

**CLASS X (2020-21)**  
**MATHEMATICS STANDARD (041)**  
**SAMPLE PAPER-01**

**Time : 3 Hours**

**Maximum Marks : 80**

**General Instructions :**

1. This question paper contains two parts A and B.
2. Both Part A and Part B have internal choices.

**Part-A :**

1. It consists of two sections- I and II.
2. Section I has 16 questions. Internal choice is provided in 5 questions.
3. Section II has four case study-based questions. Each case study has 5 case-based sub-parts. An examinee is to attempt any 4 out of 5 sub-parts.

**Part-B :**

1. Question no. 21 to 26 are very short answer type questions of 2 mark each.
2. Question no. 27 to 33 are short answer type questions of 3 marks each.
3. Question no. 34 to 36 are long answer type questions of 5 marks each.
4. Internal choice is provided in 2 questions of 2 marks, 2 questions of 3 marks and 1 question of 5 marks.



**Part - A**

**Section - I**

1. If  $x = 0.\bar{7}$ , then find  $2x$ .

**Ans :**

We have  $x = 0.\bar{7}$   
 $10x = 7.\bar{7}$

Subtracting,  $9x = 7$   
 $x = \frac{7}{9}$   
 $2x = \frac{14}{9} = 1.555 \dots\dots$   
 $= 1.\bar{5}$



**or**

1. The L.C.M. of  $x$  and 18 is 36.
  2. The H.C.F. of  $x$  and 18 is 2.
- What is the number  $x$ ?



**Ans :**

$LCM \times HCF = \text{First number} \times \text{second number}$

Hence, required number  $= \frac{36 \times 2}{18} = 4$

2. Find the value of  $k$  for which the system of linear equations  $x + 2y = 3$ ,  $5x + ky + 7 = 0$  is inconsistent.

**Ans :** [Board 2020 OD Standard]

We have  $x + 2y - 3 = 0$   
 and  $5x + ky + 7 = 0$   
 If system is inconsistent, then



$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

From first two orders, we have

$\frac{1}{5} = \frac{2}{k} \Rightarrow k = 10$

3. If the sum and product of the zeroes of a quadratic polynomial are 3 and  $-10$  respectively, find the quadratic polynomial.

**Ans :** [Board 2020 Delhi Basic]

Sum of zeroes,  $\alpha + \beta = 3$   
 and product of zeroes,  $\alpha\beta = -10$   
 Quadratic polynomial,



$p(x) = x^2 - (\alpha + \beta)x + \alpha\beta$   
 $= x^2 - 3x - 10$

**or**

If the sum of the zeroes of the quadratic polynomial  $kx^2 + 2x + 3k$  is equal to their product, then what is the value of  $k$ ?

**Ans :** [Board 2020 OD Basic]

We have  $p(x) = kx^2 + 2x + 3k$   
 Comparing it by  $ax^2 + bx + c$ , we get  $a = k$ ,  $b = 2$  and  $c = 3k$ .

Sum of zeroes,  $\alpha + \beta = -\frac{b}{a} = -\frac{2}{k}$



Product of zeroes,  $\alpha\beta = \frac{c}{a} = \frac{3k}{k} = 3$

According to question, we have

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

4. What is the  $n^{\text{th}}$  term of the AP  $a, 3a, 5a, \dots$  ?

**Ans :** [Board 2020 OD Standard]

Given AP is  $a, 3a, 5a, \dots$

First term is  $a$  and  $d = 3a - a = 2a$

$n^{\text{th}}$  term  $a_n = a + (n - 1)d$   
 $= a + (n - 1)2a$   
 $= a + 2na - 2a$   
 $= 2na - a = (2n - 1)a$



**or**

What is the common difference of the AP  $\frac{1}{p}, \frac{1-p}{p}, \frac{1-2p}{p}, \dots$ ?

**Ans :** [Board 2020 OD Standard]

Given AP is  $\frac{1}{p}, \frac{1-p}{p}, \frac{1-2p}{p}, \dots$



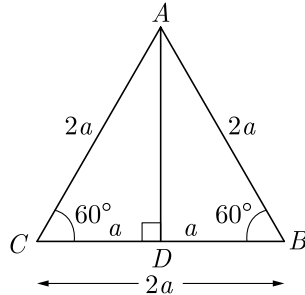
Common difference

$$d = \frac{1-p}{p} - \frac{1}{p} = \frac{1-p-1}{p} = \frac{-p}{p} = -1$$

5.  $\Delta ABC$  is an equilateral triangle of side  $2a$ , then length of one of its altitude is .....

**Ans :** [Board 2020 Delhi Standard]

$\Delta ABC$  is an equilateral triangle as shown below, in which  $AD \perp BC$ .

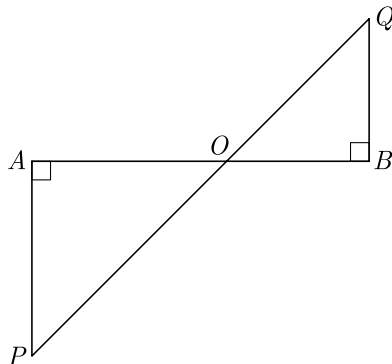


Using Pythagoras theorem we have

$$\begin{aligned} AB^2 &= (AD)^2 + (BD)^2 \\ (2a)^2 &= (AD)^2 + (a)^2 \\ 4a^2 - a^2 &= (AD)^2 \\ (AD)^2 &= 3a^2 \\ AD &= a\sqrt{3} \end{aligned}$$

Hence, the length of altitude is  $a\sqrt{3}$ .

6. In the given figure, if  $\angle A = 90^\circ, \angle B = 90^\circ, OB = 4.5$  cm  $OA = 6$  cm and  $AP = 4$  cm then find  $QB$ .



**Ans :** [Board Term-1, 2015]

In  $\Delta PAO$  and  $\Delta QBO$  we have

$$\angle A = \angle B = 90^\circ$$

Vertically opposite angle,

$$\angle POA = \angle QOB$$

Thus  $\Delta PAO \sim \Delta QBO$

$$\frac{OA}{OB} = \frac{PA}{QB}$$

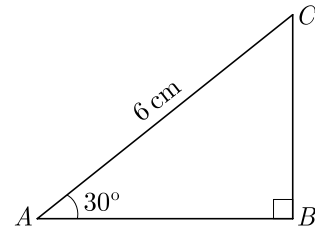
$$\frac{6}{4.5} = \frac{4}{QB}$$

$$QB = \frac{4 \times 4.5}{6} = 3 \text{ cm}$$



Thus  $QB = 3$  cm

7. In the adjoining figure, what is the length of  $BC$ ?



**Ans :**

In  $\Delta ABC$ ,  $\sin 30^\circ = \frac{BC}{AC}$

$$\frac{1}{2} = \frac{BC}{6}$$

$$BC = 3 \text{ cm}$$



8. Prove that

$$(1 + \tan A - \sec A) \times (1 + \tan A + \sec A) = 2 \tan A$$

**Ans :** [Board 2020 Delhi Basic]

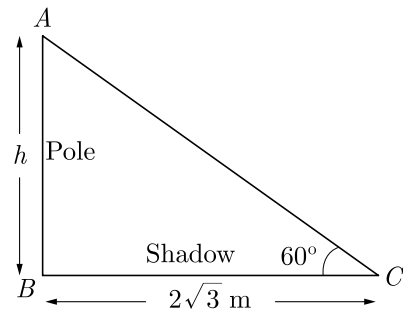
$$\begin{aligned} \text{LHS} &= (1 + \tan A - \sec A) \times (1 + \tan A + \sec A) \\ &= (1 + \tan A)^2 - \sec^2 A \\ &= 1 + \tan^2 A + 2 \tan A - \sec^2 A \\ &= \sec^2 A + 2 \tan A - \sec^2 A \\ &= 2 \tan A = \text{RHS} \end{aligned}$$



