

**CLASS X (2020-21)**  
**MATHEMATICS BASIC(241)**  
**SAMPLE PAPER-6**

**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. Expressed 225 in prime factorization.

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

By prime factorization of 225, we have

$$225 = 3 \times 3 \times 5 \times 5$$

$$= 3^2 \times 5^2 \text{ or } 5^2 \times 3^2$$



**or**

The decimal expansion of  $\frac{23}{2^5 \times 5^2}$  will terminate after how many places of decimal?

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

$$\frac{23}{2^5 \times 5^2} = \frac{23 \times 5^3}{2^5 \times 5^2 \times 5^3}$$

$$= \frac{23 \times 125}{2^5 \times 5^5} = \frac{2875}{(10)^5}$$

$$= \frac{2875}{100000} = 0.02875$$



Hence,  $\frac{23}{2^5 \times 5^2}$  will terminate after 5 five decimal places.

2. If  $\alpha$  and  $\beta$  are zeroes and the quadratic polynomial  $f(x) = x^2 - x - 4$ , then what is the value of  $\frac{1}{\alpha} + \frac{1}{\beta} - \alpha\beta$  ?

**Ans :**

We have  $f(x) = x^2 - x - 4$

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

Now  $\frac{1}{\alpha} + \frac{1}{\beta} - \alpha\beta = \frac{\alpha + \beta}{\alpha\beta} - \alpha\beta$

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

$$= \frac{15}{4}$$



3. If  $ad \neq bc$ , then find whether the pair of linear equations  $ax + by = p$  and  $cx + dy = q$  has no solution, unique solution or infinitely many solutions.

**Ans :**

Since  $ad \neq bc$  or  $\frac{a}{c} \neq \frac{b}{d}$

Hence, the pair of given linear equations has unique solution.



4. Find the nature of roots of the quadratic equation  $x^2 + 3x + 2\sqrt{2} = 0$ .

**Ans :**

We have  $x^2 + 3x + 2\sqrt{2} = 0$

Here,  $a = 1, b = 3$  and  $c = 2\sqrt{2}$

Now,  $D = b^2 - 4ac$

$$= (3)^2 - 4(1)(2\sqrt{2})$$

$$= 9 - 8\sqrt{2} < 0$$

Hence, roots of the equation are not real. Thus (c) is correct option.



**or**

Find the nature of roots of the quadratic equation  $5x^2 - 3x + 1 = 0$ .

**Ans :**

We have  $5x^2 - 3x + 1 = 0$

Here  $a = 5, b = -3, c = 1$

Now,  $D = b^2 - 4ac$

$$= (-3)^2 - 4(5)(1)$$

$$= 9 - 20 < 0$$

Hence, roots of the equation are not real. Thus (c) is correct option.



5. If  $A(\frac{m}{3}, 5)$  is the mid-point of the line segment joining the points  $Q(-6, 7)$  and  $R(-2, 3)$ , then what is the value of  $m$  ?

**Ans :**

[Board 2020 SQP Standard]

Given points are  $Q(-6, 7)$  and  $R(-2, 3)$

Mid point  $A\left(\frac{m}{3}, 5\right) = \left(\frac{-6-2}{2}, \frac{7+3}{2}\right)$   
 $= (-4, 5)$



Equating,  $\frac{m}{3} = -4 \Rightarrow m = -12$

or

The mid-point of the line-segment  $AB$  is  $P(0, 4)$ , if the coordinates of  $B$  are  $(-2, 3)$  then find the coordinates of  $A$ .

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

Let point  $A$  be  $(x, y)$ .

Now using mid-point formula,

$$(0, 4) = \left(\frac{x-2}{2}, \frac{y+3}{2}\right)$$



Thus  $0 = \frac{x-2}{2} \Rightarrow x = 2$

and  $4 = \frac{y+3}{2} \Rightarrow y = 5$

Hence point  $A$  is  $(2, 5)$ .

