

**Class X Session 2024-25**  
**Subject - Mathematics (Standard)**  
**Sample Question Paper - 1**

**Time Allowed: 3 hours**

**Maximum Marks: 80**

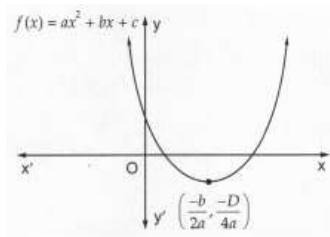
**General Instructions:**

1. This Question Paper has 5 Sections A, B, C, D and E.
2. Section A has 20 MCQs carrying 1 mark each
3. Section B has 5 questions carrying 02 marks each.
4. Section C has 6 questions carrying 03 marks each.
5. Section D has 4 questions carrying 05 marks each.
6. Section E has 3 case based integrated units of assessment (04 marks each) with sub- parts of the values of 1, 1 and 2 marks each respectively.
7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2marks questions of Section E
8. Draw neat figures wherever required. Take  $\pi = \frac{22}{7}$  wherever required if not stated.

**Section A**

1. (HCF  $\times$  LCM) for the numbers 30 and 70 is: [1]
  - a) 21
  - b) 70
  - c) 2100
  - d) 210

2. Figure show the graph of the polynomial  $f(x) = ax^2 + bx + c$  for which [1]

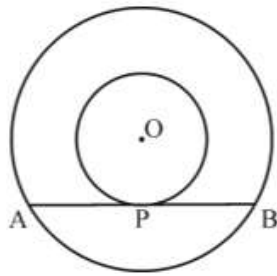


- a)  $a > 0, b < 0$  and  $c > 0$
  - b)  $a < 0, b < 0$  and  $c < 0$
  - c)  $a < 0, b > 0$  and  $c > 0$
  - d)  $a > 0, b > 0$  and  $c < 0$
3. The pair of equations  $x + 2y + 5 = 0$  and  $-3x - 6y + 1 = 0$  have [1]









24. Show that:  $\tan^4 \theta + \tan^2 \theta = \sec^4 \theta - \sec^2 \theta$  for  $0^\circ \leq \theta \leq 90^\circ$  [2]

OR

Prove that:  $\frac{\tan \theta}{1 - \cot \theta} + \frac{\cot \theta}{1 - \tan \theta} = 1 + \tan \theta + \cot \theta$

25. Find the length of the arc of a circle of diameter 42 cm which subtends an angle of  $60^\circ$  at the centre. [2]

OR

A horse is tethered to one corner of a rectangular field of dimensions  $70 \text{ m} \times 52 \text{ m}$ , by a rope of length 21 m. How much area of the field can it graze?

### Section C

26. Prove that  $3 + \sqrt{5}$  is an irrational number. [3]

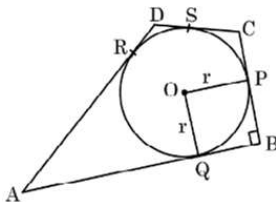
27. If  $\alpha$  and  $\beta$  are the zeros of the polynomial  $f(x) = 6x^2 + x - 2$ , find the value of  $\left(\frac{\alpha}{\beta} + \frac{\beta}{\alpha}\right)$  [3]

28. A two-digit number is 4 times the sum of its digits. If 18 is added to the number, the digits are reversed. Find the number. [3]

OR

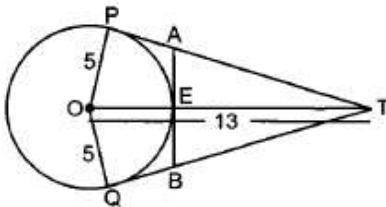
A plane left 30 minutes late than its scheduled time and in order to reach the destination 1500 km away in time, it had to increase its speed by 100 km/h from the usual speed. Find its usual speed.

29. In the given figure, a circle is inscribed in a quadrilateral ABCD in which  $\angle B = 90^\circ$ . If  $AD = 17 \text{ cm}$ ,  $AB = 20 \text{ cm}$  and  $DS = 3 \text{ cm}$ , then find the radius of the circle. [3]



OR

In figure, O is the centre of a circle of radius 5 cm. T is a point such that  $OT = 13 \text{ cm}$  and OT intersects circle at E. AB is a tangent to the circle at E, find the length of AB. where TP and TQ are two tangents to the circle.



30. Prove that: [3]

$$\frac{\tan \theta + \sec \theta - 1}{\tan \theta - \sec \theta + 1} = \frac{1 + \sin \theta}{\cos \theta}$$

31. The percentage of marks obtained by 100 students in an examination are given below: [3]

Marks	30-35	35-40	40-45	45-50	50-55	55-60	60-65
Frequency	14	16	18	23	18	8	3

Determine the median percentage of marks.

**Section D**

32. Solve:  $\frac{x-1}{2x+1} + \frac{2x+1}{x-1} = 2, x \neq -\frac{1}{2}, 1$  [5]

OR

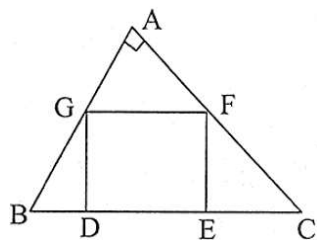
₹ 9000 were divided equally among a certain number of persons. Had there been 20 more persons, each would have got ₹ 160 less. Find the original number of persons.