9. A pole casts a shadow of length  $2\sqrt{3}$  m on the ground, when the Sun's elevation is  $60^\circ$ . Find the height of the pole.

**Ans :** [Board Term-2 Foreign 2015]

Let the height of pole be  $h$ . As per given in question we have drawn figure below.



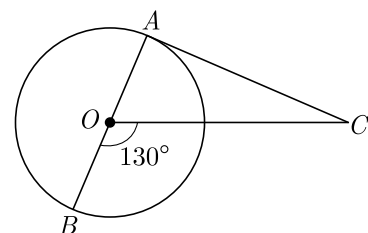
Now  $\frac{h}{2\sqrt{3}} = \tan 60^\circ$

$$h = 2\sqrt{3} \tan 60^\circ$$

$$= 2\sqrt{3} \times \sqrt{3} = 6 \text{ m}$$



10. In the given figure,  $AOB$  is a diameter of the circle with centre  $O$  and  $AC$  is a tangent to the circle at  $A$ . If  $\angle BOC = 130^\circ$ , the find  $\angle ACO$ .



**Ans :** [Board Term-2 Foreign 2016]

Here  $OA$  is radius and  $AC$  is tangent at  $A$ , since radius is always perpendicular to tangent, we have

$$\angle OAC = 90^\circ$$

From exterior angle property,

$$\angle BOC = \angle OAC + \angle ACO$$

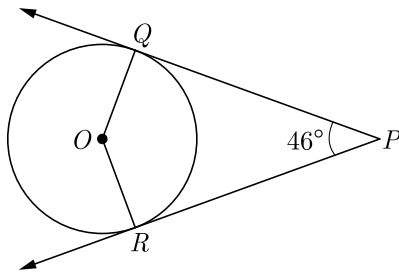
$$130^\circ = 90^\circ + \angle ACO$$

$$\angle ACO = 130^\circ - 90^\circ = 40^\circ$$



j145

11. If  $PQ$  and  $PR$  are two tangents to a circle with centre  $O$ . If  $\angle QPR = 46^\circ$  then find  $\angle QOR$ .



**Ans :** [Board Term-2 Delhi 2014]

We have  $\angle QPR = 46^\circ$

Since  $\angle QOR$  and  $\angle QPR$  are supplementary angles

$$\angle QOR + \angle QPR = 180^\circ$$

$$\angle QOR + 46^\circ = 180^\circ$$

$$\angle QOR = 180^\circ - 46^\circ = 134^\circ$$



j149

12. If the perimeter and the area of the circle are numerically equal, then find the radius of the circle.

**Ans :** [Board Term-2, 2012 Set(13)]

Perimeter of the circle = area of the circle.

$$2\pi r = \pi r^2$$

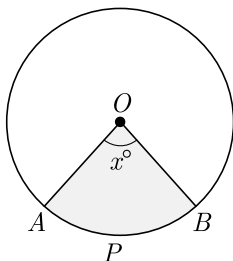
$$r = 2 \text{ units}$$



l115

or

In given fig.,  $O$  is the centre of a circle. If the area of the sector  $OAPB$  is  $\frac{5}{36}$  times the area of the circle, then find the value of  $x$ .



l116

**Ans :** [Board Term-2 2012]

Area of the sector,

$$A_s = \frac{\pi r^2 \theta}{360^\circ}$$

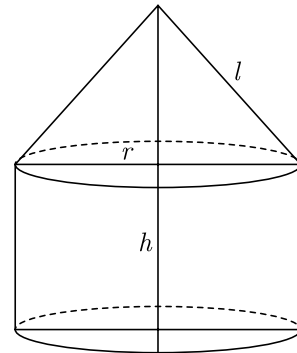
Area of sector  $OAPB$  is  $\frac{5}{36}$  times the area of circle.

$$\text{Thus } \pi r^2 \times \frac{x}{360} = \frac{5}{36} \pi r^2$$

$$\frac{x}{360} = \frac{5}{36}$$

$$x = 50^\circ$$

13. The total surface area of the given solid figure is .....



m262

**Ans :** [Board 2020 SQP Standard]

Given figure is combination of right circular cone and cylinder.

Total surface area

$$= \text{Area of base of cylinder} +$$

$$+ \text{Curved surface area of cylinder} +$$

$$+ \text{Curved surface area of cone}$$

$$= \pi r^2 + 2\pi r h + \pi r l$$

$$= \pi r(r + 2h + l)$$

14. A cylinder, a cone and a hemisphere have same base and same height. Find the ratio of their volumes.

**Ans :** [Board Term-2 Delhi 2014]

$$V_{\text{cylinder}} : V_{\text{cone}} : V_{\text{hemisphere}} = \pi r^2 h : \frac{1}{3} \pi r^2 h : \frac{2}{3} \pi r^3$$

$$= \pi r^2 r : \frac{1}{3} \pi r^2 r : \frac{2}{3} \pi r^3 \quad (h = r)$$

$$= 1 : \frac{1}{3} : \frac{2}{3}$$

$$= 3 : 1 : 2$$



m103

15. Find the class marks of the classes 20-50 and 35-60.

**Ans :** [Board 2020 OD Standard]

$$\text{Class mark of } 20 - 50 = \frac{20 + 50}{2}$$

$$= \frac{70}{2} = 35 \text{ and}$$

$$\text{Class mark of } 35 - 60 = \frac{35 + 60}{2}$$

$$= \frac{95}{2} = 47.5.$$



n152

or

If the median of a series exceeds the mean by 3, find by what number the mode exceeds its mean?

**Ans :** [Board Term-1, 2015]

$$\text{We have } M_d = M + 3$$

$$\text{Now } M_o = 3M_d - 2M$$

$$= 3(M + 3) - 2M$$

$$= 3M + 9 - 2M = M + 9$$

Hence mode exceeds mean by 9.



n153

16. Median of a data is 52.5 and its mean is 54, use empirical relationship between three measure of central tendency to find its mode.

