac{\overset{7}{\cancel{21}} \times \overset{11}{\cancel{22}} \times 43}{\cancel{6}\,\cancel{3}} - \frac{5\times \cancel{6}\times 11}{\cancel{6}}$$

$$= (7\times 11\times 43) - (5\times 11)$$

$$= 3311 - 55$$

$$= 3256$$

$$\frac{3\cancel{11} \times 2 = 22}{3\times 2 = 6}$$

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(26) Find the sum of $15^2 + 16^2 + 17^2 + \ldots\ldots + 28^2$

(16)

Solution

$$15^2 + 16^2 + 17^2 + \cdots + 28^2 =$$

$$= (1^2 + 2^2 + 3^2 + \cdots + 28^2) - (1^2 + 2^2 + \cdots + 14^2)$$

$\boxed{n = 28}$ $\boxed{n = 14}$

$$= \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)(2n+1)}{6}$$

$$= \frac{28(28+1)(2\times 28+1)}{6} - \frac{14(14+1)(2\times 14+1)}{6}$$

$$= \frac{\overset{14}{\cancel{28}} \times 29 \times \overset{19}{\cancel{57}}}{\cancel{3} \times \cancel{2}} - \frac{\overset{7}{\cancel{14}} \times \overset{5}{\cancel{15}} \times 29}{\cancel{3} \times \cancel{2}}$$

$$= (14 \times 29 \times 19) - (7 \times 5 \times 29)$$

$$= 7714 - 1015$$

$$= 6699$$

(27) Rekha has 15 square colour papers of sizes 10 cm, 11 cm, 12 cm, ..., 24 cm. How much area can be decorated with these colour papers?

Solution: Given: $10^2 + 11^2 + 12^2 + \cdots + 24^2 =$

$$= \underbrace{(1^2 + 2^2 + \cdots 24^2)}_{\boxed{n=24}} - \underbrace{(1^2 + 2^2 + \cdots + 9^2)}_{\boxed{n=9}}$$

$$= \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)(2n+1)}{6}$$

$$= \frac{24(24+1)(2\times24+1)}{6} - \frac{9(9+1)(2\times9+1)}{6}$$

$$= \frac{\cancel{24}^{4} \times 25 \times 49}{\cancel{6}} - \frac{\cancel{9}^{3} \times \cancel{10}^{5} \times 19}{\cancel{6}\,\cancel{2}}$$

$$= (4 \times 25 \times 49) - (3 \times 5 \times 19)$$

$$= 4900 - 285$$

$$= 4615$$

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(28) Find the sum of $9^3 + 10^3 + \ldots\ldots + 21^3$

Solution Given $9^3 + 10^3 + \cdots + 21^3 =$

$$= (1^3 + 2^3 + \cdots + 21^3) - (1^3 + 2^3 + \cdots + 8^3)$$

$\boxed{n=21}$ $\boxed{n=8}$

$$= \left[\frac{n(n+1)}{2}\right]^2 - \left[\frac{n(n+1)}{2}\right]^2$$

$$= \left[\frac{21 \times \overset{11}{\cancel{22}}}{\cancel{2}}\right]^2 - \left[\frac{\overset{4}{\cancel{8}} \times 9}{\cancel{2}}\right]^2$$

$$= (21 \times 11)^2 - (4 \times 9)^2$$

$$= 231^2 - 36^2$$

$$= 53361 - 1296$$

$$= 52065$$

Rough work

$$\begin{array}{r} 231 \times 231 \\ \hline 231 \\ 693\,0 \\ 462\,0\,0 \\ \hline 53361 \end{array}$$

$$\begin{array}{r} 36 \times 36 \\ \hline 216 \\ 108\,0 \\ \hline 1296 \end{array}$$

(29) Find the Sum of

$10^3 + 11^3 + 12^3 + \ldots\ldots + 20^3$

Solution: Given: $10^3 + 11^3 + 12^3 + \cdots + 20^3 =$

$= (1^3 + 2^3 + \cdots + 20^3) - (1^3 + 2^3 + \cdots + 9^3)$

$\boxed{n=20}$ $\boxed{n=9}$

$= \left[\frac{n(n+1)}{2}\right]^2 - \left[\frac{n(n+1)}{2}\right]^2$

$= \left[\frac{\cancel{20}^{10} \times 21}{\cancel{2}}\right]^2 - \left[\frac{9 \times \cancel{10}^{5}}{\cancel{2}}\right]^2$

$= (10 \times 21)^2 - (9 \times 5)^2$

$= 210^2 - 45^2$

$= 44100 - 2025$

$= 42075$

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(30) Find the sum of the Geometric series
$3 + 6 + 12 + \ldots\ldots + 1536$

Solution

Given: $3+6+12+\cdots+1536$

$a=3$, $r=\frac{t_2}{t_1}=\frac{6}{3}=2$, $\boxed{r=2}$

$t_n = 1536$, $\boxed{t_n = ar^{n-1}}$

$ar^{n-1} = 1536$

$3(2)^{n-1} = 1536$

$\cancel{3}\times 2^{n-1} = \cancel{3}\times 2^9$

$2^{n-1} = 2^9$

$n-1 = 9$

$n = 9+1$

$\boxed{n=10}$

2	1536
2	768
2	384
2	192
2	96
2	48
2	24
2	12
2	6
3	3
	1

$2^9 \times 3^1 = 1536$

$$S_n = \frac{a(r^n-1)}{r-1}$$

$$= \frac{3(2^{10}-1)}{2-1}$$

$$= \frac{3(1024-1)}{1}$$

$$= 3\times 1023$$

$$= 3069$$

(31) The sum of the cubes of the first n natural numbers is 2025, then find the value of n.

Solution

Given: $1^3 + 2^3 + 3^3 + \cdots + n^3 = 2025$

$$\left[\frac{n(n+1)}{2}\right]^2 = 2025$$

$$\left[\frac{n(n+1)}{2}\right]^2 = 45^2$$

$$\frac{n(n+1)}{2} = 45$$

$$n(n+1) = 90$$

$$\begin{array}{r} 10 \\ -9 \\ \hline 1 \end{array} > 90$$

$$n^2 + n - 90 = 0$$

$$(n-9)(n+10)$$

$$n-9=0, \quad n+10=0$$

$$\boxed{n=9} \quad \boxed{n=-10}$$

Select +ve number

$$\boxed{n=9}$$

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(32) The sum of first n, 2n and 3n terms of an A.P. are S_1, S_2, and S_3 respectively. Prove that $S_3 = 3(S_2 - S_1)$.

Solution: Let $S_1 = \frac{n}{2}[2a+(n-1)d]$

$S_2 = \frac{2n}{2}[2a+(2n-1)d]$, $S_3 = \frac{3n}{2}[2a+(3n-1)d]$

$$S_2 - S_1 = \frac{2n}{2}[2a+(2n-1)d] - \frac{n}{2}[2a+(n-1)d]$$

$$= \frac{n}{2}[4a+2(2n-1)d] - \frac{n}{2}[2a+(n-1)d]$$

$$= \frac{n}{2}[(4a+4nd-2d) - (2a+nd-d)]$$

$$= \frac{n}{2}[4a+4nd-2d-2a-nd+d]$$

$$= \frac{n}{2}[2a+3nd-d]$$

$$= \frac{n}{2}[2a+(3n-1)d]$$

$$3(S_2-S_1) = \frac{3n}{2}[2a+(3n-1)d]$$

$$\therefore 3(S_2-S_1) = S_3$$

$\therefore$ Proved

33 Find the sum of all natural numbers between 300 and 600 which are divisible by 7.

Solution

Natural Numbers between 300 and 600 are divisible by 7.

301, 308, 315, ... 595

$301 + 308 + 315 + \cdots + 595$

$a = 301, \quad l = 595, \quad d = 308 - 301 = 7$

No. of Terms $\boxed{n = \frac{l-a}{d} + 1}$

$= \frac{595-301}{7} + 1$

$= \frac{294}{7} + 1 = 42 + 1 = 43$

$\therefore \boxed{n = 43}$

Sum of n terms $\boxed{S_n = \frac{n}{2}[a + l]}$

$S_{43} = \frac{43}{2}[301 + 595]$

$= 21.5 \times 896$

$\boxed{S_{43} = 19264.}$

34 Find the sum of all odd positive integers less than 450.

Solution:

$1 + 3 + 5 + \cdots + 449$

$a = 1, \quad l = 449, \quad d = 3 - 1 = 2$

No. of Terms $\boxed{n = \frac{l-a}{d} + 1}$

$= \frac{449 - 1}{2} + 1$

$= \frac{\cancel{448}^{224}}{\cancel{2}} + 1 = 224 + 1$

$\therefore \boxed{n = 225}$

Sum of n terms $\boxed{S_n = \frac{n}{2}[a + l]}$

$S_{225} = \frac{225}{2}[1 + 449]$

$= 112.5 \times 450$

$\boxed{S_{225} = 50625}$

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(35) Find the sum of all natural numbers between 602 and 902 which are not divisible by 4.

Solution:

(i) To find sum of between 602 and 902.

$603 + 604 + 605 + \cdots + 901$

$a = 603,\ l = 901,\ d = 604 - 603 = 1$

No. of Terms, $\boxed{n = \frac{l-a}{d} + 1} = \frac{901-603}{1} + 1$

$n = \frac{298}{1} + 1 = 298 + 1 = 299 \quad \therefore \boxed{n = 299}$

Sum of n terms, $\boxed{S_n = \frac{n}{2}[a + l]}$

$S_{299} = \frac{299}{2}[603 + 901] = 149.5 \times 1504$

$\boxed{S_{299} = 224848}$

(ii) To find sum of between 602 and 902 divisible by 4.