33. In Fig., DEFG is a square in a triangle ABC right angled at A. [5]

Prove that

i.  $\triangle AGF \sim \triangle DBG$

ii.  $\triangle AGF \sim \triangle EFC$



34. A solid is composed of a cylinder with hemispherical ends. If the whole length of the solid is 104 cm and the radius of each of the hemispherical ends is 7 cm, find the cost of polishing its surface at the rate of ₹10 per  $\text{dm}^2$ . [5]

OR

A solid is in the form of a cylinder with hemispherical ends. The total height of the solid is 19 cm and the diameter of the cylinder is 7 cm. Find the volume and total surface area of the solid (Use  $\pi = 22/7$ )

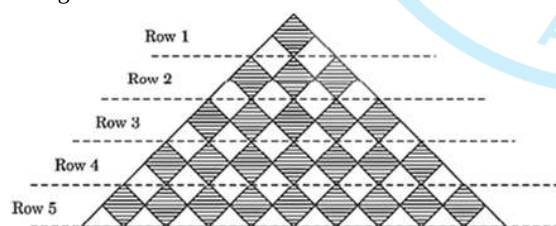
35. Find the mean from the following frequency distribution of marks at a test in statistics: [5]

Marks (x):	5	10	15	20	25	30	35	40	45	50
No. of students (f):	15	50	80	76	72	45	39	9	8	6

**Section E**

36. **Read the text carefully and answer the questions:** [4]

A fashion designer is designing a fabric pattern. In each row, there are some shaded squares and unshaded triangles.



- (a) Identify A.P. for the number of squares in each row.
- (b) Identify A.P. for the number of triangles in each row.

OR

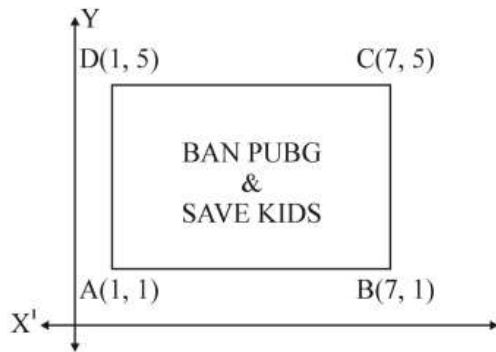
Write a formula for finding total number of triangles in n number of rows. Hence, find  $S_{10}$ .

- (c) If each shaded square is of side 2 cm, then find the shaded area when 15 rows have been designed.

37. **Read the text carefully and answer the questions:** [4]

Use of mobile screen for long hours makes your eye sight weak and give you headaches. Children who are addicted to play "PUBG" can get easily stressed out. To raise social awareness about ill effects of playing PUBG, a school decided to start 'BAN PUBG' campaign, in which students are asked to prepare campaign board in the shape of a rectangle. One such campaign board made by class X student of the school is shown in

the figure.



- Find the coordinates of the point of intersection of diagonals AC and BD.
- Find the length of the diagonal AC.

**OR**

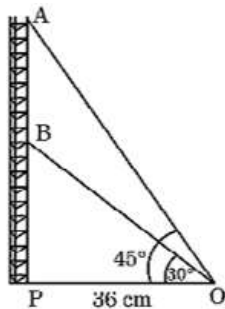
Find the ratio of the length of side AB to the length of the diagonal AC.

- Find the area of the campaign Board ABCD.

38. **Read the text carefully and answer the questions:**

[4]

Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two Sections A and B. Tower is supported by wires from a point O. Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is  $30^\circ$  and the angle of elevation of the top of Section A is  $45^\circ$ .



- Find the length of the wire from the point O to the top of Section B.
- Find the distance AB.

**OR**

Find the height of the Section A from the base of the tower.

- Find the area of  $\triangle OPB$ .





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**Anubhav Gupta**



**Akash Basu**



**Shaurya Gangal**



**Abhishek Gaur**



**Rudraksh Chaudhary**



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**Harshit Chaudhary**



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# Solution

## Section A

1.

(c) 2100

**Explanation:** As we know  $\text{HCF} \times \text{LCM} = \text{Product of the Numbers}$   
Hence  $\text{HCF} \times \text{LCM} (30,70) = 30 \times 70 = 2100$

2. (a)  $a > 0$ ,  $b < 0$  and  $c > 0$

**Explanation:** Clearly,  $f(x) = ax^2 + bx + c$  represent a parabola opening upwards.  
Therefore,  $a > 0$

The vertex of the parabola is in the fourth quadrant, therefore  $b < 0$

$y = ax^2 + bx + c$  cuts Y axis at P which lies on OY.

Putting  $x = 0$  in  $y = ax^2 + bx + c$ , we get  $y = c$ .

So the coordinates of P is (0, c).

Clearly, P lies on OY.  $\Rightarrow c > 0$

Hence,  $a > 0$ ,  $b < 0$  and  $c > 0$

3.

(c) no solution

**Explanation:** Given, equations are  
 $x + 2y + 5 = 0$ , and  
 $-3x - 6y + 1 = 0$ .

Comparing the equations with general form:

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\text{Here, } a_1 = 1, b_1 = 2, c_1 = 5$$

$$\text{And } a_2 = -3, b_2 = -6, c_2 = 1$$

Taking the ratio of coefficients to compare

$$\frac{a_1}{a_2} = \frac{-1}{-3}, \frac{b_1}{b_2} = \frac{-1}{-3}, \frac{c_1}{c_2} = \frac{5}{1}$$

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

This represents a pair of parallel lines.

Hence, the pair of equations has no solution.

4.

(d)  $x^2 - 14x + 48 = 0$

**Explanation:** For 1<sup>st</sup> one,

Let the equation be  $x^2 + ax + b = 0$

Since roots are 5 and 9

$$\therefore a = -14 \text{ and } b = 45$$

For 2<sup>nd</sup> one,

Let the equation be  $x^2 + px + q = 0$

Since roots are 12 and 4.

$$\therefore p = -16 \text{ and } q = 48$$

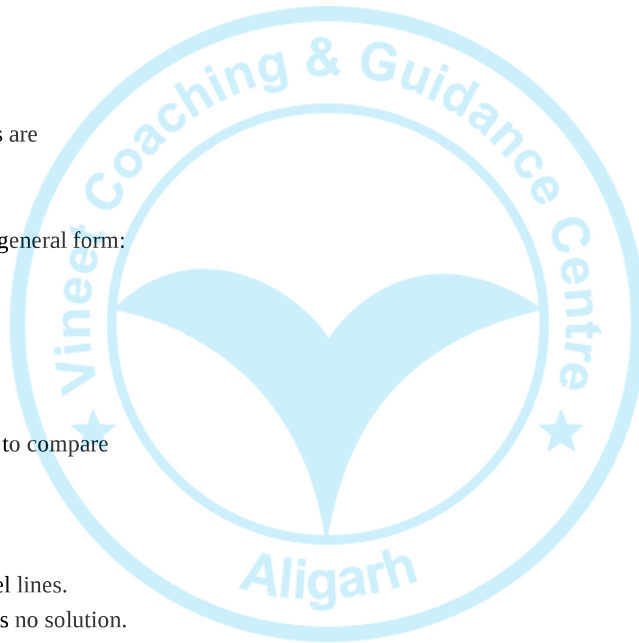
Now, according to the question, b and p both are wrong.