Ans : [Board Term-1 2012]

Median  $M_d = 52.5$

and mean  $M = 54$

Now  $3M_d = M_o + 2M$

$3 \times 52.5 = M_o + 2 \times 54$

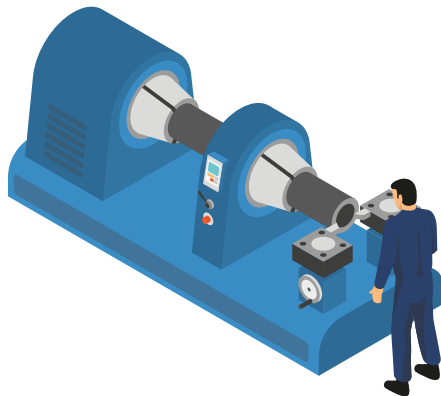
Mode  $M_o = 157.5 - 108 = 49.5$



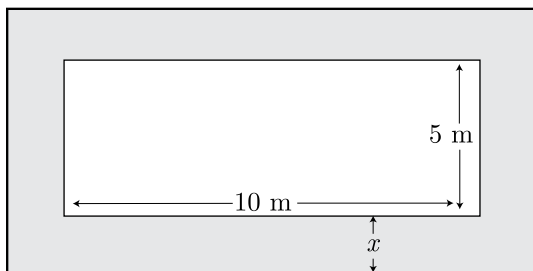
## Section II

Case study-based questions are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

17. RK Fabricators has got a order for making a frame for machine of their client. For which, they are using a AutoCAD software to create a constructible model that includes the relevant information such as dimensions of the frame and materials needed.



The frame will have a solid base and will be cut out of a piece of steel. The final area of the frame should be 54 sq m. The digram of frame is shown below.



In order to input the right values in the AutoCAD software, the engineer needs to calculate some basic values.

- (i) What are the dimensions of the outer frame ?
  - (a)  $(10 + x)$  and  $(5 + x)$
  - (b)  $(10 - x)$  and  $(5 - x)$
  - (c)  $(10 + 2x)$  and  $(5 + 2x)$
  - (d)  $(10 - 2x)$  and  $(5 - 2x)$



- (ii) A metal sheet of minimum area is used to make the frame. What should be the minimum area of metal sheet before cutting ?
  - (a)  $4x^2 + 30x + 50$
  - (b)  $x^2 + 27x + 55$
  - (c)  $5x^2 + 30$
  - (d)  $4x^2 + 50$

- (iii) What is the area of required final metal frame ?
  - (a)  $4x^2 + 30x + 50 \text{ m}^2$
  - (b)  $x^2 + 27x + 55 \text{ m}^2$
  - (c)  $4x^2 + 50x \text{ m}^2$
  - (d)  $4x^2 + 30x \text{ m}^2$
- (iv) If the area of the frame is 54 sq m, what is the value of  $x$  ?
  - (a) 0.75 m
  - (b) 3.0 m
  - (c) 1.5 m
  - (d) 1.8 m
- (v) What is the perimeter of the frame?
  - (a) 36 m
  - (b) 42 m
  - (c) 45 m
  - (d) 39 m

Ans :

(i) Length =  $(10 + x + x) = (10 + 2x)$   
 Breadth =  $(5 + x + x) = (5 + 2x)$  cm  
 Thus (c) is correct option.

(ii) Length of steel plate,  $l = (10 + 2x)$   
 Breadth of steel plate,  $b = (5 + 2x)$   
 Area of steel plate,  $A = lb$   
 $= (10 + 2x)(5 + 2x)$   
 $= 50 + 10x + 20x + 4x^2$   
 $= 50 + 30x + 4x^2$   
 $A = 4x^2 + 30x + 50$

Thus (a) is correct option.

(iii) Area of frame to be cut =  $10 \times 5 = 50 \text{ m}^2$   
 Area of frame left =  $4x^2 + 30x + 50 - 50$   
 $= 4x^2 + 30x \text{ m}^2$

Thus (d) is correct option.

(iv) Here, area of frame =  $54 \text{ m}^2$   
 $4x^2 + 30x = 54$   
 $2x^2 + 15x - 27 = 0$   
 $2x^2 + 18x - 3x - 27 = 0$   
 $(x + 9)(2x - 3) = 0$

$x = 1.5 \text{ or } -9$

Thus (c) is correct option.

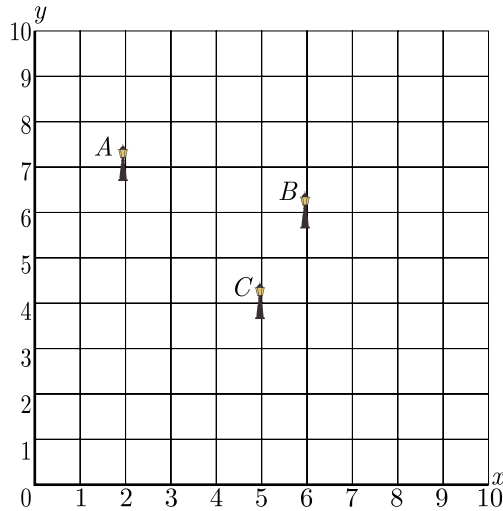
(v) Perimeter of frame = Perimeter of Outside Rectangle  
 $= 2(10 + 2x + 5 + 2x)$   
 $= 2(15 + 4x)$   
 $= 2(15 + 4 \times 1.5) = 42 \text{ m}$

Thus (b) is correct option.

18. Resident Welfare Association (RWA) of a Gulmohar Society in Delhi have installed three electric poles A, B and C in a society's common park. Despite these three poles, some parts of the park are still in dark. So, RWA decides to have one more electric pole D in the park.



The park can be modelled as a coordinate systems given below.



On the basis of the above information, answer any four of the following questions:

- (i) What is the position of the pole  $C$ ?
  - (a)  $(4, 5)$                       (b)  $(5, 4)$
  - (c)  $(6, 5)$                       (d)  $(5, 6)$
- (ii) What is the distance of the pole  $B$  from the corner  $O$  of the park?
  - (a)  $6\sqrt{2}$  units                      (b)  $3\sqrt{2}$  units
  - (c)  $6\sqrt{3}$  units                      (d)  $3\sqrt{3}$  units
- (iii) Find the position of the fourth pole  $D$  so that four points  $A, B, C$  and  $D$  form a parallelogram.
  - (a)  $(5, 2)$                       (b)  $(1, 5)$
  - (c)  $(1, 4)$                       (d)  $(2, 5)$
- (iv) What is the distance between poles  $A$  and  $C$ ?
  - (a)  $6\sqrt{2}$  units                      (b)  $3\sqrt{2}$  units
  - (c)  $6\sqrt{3}$  units                      (d)  $3\sqrt{3}$  units
- (v) What is the distance between poles  $B$  and  $D$ ?
  - (a)  $2\sqrt{3}$  units                      (b)  $\sqrt{28}$  units
  - (c)  $6\sqrt{3}$  units                      (d)  $\sqrt{26}$  units

**Ans :**

(i) From the given diagram we can easily get that position of the pole  $C$   $(5, 4)$ .