$604 + 608 + 612 + \cdots + 900$

$a = 604,\ l = 900,\ d = 608 - 604 = 4$

No. of Terms, $\boxed{n = \frac{l-a}{d} + 1} = \frac{900-604}{4} + 1$

$n = \frac{\overset{74}{\cancel{296}}}{4} + 1 = 74 + 1 = 75 \quad \therefore \boxed{n = 75}$

Sum of n terms,

$\boxed{S_n = \frac{n}{2}[a + l]}$

$S_{75} = \frac{75}{2}[604 + 900]$

$= 37.5 \times 1504$

$\boxed{S_{75} = 56400}$

(iii) The sum of not divisible by 4 between 602 and 902:

$S_{299} - S_{75} = 224848 - 56400$

$= 168448$

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(36) Find the square root of
$64x^4 - 16x^3 + 17x^2 - 2x + 1$

28
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Solution :

Given : $64x^4 - 16x^3 + 17x^2 - 2x + 1$

			8	−1	1		×2
		8	64	−16	17	−2	1
			64				
			(−)				
16	−1			−16	17		
				−16	1		
				+	−		
16	−2	1			16	−2	1
					16	−2	1
					(−)	(+)	(−)
					0		

∴ Square root is $8x^2 - 1x + 1$

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(37) Find the square root of the following polynomials by division method

i. $x^4 - 12x^3 + 42x^2 - 36x + 9$

(19)

Solution

Given: $x^4 - 12x^3 + 42x^2 - 36x + 9$

			1	−6	3		×2
		1	1	−12	42	−36	9
			1				
			(−)				
	2	−6		−12	42		
				−12	36		
				(+)	(−)		
2	−12	3			6	−36	9
					6	−36	9
					(−)	(+)	(−)
					0		

∴ Square root is $\boxed{x^2 - 6x + 3}$

(38) Find the Square root of

$121x^4 - 198x^3 - 183x^2 + 216x + 144$

Solution:

Given: $121x^4 - 198x^3 - 183x^2 + 216x + 144$

			11	−9	−12	×2
		11	121	−198	−183	216	144
			121				
			(−)				
	22	−9		−198	−183		
				−198	81		
				(+)	(−)		
22	−18	−12			−264	216	144
					−264	216	144
					(+)	(−)	(−)
					0		

∴ Square root is $\boxed{11x^2 - 9x - 12}$

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(39) Find the square root of

$37x^2 - 28x^3 + 4x^4 + 42x + 9$

Solution Given: $37x^2 - 28x^3 + 4x^4 + 42x + 9$

To change standard form:

$4x^4 - 28x^3 + 37x^2 + 42x + 9$

			2	−7	−3		
		2	4	−28	37	42	9
			4				
			(−)				
	4	−7		−28	37		
				−28	49		
				(+)	(−)		
4	−14	−3			−12	42	9
					−12	42	9
					(+)	(−)	(−)
					0		

∴ Square root is $\boxed{2x^2 - 7x - 3}$

(40) Find the square root of

$16x^4 + 8x^2 + 1$

Solution Given: $16x^4 + 8x^2 + 1$

To change standard form:

$$16x^4 + 0x^3 + 8x^2 + 0x + 1$$

		4	0	1		
	4	16	0	8	0	1
		16				
		(−)				
8	0		0	8		
			0	0		
8	0	1		8	0	1
				8	0	1
				(−)		(−)
				0		

∴ Square root is $|4x^2 + 1|$

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41 If $9x^4 + 12x^3 + 28x^2 + ax + b$ is a perfect square, find the values of a and b.

Solution:

Given: $9x^4 + 12x^3 + 28x^2 + ax + b$

		3	2	4		
	3	9	12	28	a	b
		9				
		(−)				
6	2		12	28		
			12	4		
			(−)	(−)		
6	4	4		24	a	b
				24	16	16
				(−)	(−)	(−)
				0		

$a - 16 = 0$ $\quad$ $b - 16 = 0$

$\boxed{a = 16}$ $\quad$ $\boxed{b = 16}$

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42. Find the values of a and b if the following polynomials are perfect squares

$4x^4 - 12x^3 + 37x^2 + bx + a$

Solution : Given: $4x^4 - 12x^3 + 37x^2 + bx + a$

		2	−3	7		
	2	4	−12	37	b	a
		4				
		(−)				
4	−3		−12	37		
			−12	9		
			(+)	(−)		
4	−6	7		28	b	a
				28	−42	49
				(−)	(+)	(−)
					0	

$b + 42 = 0$ $\qquad$ $a - 49 = 0$

$\boxed{b = -42}$ $\qquad$ $\boxed{a = 49}$

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(43) $ax^4 + bx^3 + 361x^2 + 220x + 100$ is perfect square then find the value of a and b.

Solution: Given: $ax^4 + bx^3 + 361x^2 + 220x + 100$

To change standard form: (change order)

$$100 + 220x + 361x^2 + bx^3 + ax^4$$

		10				
	10	100	220	361	b	a
		100				
		(−)				
20	11		220	361		
			220	121		
			(−)	(−)		
20	22	12		240	b	a
				240	264	144
				(−)	(−)	(−)
					0	

$b - 264 = 0$

$\boxed{b = 264}$

$a - 144 = 0$

$\boxed{a = 144}$

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(44) Find the values of m and n if the following polynomials are perfect squares

$$36x^4 - 60x^3 + 61x^2 - mx + n$$

Solution:

Given: $36x^4 - 60x^3 + 61x^2 - mx + n$

		6	-5	3		
	6	36	-60	61	-m	n
		36				
		(-)				
12	-5		-60	61		
			-60	25		
			(+)	(-)		
12	-10	3		36	-m	n
				36	-30	9
				(-)	(+)	(-)
				0		

$-m + 30 = 0$

$-m = -30$

$\boxed{m = 30}$

$n - 9 = 0$

$\boxed{n = 9}$

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(45) Find the value of m and n If the following polynomials are perfect square. (21)

(ii) $x^4 - 8x^3 + mx^2 + nx + 16$

Solution :

Given: $x^4 - 8x^3 + mx^2 + nx + 16$

		1	−4	4			
	1	1	−8	m	n	16	
		1					
		(−)					
2	−4		−8	m			
			−8	16			
			(+)	(−)			
2	−8	4		m−16	n	16	
				8	−32	16	
				(−)	(+)	(−)	
				0			

$m - 16 - 8 = 0$

$m - 24 = 0$

$\boxed{m = 24}$

$n + 32 = 0$

$\boxed{n = -32}$

(46) If $A = \begin{pmatrix} 4 & 3 & 1 \\ 2 & 3 & -8 \\ 1 & 0 & -4 \end{pmatrix}$, $B = \begin{pmatrix} 2 & 3 & 4 \\ 1 & 9 & 2 \\ -7 & 1 & -1 \end{pmatrix}$

and $C = \begin{pmatrix} 8 & 3 & 4 \\ 1 & -2 & 3 \\ 2 & 4 & -1 \end{pmatrix}$ then verify that

$A + (B + C) = (A + B) + C$.

Solution

Given: $A = \begin{bmatrix} 4 & 3 & 1 \\ 2 & 3 & -8 \\ 1 & 0 & -4 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 9 & 2 \\ -7 & 1 & -1 \end{bmatrix}$, $C = \begin{bmatrix} 8 & 3 & 4 \\ 1 & -2 & 3 \\ 2 & 4 & -1 \end{bmatrix}$

Steps:
1. B+C
2. A+(B+C)
3. (A+B)
4. (A+B)+C

(i) $B+C = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 9 & 2 \\ -7 & 1 & -1 \end{bmatrix} + \begin{bmatrix} 8 & 3 & 4 \\ 1 & -2 & 3 \\ 2 & 4 & -1 \end{bmatrix}$

$= \begin{bmatrix} 10 & 6 & 8 \\ 2 & 7 & 5 \\ -5 & 5 & -2 \end{bmatrix}$ —— (1)

(ii) $A + (B+C) = \begin{bmatrix} 4 & 3 & 1 \\ 2 & 3 & -8 \\ 1 & 0 & -4 \end{bmatrix} + \begin{bmatrix} 10 & 6 & 8 \\ 2 & 7 & 5 \\ -5 & 5 & -2 \end{bmatrix} = \begin{bmatrix} 14 & 9 & 9 \\ 4 & 10 & -3 \\ -4 & 5 & -6 \end{bmatrix}$ —— (2)

(iii) $A+B = \begin{bmatrix} 4 & 3 & 1 \\ 2 & 3 & -8 \\ 1 & 0 & -4 \end{bmatrix} + \begin{bmatrix} 2 & 3 & 4 \\ 1 & 9 & 2 \\ -7 & 1 & -1 \end{bmatrix} = \begin{bmatrix} 6 & 6 & 5 \\ 3 & 12 & -6 \\ -6 & 1 & -5 \end{bmatrix}$ —— (3)

(iv) $(A+B)+C = \begin{bmatrix} 6 & 6 & 5 \\ 3 & 12 & -6 \\ -6 & 1 & -5 \end{bmatrix} + \begin{bmatrix} 8 & 3 & 4 \\ 1 & -2 & 3 \\ 2 & 4 & -1 \end{bmatrix} = \begin{bmatrix} 14 & 9 & 9 \\ 4 & 10 & -3 \\ -4 & 5 & -6 \end{bmatrix}$ —— (4)

$\therefore$ LHS = RHS

$\boxed{A + (B+C) = (A+B) + C}$ verified.

(47) Given that $A = \begin{pmatrix} 1 & 3 \\ 5 & -1 \end{pmatrix}$,

$B = \begin{pmatrix} 1 & -1 & 2 \\ 3 & 5 & 2 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 3 & 2 \\ -4 & 1 & 3 \end{pmatrix}$

(SC) verify that $A(B+C) = AB + AC$.

Solution

Given: $A = \begin{bmatrix} 1 & 3 \\ 5 & -1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & -1 & 2 \\ 3 & 5 & 2 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 3 & 2 \\ -4 & 1 & 3 \end{bmatrix}$

STEPS
1. $B+C$
2. $A(B+C)$
3. AB
4. AC
5. $AB+AC$

(i) $B+C = \begin{bmatrix} 1 & -1 & 2 \\ 3 & 5 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 3 & 2 \\ -4 & 1 & 3 \end{bmatrix}$

$= \begin{bmatrix} 2 & 2 & 4 \\ -1 & 6 & 5 \end{bmatrix}$ —— (1)

(ii) $A(B+C) = \begin{bmatrix} 1 & 3 \\ 5 & -1 \end{bmatrix} \times \begin{bmatrix} 2 & 2 & 4 \\ -1 & 6 & 5 \end{bmatrix}$

$= \begin{bmatrix} 2-3 & 2+18 & 4+15 \\ 10+1 & 10-6 & 20-5 \end{bmatrix} = \begin{bmatrix} -1 & 20 & 19 \\ 11 & 4 & 15 \end{bmatrix}$ —— (2)

(iii) $AB = \begin{bmatrix} 1 & 3 \\ 5 & -1 \end{bmatrix} \times \begin{bmatrix} 1 & -1 & 2 \\ 3 & 5 & 2 \end{bmatrix} = \begin{bmatrix} 1+9 & -1+15 & 2+6 \\ 5-3 & -5-5 & 10-2 \end{bmatrix}$

$= \begin{bmatrix} 10 & 14 & 8 \\ 2 & -10 & 8 \end{bmatrix}$ —— (3)

(iv) $AC = \begin{bmatrix} 1 & 3 \\ 5 & -1 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 2 \\ -4 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 1-12 & 3+3 & 2+9 \\ 5+4 & 15-1 & 10-3 \end{bmatrix}$

$= \begin{bmatrix} -11 & 6 & 11 \\ 9 & 14 & 7 \end{bmatrix}$ —— (4)

(v) $AB+AC = \begin{bmatrix} 10 & 14 & 8 \\ 2 & -10 & 8 \end{bmatrix} + \begin{bmatrix} -11 & 6 & 11 \\ 9 & 14 & 7 \end{bmatrix} = \begin{bmatrix} -1 & 20 & 19 \\ 11 & 4 & 15 \end{bmatrix}$ —— (5)

$\therefore$ LHS = RHS, $\boxed{A(B+C) = AB + AC}$ verified.

(48) If $A = \begin{pmatrix} 1 & 1 \\ -1 & 3 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 2 \\ -4 & 2 \end{pmatrix}$, $C = \begin{pmatrix} -7 & 6 \\ 3 & 2 \end{pmatrix}$ verify that $A(B + C) = AB + AC$.