Therefore, the correct equation would be

$$x^2 - 14x + 48 = 0$$

5.

(d) 8



**Explanation:**  $a_{18} - a_{14} = 32$

$$(18 - 14)d = 32$$

$$\Rightarrow 4d = 32$$

$$\Rightarrow d = 8.$$

6. (a) 5

**Explanation:** Three vertices of a rectangle ABCD are B (4,0), C (4, 3) and D (0, 3) length of one of its diagonals

$$BD = \sqrt{(4-0)^2 + (0-3)^2} = \sqrt{4^2 + 3^2}$$

$$= \sqrt{16 + 9} = \sqrt{25} = 5$$

7. (a) 2 : 1

**Explanation:** 2 : 1

8. (a)  $20^\circ, 30^\circ$ .

**Explanation:** In triangle ABC,  $\angle A + \angle B + \angle C = 180^\circ$

$$\Rightarrow \angle A + 30^\circ + 20^\circ = 180^\circ$$

$$\Rightarrow \angle A = 130^\circ$$

In triangle ABC and QRP,  $\frac{AB}{QR} = \frac{AC}{PQ}$

$$\Rightarrow \frac{45}{5} = \frac{63}{7} \Rightarrow \frac{9}{1} = \frac{9}{1}$$

Since sides of triangles ABC and QRP are proportional, and included angles are equal, therefore by SAS similarity criteria ,

$\triangle ABC \sim \triangle QRP$

$$\angle A = \angle Q, \angle B = \angle R, \angle C = \angle P$$

$$\Rightarrow \angle P = 20^\circ, \angle R = 30^\circ$$

9.

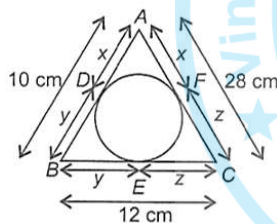
(b)  $47.5^\circ$

**Explanation:**  $47.5^\circ$

10.

(b) 25 cm

**Explanation:**



$$x + y = 10 \text{ cm ... (i)}$$

$$y + z = 12 \text{ cm ... (ii)}$$

$$x + z = 28 \text{ cm ... (iii)}$$

Adding (i), (ii) and (iii), we get

$$2(x + y + z) = 50$$

$$\Rightarrow x + y + z = 25 \text{ cm}$$

11.

(c)  $\operatorname{cosec} \alpha$

**Explanation:**  $1 + \frac{\cot^2 \alpha}{1 + \operatorname{cosec} \alpha}$

$$= 1 + \frac{\operatorname{cosec}^2 \alpha - 1}{1 + \operatorname{cosec} \alpha}$$

$$= 1 + \frac{(\operatorname{cosec} \alpha - 1)(\operatorname{cosec} \alpha + 1)}{1 + \operatorname{cosec} \alpha}$$

$$= 1 + \operatorname{cosec} \alpha - 1 = \operatorname{cosec} \alpha$$

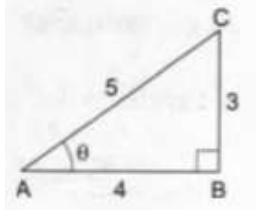
12. (a)  $\frac{3}{4}$

**Explanation:**  $\cos \theta = \frac{4}{5} = \frac{AB}{AC}$

$$\therefore BC^2 = AC^2 - AB^2 = 25 - 16 = 9$$

$$\Rightarrow BC = 3$$

$$\therefore \tan \theta = \frac{BC}{AB} = \frac{3}{4}$$

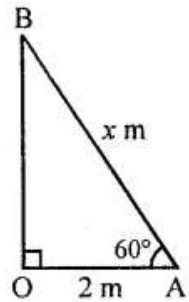


13.

(c) 4

**Explanation:** Suppose AB is the ladder of length  $x$  m

$$\therefore OA = 2\text{m}, \angle OAB = 60^\circ$$



$$\begin{aligned} \text{In right } \triangle AOB, \sec 60^\circ &= \frac{x}{2} \\ \Rightarrow 2 &= \frac{x}{2} \Rightarrow x = 4 \text{ m} \end{aligned}$$

14.

(c)  $120.56 \text{ cm}^2$

$$\begin{aligned} \text{Explanation: ar(segment)} &= \left( \frac{\pi r^2 \theta}{360} - r^2 \sin \frac{\theta}{2} \cos \frac{\theta}{2} \right) \\ &= \left( \frac{22}{7} \times 14 \times 14 \times \frac{120}{360} \right) - (14 \times 14 \times \sin 60^\circ \cos 60^\circ) \\ &= \left( \frac{616}{3} - \frac{\sqrt{3}}{2} \times \frac{1}{2} \times 14 \times 14 \right) \text{ cm}^2 \\ &= (205.33 - 49 \times 1.73) \text{ cm}^2 \\ &= (205.33 - 84.77) \text{ cm}^2 \\ &= 120.56 \text{ cm}^2 \end{aligned}$$

15.

(d) 16.8 cm

**Explanation:** Length of the pendulum = Radius of a sector of the circle

$$\text{Arc length} = 8.8$$

$$\frac{\theta}{360} (2\pi r) = 8.8$$

$$\frac{30}{360} \times 2 \times \frac{22}{7} \times r = 8.8$$

$$r = 16.8 \text{ cm}$$

16.