Thus (b) is correct option.

(ii) Coordinates of  $B$  are  $(6, 6)$ .

$$\begin{aligned} \text{Distance from origin} &= \sqrt{(6-0)^2 + (6-0)^2} \\ &= \sqrt{36 + 36} = 6\sqrt{2} \text{ units} \end{aligned}$$

Thus (a) is correct option.

(iii) If  $ABCD$  is a parallelogram, the diagonals bisect each other. Here  $AC$  and  $BD$  are diagonals.

$$\text{Mid-point of } AC = \left(\frac{2+5}{2}, \frac{7+4}{2}\right) = (3.5, 5.5)$$

Now, mid-point of diagonal,  $BD$  will be  $(3.5, 5.5)$  also.

Let, the coordinates of  $D$  be  $(x, y)$

$$\text{Now } \frac{6+x}{2} = 3.5 \text{ and } \frac{6+y}{2} = 5.5$$

$$x = 1 \text{ and } y = 5$$

Thus (b) is correct option.

(iv) Coordinates of  $A$  are  $(2, 7)$  and coordinates of  $C$  are  $(5, 4)$ .

Distance between pole  $A$  and  $C$ ,

$$\begin{aligned} AC &= \sqrt{(5-2)^2 + (4-7)^2} \\ &= \sqrt{9+9} = 3\sqrt{2} \text{ units} \end{aligned}$$

Thus (b) is correct option.

(v) Coordinates of  $B$  are  $(6, 6)$  and coordinates of  $D$  are  $(1, 5)$ .

Distance between pole  $B$  and  $D$ ,

$$\begin{aligned} BD &= \sqrt{(6-1)^2 + (6-5)^2} \\ &= \sqrt{5^2 + 1^2} \\ &= \sqrt{25 + 1} = \sqrt{26} \text{ units} \end{aligned}$$

Thus (d) is correct option.

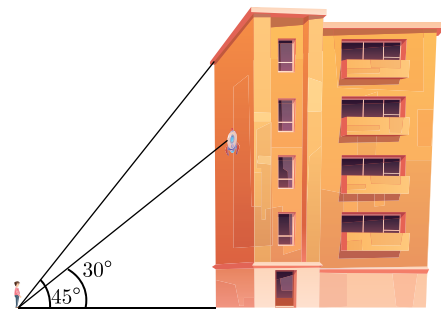
19. A clinometer is a tool that is used to measure the angle of elevation, or angle from the ground, in a right - angled triangle. We can use a clinometer to measure the height of tall things that you can't possibly reach to the top of, flag poles, buildings, trees.



i401



Ravish got a clinometer from school lab and started the measuring elevation angle in surrounding. He saw a building on which society logo is painted on wall of building.



From a point  $P$  on the ground level, the angle of elevation of the roof of the building is  $45^\circ$ . The angle of elevation of the centre of logo is  $30^\circ$  from same point. The point  $P$  is at a distance of  $24$  m from the base of the building.

- (i) What is the height of the building logo from ground?
  - (a)  $8\sqrt{2}$  m                      (b)  $4\sqrt{3}$  m
  - (c)  $8\sqrt{3}$  m                      (d)  $4\sqrt{2}$  m
- (ii) What is the height of the building from ground?
  - (a)  $24(3-\sqrt{3})$  m                      (b)  $8(3-\sqrt{3})$  m
  - (c)  $24$  m                      (d)  $32$  m
- (iii) What is the aerial distance of the point  $P$  from the top of the building?
  - (a)  $24\sqrt{3}$  m                      (b)  $24\sqrt{2}$  m
  - (c)  $32\sqrt{3}$  m                      (d)  $32\sqrt{2}$  m

(iv) If the point of observation  $P$  is moved 9 m towards the base of the building, then the angle of elevation  $\theta$  of the logo on building is given by

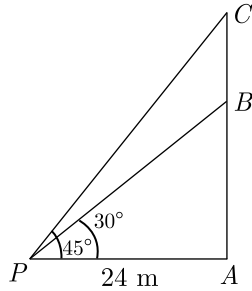
- (a)  $\tan \theta = \sqrt{3}$
- (b)  $\tan \theta = \frac{2}{\sqrt{3}}$
- (c)  $\tan \theta = \frac{1}{2}$
- (d)  $\tan \theta = \frac{8\sqrt{3}}{15}$

(v) In above case the angle of elevation  $\phi$  of the top of building is given by

- (a)  $\tan \phi = 1.6$
- (b)  $\tan \phi = 1.5$
- (c)  $\tan \phi = 0.75$
- (d)  $\tan \phi = 0.8$

Ans :

(i) As per question statement we have shown the digram below.



The height of the building logo from ground is  $AB$ . Here  $C$  is top of building and  $AC$  is height of building.

In  $\Delta PAB$ ,  $\tan 30^\circ = \frac{AB}{PA}$

$$\frac{1}{\sqrt{3}} = \frac{AB}{24}$$

$$AB = \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 8\sqrt{3} \text{ m}$$

Thus (c) is correct option.

(ii) The height of the building from ground is  $AC$ .

In  $\Delta APC$ ,  $\tan 45^\circ = \frac{AC}{AP}$

$$1 = \frac{AC}{24}$$

$$AC = 24 \text{ m}$$

Thus (c) is correct option.

(iii) In  $\Delta APC$ ,

$$\cos 45^\circ = \frac{AP}{AC}$$

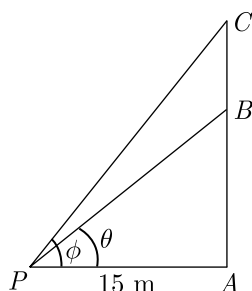
$$\frac{1}{\sqrt{2}} = \frac{24}{PC}$$

$$PC = 24\sqrt{2} \text{ m}$$

Thus (b) is correct option.

(iv) In this case we have made diagram as follows.

Now  $AP = 24 - 9 = 15 \text{ m}$



$$\tan \theta = \frac{AB}{AP} = \frac{8\sqrt{3}}{15}$$

Thus (d) is correct option.

(v)  $\tan \phi = \frac{AC}{AP} = \frac{24}{15} = \frac{8}{5} = 1.6$

Thus (a) is correct option.

20. Cards on which numbers 1, 2, 3 ..... 100 are written (one number on one card and no number is repeated), put in a bag and are mixed thoroughly. A card is drawn at random from the bag.



(i) What is the probability that card taken out has a odd number ?

- (a) 0.25
- (b) 0.49
- (c) 0.50
- (d) 0.51

(ii) What is the probability that card taken out has a two digit odd number ?

- (a) 0.23
- (b) 0.45
- (c) 0.56
- (d) 0.34

(iii) What is the probability that card taken out has a odd number which is multiple of 11?