Solution

Given: $A = \begin{bmatrix} 1 & 1 \\ -1 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 2 \\ -4 & 2 \end{bmatrix}$, $C = \begin{bmatrix} -7 & 6 \\ 3 & 2 \end{bmatrix}$

Steps
1. B+C
2. A(B+C)
3. AB
4. AC
5. AB+AC

(i) $B+C = \begin{bmatrix} 1 & 2 \\ -4 & 2 \end{bmatrix} + \begin{bmatrix} -7 & 6 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} -6 & 8 \\ -1 & 4 \end{bmatrix}$ — (1)

(ii) $A(B+C) = \begin{bmatrix} 1 & 1 \\ -1 & 3 \end{bmatrix} \times \begin{bmatrix} -6 & 8 \\ -1 & 4 \end{bmatrix}$

$= \begin{bmatrix} 1\ 1 \ \ -6 \ \ -1 & 1\ 1 \ \ 8 \ \ 4 \\ -1\ -3 \ \ -6 \ \ -1 & -1\ -3 \ \ 8 \ \ 4 \end{bmatrix} = \begin{bmatrix} -6-1 & 8+4 \\ 6-3 & -8+12 \end{bmatrix} = \begin{bmatrix} -7 & 12 \\ 3 & 4 \end{bmatrix}$ — (2)

(iii) $AB = \begin{bmatrix} 1 & 1 \\ -1 & 3 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ -4 & 2 \end{bmatrix} = \begin{bmatrix} 1-4 & 2+2 \\ -1-12 & -2+6 \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ -13 & 4 \end{bmatrix}$ — (3)

(iv) $AC = \begin{bmatrix} 1 & 1 \\ -1 & 3 \end{bmatrix} \times \begin{bmatrix} -7 & 6 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} -7+3 & 6+2 \\ 7+9 & -6+6 \end{bmatrix} = \begin{bmatrix} -4 & 8 \\ 16 & 0 \end{bmatrix}$ — (4)

(v) $AB+AC = \begin{bmatrix} -3 & 4 \\ -13 & 4 \end{bmatrix} + \begin{bmatrix} -4 & 8 \\ 16 & 0 \end{bmatrix}$

$= \begin{bmatrix} -7 & 12 \\ 3 & 4 \end{bmatrix}$ — (5)

$\therefore$ (2) = (5), LHS = RHS

$\boxed{A(B+C) = AB+AC}$ is verified.

(49) If $A = \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$ show that $A^2 - 5A + 7I_2 = 0$ (22)

Solution

Given : $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$

$$A^2 = A \times A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix} \times \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 9-1 & 3+2 \\ -3-2 & -1+4 \end{bmatrix} = \begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix}$$

$$5A = 5\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 15 & 5 \\ -5 & 10 \end{bmatrix}$$

$$7I_2 = 7\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$$

$$A^2 - 5A + 7I_2 = 0$$

$$\begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix} - \begin{bmatrix} 15 & 5 \\ -5 & 10 \end{bmatrix} + \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$\therefore$ proved.

Rough work:

$$A^2 = \begin{bmatrix} 3 & 1 & 3 & 1 \\ -1 & 2 & -1 & 2 \\ 3 & 1 & 1 & 1 \\ -1 & 2 & 2 & 2 \end{bmatrix} = \begin{bmatrix} 9-1 & 3+2 \\ -3-2 & -1+4 \end{bmatrix} = \begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix}$$

56 If $A = \begin{pmatrix} 5 & 2 & 9 \\ 1 & 2 & 8 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 7 \\ 1 & 2 \\ 5 & -1 \end{pmatrix}$

verify that $(AB)^T = B^T A^T$

Solution. Given: $A = \begin{bmatrix} 5 & 2 & 9 \\ 1 & 2 & 8 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 7 \\ 1 & 2 \\ 5 & -1 \end{bmatrix}$

Steps
1. AB
2. $(AB)^T$
3. B^T
4. A^T
5. $B^T A^T$

(i) $AB = \begin{bmatrix} 5 & 2 & 9 \\ 1 & 2 & 8 \end{bmatrix} \times \begin{bmatrix} 1 & 7 \\ 1 & 2 \\ 5 & -1 \end{bmatrix}$

$= \begin{bmatrix} 5+2+45 & 35+4-9 \\ 1+2+40 & 7+4-8 \end{bmatrix}$

$= \begin{bmatrix} 52 & 30 \\ 43 & 3 \end{bmatrix}$ —— (1)

(ii) $(AB)^T = \begin{bmatrix} 52 & 43 \\ 30 & 3 \end{bmatrix}$ —— (2)

(iii) $B^T = \begin{bmatrix} 1 & 1 & 5 \\ 7 & 2 & -1 \end{bmatrix}$ —— (3)

(iv) $A^T = \begin{bmatrix} 5 & 1 \\ 2 & 2 \\ 9 & 8 \end{bmatrix}$ —— (4)

(v) $B^T A^T = \begin{bmatrix} 1 & 1 & 5 \\ 7 & 2 & -1 \end{bmatrix} \times \begin{bmatrix} 5 & 1 \\ 2 & 2 \\ 9 & 8 \end{bmatrix}$

$= \begin{bmatrix} 52 & 43 \\ 30 & 3 \end{bmatrix}$ —— (5)

LHS = RHS, $\boxed{(AB)^T = B^T A^T}$ is verified.

(51) If $A = \begin{pmatrix} 1 & 2 & 1 \\ 2 & -1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & -1 \\ -1 & 4 \\ 0 & 2 \end{pmatrix}$ show that $(AB)^T = B^T A^T$

Solution

Given: $A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & -1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & -1 \\ -1 & 4 \\ 0 & 2 \end{bmatrix}$

(i) $AB = \begin{bmatrix} 1 & 2 & 1 \\ 2 & -1 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & -1 \\ -1 & 4 \\ 0 & 2 \end{bmatrix}$

$= \begin{bmatrix} 2-2+0 & -1+8+2 \\ 4+1+0 & -2-4+2 \end{bmatrix} = \begin{bmatrix} 0 & 9 \\ 5 & -4 \end{bmatrix}$ —— (1)

Steps
1. AB
2. $(AB)^T$
3. B^T
4. A^T
5. $B^T A^T$

(ii) $(AB)^T = \begin{bmatrix} 0 & 5 \\ 9 & -4 \end{bmatrix}$ —— (2)

(iii) $B^T = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 4 & 2 \end{bmatrix}$ —— (3)

(iv) $A^T = \begin{bmatrix} 1 & 2 \\ 2 & -1 \\ 1 & 1 \end{bmatrix}$ —— (4)

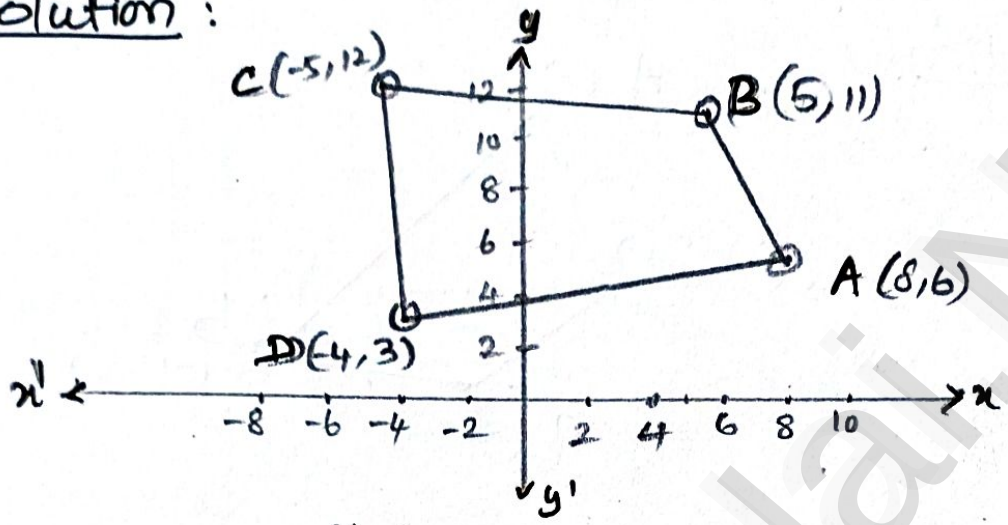
(v) $B^T A^T = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 4 & 2 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 2 & -1 \\ 1 & 1 \end{bmatrix}$

$= \begin{bmatrix} 0 & 5 \\ 9 & -4 \end{bmatrix}$ —— (5)

LHS = RHS, $\boxed{(AB)^T = B^T A^T}$ is verified.

(52) Find the area of the quadrilateral formed by the points (8, 6), (5, 11), (–5, 12) and (–4, 3)..

Solution :



Given points : $A(\overset{x_1}{8},\overset{y_1}{6})$ $B(\overset{x_2}{5},\overset{y_2}{11})$ $C(\overset{x_3}{-5},\overset{y_3}{12})$ $D(\overset{x_4}{-4},\overset{y_4}{3})$

$$\boxed{\text{Area of Quadrilateral} = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_4 & x_1 \\ y_1 & y_2 & y_3 & y_4 & y_1 \end{vmatrix} \text{ sq unit.}}$$

$$= \frac{1}{2}\begin{bmatrix} 8 & 5 & -5 & -4 & 8 \\ 6 & 11 & 12 & 3 & 6 \end{bmatrix}$$

$$= \frac{1}{2}\left[(88+60-15-24)-(30-55-48+24)\right]$$

$$= \frac{1}{2}\left[88+60-15-24-30+55+48-24\right]$$

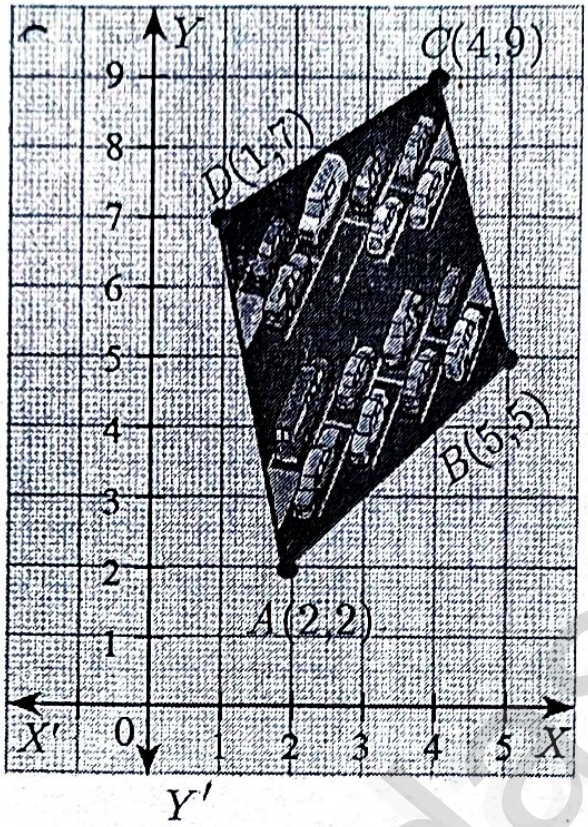
$$= \frac{1}{2}\left[88+60+55+48-15-24-30-24\right]$$

$$= \frac{1}{2}\left[251-93\right] = \frac{1}{\cancel{2}}\left[\overset{79}{\cancel{158}}\right]$$

$$= 79 \text{ squ unit}$$

(53) The given diagram shows a plan for constructing a new parking lot at a campus. It is estimated that such construction would cost ₹ 1300 per square feet. What will be the total cost for making the parking lot?