6. If  $\sin \theta = \frac{a}{b}$ , then find the value of  $\cos \theta$ ?

**Ans :**

We have  $\sin \theta = \frac{a}{b} = \frac{\text{Perpendicular}}{\text{Hypotenuse}}$



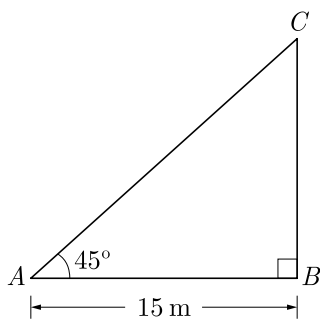
$$\text{Base} = \sqrt{b^2 - a^2}$$

So,  $\cos \theta = \frac{\text{Base}}{\text{Hypotenuse}}$   
 $= \frac{\sqrt{b^2 - a^2}}{b}$

7. A tree casts a shadow 15 m long on the level of ground, when the angle of elevation of the sun is  $45^\circ$ . Find the height of a tree.

**Ans :**

Let  $BC$  be the tree of height  $h$  meter. Let  $AB$  be the shadow of tree.



In  $\Delta ABC$ ,  $CB = 90^\circ$   
 $\frac{BC}{BA} = \tan 45^\circ$

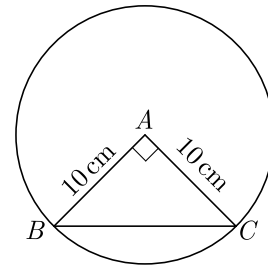


$$BC = AB = 15 \text{ m}$$

8. A chord of a circle of radius 10 cm, subtends a right angle at its centre. What is the length of the chord?

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

As per given information we have drawn the figure below.



Using Pythagoras theorem in  $\Delta ABC$ , we get

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

$$= 10^2 + 10^2$$

$$= 100 + 100 = 200$$

$$BC = 10\sqrt{2} \text{ cm}$$

9. To divide a line segment  $AB$  in the ratio  $3 : 4$ , we draw a ray  $AX$ , so that  $\angle BAX$  is an acute angle and then mark the points on ray  $AX$  at equal distances such that the minimum number of these points is \_

**Ans :**



Minimum number of these points =  $3 + 4 = 7$

10. The radius of a circle is 17.5 cm. find the area of the sector of the circle enclosed by two radii and an arc 44 cm in length.

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

Given, arc length = 44 cm

Radius of circle,  $r = 17.5$  cm



So, area of sector =  $\frac{\text{arc length}}{2\pi r} \times \pi r^2$   
 $= \frac{\text{arc length} \times r}{2}$   
 $= \frac{44 \times 17.5}{2}$   
 $= 22 \times 17.5 = 385 \text{ sq. cm.}$

or

Find the area of the sector of a circle of radius 6 cm whose central angle is  $30^\circ$ . (Take  $\pi = 3.14$ )

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

Radius,  $r = 6$  cm

Central angle,  $\theta = 30^\circ$



Area of the sector,

$$\frac{\pi r^2 \theta}{360^\circ} = \frac{3.14 \times 6 \times 6 \times 30^\circ}{360^\circ}$$

$$= 9.42 \text{ cm}^2$$

11. A sphere is melted and half of the melted liquid is used to form 11 identical cubes, whereas the remaining half is used to form 7 identical smaller spheres. Find the ratio of the side of the cube to the radius of the new small sphere.

**Ans :**

As per the given conditions,

$$11a^3 = 7 \times \frac{4}{3} \times \frac{22}{7} \times r^3$$

$$\frac{a}{r} = \left(\frac{8}{3}\right)^{1/3}$$



12. If two solid hemispheres of same base radius  $r$  are joined together along their bases, then find the curved surface area of this new solid.

Ans :

Because curved surface area of a hemisphere is  $2\pi r^2$  and here, we join two solid hemispheres along their bases of radius  $r$ , from which we get a solid sphere.