- (a) 0.05
- (b) 0.10
- (c) 0.12
- (d) 0.06

(iv) What is the probability that card taken out has an odd number which is not less than 70 ?

- (a) 0.13
- (b) 0.14
- (c) 0.12
- (d) 0.15

(v) What is the probability that card taken out has an odd number which is not multiple of 11 ?

- (a) 0.25
- (b) 0.50
- (c) 0.40
- (d) 0.45

Ans :

(i) There are 100 cards in bags. Thus we have 100 possible outcomes for all cases.

$$n(S) = 100$$

Odd numbers 1 to 100 are 50.

Number of favourable outcomes,

$$n(E_1) = 50$$

$P$ (an odd number),

$$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{50}{100} = \frac{1}{2} = 0.5$$

Thus (c) is correct option.

(ii) Total odd number are 50 and 5 numbers are one digit odd number. Hence two digit odd number are 45.

Thus favourable outcomes,

$$n(E_2) = 50 - 5 = 45$$

$P$ (Two digit odd number),

$$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{45}{100} = 0.45$$

Thus (b) is correct option.



o401

(iii) Favourable outcomes are {11, 33, 55, 77, 99}.  
Number of favourable outcomes is 5. Therefore

$$n(E_3) = 5$$

$P(\text{odd number multiple of 11}),$

$$P(E_3) = \frac{n(E_3)}{n(S)} = \frac{5}{100} = 0.05$$

Thus (a) is correct option.

(iv) Favourable outcomes are 71, 73, 75, .....99.

Number of favourable outcomes,

$$n(E_4) = 15$$

$P(\text{odd number not less than 70}),$

$$P(E_4) = \frac{n(E_4)}{n(S)} = \frac{15}{100} = 0.15$$

Thus (d) is correct option.

(v) Total odd number are 50 and out of which {11, 33, 55, 77, 99} are multiple of 11. Thus  $50 - 5 = 45$  numbers are not multiple of 11.

Therefore  $n(E_5) = 45$

$P(\text{odd number not multiple of 11}),$

$$P(E_5) = \frac{n(E_5)}{n(S)} = \frac{45}{100} = 0.45$$

Thus (d) is correct option.

## Part - B

**All questions are compulsory. In case of internal choices, attempt anyone.**

21. Explain why  $(7 \times 13 \times 11) + 11$  and  $(7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 3$  are composite numbers.

**Ans :** [Board Term-1 2012, Set-64]

$$\begin{aligned} (7 \times 13 \times 11) + 11 &= 11 \times (7 \times 13 + 1) \\ &= 11 \times (91 + 1) \\ &= 11 \times 92 \end{aligned}$$



a111

and

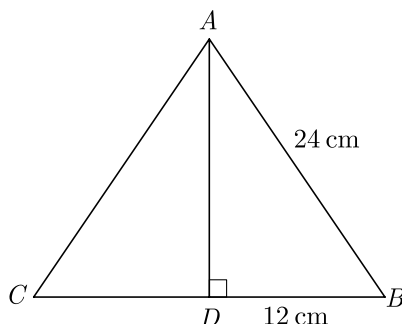
$$\begin{aligned} (7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 3 &= 3(7 \times 6 \times 5 \times 4 \times 2 \times 1 + 1) \\ &= 3 \times (1681) = 3 \times 41 \times 41 \end{aligned}$$

Since given numbers have more than two prime factors, both number are composite.

22. In an equilateral triangle of side 24 cm, find the length of the altitude.

**Ans :** [Board Term-1 2015]

Let  $\Delta ABC$  be an equilateral triangle of side 24 cm and  $AD$  is altitude which is also a perpendicular bisector of side  $BC$ . This is shown in figure given below.



Now  $BD = \frac{BC}{2} = \frac{24}{2} = 12 \text{ cm}$

$$AB = 24 \text{ cm}$$

$$\begin{aligned} AD &= \sqrt{AB^2 - BD^2} \\ &= \sqrt{(24)^2 - (12)^2} \\ &= \sqrt{576 - 144} \\ &= \sqrt{432} = 12\sqrt{3} \end{aligned}$$

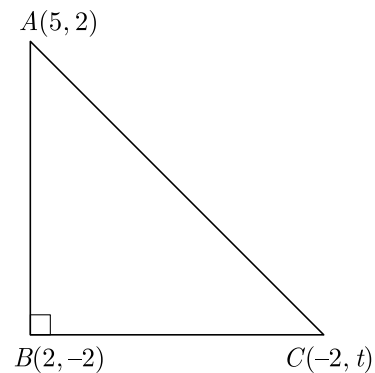
Thus  $AD = 12\sqrt{3} \text{ cm}.$

23. If  $A(5, 2)$ ,  $B(2, -2)$  and  $C(-2, t)$  are the vertices of a right angled triangle with  $\angle B = 90^\circ$ , then find the value of  $t$ .

**Ans :**

[Board Term-2 Delhi 2015]

As per question, triangle is shown below.



Now  $AB^2 = (2 - 5)^2 + (-2 - 2)^2 = 9 + 16 = 25$   
 $BC^2 = (-2 - 2)^2 + (t + 2)^2 = 16 + (t + 2)^2$   
 $AC^2 = (5 + 2)^2 + (2 - t)^2 = 49 + (2 - t)^2$

Since  $\Delta ABC$  is a right angled triangle

$$\begin{aligned} AC^2 &= AB^2 + BC^2 \\ 49 + (2 - t)^2 &= 25 + 16 + (t + 2)^2 \\ 49 + 4 - 4t + t^2 &= 41 + t^2 + 4t + 4 \\ 53 - 4t &= 45 + 4t \\ 8t &= 8 \\ t &= 1 \end{aligned}$$



g121

24. If  $\sqrt{3} \sin \theta - \cos \theta = 0$  and  $0^\circ < \theta < 90^\circ$ , find the value of  $\theta$ .

**Ans :**

[Boar Term-1, 2012]

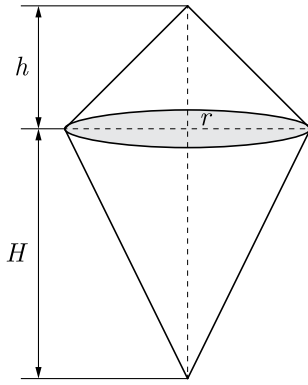
We have

$$\begin{aligned} \sqrt{3} \sin \theta - \cos \theta &= 0 \text{ and } 0^\circ < \theta < 90^\circ \\ \sqrt{3} \sin \theta &= \cos \theta \\ \frac{\sin \theta}{\cos \theta} &= \frac{1}{\sqrt{3}} \\ \tan \theta &= \frac{1}{\sqrt{3}} = \tan 30^\circ \quad \left[ \tan \theta = \frac{\sin \theta}{\cos \theta} \right] \\ \theta &= 30^\circ \end{aligned}$$



h128

25. A solid metallic object is shaped like a double cone as shown in figure. Radius of base of both cones is same but their heights are different. If this cone is immersed in water, find the quantity of water it will displace.