(23)



Solution:

Given points: A(2,2) B(5,5) C(4,9) D(1,7)

Area of Quadrilateral $= \frac{1}{2}\begin{vmatrix} 2 & 5 & 4 & 1 & 2 \\ 2 & 5 & 9 & 7 & 2 \end{vmatrix}$ sq unit

$= \frac{1}{2}\left[(10+45+28+2)-(10+20+9+14)\right]$

$= \frac{1}{2}\left[85-53\right]$

$= \frac{1}{2}\left[32\right]$

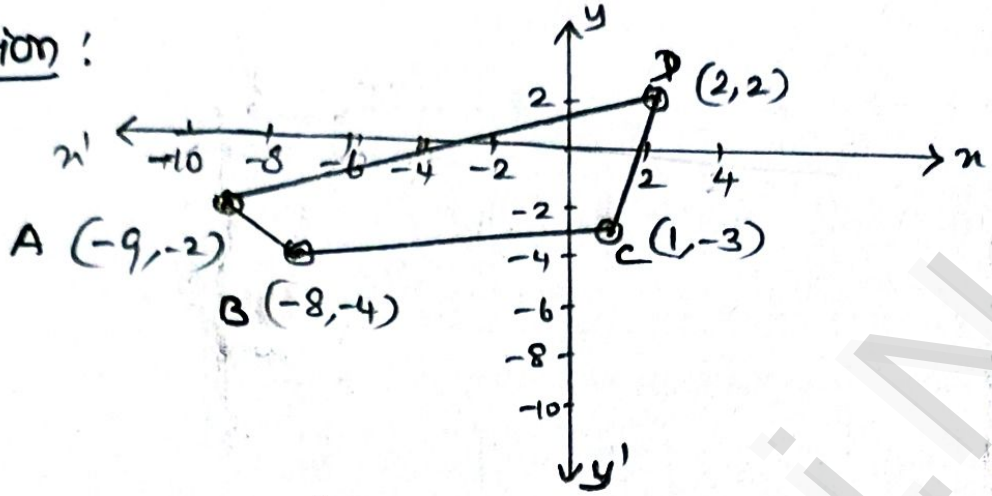
$= 16$ sq unit, ∴ Total cost $= 16 \times 1300$

$= 20800$

(54) Find the area of the quadrilateral whose vertices are at

(–9, –2), (–8, –4), (2, 2) and (1, –3)

Solution :



Given points : $A(\overset{x_1}{-9},\overset{y_1}{-2})$ $B(\overset{x_2}{-8},\overset{y_2}{-4})$ $C(\overset{x_3}{1},\overset{y_3}{-3})$ $D(\overset{x_4}{2},\overset{y_4}{2})$

$$\left.\begin{array}{l}\text{Area of}\\ \text{Quadrilateral}\end{array}\right\} = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_4 & x_1 \\ y_1 & y_2 & y_3 & y_4 & y_1 \end{vmatrix} \text{ sq unit}$$

$$= \frac{1}{2}\begin{vmatrix} -9 & -8 & 1 & 2 & -9 \\ -2 & -4 & -3 & 2 & -2 \end{vmatrix} \text{ sq unit.}$$

$$= \frac{1}{2}\left[(36+24+2-4)-(16-4-6-18)\right]$$

$$= \frac{1}{2}\left[36+24+2-4-16+4+6+18\right]$$

$$= \frac{1}{2}\left[90-20\right]$$

$$= \frac{1}{\cancel{2}}\left[\overset{35}{\cancel{70}}\right]$$

$$= 35 \text{ sq. unit.}$$

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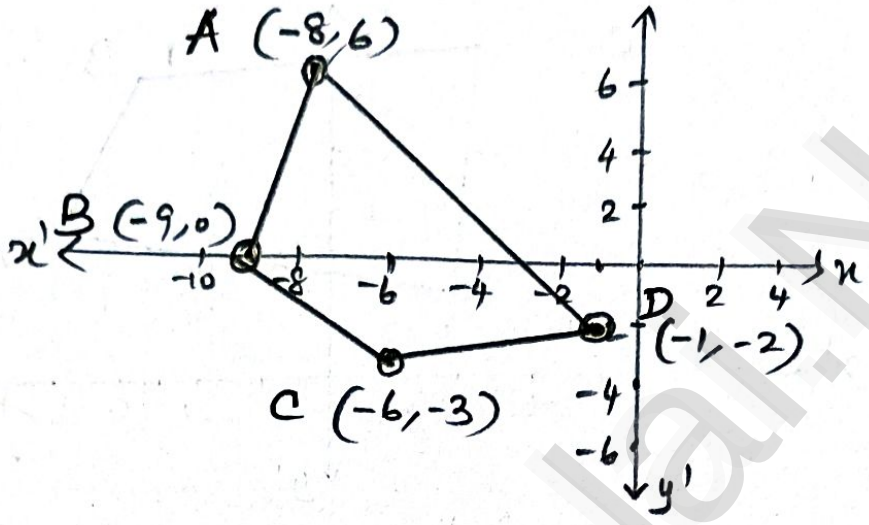
(55) Find the area of the quadrilateral,

(–9, 0), (–8, 6), (–1, –2) and (–6, –3)

Solution:



Given points: A (-8,6) B(-9,0) C(-6,-3) D(-1,-2)

$$\text{Area of Quadril} = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_4 & x_1 \\ y_1 & y_2 & y_3 & y_4 & y_1 \end{vmatrix} \text{ sq unit.}$$

$$= \frac{1}{2}\begin{vmatrix} -8 & -9 & -6 & -1 & -8 \\ 6 & 0 & -3 & -2 & 6 \end{vmatrix}$$

$$= \frac{1}{2}\left[(0+27+12-6)-(-54+0+3+16)\right]$$

$$= \frac{1}{2}\left[27+12-6+54+3+16\right]$$

$$= \frac{1}{2}\left[93-25\right]$$

$$= \frac{1}{\cancel{2}}\left[\overset{34}{\cancel{68}}\right]$$

$$= 34 \text{ sq unit.}$$

56 The floor of a hall is covered with identical tiles which are in the shapes of triangles. One such triangle has the vertices at (–3, 2), (–1, –1) and (1, 2). If the floor of the hall is completely covered by 110 tiles, find the area of the floor.

Solution:

Given points: $A(\overset{x_1}{-3},\overset{y_1}{2})$ $B(\overset{x_2}{-1},\overset{y_2}{-1})$ $C(\overset{x_3}{1},\overset{y_3}{2})$

$$\text{Area of Triangle} = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_1 \\ y_1 & y_2 & y_3 & y_1 \end{vmatrix} \text{ sq unit}$$

$$= \frac{1}{2}\begin{vmatrix} -3 & -1 & 1 & -3 \\ 2 & -1 & 2 & 2 \end{vmatrix}$$

$$= \frac{1}{2}\left[(3-\cancel{2}+\cancel{2})-(-2-1-6)\right]$$

$$= \frac{1}{2}\left[3+2+1+6\right]$$

$$= \frac{1}{\cancel{2}}(\overset{6}{\cancel{12}})$$

$$= 6 \text{ sq unit}$$

$\therefore$ Area of the floor $= 110 \times 6$

$= 660$ sq. units.

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(57) Find the value of k, if the area of a quadrilateral is 28 sq.units, whose vertices are $(-4, -2)$, $(-3, k)$, $(3, -2)$ and $(2, 3)$

(24)

Solution:

Given points: $(-4,-2)$ $(-3,k)$ $(3,-2)$ $(2,3)$

$$\left.\begin{array}{l}\text{Area of}\\ \text{Quadrilateral}\end{array}\right\} = \frac{1}{2}\begin{vmatrix} -4 & -3 & 3 & 2 & -4 \\ -2 & k & -2 & 3 & -2 \end{vmatrix} = 28$$

$$\Rightarrow \frac{1}{2}\left[(-4k+6+9-4)-(6+3k-4-12)\right] = 28$$

$$\Rightarrow \frac{1}{2}\left[-4k+15-4-6-3k+4+12\right] = 28$$

$$\Rightarrow \frac{1}{2}\left[-7k+31-10\right] = 28$$

$$\Rightarrow -7k+21 = 56$$

$$-7k = 56-21$$

$$-7k = 35$$

$$k = \frac{\cancel{35}^{5}}{\cancel{-7}}$$

$$\boxed{k = -5}$$

58 A triangular shaped glass with vertices at A (–5, –4) , B (1, 6) and C (7, –4) has to be painted. If one bucket of paint covers 6 square feet, how many buckets of paint will be required to paint the whole glass, if only one coat of paint is applied.

Solution:

Given points: $A(\overset{x_1}{-5}, \overset{y_1}{-4})$ $B(\overset{x_2}{1}, \overset{y_2}{6})$ $C(\overset{x_3}{7}, \overset{y_3}{-4})$

$$\text{Area of } \Delta = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_1 \\ y_1 & y_2 & y_3 & y_1 \end{vmatrix} \text{ sq unit}$$

$$= \frac{1}{2}\begin{vmatrix} -5 & 1 & 7 & -5 \\ -4 & 6 & -4 & -4 \end{vmatrix}$$

$$= \frac{1}{2}\left[(-30-4-28)-(-4+42+20)\right]$$

$$= \frac{1}{2}\left[-62-58\right]$$

$$= \frac{1}{\cancel{2}}\left[-\overset{60}{\cancel{120}}\right]$$

$$= |-60|$$

$$= 60 \text{ sq units}$$

$$\text{Required no. of buckets} = \frac{\cancel{60}}{\cancel{6}} = 10$$

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(59) If the points A (–3, 9), B (a, b) and C (4, –5) are collinear and if a + b = 1, then find a and b.

Solution :

Given points : $A(-3,9)$ $B(a,b)$ $C(4,-5)$ are Collinear

$$\text{Area of } \Delta = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 & x_1 \\ y_1 & y_2 & y_3 & y_1 \end{vmatrix} = 0$$

$$\Rightarrow \frac{1}{2}\begin{vmatrix} -3 & a & 4 & -3 \\ 9 & b & -5 & 9 \end{vmatrix} = 0$$

$$\Rightarrow \left[(-3b-5a+3b)-(9a+4b+15)\right] = 0\times 2$$

$$\Rightarrow -3b-5a+3b-9a-4b-15 = 0$$

$$\Rightarrow -14a-7b+21 = 0$$

$$-14a-7b = -21 \quad [\because \text{divide by } -7]$$

$$2a+b = 3 \quad \text{——— (1)}$$

Given equation, $a+b = 1$ ——— (2)

$$a = 2$$

$$\therefore \boxed{a=2}$$

(2) $\Rightarrow$ $2+b=1$

$$b = 1-2$$

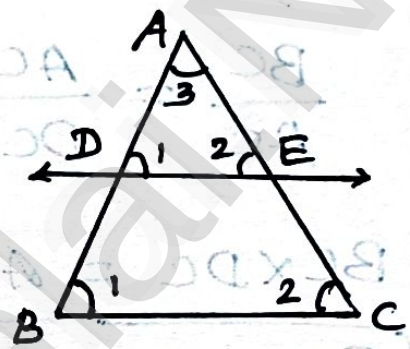
$$\therefore \boxed{b=-1}$$

60

Theorem-1, Basic proportionality Theorem (or) Thales Theorem.