(d)  $\frac{1}{2}$

**Explanation:** Number of all possible outcomes = 6.

Even numbers are 2, 4, 6. Their number is 3.

$$\therefore P(\text{getting an even number}) = \frac{3}{6} = \frac{1}{2}$$

17.

(c)  $\frac{1}{5}$

**Explanation:** Number of possible outcomes = 3

Number of Total outcomes = 15

$$\therefore \text{Required Probability} = \frac{3}{15} = \frac{1}{5}$$

18. (a) 30 - 40

**Explanation:** 30 - 40

19.

(c) A is true but R is false.

**Explanation:** A is true but R is false.

20. (a) Both A and R are true and R is the correct explanation of A.

**Explanation:** Both A and R are true and R is the correct explanation of A.

### Section B

21. The given numbers are 320 and 457

Now as 5 and 7 are remainders on division of 320 and 457 by said number

On subtracting the remainders 5 and 7 from 320 and 457 respectively we get:

$$320 - 5 = 315,$$

$$457 - 7 = 450$$

The prime factorizations of 315 and 405 are

$$315 = 3 \times 3 \times 5 \times 7$$

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

$$450 = 2 \times 3 \times 3 \times 5 \times 5$$

$$= 2 \times 3^2 \times 5^2$$

$$\therefore \text{H.C.F. of 315 and 450} = 3^2 \times 5 = 9 \times 5 = 45$$

Hence the said number = 45

22. Given  $XY \parallel BC$

$AX = 1$  cm,  $XB = 3$  cm, and  $BC = 6$  cm

$$AB = AX + XB$$

$$= 1 + 3 = 4 \text{ cm}$$

In  $\triangle AXY$  and  $\triangle ABC$

$$\angle A = \angle A \text{ [Common]}$$

$$\angle AXY = \angle ABC \text{ [Corresponding angles]}$$

Then,  $\triangle AXY \sim \triangle ABC$  [By AA similarity]

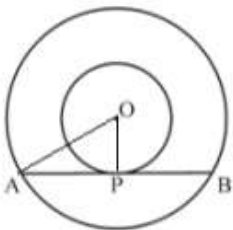
$$\therefore \frac{AX}{AB} = \frac{XY}{BC} \text{ [Corresponding parts of similar } \triangle \text{ are proportional]}$$

$$\Rightarrow \frac{1}{4} = \frac{XY}{6}$$

$$\Rightarrow XY = \frac{6}{4} = 1.5 \text{ cm}$$

23. Join OA and OP

$OP \perp AB$  (radius  $\perp$  tangent at the point of contact)



OP is the radius of smaller circle and AB is tangent at P.

AB is chord of larger circle and  $OP \perp AB$

$\therefore AP = PB$  ( $\perp$  from centre bisects the chord)

$$\text{In right } \triangle AOP, AP^2 = OA^2 - OP^2$$

$$= (5)^2 - (3)^2 = 16$$

$$AP = 4 \text{ cm} = PB$$

$$\therefore AB = 8 \text{ cm}$$

24. L.  $HS = \tan^4 \theta + \tan^2 \theta$

$$= \tan^2 \theta (\tan^2 \theta + 1)$$

$$= \tan^2 \theta \sec^2 \theta$$

$$= (\sec^2 \theta - 1) \sec^2 \theta \text{ [} \because \tan^2 \theta = \sec^2 \theta - 1 \text{]}$$

$$= \sec^4 \theta - \sec^2 \theta$$

= R.H.S.

OR

$$\frac{\tan \theta}{1-\cot \theta} + \frac{\cot \theta}{1-\tan \theta} = 1 + \tan \theta + \cot \theta$$

$$\text{L.H.S.} = \frac{\tan \theta}{1-\cot \theta} + \frac{\cot \theta}{1-\tan \theta}$$

$$= \frac{\frac{\sin \theta}{\cos \theta}}{1-\frac{\cos \theta}{\sin \theta}} + \frac{\frac{\cos \theta}{\sin \theta}}{1-\frac{\sin \theta}{\cos \theta}}$$

$$= \frac{\frac{\sin^2 \theta}{\cos \theta}}{\frac{\sin \theta - \cos \theta}{\sin \theta \cos \theta}} + \frac{\frac{\cos^2 \theta}{\sin \theta}}{\frac{\sin \theta - \cos \theta}{\sin \theta \cos \theta}}$$

$$= \frac{\sin^2 \theta + \cos^2 \theta}{\sin \theta \cos \theta (\sin \theta - \cos \theta)} \left[ \because a^3 - b^3 = (a-b)(a^2 + ab + b^2) \right]$$

$$= \frac{\sin^2 \theta}{\sin \theta \cos \theta} + \frac{\cos^2 \theta}{\sin \theta \cos \theta} + \frac{\sin \theta \cos \theta}{\sin \theta \cos \theta}$$

$$= \tan \theta + \cot \theta + 1 = 1 + \tan \theta + \cot \theta = \text{RHS}$$

Hence proved.

25. Diameter of a circle = 42 cm

$$\Rightarrow \text{Radius of a circle} = r = \frac{42}{2}$$

$$= 21 \text{ cm}$$

$$\text{Central angle} = \theta = 60^\circ$$

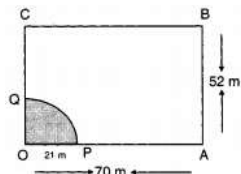
$$\therefore \text{Length of the arc} = \frac{2\pi r \theta}{360}$$

$$= \frac{2 \times \frac{22}{7} \times 21 \times 60^\circ}{360^\circ} \text{ cm}$$

$$= 22 \text{ cm}$$

OR

Shaded portion indicates the area which the horse can graze. Clearly, shaded area is the area of a quadrant of a circle of radius r - 21 m.



$$\therefore \text{Required Area} = \frac{1}{4} \pi r^2$$

$$\therefore \text{Required Area} = \left\{ \frac{1}{4} \times \frac{22}{7} \times (21)^2 \right\} \text{ cm}^2 = \frac{693}{2} \text{ cm}^2 = 346.5 \text{ cm}^2$$

Section C

26. Let  $3 + \sqrt{5}$  is a rational number.

$$3 + \sqrt{5} = \frac{p}{q}, q \neq 0$$

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

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

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

Now in RHS  $\frac{p-3q}{q}$  is rational

This shows that  $\sqrt{5}$  is rational

But this contradicts the fact that  $\sqrt{5}$  is irrational, This is because we assumed that  $3 + \sqrt{5}$  is a rational number.