**Ans :** [Board Term-2, 2012 ]

Volume of the upper cone =  $\frac{1}{3}\pi r^2 h$

Volume of the lower cone =  $\frac{1}{3}\pi r^2 H$

Total volume of both the cones =  $\frac{1}{3}\pi r^2 h + \frac{1}{3}\pi r^2 H$   
 $= \frac{1}{3}\pi r^2 (h + H)$

The quantity of water displaced will be  $\frac{1}{3}\pi r^2 (h + H)$  cube units.

**or**

Find the number of solid sphere of diameter 6 cm can be made by melting a solid metallic cylinder of height 45 cm and diameter 4 cm.

**Ans :** [Board Term-2 Delhi 2014]

Let the number of sphere be  $n$ .  
 Radius of sphere = 3 cm,  
 Radius of cylinder = 2 cm

Volume of spheres = Volume of cylinder

$$n \times \frac{4}{3}\pi r^3 = \pi r_1^2 h$$

$$n \times \frac{4}{3} \times \frac{22}{7} \times (3)^3 = \frac{22}{7} \times (2)^2 \times 45$$

$$36n = 180$$

$$n = \frac{180}{36} = 5$$

Number of solid sphere is 5.

**26.** Find the median for the given frequency distribution :

Class	40 - 45	45 - 50	50 - 55	55 - 60	60 - 65	65 - 70	70 - 75
Frequency	2	3	8	6	6	3	2

**Ans :** [Board 2020 OD Basic]

Class	Frequency	c.f.
40-45	2	2
45-50	3	5
50-55	8	13
55-60	6	19
60-65	6	25
65-70	3	28
70-75	2	30

Class	Frequency	c.f.
	$N = 30$	

We have  $N = 30 ; \frac{N}{2} = 15$   
 Cumulative frequency just greater than  $\frac{N}{2}$  is 19 and the corresponding class is 55-60. Thus median class is 55-60.

Now  $l = 55, f = 6, F = 13, h = 5$

Median,  $M_d = l + \left(\frac{\frac{N}{2} - F}{f}\right) \times h$   
 $= 55 + \left(\frac{15 - 13}{6}\right) \times 5$   
 $= 55 + \frac{5}{3} = 55 + 1.67$   
 $= 56.67$

**or**

Find the mean of the following distribution :

Class	10 - 25	25 - 40	40 - 55	55 - 70	70 - 85	85 - 100
Frequency	2	3	7	6	6	6

**Ans :** [Board 2020 Delhi Basic]

Let  $a = 62.5$  be assumed mean.

Class Interval	Frequency (f)	c.f.	$x_i$	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
10-25	2	2	17.5	-3	-6
25-40	3	5	32.5	-2	-6
40-55	7	12	47.5	-1	-7
55-70	6	18	62.50 = a	0	0
70-85	6	24	77.5	1	6
85-100	6	30	92.5	2	12
	$\sum f_i = 30$				$\sum f_i u_i = -1$

Mean,  $\bar{x} = a + \frac{\sum f_i u_i}{\sum f_i} \times h$   
 $= 62.5 + \frac{-1}{30} \times 15$   
 $= 62.5 - \frac{1}{2} = 62.5 - 0.5 = 62$

**27.** Given that  $\sqrt{2}$  is irrational, prove that  $(5 + 3\sqrt{2})$  is an irrational number.

**Ans :** [Board 2018]

Assume that  $(5 + 3\sqrt{2})$  is a rational number. Therefore, we can write it in the form of  $\frac{p}{q}$  where  $p$  and  $q$  are co-prime integers and  $q \neq 0$ .

Now  $5 + 3\sqrt{2} = \frac{p}{q}$

where  $q \neq 0$  and  $p$  and  $q$  are integers. Rewriting the above expression as,

$$3\sqrt{2} = \frac{p}{q} - 5$$

$$\sqrt{2} = \frac{p - 5q}{3q}$$



Here  $\frac{p-5q}{3q}$  is rational because  $p$  and  $q$  are co-prime integers, thus  $\sqrt{2}$  should be a rational number. But  $\sqrt{2}$  is irrational. This contradicts the given fact that  $\sqrt{2}$  is irrational. Hence  $(5 + 3\sqrt{2})$  is an irrational number.

28. A part of monthly hostel charge is fixed and the remaining depends on the number of days one has taken food in the mess. When Swati takes food for 20 days, she has to pay Rs. 3,000 as hostel charges whereas Mansi who takes food for 25 days Rs. 3,500 as hostel charges. Find the fixed charges and the cost of food per day.

**Ans :** [Board Term-1 2016, 2015]

Let fixed charge be  $x$  and per day food cost be  $y$

$$x + 20y = 3000 \quad \dots(1)$$

$$x + 25y = 3500 \quad \dots(2)$$

Subtracting (1) from (2) we have

$$5y = 500 \Rightarrow y = 100$$

Substituting this value of  $y$  in (1), we get

$$x + 20(100) = 3000$$

$$x = 1000$$

Thus  $x = 1000$  and  $y = 100$

Fixed charge and cost of food per day are Rs. 1,000 and Rs. 100.

29. Divide 56 in four parts in AP such that the ratio of the product of their extremes ( $1^{st}$  and  $4^{th}$ ) to the product of means ( $2^{nd}$  and  $3^{rd}$ ) is 5:6.

**Ans :** [Board Term-2 Foreign 2016]

Let the four numbers be  $a - 3d, a - d, a + d, a + 3d$

$$\text{Now } a - 3d + a - d + a + d + a + 3d = 56$$

$$4a = 56 \Rightarrow a = 14$$

Hence numbers are  $14 - 3d, 14 - d, 14 + d, 14 + 3d$

Now, according to question, we have

$$\frac{(14 - 3d)(14 + 3d)}{(14 - d)(14 + d)} = \frac{5}{6}$$

$$\frac{196 - 9d^2}{196 - d^2} = \frac{5}{6}$$

$$6(196 - 9d^2) = 5(196 - d^2)$$

$$6 \times 196 - 54d^2 = 5 \times 196 - 5d^2$$

$$(6 - 5) \times 196 = 49d^2$$

$$d^2 = \frac{196}{49} = 4$$

$$d = \pm 2$$

Thus numbers are  $a - 3d = 14 - 3 \times 2 = 8$

$$a - d = 14 - 2 = 12$$

$$a + d = 14 + 2 = 16$$

$$a + 3d = 14 + 3 \times 2 = 20$$

Thus required AP is 8,12,16,20.

**or**

The sum of  $n$  terms of an AP is  $3n^2 + 5n$ . Find the AP Hence find its  $15^{th}$  term.