Statement: A straight Line drawn parallel to a side of triangle, intersecting the other two sides, divides the sides in the same ratio.

$$\boxed{\frac{AD}{DB} = \frac{AE}{EC}}$$



Proof: Let

$\angle 1 = \angle ABC = \angle ADE$, $\angle 2 = \angle ACB = \angle AED$

$\angle 3 = \angle BAC = \angle DAE$.

$$\Delta ABC \sim \Delta ADE$$

$$\frac{AB}{AD} = \frac{AC}{AE}$$

$$\frac{AD + DB}{AD} = \frac{AE + EC}{AE} \Rightarrow \frac{\cancel{AD}}{\cancel{AD}} + \frac{DB}{AD} = \frac{\cancel{AE}}{\cancel{AE}} + \frac{EC}{AE}$$

$$\cancel{1} + \frac{DB}{AD} = \cancel{1} + \frac{EC}{AE}$$

$$\frac{DB}{AD} = \frac{EC}{AE}$$ [∵ Taking reciprocals]

$$\boxed{\frac{AD}{DB} = \frac{AE}{EC}}$$

∴ Hence proved.

61)

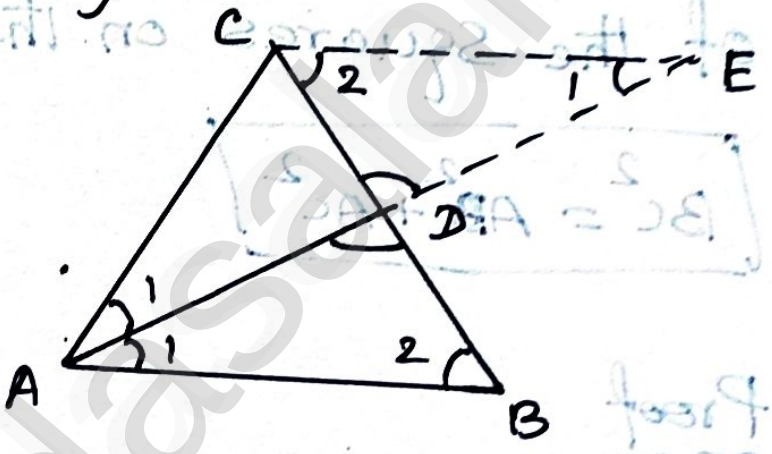
Theorem - 2, Angle Bisector Theorem.

(25)

Statement:

The internal bisector of an angle of a triangle divides the opposite side internally in the ratio of the corresponding sides containing the angle.

$$\boxed{\frac{AB}{AC} = \frac{BD}{CD}}$$



Proof:

Let $\angle 1 = \angle AEC = \angle BAE$

$\triangle ACE$ is isosceles

$AC = CE$ ——— (1)

$\triangle ABD \sim \triangle ECD$

$$\frac{AB}{CE} = \frac{BD}{CD}$$

from eqn (1), $AC = CE$

$$\boxed{\frac{AB}{AC} = \frac{BD}{CD}}$$

∴ Hence proved.

Theorem - 3,

(62)

PYTHAGORAS THEOREM

Statement:

In a right angle triangle, the square on the hypotenuse is equal to the sum of the squares on the other two sides.

$$\boxed{BC^2 = AB^2 + AC^2}$$

Proof

(i) Compare ΔABC and ΔABD ($\because \angle B$ is common)

Let $\angle BAC = \angle BDA = 90^\circ$

$\Delta ABC \sim \Delta ABD$

$$\frac{BC}{AB} = \frac{AB}{BD} \quad \left[\because \frac{Hypo}{Adja}\right]$$

$$BC \times BD = AB \times AB$$

$$\boxed{BC \times BD = AB^2} \quad \text{—— ①}$$

(ii) Compare ΔABC and ΔADC ($\because \angle C$ is common)

Let $\angle BAC = \angle ADC = 90^\circ$

$\Delta ABC \sim \Delta ADC$

$$\frac{BC}{AC} = \frac{AC}{DC} \quad \left[\because \frac{Hypo}{oppo} = \frac{CA}{BC}\right]$$

$$BC \times DC = AC \times AC$$

$$\boxed{BC \times DC = AC^2} \quad \text{—— ②}$$

Adding ① and ②

$$(BC \times BD) + (BC \times DC) = AB^2 + AC^2$$

$$BC[BD + DC] = AB^2 + AC^2$$

$$BC \times BC = AB^2 + AC^2$$

$$\boxed{BC^2 = AB^2 + AC^2}$$

Hence proved.

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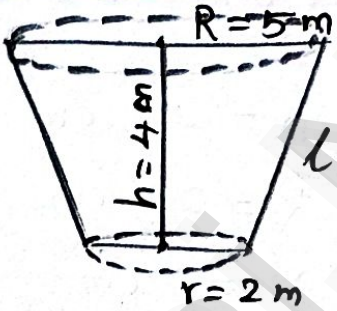
(63) An industrial metallic bucket is in the shape of the frustum of a right circular cone whose top and bottom diameters are 10 m and 4 m and whose height is 4 m. Find the curved and total surface area of the bucket.

Solution:



Hight $h = 4$ m

Given: Top Diameter $= 10$ m

Top Radius $R = 5$ m

Bottom Diameter $= 4$ m

Bottom Radius $r = 2$ m

$$\boxed{l = \sqrt{h^2 + (R-r)^2}} = \sqrt{4^2 + (5-2)^2} = \sqrt{4^2 + 3^2} = \sqrt{16+9} = \sqrt{25}$$

$$\boxed{l = 5 \text{ m}}$$

$$\boxed{C.S.A = \pi (R+r) l \text{ sq unit}}$$

$$= \frac{22}{7}(5+2) \times 5 = \frac{22}{\cancel{7}} \times \cancel{7} \times 5 = 22 \times 7$$

$$\boxed{CSA = 110 \text{ m}^2}$$

$$T.S.A = \pi (R+r) l + \pi R^2 + \pi r^2 \text{ sq unit.}$$

$$= \pi \left[(R+r) l + R^2 + r^2 \right]$$

$$= \frac{22}{7} \left[(5+2) 5 + 5^2 + 2^2 \right]$$

$$= \frac{22}{7} \left[35 + 25 + 4 \right] = \frac{22}{7} \times 64 = \frac{1408}{7}$$

$$\boxed{TSA = 201.14 \text{ m}^2}$$

(64) The frustum shaped outer portion of the table lamp has to be painted including the top part. Find the total cost of painting the lamp if the cost of painting 1 sq.cm is ₹ 2.

(26)

Solution

Given: $h = 8$ cm

$R = 12$ cm, $r = 6$ cm

$$l = \sqrt{h^2 + (R-r)^2} = \sqrt{8^2 + (12-6)^2} = \sqrt{8^2 + 6^2}$$

$$= \sqrt{64 + 36} = \sqrt{100} = 10 \text{ cm}$$

Total Area of table lamp with Top part.

= CSA of frustrum + Area of Top part.

$$= \pi (R + r) l + \pi r^2$$

$$= \frac{22}{7}(12+6)10 + \frac{22}{7} \times 6 \times 6$$

$$= \frac{22}{7} \times 18 \times 10 + \frac{22}{7} \times 36$$

$$= \frac{22}{7} \times 180 + \frac{22}{7} \times 36$$

$$= \frac{22}{7}[180 + 36] = \frac{22}{7} \times 216 = 3.14 \times 216$$

$$= 678.24 \text{ cm}^2$$

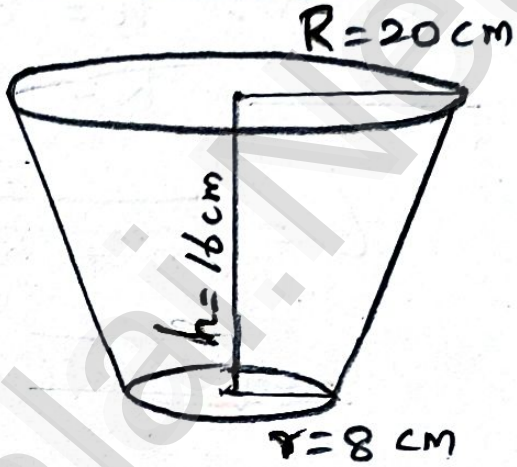
$\therefore$ Total cost of painting $= 678.24 \times 2$

$\approx$ ₹. 1356.48

(15) A container open at the top is in the form of a frustum of a cone of height 16 cm with radii of its lower and upper ends are 8 cm and 20 cm respectively. Find the cost of milk which can completely fill a container at the rate of ₹40 per litre. $\pi = \frac{22}{7} = 3.14$, ($1000\ cm^3 = 1\ lt$)

may 22

Solution :



Given: $h = 16$ cm

$R = 20$ cm

$r = 8$ cm

Volume of the frustum :

$$= \frac{1}{3}\pi h\left[R^2 + Rr + r^2\right] \text{ cu. units}$$

$$= \frac{1}{3} \times \frac{22}{7} \times 16\left[20^2 + 20(8) + 8^2\right]$$

$$= \frac{1}{3} \times \frac{22}{7} \times 16\left[400 + 160 + 64\right]$$

$$= \frac{1}{\cancel{3}} \times \frac{22}{7} \times 16 \times \cancel{624}^{208}$$

$$= 3.14 \times 16 \times 208 = 10449.92$$

$$@ = 10450\ cm^3$$

$$= 10.450 \text{ litre}$$

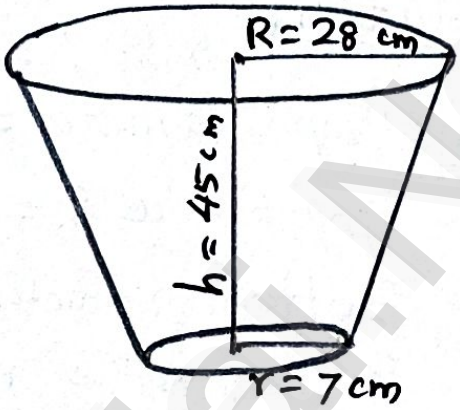
$\therefore$ The cost of milk $= 10.450 \times 40$

$$\simeq \boxed{418.00}$$

(66) If the radii of the circular ends of a frustum which is 45 cm high are 28 cm and 7 cm, find the volume of the frustum.