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

27. Let  $f(x) = 6x^2 + x - 2$

$$a = 6, b = 1 \text{ and } c = -2$$

And  $\alpha$  and  $\beta$  are the zeros of polynomial,

$$\alpha + \beta = -\frac{b}{a} = -\frac{1}{6}$$

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

$$\therefore \frac{\alpha}{\beta} + \frac{\beta}{\alpha} = \frac{\alpha^2 + \beta^2}{\alpha\beta}$$

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

$$= \frac{\left(-\frac{1}{6}\right)^2 - 2\left(-\frac{1}{3}\right)}{\left(-\frac{1}{3}\right)}$$

$$= -\frac{\frac{1}{36} + \frac{2}{3}}{\frac{1}{3}}$$

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



$$\begin{aligned}
 &= -\frac{25}{36} \\
 &= -\frac{1}{\frac{36}{25}} \\
 &= -\frac{25}{36} \times \frac{3}{1} \\
 &= -\frac{25}{12}
 \end{aligned}$$

28. Let us suppose that the digit at unit place be x

Suppose the digit at tens place be y.

Thus, the number is  $10y + x$ .

According to question it is given that the number is 4 times the sum of the two digits.

Therefore, we have

$$\begin{aligned}
 10y + x &= 4(x + y) \\
 \Rightarrow 10y + x &= 4x + 4y \\
 \Rightarrow 4x + 4y - 10y - x &= 0 \\
 \Rightarrow 3x - 6y &= 0 \\
 \Rightarrow 3(x - 2y) &= 0 \\
 \Rightarrow x - 2y &= 0
 \end{aligned}$$

After interchanging the digits, the number becomes  $10x + y$ .

Again according to question If 18 is added to the number, the digits are reversed.

Thus, we have

$$\begin{aligned}
 (10y + x) + 18 &= 10x + y \\
 \Rightarrow 10x + y - 10y - x &= 18 \\
 \Rightarrow 9x - 9y &= 18 \\
 \Rightarrow 9(x - y) &= 18 \\
 \Rightarrow x - y &= \frac{18}{9} \\
 \Rightarrow x - y &= 2
 \end{aligned}$$

Therefore, we have the following systems of equations

$$x - 2y = 0 \dots\dots\dots(1)$$

$$x - y = 2 \dots\dots\dots(2)$$

Here x and y are unknowns. Now let us solve the above systems of equations for x and y.

Subtracting the equation (1) from the (2), we get

$$\begin{aligned}
 (x - y) - (x - 2y) &= 2 - 0 \\
 \Rightarrow x - y - x + 2y &= 2 \\
 \Rightarrow y &= 2
 \end{aligned}$$

Now, substitute the value of y in equation (1), we get

$$\begin{aligned}
 x - 2 \times 2 &= 0 \\
 \Rightarrow x - 4 &= 0 \\
 \Rightarrow x &= 4
 \end{aligned}$$

Therefore the number is  $10 \times 2 + 4 = 24$

Thus the number is 24

OR

Let the usual speed of the plane = x km/hr.

Distance to the destination = 1500 km

Case (i):

we know that,  $Speed = \frac{Distance}{Time}$

$$\Rightarrow Time = \frac{Distance}{speed}$$

So, in case(i) Time =  $\frac{1500}{x}$  Hrs

Case (ii)

Distance to the destination = 1500 km

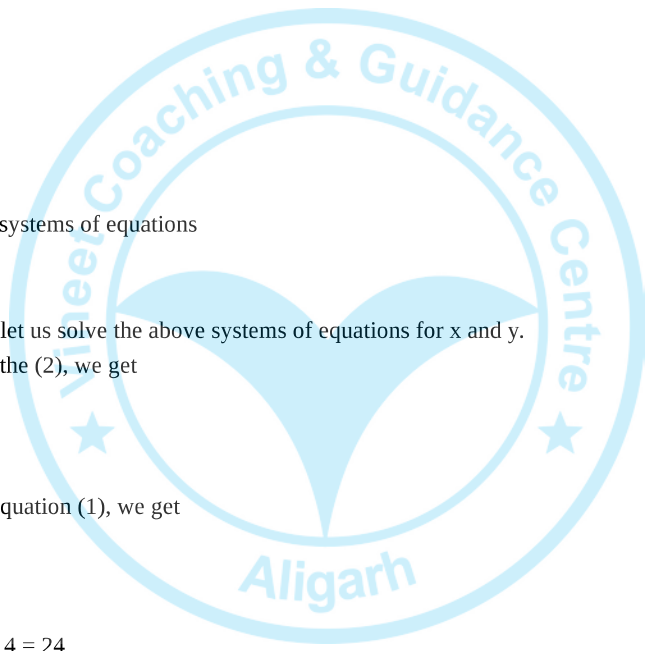
Increased speed = 100 km/hr

So, speed = x+100

So, in case(ii) Time =  $\frac{1500}{x+100}$  Hrs

So, according to the question

$$\therefore \frac{1500}{x} - \frac{1500}{x+100} = \frac{30}{60}$$



$$\Rightarrow x^2 + 100x - 300000 = 0$$

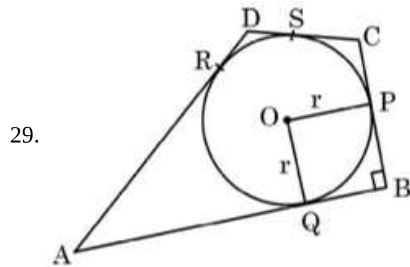
$$\Rightarrow x^2 + 600x - 500x - 300000 = 0$$

$$\Rightarrow (x + 600)(x - 500) = 0$$

$$\Rightarrow x = 500 \text{ or } x = -600$$

Since, speed can not be negative,  $x = 500$

Therefore, Speed of plane = 500 km/hr.