Hence, the curved surface area of new solid  $= 2\pi r^2 + 2\pi r^2 = 4\pi r^2$



m296

13. If the mean of the squares of first  $n$  natural numbers is 105, then find the first  $n$  natural numbers.

Sum of square,  $\sum x^2 = \frac{n(n+1)(2n+1)}{6}$

Mean of squares of first  $n$  natural numbers,

$$105 = \frac{(n+1)(2n+1)}{6}$$

$$2n^2 + 3n + 1 = 630$$

$$2n^2 + 3n - 629 = 0$$

$$2n^2 + 37n - 34n - 629 = 0$$

$$n(2n + 37) - 17(2n + 37) = 0$$

$$(2n + 37)(n - 17) = 0 \Rightarrow n = 17$$

Since,  $n$  is odd, therefore median is  $= \left(\frac{17+1}{2}\right)^{\text{th}} = 9^{\text{th}}$  observation.



n114

14. For the following distribution what is the modal class:

Marks	Number of students
Below 10	3
Below 20	12
Below 30	27
Below 40	57
Below 50	75
Below 60	80

Ans :



n122

Marks	Number of students
0-10	$3 - 0 = 3$
10-20	$12 - 3 = 9$
20-30	$27 - 12 = 15$
30-40	$57 - 27 = 30$
40-50	$75 - 57 = 18$
50-60	$80 - 75 = 5$

Class 30-40 has the maximum frequency 30, therefore this is model class.

15. Find the class-marks of the classes 10-25 and 35-66.

Ans : [Board 2020 OD Standard]

Class mark of 10 - 25,  $= \frac{10+25}{2} = \frac{35}{2} = 17.5$

and class mark of 35 - 55,

$$= \frac{35+55}{2} = \frac{90}{2} = 45$$



n149

16. If the probability of winning a game is 0.07, what is the probability of losing it?

Ans : [Board 2020 Delhi Standard]

$P(\text{winning the game}), P(E) = 0.07$

$P(\text{number less game}), P(\bar{E}) = 1 - P(E)$   
 $= 1 - 0.07$   
 $= 0.93$



o141

or

A die is thrown once. Find the probability of getting "at most 2."

Ans : [Board Term-2 OD Compt 2017]

All possible outcome i.e. sample space,

$$S = \{1, 2, 3, 4, 5, 6\}$$

Number of all possible outcome,

$$n(S) = 6$$

Favourable outcomes,

$$E = \{1, 2\}$$

Number of favourable outcome,

$$n(E) = 2$$

Thus  $P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$



o142

## Section II

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

17. The Prime Minister's Citizen Assistance and Relief in Emergency Situations Fund was created on 28 March 2020, following the COVID-19 pandemic in India. The fund will be used for combating, and containment and relief efforts against the coronavirus outbreak and similar pandemic like situations in the future.



The allotment officer is trying to come up with a method to calculate fair division of funds across various affected families so that the fund amount and amount received per family can be easily adjusted based on daily revised numbers. The total fund allotted for a village is  $x^3 + 6x^2 + 20x + 9$ . The officer has divided the fund equally among families of the village and each family receives an amount of  $x^2 + 2x + 2$ . After distribution, some amount is left.

- (i) How many families are there in the village?

- (a)  $x + 4$  (b)  $x - 3$   
 (c)  $x - 4$  (d)  $x + 3$



b402

- (ii) If an amount of ₹1911 is left after distribution, what is value of  $x$ ?
  - (a) 190
  - (b) 290
  - (c) 191
  - (d) 291
- (iii) How much amount does each family receive?
  - (a) 24490
  - (b) 34860
  - (c) 22540
  - (d) 36865
- (iv) What is the amount of fund allocated?
  - (a) Rs 72 72 759
  - (b) Rs 75 72 681
  - (c) Rs 69 72 846
  - (d) Rs 82 74 888
- (v) How many families are there in the village?
  - (a) 191
  - (b) 98
  - (c) 187
  - (d) 195

**Ans :**

(i) To get number of families we divide  $x^3 + 6x^2 + 20x + 9$  by  $x^2 + 2x + 2$ .

$$\begin{array}{r}
 x + 4 \\
 x^2 + 2x + 2 \overline{) x^3 + 6x^2 + 20x + 9} \\
 \underline{x^3 + 2x^2 + 2x} \phantom{+ 9} \\
 4x^2 + 18x + 9 \\
 \underline{4x^2 + 8x + 8} \\
 10x + 1
 \end{array}$$

Number of families are  $x + 4$ .