**Ans :** [Board Term-2 2013, 2012]

Let the first term be  $a$ , common difference be  $d$ ,  $n$ th

term be  $a_n$  and sum of  $n$  term be  $S_n$

Now  $S_n = 3n^2 + 5n$

$$S_{n-1} = 3(n-1)^2 + 5(n-1)$$

$$= 3(n^2 + 1 - 2n) + 5n - 5$$

$$= 3n^2 + 3 - 6n + 5n - 5$$

$$= 3n^2 - n - 2$$

$$a_n = S_n - S_{n-1}$$

$$= 3n^2 + 5n - (3n^2 - n - 2)$$

$$= 6n + 2$$

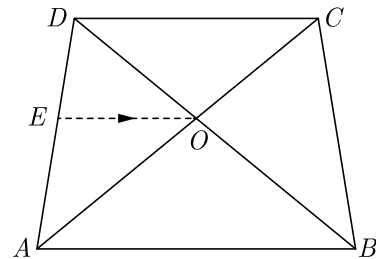
Thus AP is 8, 14, 20, .....

Now  $a_{15} = a + 14d = 8 + 14(6) = 92$

30. If the diagonals of a quadrilateral divide each other proportionally, prove that it is a trapezium.

**Ans :** [Board Term-1 2011]

As per given condition we have drawn quadrilateral  $ABCD$ , as shown below.



We have drawn  $EO \parallel AB$  on  $DA$ .

In quadrilateral  $ABCD$ , we have

$$\frac{AO}{BO} = \frac{CO}{DO}$$

$$\frac{AO}{CO} = \frac{BO}{DO} \quad \dots(1)$$

In  $\Delta ABD$ ,  $EO \parallel AB$

By BPT we have

$$\frac{AE}{ED} = \frac{BO}{DO} \quad \dots(2)$$

From equation (1) and (2), we get

$$\frac{AE}{ED} = \frac{AO}{CO}$$

In  $\Delta ADC$ ,  $\frac{AE}{ED} = \frac{AO}{CO}$

$$EO \parallel DC \quad \text{(Converse of BPT)}$$

$$EO \parallel AB \quad \text{(Construction)}$$

$$AB \parallel DC$$

Thus in quadrilateral  $ABCD$  we have

$$AB \parallel CD$$

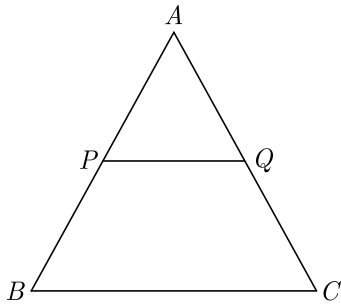
Thus  $ABCD$  is a trapezium.

Hence Proved

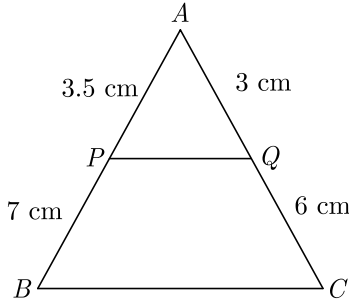
**or**

In the given figure,  $P$  and  $Q$  are the points on the sides  $AB$  and  $AC$  respectively of  $\Delta ABC$ , such that  $AP = 3.5\text{cm}$ ,  $PB = 7\text{ cm}$ ,  $AQ = 3\text{ cm}$  and  $QC = 6\text{ cm}$ . If  $PQ = 4.5\text{ cm}$ , find  $BC$ .





**Ans :** [Board Term-1 2011]  
We have redrawn the given figure as below.



We have  $\frac{AP}{AB} = \frac{3.5}{10.5} = \frac{1}{3}$

and  $\frac{AQ}{AC} = \frac{3}{9} = \frac{1}{3}$

In  $\Delta ABC$ ,  $\frac{AP}{AB} = \frac{AQ}{AC}$  and  $\angle A$  is common.

Thus due to SAS we have

$$\Delta APQ \sim \Delta ABC$$

$$\frac{AP}{AB} = \frac{PQ}{BC}$$

$$\frac{1}{3} = \frac{4.5}{BC}$$

$$BC = 13.5 \text{ cm.}$$

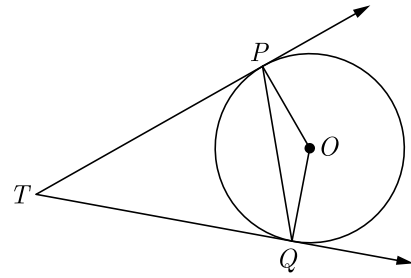
**31.** Prove that :  $\frac{\cos A}{1 - \tan A} + \frac{\sin A}{1 - \cot A} = \sin A + \cos A$ .

**Ans :** [Board Term-1 2013, 2011]

$$\begin{aligned} \text{LHS} &= \frac{\cos A}{1 - \tan A} + \frac{\sin A}{1 - \cot A} \\ &= \frac{\cos A}{1 - \left(\frac{\sin A}{\cos A}\right)} + \frac{\sin A}{1 - \left(\frac{\cos A}{\sin A}\right)} \\ &= \frac{\cos^2 A}{\cos A - \sin A} + \frac{\sin^2 A}{\sin A - \cos A} \\ &= \frac{\cos^2 A}{\cos A - \sin A} - \frac{\sin^2 A}{\cos A - \sin A} \\ &= \frac{\cos^2 A - \sin^2 A}{\cos A - \sin A} \\ &= \frac{(\cos A - \sin A)(\cos A + \sin A)}{(\cos A - \sin A)} \\ &= \cos A + \sin A \\ &= \sin A + \cos A \\ &= \text{RHS} \end{aligned}$$

Hence proved.

**32.** In the given figure  $PQ$  is chord of length 6 cm of the circle of radius 6 cm.  $TP$  and  $TQ$  are tangents to the circle at points  $P$  and  $Q$  respectively. Find  $\angle PTQ$ .



**Ans :** [Board Term-2 Delhi 2016]

We have  $PQ = 6 \text{ cm}$ ,  $OP = OQ = 6 \text{ cm}$

Since  $PQ = OP = OQ$ , triangle  $\Delta PQO$  is an equilateral triangle.

Thus  $\angle POQ = 60^\circ$

Now we know that  $\angle POQ$  and  $\angle PTQ$  are supplementary angle,

$$\angle POQ + \angle PTQ = 180^\circ$$

$$\angle PTQ = 180^\circ - \angle POQ$$

$$= 180^\circ - 60^\circ = 120^\circ$$

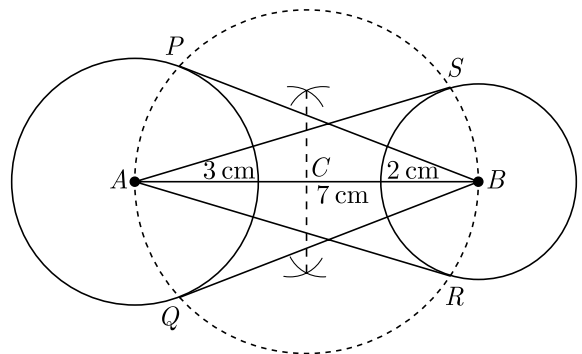
Thus  $\angle PTQ = 120^\circ$

**33.** Draw a line segment  $AB$  of length 7 cm. Taking  $A$  as centre, draw a circle of radius 3 cm and taking  $B$  as centre, draw another circle of radius 2 cm. Construct tangents to each circle from the centre of the other circle.