$$DR = DS = 3 \text{ cm}$$

$$\therefore AR = AD - DR = 17 - 3 = 14 \text{ cm}$$

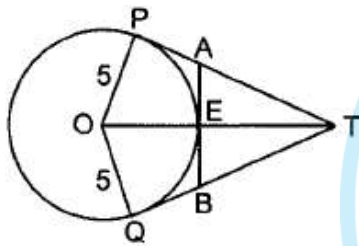
$$\Rightarrow AQ = AR = 14 \text{ cm}$$

$$\therefore QB = AB - AQ = 20 - 14 = 6 \text{ cm}$$

Since  $QB = OP = r$ ,  $\therefore$  radius = 6 cm

According to the question,

O is the centre of a circle of radius 5 cm. T is a point such that  $OT = 13$  cm and OT intersects circle at E.



$\therefore OP \perp TP$  [Radius from point of contact of the tangent]

$$\therefore \angle OPT = 90^\circ$$

In right  $\triangle OPT$  \*

$$OT^2 = OP^2 + PT^2$$

$$\Rightarrow (13)^2 = (5)^2 + PT^2 \Rightarrow PT = 12 \text{ cm}$$

$$\text{Let } AP = x \text{ cm } AE = AP \Rightarrow AE = x \text{ cm}$$

$$\text{and } AT = (12 - x) \text{ cm}$$

$$TE = OT - OE = 13 - 5 = 8 \text{ cm}$$

$\therefore OE \perp AB$  [Radius from the point of contact]

$$\therefore \angle AEO = 90^\circ \Rightarrow \angle AET = 90^\circ$$

In right  $\triangle AET$ ,

$$AT^2 = AE^2 + ET^2$$

$$(12 - x)^2 = x^2 + 8^2$$

$$\Rightarrow 144 + x^2 - 24x = x^2 + 64$$

$$\Rightarrow 24x = 80 \Rightarrow x = \frac{80}{24} = \frac{10}{3} \text{ cm}$$

$$\text{Also } BE = AE = \frac{10}{3} \text{ cm}$$

$$\Rightarrow AB = \frac{10}{3} + \frac{10}{3} = \frac{20}{3} \text{ cm}$$

30. We have,

$$\text{LHS} = \frac{\tan\theta + \sec\theta - 1}{\tan\theta - \sec\theta + 1}$$

$$\Rightarrow \text{LHS} = \frac{(\tan\theta + \sec\theta) - 1}{(\tan\theta - \sec\theta) + 1}$$

$$\Rightarrow \text{LHS} = \frac{(\sec\theta + \tan\theta) - (\sec^2\theta - \tan^2\theta)}{\tan\theta - \sec\theta + 1} \quad [ \because \sec^2\theta - \tan^2\theta = 1 ]$$

$$\begin{aligned} \Rightarrow \text{LHS} &= \frac{(\sec\theta + \tan\theta) - (\sec\theta + \tan\theta)(\sec\theta - \tan\theta)}{\tan\theta - \sec\theta + 1} \\ \Rightarrow \text{LHS} &= \frac{(\sec\theta + \tan\theta)[1 - (\sec\theta - \tan\theta)]}{\tan\theta - \sec\theta + 1} \\ \Rightarrow \text{LHS} &= \frac{(\sec\theta + \tan\theta)(1 - \sec\theta + \tan\theta)}{(\tan\theta - \sec\theta + 1)} \\ \Rightarrow \text{LHS} &= \frac{(\sec\theta + \tan\theta)(\tan\theta - \sec\theta + 1)}{(\tan\theta - \sec\theta + 1)} \\ \Rightarrow \text{LHS} &= \sec\theta + \tan\theta = \frac{1}{\cos\theta} + \frac{\sin\theta}{\cos\theta} = \frac{1 + \sin\theta}{\cos\theta} = \text{RHS} \end{aligned}$$

Marks (Class)	Number of Students (Frequency)	Cumulative frequency
30-35	14	14
35-40	16	30
40-45	18	48
45-50	23	71 (Median class)
50-55	18	89
55-60	8	97
60-65	3	100

Here,  $N = 100$

Therefore,  $\frac{N}{2} = 50$ , This observation lies in the class 45-50.

$l$  (the lower limit of the median class) = 45

cf (the cumulative frequency of the class preceding the median class) = 48

$f$  (the frequency of the median class) = 23

$h$  (the class size) = 5

$$\text{Median} = l + \left( \frac{\frac{N}{2} - \text{cf}}{f} \right) h$$

$$= 45 + \left( \frac{50 - 48}{23} \right) \times 5$$

$$= 45 + \frac{10}{23} = 45.4$$

So, the median percentage of marks is 45.4.

32. Given

$$\frac{x-1}{2x+1} + \frac{2x+1}{x-1} = 0$$

$$\text{Let } \frac{x-1}{2x+1} \text{ be } y \text{ so } \frac{2x+1}{x-1} = \frac{1}{y}$$

$\therefore$  Substituting this value

$$y + \frac{1}{y} = 2 \text{ or } \frac{y^2+1}{y} = 2$$

$$\text{or } y^2 + 1 = 2y$$

$$\text{or } y^2 - 2y + 1 = 0$$

$$\text{or } (y - 1)^2 = 0$$

$$\text{Putting } y = \frac{x-1}{2x+1},$$

$$\frac{x-1}{2x+1} = 1 \text{ or } x - 1 = 2x + 1$$

$$\text{or } x = -2$$

OR

Let the original number of persons be  $x$ .