Thus (a) is correct option.

(ii) Amount left =  $10x + 1$

$$\begin{aligned}
 10x + 1 &= 1911 \\
 x &= \frac{1910}{10} = 191
 \end{aligned}$$

Thus (c) is correct option.

(iii) Since,  $x = 191$ , amount received by each family is

$$\begin{aligned}
 x^2 + 2x + 2 &= (191)^2 + 2(191) + 2 \\
 &= 36865
 \end{aligned}$$

Thus (d) is correct option.

(iv) Since  $x = 191$ , allotted fund,

$$\begin{aligned}
 x^3 + 6x^2 + 20x + 9 &= (x^2 + 2x + 2)(x + 4) + 10x + 1 \\
 &= 36865(191 + 4) + 1911 \\
 &= 69,72,846
 \end{aligned}$$

Thus (c) is correct option.

(v) No. of families =  $x + 4$

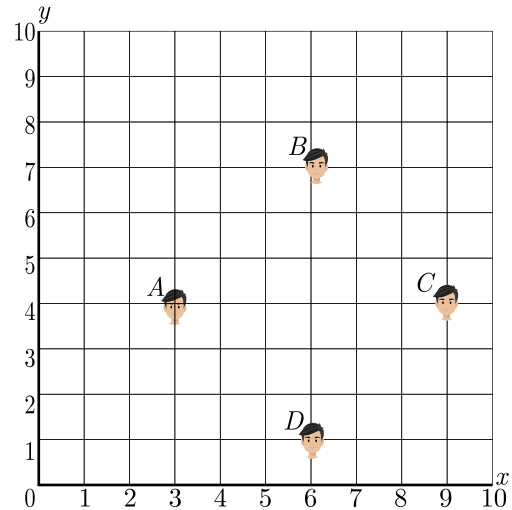
$$= 191 + 4 = 195$$

Thus (d) is correct option.

**18.** Morning assembly is an integral part of the school's schedule. Almost all the schools conduct morning assemblies which include prayers, information of latest happenings, inspiring thoughts, speech, national anthem, etc. A good school is always particular about their morning assembly schedule. Morning assembly is important for a child's development. It is essential to understand that morning assembly is not just about standing in long queues and singing prayers or national anthem, but it's something beyond just prayers. All the activities carried out in morning assembly by the school staff and students have a great influence in every point of life. The positive effects of attending school assemblies can be felt throughout life.



Have you noticed that in school assembly you always stand in row and column and this make a coordinate system. Suppose a school have 100 students and they all assemble in prayer in 10 rows as given below.



Here  $A, B, C$  and  $D$  are four friend Amar, Bharat, Colin and David.

- (i) What is the distance between  $A$  and  $B$  ?
  - (a) 8
  - (b) 6
  - (c)  $3\sqrt{3}$
  - (d)  $2\sqrt{3}$
- (ii) What is the distance between  $C$  and  $D$  ?
  - (a) 8
  - (b) 6
  - (c)  $3\sqrt{3}$
  - (d)  $2\sqrt{3}$
- (iii) What is the distance between  $A$  and  $C$  ?
  - (a) 8
  - (b) 6
  - (c)  $3\sqrt{3}$
  - (d)  $2\sqrt{3}$
- (iv) What is the distance between  $D$  and  $B$  ?
  - (a) 8
  - (b) 6
  - (c)  $3\sqrt{3}$
  - (d)  $2\sqrt{3}$
- (v) These 4 friends seating arrangement make a
  - (a) square
  - (b) rhombus
  - (c) parallelogram
  - (d) rectangle

**Ans :**

(i) We have  $A(3, 4)$  and  $B(6, 7)$ .

$$AB = \sqrt{(6 - 3)^2 + (7 - 4)^2} = 2\sqrt{3}$$

Thus (d) is correct option.