Sep 2021

Solution:



Given: $h = 45$ cm

$R = 28$ cm

$r = 7$ cm

Volume of the Frustum:

$$= \frac{1}{3}\pi h\left[R^2 + Rr + r^2\right] \text{ cu. units.}$$

$$= \frac{1}{3} \times \frac{22}{7} \times 45\left[28^2 + 28(7) + 7^2\right]$$

$$= \frac{1}{3} \times \frac{22}{7} \times 45\left[784 + 196 + 49\right]$$

$$= \frac{1}{\cancel{3}} \times \frac{22}{\cancel{7}} \times \overset{15}{\cancel{45}} \times \overset{147}{\cancel{1029}}$$

$$= 22 \times 15 \times 147$$

$$= \boxed{48510 \text{ cm}^3}$$

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(67) Two dice are rolled. Find the probability that the sum of outcomes is (i) equal to 4 (ii) greater than 10 (iii) less than 13

Solution :

Sample space $S = \{(1,1)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\ (1,6)$
$(2,1)\ (2,2)\ (2,3)\ (2,4)\ (2,5)\ (2,6)$
$(3,1)\ (3,2)\ (3,3)\ (3,4)\ (3,5)\ (3,6)$
$(4,1)\ (4,2)\ (4,3)\ (4,4)\ (4,5)\ (4,6)$
$(5,1)\ (5,2)\ (5,3)\ (5,4)\ (5,5)\ (5,6)$
$(6,1)\ (6,2)\ (6,3)\ (6,4)\ (6,5)\ (6,6)\}$

$\boxed{n(S) = 36}$

(i) Let A = Sum of out come is equal to 4 :

$A = \{(1,3)\ (2,2)\ (3,1)\}$, $n(A) = 3$

$$P(A) = \frac{n(A)}{n(S)} = \frac{\cancel{3}^{1}}{\cancel{36}_{12}} = \frac{1}{12}$$

(ii) Let B = Sum of outcome greater then 10 :

$B = \{(5,6)\ (6,5)\ (6,6)\}$, $n(B) = 3$

$$P(B) = \frac{n(B)}{n(S)} = \frac{\cancel{3}^{1}}{\cancel{36}_{12}} = \frac{1}{12}$$

(iii) Let C = Sum of outcome Less than 13 :

$C = \{(1,1)\ (1,2) \ldots\ldots (6,5)\ (6,6)\}$, $n(C) = 36$

$$P(C) = \frac{n(C)}{n(S)} = \frac{\cancel{36}^{1}}{\cancel{36}} = 1$$

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(68) Two dice are rolled together. Find the probability of getting a doublet or sum of faces as 4.

(27)

Solution:

Sample space : $S = \{(1,1)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\ (1,6)$
$(2,1)\ (2,2)\ (2,3)\ (2,4)\ (2,5)\ (2,6)$
$(3,1)\ (3,2)\ (3,3)\ (3,4)\ (3,5)\ (3,6)$
$(4,1)\ (4,2)\ (4,3)\ (4,4)\ (4,5)\ (4,6)$
$(5,1)\ (5,2)\ (5,3)\ (5,4)\ (5,5)\ (5,6)$
$(6,1)\ (6,2)\ (6,3)\ (6,4)\ (6,5)\ (6,6)\}$

$\boxed{n(S) = 36}$

(i) Let A = Double of face:

$A = \{(1,1)\ (2,2)\ (3,3)\ (4,4)\ (5,5)\ (6,6)$

$n(A) = 6, \quad P(A) = \frac{n(A)}{n(S)} = \frac{6}{36}$

(ii) Let B = Sum of face as 4:

$B = \{(1,3)\ (2,2)\ (3,1)\}, \quad n(B) = 3$

$P(B) = \frac{n(B)}{n(S)} = \frac{3}{36}$

$(A \cap B) = \{(1,1)\ (2,2)\ (3,3)\ (4,4)\ (5,5)\ (6,6)\} \cap$
$\{(1,3)\ (2,2)\ (3,1)\}$

$\therefore A \cap B = \{(2,2)\}, \quad n(A \cap B) = 1$

$P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{1}{36}$

$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= \frac{6}{36} + \frac{3}{36} - \frac{1}{36} = \frac{8}{36} = \frac{2}{9}$

69 Two unbiased dice are rolled once. Find the probability of getting

(i) a doublet (equal numbers on both dice)

(ii) the product as a prime number

(iii) the sum as a prime number

(iv) the sum as 1

Solution

Sample space S = {(1,1), (1,2), (1,3), (1,4), (1,5), (1,6),
(2,1), (2,2), (2,3), (2,4), (2,5), (2,6)
(3,1), (3,2), (3,3), (3,4), (3,5), (3,6)
(4,1), (4,2), (4,3), (4,4), (4,5), (4,6)
(5,1), (5,2), (5,3), (5,4), (5,5), (5,6)
(6,1), (6,2), (6,3), (6,4), (6,5), (6,6)}

$n(S) = 36$

(i) Let A = double :

$A = \{(1,1)\ (2,2)\ (3,3)\ (4,4)\ (5,5)\ (6,6)\}$, $n(A) = 6$

$$P(A) = \frac{n(A)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

(ii) Let B = The product as a prime number :

$B = \{(1,2)\ (1,3)\ (1,5)\ (2,1)\ (3,1)\ (5,1)\}$, $n(B) = 6$

$$P(B) = \frac{n(B)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

(iii) Let C = The sum as a prime number :

$C = \{(1,1)\ (2,1)\ (1,2)\ (1,4)\ (4,1)\ (1,6)\ (6,1)$
$(2,3)\ (2,5)\ (3,2)\ (3,4)\ (4,3)\ (5,2)\ (5,6)\ (6,5)\}$

$n(C) = 15$, $P(C) = \frac{n(C)}{n(S)} = \frac{\cancel{15}^{5}}{\cancel{36}_{12}} = \frac{5}{12}$

(iv) Let D = The sum as 1 :

$D = \{\phi\}$, $n(D) = 0$

$$P(D) = \frac{n(D)}{n(S)} = \frac{0}{36} = 0$$

(10) Three fair coins are tossed together. Find the probability of getting
(i) all heads
(ii) atleast one tail
(iii) atmost one head
(iv) atmost two tails

Solution :

Sample space $S = \{HHH, HHT, HTH, THH, TTT, TTH, THT, HTT\}$

$n(S) = 8$

(i) Let A = all heads :

$A = \{HHH\}$ $n(A) = 1$

$$\boxed{P(A) = \frac{n(A)}{n(S)}} = \frac{1}{8}$$

(ii) Let B = atLeast one tail :

$B = \{HHT, HTH, THH, TTT, TTH, THT, HTT\}$

$n(B) = 7$, $P(B) = \frac{n(B)}{n(S)} = \frac{7}{8}$

(iii) Let C = atmost one head : (அதிகபட்சம் ஒரு தலை)

$C = \{HTT, THT, TTH, TTT\}$, $n(C) = 4$

$P(C) = \frac{n(C)}{n(S)} = \frac{\cancel{4}^{1}}{\cancel{8}_{2}} = \frac{1}{2}$

(iv) Let D = atmost two tails : (அதிகபட்சம் 2 பூ)

$D = \{HHH, HHT, HTH, THH, TTH, THT, HTT\}$, $n(D) = 7$

$P(D) = \frac{n(D)}{n(S)} = \frac{7}{8}$

71 A bag contains 5 red balls, 6 white balls, 7 green balls, 8 black balls. One ball is drawn at random from the bag. Find the probability that the ball drawn is

(i) white
(ii) black or red
(iii) not white
(iv) neither white nor black

Solution: Given: Sample space

$S = \{5 \text{ red}, 6 \text{ white}, 7 \text{ green}, 8 \text{ black}\}$

$\boxed{n(S) = 26}$

(i) Let A = Getting white balls:

$n(A) = 6, \quad P(A) = \frac{n(A)}{n(S)} = \frac{6}{26} = \frac{3}{13}$

(ii) Let B = getting black or red Balls:

$n(B) = 8 + 5 = 13, \quad P(B) = \frac{n(B)}{n(S)} = \frac{13}{26} = \frac{1}{2}$

(iii) Let C = Not getting white balls:

$n(C) = 5 + 7 + 8 = 20, \quad P(C) = \frac{n(C)}{n(S)} = \frac{20}{26} = \frac{10}{13}$

(iv) Let D = getting of neither white nor black:
(white & black இல்லாமல்)

$n(D) = 5 + 7 = 12,$

$P(D) = \frac{n(D)}{n(S)} = \frac{12}{26} = \frac{6}{13}$

12 Two dice are rolled once. Find the probability of getting an even number on the first die or a total of face sum 8.

Solution

Sample space $S = \{(1,1),(1,2),(1,3),(1,4),(1,5),(1,6),$
$(2,1),(2,2),(2,3),(2,4),(2,5),(2,6)$ → Even num
$(3,1),(3,2),(3,3),(3,4),(3,5),(3,6)$
$(4,1),(4,2),(4,3),(4,4),(4,5),(4,6)$ → Even
$(5,1),(5,2),(5,3),(5,4),(5,5),(5,6)$
$(6,1),(6,2),(6,3),(6,4),(6,5),(6,6)\}$ – Even

$$\boxed{n(S) = 36}$$

(i) Let A = Getting on even number on first die:

$A = \{(2,1)\ (2,2)\ (2,3)\ (2,4)\ (2,5)\ (2,6)$
$(4,1)\ (4,2)\ (4,3)\ (4,4)\ (4,5)\ (4,6)$
$(6,1)\ (6,2)\ (6,3)\ (6,4)\ (6,5)\ (6,6)\}$

$n(A) = 18, \quad P(A) = \frac{n(A)}{n(S)} = \frac{18}{36}$

(ii) Let B = Getting total face sum 8:

$B = \{(2,6)\ (3,5)\ (4,4)\ (5,3)\ (6,2)\}$

$n(B) = 5, \quad P(B) = \frac{n(B)}{n(S)} = \frac{5}{36}$

(iii) $A \cap B = \{(2,6)\ (4,4)\ (6,2)\}$

$n(A \cap B) = 3, \quad P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{3}{36}$

$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{18}{36} + \frac{5}{36} - \frac{3}{36} = \frac{20}{36} = \frac{5}{9}$

$\therefore \boxed{P(A \cup B) = \frac{5}{9}}$

(73) A flower is selected at random from a basket containing 80 yellow, 70 red and 50 white flowers. Find the probability of selecting a yellow or red flower?

Solution:

Sample space $S = \{80 \text{ yellow}, 70 \text{ red}, 50 \text{ white}\}$

$n(S) = 200$

(i) Let A = yellow flower:

$n(A) = 80$, $P(A) = \frac{n(A)}{n(S)} = \frac{80}{200}$

(ii) Let B = Red flower:

$n(B) = 70$, $P(B) = \frac{n(B)}{n(S)} = \frac{70}{200}$

(iii) $P(A \cup B) = P(A) + P(B)$

$= \frac{80}{200} + \frac{70}{200}$

$= \frac{150}{200}$

$= \frac{3}{4}$

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(74) In a class of 50 students, 28 opted for NCC, 30 opted for NSS and 18 opted both NCC and NSS. One of the students is selected at random. Find the probability that

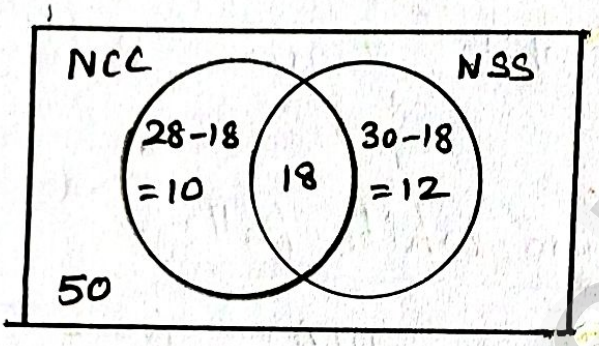
(i) The student opted for NCC but not NSS.

(ii) The student opted for NSS but not NCC.