Total amount to be divided among all people = Rs. 9000/-

So, Share of each person = Rs.  $\frac{9000}{x}$

If the number of persons is increased by 20. Then,

New share of each person = Rs.  $\frac{9000}{x+20}$

According to the question ;

$$\frac{9000}{x} - \frac{9000}{x+20} = 160$$

$$\Rightarrow \frac{9000(x+20) - 9000x}{x(x+20)} = 160$$

$$\begin{aligned} \Rightarrow \frac{9000x+180000-9000x}{x^2+20} &= 160 \\ \Rightarrow \frac{180000}{x^2+20} &= 160 \\ \Rightarrow \frac{180000}{160} &= x^2 + 20 \\ \Rightarrow 1125 &= x^2 + 20x \\ \Rightarrow x^2 + 20x - 1125 &= 0 \\ \Rightarrow x^2 + 45x - 25x - 1125 &= 0 \\ \Rightarrow x(x + 45) - 25(x + 45) &= 0 \\ \Rightarrow (x + 45)(x - 25) &= 0 \\ \Rightarrow x - 25 = 0 \quad [ \because \text{The number of persons cannot be negative. } \therefore x + 45 \neq 0 ] \\ \Rightarrow x &= 25 \end{aligned}$$

Hence, the original number of persons is 25.

33.  $GF \parallel DE$  (DEFG is square)

$\therefore \angle AGF = \angle ABC$  (Corresponding angles)

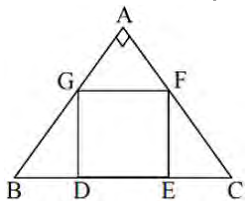
$\therefore \angle A = \angle GDB = 90^\circ$

$\therefore \angle AGF \sim \angle DBG$  (By AA similarity)

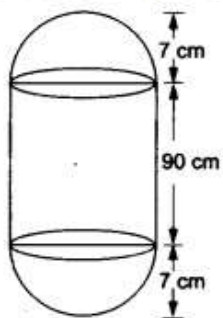
Again DEFG being a square  $\angle AFG = \angle ACB$  (corresponding angles)

$\therefore \angle A = \angle CEF$  (each  $90^\circ$ )

$\angle AGF \sim \angle EFC$  (By AA similarity)



34.



Radius of each hemispherical end = 7 cm.

Height of each hemispherical part = its radius = 7 cm.

Height of the cylindrical part =  $(104 - 2 \times 7)$  cm = 90 cm.

Area of surface to be polished = 2(curved surface area of the hemisphere) + (curved surface area of the cylinder)

=  $[2(2\pi r^2) + 2\pi r h]$  sq units

=  $\left[ \left( 4 \times \frac{22}{7} \times 7 \times 7 \right) + \left( 2 \times \frac{22}{7} \times 7 \times 90 \right) \right] \text{ cm}^2$

=  $(616 + 3960) \text{ cm}^2 = 4576 \text{ cm}^2$

=  $\left( \frac{4576}{10 \times 10} \right) \text{ dm}^2 = 45.76 \text{ dm}^2$  [ $\because 10 \text{ cm} = 1 \text{ dm}$ ].

$\therefore$  cost of polishing the surface of the solid

= ₹ $(45.76 \times 10)$  = ₹ 457.60.

OR

Diameter of the cylinder = 7 cm

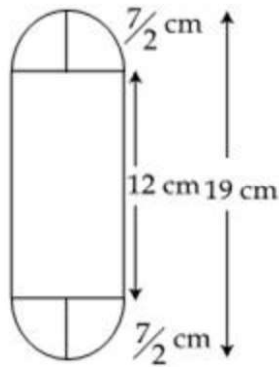
Therefore radius of the cylinder =  $\frac{7}{2} \text{ cm}$

Total height of the solid = 19 cm

Therefore, Height of the cylinder portion =  $19 - 7 = 12$  cm

Also, radius of hemisphere =  $\frac{7}{2} \text{ cm}$





Let  $V$  be the volume and  $S$  be the surface area of the solid. Then,

$V$  = Volume of the cylinder + Volume of two hemispheres

$$\Rightarrow V = \left\{ \pi r^2 h + 2 \left( \frac{2}{3} \pi r^3 \right) \right\} \text{cm}^3$$

$$\Rightarrow V = \pi r^2 \left( h + \frac{4r}{3} \right) \text{cm}^3$$

$$\Rightarrow V = \left\{ \frac{22}{7} \times \left( \frac{7}{2} \right)^2 \times \left( 12 + \frac{4}{3} \times \frac{7}{2} \right) \right\} \text{cm}^3 = \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times \frac{50}{3} \text{cm}^3 = 641.66 \text{cm}^3$$

and,

$S$  = Curved surface area of cylinder + Surface area of two hemispheres

$$\Rightarrow S = (2\pi r h + 2 \times 2\pi r^2) \text{cm}^2$$

$$\Rightarrow S = 2\pi r (h + 2r) \text{cm}^2$$

$$\Rightarrow S = 2 \times \frac{22}{7} \times \frac{7}{2} \times \left( 12 + 2 \times \frac{7}{2} \right) \text{cm}^2$$

$$= \left( 2 \times \frac{22}{7} \times \frac{7}{2} \times 19 \right) \text{cm}^2$$

$$= 418 \text{cm}^2$$

35. Let the assumed mean be  $A = 25$  and  $h = 5$ .

marks ( $x_1$ ):	no. of students ( $f_1$ ):	$d_1 = x_1 - A = x_1 - 25$	$u_1 = \frac{1}{h}(d_1)$	$f_1 u_1$
5	15	-20	-4	-60
10	50	-15	-3	-150
15	80	-10	-2	-160
20	76	-5	-1	-76
25	72	0	0	0
30	45	5	1	45
35	39	10	2	78
30	9	15	3	27
45	8	20	4	32
50	6	25	5	30
	$\sum f_1 = 400$			$\sum f_1 u_1 = -234$

We know that mean,  $\bar{X} = A + h \left( \frac{1}{N} \sum_{i=1}^n f_i u_i \right)$

Now, we have  $N = \sum f_1 = 400$ ,  $\sum f_1 u_1 = -234$ ,  $h = 5$  and  $A = 25$ .