**Ans :** [Board Term-2 Delhi 2015]

**Steps of Construction :**

1. Draw a line segment  $AB$  of 7 cm.
2. Taking  $A$  and  $B$  as centre draw two circle of 3 cm and 2 cm radius respectively.
3. Bisect the line  $AB$ . Let mid-point of  $AB$  be  $C$ .
4. Taking  $C$  as centre draw a circle of radius  $AC$  with intersects the two circles at point  $P, Q, R$  and  $S$ .
5. Join  $BP, BQ, AS$  and  $AR$ .  $BP, BQ$  and  $AR, AS$  are the required tangents.



**34.** Solve for  $x : \left(\frac{2x}{x-5}\right)^2 + \left(\frac{2x}{x-5}\right) - 24 = 0, x \neq 5$

**Ans :** [Board Term-2 2016]

We have  $\left(\frac{2x}{x-5}\right)^2 + 5\left(\frac{2x}{x-5}\right) - 24 = 0$

Let  $\frac{2x}{x-5} = y$  then we have

$$y^2 + 5y - 24 = 0$$

$$(y + 8)(y - 3) = 0$$

$$y = 3, -8$$



Taking  $y = 3$  we have

$$\frac{2x}{x-5} = 3$$

$$2x = 3x - 15 \Rightarrow x = 15$$

Taking  $y = -8$  we have

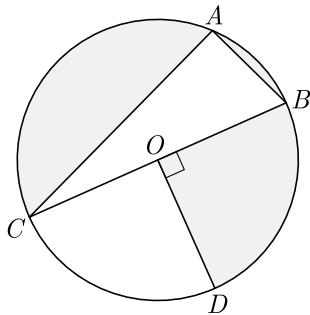
$$\frac{2x}{x-5} = -8$$

$$2x = -8x + 40$$

$$10x = 40 \Rightarrow x = 4$$

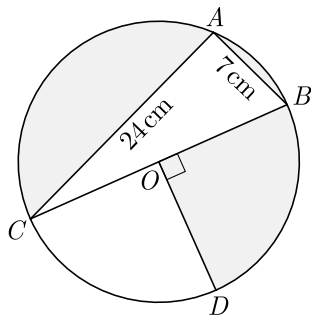
Hence,  $x = 15, 4$

35. In the given figure,  $O$  is the centre of the circle with  $AC = 24$  cm,  $AB = 7$  cm and  $\angle BOD = 90^\circ$ . Find the area of the shaded region.



Ans :

We have redrawn the given figure as shown below.



Here  $\Delta CAB$  is right angle triangle with  $\angle CAB = 90^\circ$   
In right  $\Delta CAB$ , by Pythagoras theorem, we have

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

$$= 24^2 + 7^2$$

$$= 576 + 49 = 625$$

Thus  $BC = 25$  cm which is diameter. Now radius is  $\frac{25}{2}$  or 12.5 cm.

Area of shaded region,

= area of semicircle + area of quadrant - area of  $\Delta ACB$

$$= \frac{1}{2}\pi r^2 + \frac{1}{4}\pi r^2 - \frac{1}{2} \times AB \times AC$$

$$= \frac{3}{4}\pi r^2 - \frac{1}{2} \times 7 \times 24$$

$$= \frac{3}{4} \times \frac{22}{7} \times \frac{625}{4} - 7 \times 12$$

$$= 368.3035 - 84 = 284.3 \text{ cm}^2$$

Thus area of shaded region = 284.3035  $\text{cm}^2$

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36. The median of the following data is 525. Find the values of  $x$  and  $y$ , if total frequency is 100 :

Class	Frequency
0-100	2
100-200	5
200-300	$x$
300-400	12
400-500	17
500-600	20
600-700	$y$
700-800	9
800-900	7
900-1000	4

Ans : [Board 2020 Delhi OD STD]

We prepare cumulative frequency table as given below.

Class Interval	Frequency ( $f$ )	Cumulative frequency $c.f.$
0-100	2	2
100-200	5	7
200-300	$x$	$7 + x$
300-400	12	$19 + x$
400-500	17	$36 + x$
500-600	20	$56 + x$
600-700	$y$	$56 + x + y$
700-800	9	$65 + x + y$
800-900	7	$72 + x + y$
900-1000	4	$76 + x + y$
	$N = 100$	

From table we have

$$76 + x + y = 100$$

$$x + y = 100 - 76 = 24 \quad \dots(1)$$

Here median is 525 which lies between class 500 - 600. Thus median class is 500-600.

Median,  $M_d = l + \left(\frac{\frac{N}{2} - F}{f}\right)h$

$$525 = 500 + \left[\frac{100}{2} - (36 + x)\right] \times \frac{100}{20}$$

$$25 = (50 - 36 - x) \times 5$$

$$14 - x = \frac{25}{5} = 5$$

$$x = 14 - 5 = 9$$

Substituting the value of  $x$  in equation (1), we get



$$y = 24 - 9 = 15$$

Hence,  $x = 9$  and  $y = 15$

or

Daily wages of 110 workers, obtained in a survey, are tabulated below :

Daily Wages (in ₹)	100-120	120-140	140-160	160-180	180-200	200-220	220-240
Number of Workers	10	15	20	22	18	12	13

Compute the mean daily wages and modal daily wages of these workers.

Ans : [Board 2020 SQP Standard]

Let  $a = 170$  be assumed mean.

CI	$x_i$	$(f)$	$x_i - 170$	$\frac{x_i - 170}{20}$	$f_i u_i$
100-120	110	10	-60	-3	-30
120-140	130	15	-40	-2	-30
140-160	150	20	-20	-1	-20
160-180	170	22	0	0	0
180-200	190	18	20	1	18
200-220	210	12	40	2	24
220-240	230	13	60	3	39
		$\sum f_i = 110$			$\sum f_i u_i = 1$

Mean,

$$\bar{x} = a + \frac{\sum f_i u_i}{\sum f_i} \times h$$

$$= 170 + \frac{1}{110} \times 20$$

$$= 170 + 0.1818$$



$$= 170.1818$$

Hence, mean daily wages of the workers is ₹170.1818  
 Here the maximum frequency is 22 and the corresponding class is 160-180. So, 160-180 is modal class.

Now  $l = 160$ ,  $h = 20$ ,  $f = 22$ ,  $f_1 = 20$  and  $f_2 = 18$

Mode

$$M_o = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 160 + \frac{22 - 20}{2 \times 22 - 20 - 18} \times 20$$

$$= 160 + \frac{40}{6} = 160 + 6.666$$

$$= 166.67$$

Hence, modal daily wages of the workers is ₹166.67.

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