(iii) The student opted for exactly one of them.

may 2022

Solution:



Sample space S = 50 students

$\therefore n(S) = 50$

(i) Let A = opted for NCC but not NSS

$n(A) = 10$, $P(A) = \frac{n(A)}{n(S)} = \frac{10}{50} = \frac{1}{5}$

(ii) Let B = Opted for NSS but not NCC

$n(B) = 12$, $P(B) = \frac{n(B)}{n(S)} = \frac{12}{50} = \frac{6}{25}$

(iii) Let C = opted for exactly one of them

$n(C) = 10 + 12 = 22$,

$P(C) = \frac{n(C)}{n(S)} = \frac{22}{50} = \frac{11}{25}$

(75) Three unbiased coins are tossed once. Find the probability of getting atmost 2 tails or atleast 2 heads.

Solution: Three Coins Tossed:

Sample space $S = \{HHH, HHT, HTH, THH, TTT, TTH, THT, HTT\}$

$n(S) = 8$

(i) Let A = Getting atmost 2 tails: (அதிகபட்சம் 2 பூ வரை)

$A = \{HHH, HHT, HTH, THH, TTH, THT, HTT\}$

$n(A) = 7$, $P(A) = \frac{n(A)}{n(S)} = \frac{7}{8}$

(ii) Let B = Getting atleast 2 heads (குறைந்தபட்சம் 2 தலை வரை)

$B = \{HHT, HTH, THH, HHH\}$

$n(B) = 4$, $P(B) = \frac{n(B)}{n(S)} = \frac{4}{8}$

(iii) $A \cap B = \{HHH, HHT, HTH, THH, TTH, THT, HTT\} \cap \{HHT, HTH, THH, HHH\}$

$= \{HHH, HHT, HTH, THH\}$, $n(A \cap B) = 4$

$P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{4}{8}$

$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{7}{8} + \cancel{\frac{4}{8}} - \cancel{\frac{4}{8}} = \frac{7}{8}$

76 Two customers Priya and Amuthan are visiting a particular shop in the same week (Monday to Saturday). Each is equally likely to visit the shop on any one day as on another day. What is the probability that both will visit the shop on

(i) the same day

(ii) different days

(iii) consecutive days?

29

Solution:

Sample space, S = {(M, M) (M, T) (M, W) (M, T) (M, F) (M, S)
(T, M) (T, T) (T, W) (T, T) (T, F) (T, S)
(W, M) (W, T) (WW) (W, T) (W F) (W, S)
(T, M) (T, T) (T, W) (T, T) (T, F) (T, S)
(F, M) (F, T) (F, W) (F, T) (F, F) (F, S)
(S, M) (S, T) (S, W) (S, T) (S, F) (S, S)}

n(S) = 36

i) Let A = Visit on the Same days

A = {(Mon, Mon), (Tue, Tue), (Wed, Wed), (Thurs, Thurs), (Fri, Fri), (Sat, Sat)}

n(A) = 6

$$P(A) = \frac{n(A)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

ii) Visit on Different days

$$= P(\overline{A}) = 1 - P(A) = 1 - \frac{1}{6} = \frac{5}{6}$$

(iii) visit on Consequent days

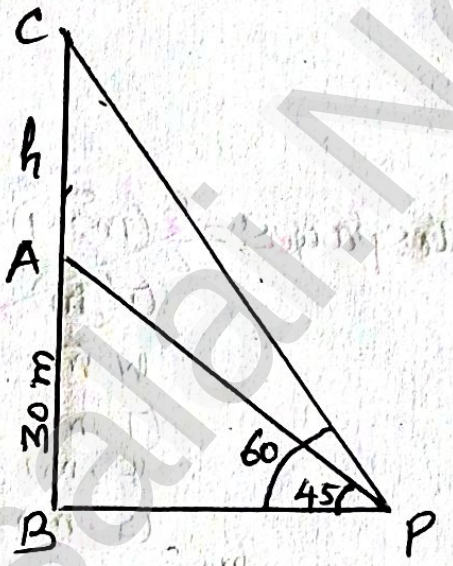
C = {(Mon, Tue), (Tue, Wed), (Wed, Thurs), (Thurs, Fri), (Fri, Sat) (Tue, Mon), (Wed, Tue), (Thurs, Wed), (Fri, Thurs), (Sat, Fri,)}

n(C) = 10

$$P(C) = \frac{n(C)}{n(S)} = \frac{10}{36} = \frac{5}{18}$$

77 From a point on the ground, the angles of elevation of the bottom and top of a tower fixed at the top of a 30 m high building are 45° and 60° respectively. Find the height of the tower. ($\sqrt{3} = 1.732$) MAY-22

Solution:



(i) $\angle APB = 45^\circ$

$$\boxed{\tan\theta = \frac{opp}{Adj}}$$

$$\tan 45 = \frac{30}{BP}$$

$$1 = \frac{30}{BP}$$

$$\boxed{BP = 30\ m}$$

(ii) $\angle BPC = 60^\circ$

$$\tan 60 = \frac{BC}{BP} = \frac{BA + AC}{BP} = \frac{h+30}{30}$$

$$\sqrt{3} = \frac{h+30}{30} \Rightarrow 30\sqrt{3} = h + 30$$

$$h + 30 = 30\sqrt{3}$$

$$\therefore h = 30\sqrt{3} - 30$$

$$= 30[\sqrt{3} - 1]$$

$$= 30(1.732 - 1)$$

$$= 30 \times 0.732$$

$$\boxed{h = 21.96\ m}$$

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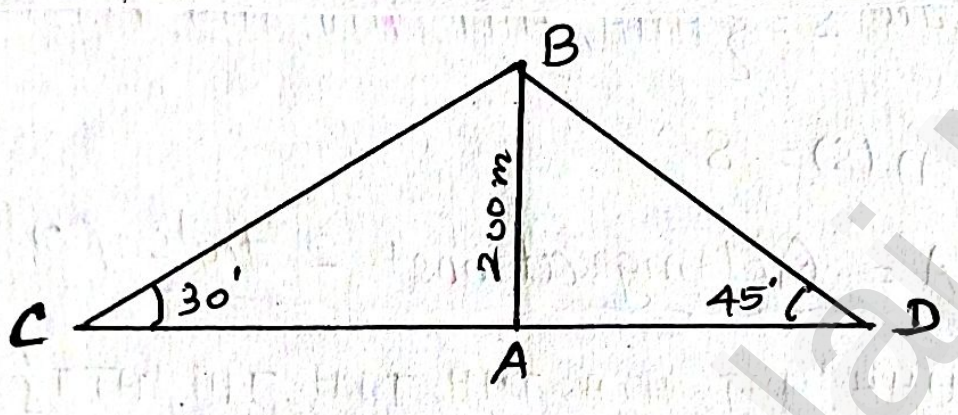
78 Two ships are sailing in the sea on either sides of a lighthouse. The angle of elevation of the top of the lighthouse as observed from the ships are 30° and 45° respectively. If the lighthouse is 200 m high, find the distance between the two ships. ($\sqrt{3} = 1.732$)

SEP-21



(i) $\angle ACB = 30°$

$\tan 30 = \frac{AB}{CA}$

$\frac{1}{\sqrt{3}} = \frac{200}{CA}$

$\boxed{CA = 200\sqrt{3}}$

(ii) $\angle ADB = 45°$

$\tan 45 = \frac{AB}{AD}$

$1 = \frac{200}{AD}$

$\boxed{AD = 200}$

$\therefore$ Distance between the two ships.

$CD = CA + AD$

$= 200\sqrt{3} + 200$

$= 200(\sqrt{3}+1)$

$= 200(1.732+1)$

$= 200 \times 2.732$

$\boxed{CD = 546.4\ m}$

(A) The marks scored by the students in a slip test are given below. Find the standard deviation of their marks.

x	4	6	8	10	12
f	7	3	5	9	5

Solution:

Standard deviation $\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$

Let $A = 8$

x	f	$d = x - A$	d^2	fd	fd^2
4	7	$4-8 = -4$	16	-28	112
6	3	$6-8 = -2$	4	-6	12
8	5	$8-8 = 0$	0	0	0
10	9	$10-8 = 2$	4	18	36
12	5	$12-8 = 4$	16	20	80
$\Sigma f = 29$				$\Sigma fd = 4$	$\Sigma fd^2 = 240$

$$\sigma = \sqrt{\frac{240}{29} - \left(\frac{4}{29}\right)^2} = \sqrt{\frac{240}{29} - \frac{4\times4}{29\times29}}$$

$$= \sqrt{\frac{29}{29}\times\frac{240}{29} - \frac{16}{29\times29}} = \sqrt{\frac{6960}{841} - \frac{16}{841}}$$

$$= \sqrt{\frac{6960-16}{841}} = \sqrt{\frac{6944}{841}} = \sqrt{8.25}$$

$$= \sqrt{8.25} \simeq 2.87 \qquad \therefore \boxed{\sigma = 2.87}$$

(80) marks of the students in a particular subject of class are given below. Find its standard deviation. (30)

marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Stud.	8	12	17	14	9	7	4

Solution

$$\boxed{\text{Standard deviation } \sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2} \times c}$$

$A = 35$, $c = 10$

marks	mid value x	f	$d = \frac{x-A}{10}$	d^2	$f \times d$	$f \times d^2$
0-10	5	8	$\frac{5-35}{10} = \frac{-30}{10} = -3$	9	-24	72
10-20	15	12	$\frac{15-35}{10} = \frac{-20}{10} = -2$	4	-24	48
20-30	25	17	$\frac{25-35}{10} = \frac{-10}{10} = -1$	1	-17	17
30-40	35	14	$\frac{35-35}{10} = \frac{0}{10} = 0$	0	0	0
40-50	45	9	$\frac{45-35}{10} = \frac{10}{10} = 1$	1	9	9
50-60	55	7	$\frac{55-35}{10} = \frac{20}{10} = 2$	4	14	28
60-70	65	4	$\frac{65-35}{10} = \frac{30}{10} = 3$	9	12	36
		$\Sigma f = 71$			$\Sigma fd = -30$	$\Sigma fd^2 = 210$

(S.D) $\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2} \times c = \sqrt{\frac{210}{71} - \left(\frac{-30}{71}\right)^2} \times 10$

$= \sqrt{\frac{210}{71} - \left(\frac{-30 \times -30}{71 \times 71}\right)} \times 10 = \sqrt{\frac{71}{71} \times \frac{210}{71} - \frac{900}{71 \times 71}} \times 10$

$= \sqrt{\frac{14910}{5041} - \frac{900}{5041}} \times 10 = \sqrt{\frac{14910 - 900}{5041}} \times 10 = \sqrt{\frac{14010}{5041}} \times 10$

$= \sqrt{2.7792} \times 10 = 1.66 \times 10 \simeq 16.6$

(81) The marks scored by 10 students in a class test are 25, 29, 30, 33, 35, 37, 38, 40, 44, 48. Find the standard diviation.