Putting the values in the above formula, we get

$$\bar{X} = A + h \left( \frac{1}{N} \sum_{i=1}^n f_i u_i \right)$$

$$= 25 + 5 \left( \frac{1}{400} \times (-234) \right)$$

$$= 25 - \frac{234}{80}$$

$$= 25 - 2.925$$

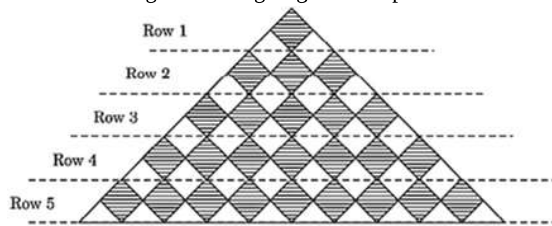
$$= 22.075$$

Hence, the mean marks is 22.075

### Section E

#### 36. Read the text carefully and answer the questions:

A fashion designer is designing a fabric pattern. In each row, there are some shaded squares and unshaded triangles.



(i) A.P. for the number of squares in each row is 1, 3, 5, 7, 9 ...

(ii) A.P. for the number of triangles in each row is 2, 6, 10, 14 ...

OR

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

$$\therefore S_{10} = 2 \times 10^2 = 200$$

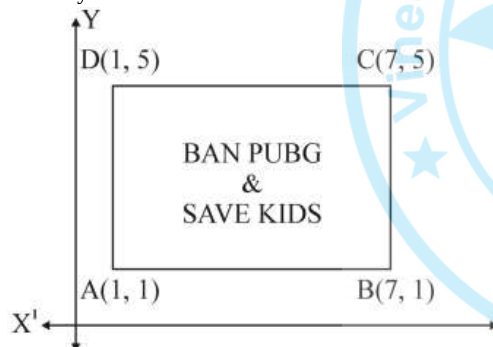
(iii) Area of each square =  $2 \times 2 = 4 \text{ cm}^2$

$$\text{Number of squares in 15 rows} = \frac{15}{2} (2 + 14 \times 2) = 225$$

$$\text{Shaded area} = 225 \times 4 = 900 \text{ cm}^2$$

#### 37. Read the text carefully and answer the questions:

Use of mobile screen for long hours makes your eye sight weak and give you headaches. Children who are addicted to play "PUBG" can get easily stressed out. To raise social awareness about ill effects of playing PUBG, a school decided to start 'BAN PUBG' campaign, in which students are asked to prepare campaign board in the shape of a rectangle. One such campaign board made by class X student of the school is shown in the figure.



(i) Point of intersection of diagonals is their midpoint

$$\text{So, } \left[ \frac{(1+7)}{2}, \frac{(1+5)}{2} \right]$$

$$= (4, 3)$$

(ii) Length of diagonal AC

$$AC = \sqrt{(7-1)(7-1) + (5-1)(5-1)}$$

$$= \sqrt{52} \text{ units}$$

OR

$$\text{Ratio of lengths} = \frac{AB}{AC}$$

$$= \frac{6}{\sqrt{52}}$$

$$= 6 : \sqrt{52}$$

(iii) Area of campaign board

$$= 6 \times 4$$

$$= 24 \text{ units square}$$

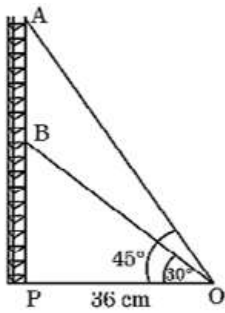
#### 38. Read the text carefully and answer the questions:

Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two

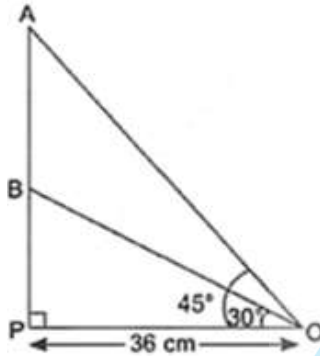


Sections A and B. Tower is supported by wires from a point O.

Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is  $30^\circ$  and the angle of elevation of the top of Section A is  $45^\circ$ .



(i) Let the length of wire BO = x cm



$$\begin{aligned} \therefore \cos 30^\circ &= \frac{PO}{BO} \\ \Rightarrow \frac{\sqrt{3}}{2} &= \frac{36}{x} \\ \Rightarrow x &= \frac{36 \times 2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} \\ &= 12 \times 2\sqrt{3} \\ &= 24\sqrt{3} \text{ cm} \end{aligned}$$

(ii) In  $\triangle APO$ ,  $\tan 45^\circ = \frac{AP}{PO}$

$$\begin{aligned} \Rightarrow 1 &= \frac{AP}{36} \\ \Rightarrow AP &= 36 \text{ cm} \dots(i) \end{aligned}$$

Now, In  $\triangle PBO$ ,

$$\begin{aligned} \tan 30^\circ &= \frac{BP}{PO} \\ \Rightarrow \frac{1}{\sqrt{3}} &= \frac{BP}{36} \\ \Rightarrow BP &= \frac{36}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} \\ &= \frac{36}{3}\sqrt{3} \\ &= 12\sqrt{3} \text{ cm} \end{aligned}$$

$$\begin{aligned} \therefore AB &= AP - BP \\ &= 36 - 12\sqrt{3} \text{ cm} \end{aligned}$$

OR

$$\text{In } \triangle APO, \tan 45^\circ = \frac{AP}{36}$$

$$1 = \frac{AP}{36}$$

$$A = 36 \text{ cm}$$

Height of section A from the base of the tower = AP = 36 cm.

(iii) In  $\triangle OPB$

$$\begin{aligned} \tan 30^\circ &= \frac{BP}{PO} \\ \Rightarrow \frac{1}{\sqrt{3}} &= \frac{BP}{36} \\ BP &= \frac{36}{\sqrt{3}} \\ &= \frac{36}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} \end{aligned}$$



$$= 12\sqrt{3} \text{ cm}$$

Now, Area of  $\triangle OPB = \frac{1}{2} \times \text{height} \times \text{base}$

$$= \frac{1}{2} \times BP \times OP$$

$$= \frac{1}{2} \times 12\sqrt{3} \times 36$$

$$= 216\sqrt{3} \text{ cm}^2$$