Solution:

$$SD\ \sigma = \sqrt{\frac{\Sigma d^2}{n} - \left(\frac{\Sigma d}{n}\right)^2}$$

$A = 35$, $n = 10$

x	$d = x - A$	d^2
25	$25-35 = -10$	100
29	$29-35 = -6$	36
30	$30-35 = -5$	25
33	$33-35 = -2$	4
35	$35-35 = 0$	0
37	$37-35 = 2$	4
38	$38-35 = 3$	9
40	$40-35 = 5$	25
44	$44-35 = 9$	81
48	$48-35 = 13$	169
	$\Sigma d = 9$	$\Sigma d^2 = 453$

$$\sigma = \sqrt{\frac{453}{10} - \left(\frac{9}{10}\right)^2}$$

$$= \sqrt{\frac{453}{10} - \frac{9\times9}{10\times10}} = \sqrt{\frac{10}{10}\times\frac{453}{10} - \frac{81}{100}}$$

$$= \sqrt{\frac{4530}{100} - \frac{81}{100}} = \sqrt{\frac{4449}{100}}$$

$$= \sqrt{44.49} \simeq 6.67$$

(82) Find the coefficient of variation of 24, 26, 33, 37, 29, 31.

Solution:

$$\boxed{\text{Coefficient of variation} \quad C.V = \frac{\sigma}{\bar{x}} \times 100}$$

(i) $$\boxed{\bar{x} = \frac{\text{Sum of Items}}{\text{No. of Items}}}$$

$$= \frac{24+26+33+37+29+31}{6}$$

$$= \frac{180}{6} \Rightarrow \boxed{\bar{x} = 30}$$

(ii) $$\boxed{\sigma = \sqrt{\frac{\Sigma d^2}{n} - \left(\frac{\Sigma d}{n}\right)^2}} \quad \boxed{n = 6}$$

$x = 24, 26, 29, 31, 33, 37$

x	$d = x - \bar{x}$	d^2
24	24-30 = -6	36
26	26-30 = -4	16
29	29-30 = -1	1
31	31-30 = 1	1
33	33-30 = 3	9
37	37-30 = 7	49
	$\Sigma d = 0$	$\Sigma d^2 = 112$

$$\sigma = \sqrt{\frac{112}{6} - \cancel{\left(\frac{0}{6}\right)^2}}$$

$$= \sqrt{\frac{112}{6}}$$

$$= \sqrt{18.67}$$

$$\boxed{\sigma = 4.32}$$

$$CV = \frac{4.32}{30} \times 100$$

$$= \frac{432}{30} = 14.4$$

$$\therefore \boxed{CV = 14.4}$$

(83) Solve:

$$\frac{1}{x^2-5x+6}+\frac{1}{x^2-3x+2}-\frac{1}{x^2-8x+15}$$

Soln.

$$\begin{array}{r}-2\\-3\\\hline -5\end{array}>6,\quad \begin{array}{r}-1\\-2\\\hline -3\end{array}>2,\quad \begin{array}{r}-5\\-3\\\hline -8\end{array}>15$$

$$=\frac{1}{(x-2)(x-3)}+\frac{1}{(x-1)(x-2)}-\frac{1}{(x-3)(x-5)}$$

$$=\frac{(x-1)(x-5)+(x-3)(x-5)-(x-1)(x-2)}{(x-1)(x-2)(x-3)(x-5)}$$

$$=\frac{x^2-6x+6+x^2-8x+15-[x^2-3x+3]}{(x-1)(x-2)(x-3)(x-5)}$$

$$=\frac{\cancel{x^2}-6x+6+x^2-8x+15-\cancel{x^2}+3x-3}{(x-1)(x-2)(x-3)(x-5)}$$

$$=\frac{x^2-11x+18}{(x-1)(x-2)(x-3)(x-5)}\qquad \begin{array}{r}-9\\-2\\\hline -11\end{array}>18$$

$$=\frac{\cancel{(x-2)}(x-9)}{(x-1)\cancel{(x-2)}(x-3)(x-5)}$$

$$=\frac{x-9}{(x+1)(x-3)(x-5)}$$

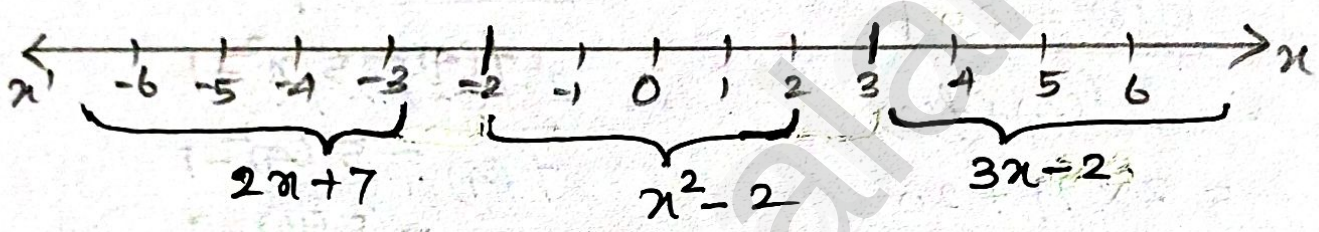
(84) இங்கு $f: R \to R$ ஆனது $f(x) = \begin{cases} 2x+7 & ; x < -2 \\ x^2-2 & ; -2 \le x < 3 \\ 3x-2 & ; x \ge 3 \end{cases}$

என வரையறுக்கப்பட்டால்

(i) $f(4)$ (ii) $f(-2)$ (iii) $f(4)+2f(1)$

(iv) $\dfrac{f(1)-3f(4)}{f(-3)}$ ஆகியவற்றின் மதிப்பு காண்க.

தீர்வு



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

$= 3(4)-2$

$= 12-2$

$\boxed{f(4) = 10}$

(ii) $f(-2) = x^2-2$

$= (-2)^2-2$

$= 4-2$

$\boxed{f(-2) = 2}$

(iii) $f(4)+2f(1)$

$f(4) = 10$

$f(1) = x^2-2$

$= (1)^2-2$

$= 1-2$

$\boxed{f(1) = -1}$

$\therefore f(4)+2f(1) = 10+2\times(-1)$

$= 10-2$

$= 8$

(iv) $f(-3) = 2x+7$

$= 2(-3)+7$

$= -6+7$

$\boxed{f(-3) = 1}$

$\therefore \dfrac{f(1)-3f(4)}{f(-3)} =$

$= \dfrac{-1-3\times 10}{1}$

$= \dfrac{-1-30}{1} = \dfrac{-31}{1}$

$= -31$

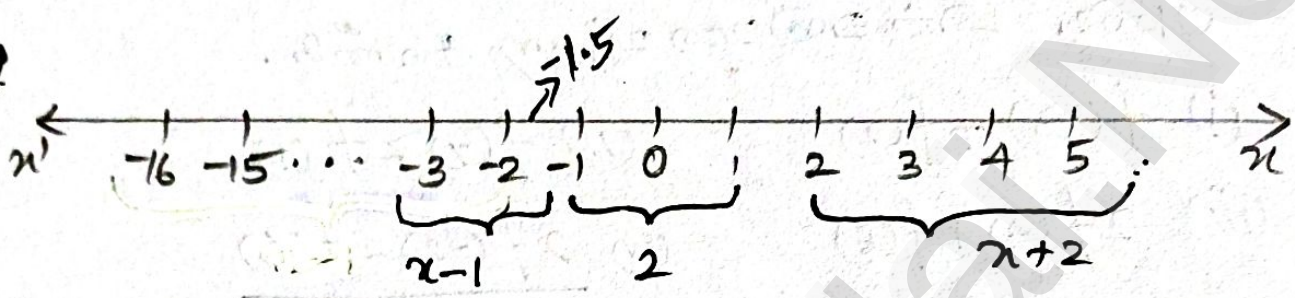
(31)

(85) f என்ற சார்பானது $f(x) = \begin{cases} x+2 & ; x>1 \\ 2 & ; -1 \le x \le 1 \\ x-1 & ; -3 < x < -1 \end{cases}$

என வரையறுக்கப்படுகிறது.

(i) $f(3)$ (ii) $f(0)$ (iii) $f(-1.5)$ (iv) $f(2)+f(-2)$ காண்க.

தீர்வு



(i) $f(3) = x+2$

$= 3+2$

$\boxed{f(3) = 5}$

(ii) $\boxed{f(0) = 2}$

(iii) $f(-1.5) = x-1$

$= -1.5-1 = -2.5$

$\boxed{f(-1.5) = -2.5}$

(iv) $f(2) = x+2$

$= 2+2$

$\boxed{f(2) = 4}$

$f(-2) = x-1$

$= -2-1$

$\boxed{f(-2) = -3}$

$\therefore f(2) + f(-2)$

$= 4 + (-3)$

$= 4-3$

$= 1$

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(86) $f : [-5, 9] \to R$ என்ற சார்பானது விதிகளால் வரையறுக்கப்படுகிறது.

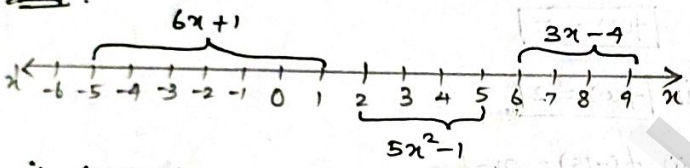
$$f(x) = \begin{cases} 6x+1 & ; -5 \le x < 2 \\ 5x^2-1 & ; 2 \le x < 6 \\ 3x-4 & ; 6 \le x \le 9 \end{cases}$$ என வரையறுக்கப்படுகிறது

என்றால் பின் வரும் மதிப்பை காண்க.

(i) $f(-3)+f(2)$ (ii) $f(7)-f(1)$

(iii) $2f(4)+f(8)$ (iv) $\dfrac{2f(-2)-f(6)}{f(4)+f(-2)}$

தீர்வு :



(i) $f(-3) = 6x+1$
$= 6(-3)+1$
$= -18+1$
$\boxed{f(-3) = -17}$

$f(2) = 5x^2-1$
$= 5(2)^2-1$
$= 5(4)-1$
$= 20-1$
$\boxed{f(2) = 19}$

$\therefore f(-3)+f(2)$
$= -17+19$
$= 2$

(ii) $f(7) = 3x-4$
$= 3(7)-4$
$= 21-4$
$\boxed{f(7) = 17}$

$f(1) = 6x+1$
$= 6(1)+1$
$= 6+1$
$\boxed{f(7) = 7}$

$\therefore f(7)-f(1)$
$= 17-7$
$= 10$

(iii) $f(4) = 5x^2-1$
$= 5(4)^2-1$
$= 5(16)-1$
$= 80-1$
$\boxed{f(4) = 79}$

$f(8) = 3x-4$
$= 3(8)-4$
$= 24-4$
$\boxed{f(8) = 20}$

$\therefore 2f(4)+f(8)$
$= 2 \times 79 + 20$
$= 158+20$
$= 178$

(iv) $f(-2) = 6x+1$
$= 6(-2)+1$
$= -12+1$
$\boxed{f(-2) = -11}$

$f(6) = 3x-4$
$= 3(6)-4$
$= 18-4$
$\boxed{f(6) = 14}$

$\therefore \dfrac{2f(-2)-f(6)}{f(4)+f(-2)}$

$= \dfrac{2 \times (-11) - 14}{79 + (-11)}$

$= \dfrac{-22-14}{79-11}$

$= \dfrac{-36}{68}$ $\left[\because \dfrac{4 \times 9 = 36}{4 \times 17 = 68}\right.$

$= \dfrac{-9}{17}$

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