(ii) We have  $C(9, 4)$  and  $D(6, 1)$ .

$$CD = \sqrt{(9 - 6)^2 + (4 - 1)^2} = 2\sqrt{3}$$

Thus (d) is correct option.

(iii) We have  $A(3, 4)$  and  $C(9, 4)$

$$AC = \sqrt{(3 - 9)^2 + (4 - 4)^2} = 6$$

Thus (b) is correct option.

(iv) We have  $B(6, 7)$  and  $D(6, 1)$ .

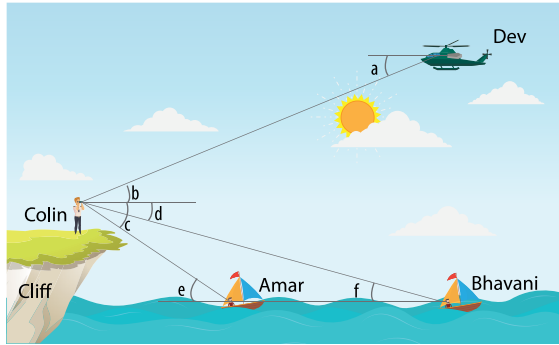
$$BD = \sqrt{(6 - 6)^2 + (7 - 1)^2} = 6$$

Thus (b) is correct option.



(v) We can also calculate  $BC = 2\sqrt{3}$  and  $AD = 2\sqrt{3}$   
 Here,  $AB = BC = CD = AD$   
 and  $AC = BD$   
 Thus it is a square.  
 Thus (a) is correct option.

19. Navy officer Mr. Colin is tasked with planning a coup on the enemy at a certain date. Currently he is inspecting the area standing on top of the cliff. Agent Dev is on a chopper in the sky. When Mr. Colin looks down below the cliff towards the sea, he has Bhawani and Amar in boats positioned to get a good vantage point. Bhawani boat is behind the Amar boat.



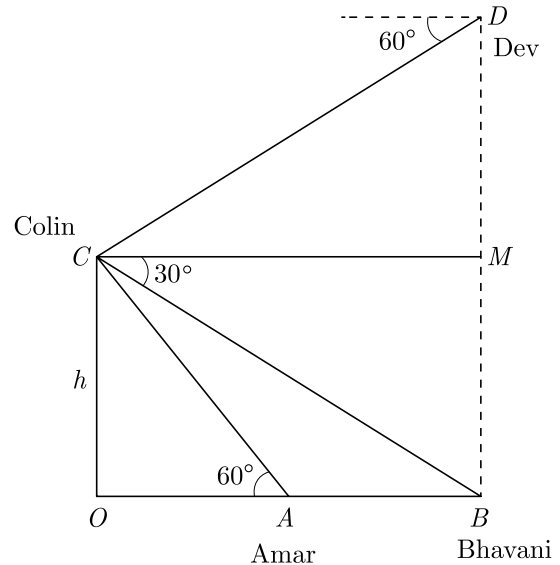
Following angle have been measured :  
 From Colin to Bhawani :  $30^\circ$   
 From Dev to Colin :  $60^\circ$   
 From Amar to Colin :  $60^\circ$

- (i) Which of the following is a pair of angle of elevation?  
 (a)  $(\angle a, \angle e)$                       (b)  $(\angle b, \angle e)$   
 (c)  $(\angle c, \angle d)$                       (d)  $(\angle a, \angle f)$
- (ii) Which of the following is a pair of angle of depression?  
 (a)  $(\angle a, \angle e)$                       (b)  $(\angle b, \angle e)$   
 (c)  $(\angle c, \angle d)$                       (d)  $(\angle a, \angle f)$
- (iii) If angle of elevation of Amar to Colin is  $60^\circ$ , what is the distance of Amar boat from the base of hill ?  
 (a)  $\frac{\sqrt{3}h}{2}$                                       (b)  $\frac{h}{\sqrt{3}}$   
 (c)  $\frac{2h}{\sqrt{3}}$                                       (d)  $\sqrt{3}h$
- (iv) If angle of depression of Colin to Bhawani is  $30^\circ$ , what is the distance of Amar boat from the Bhawani boat?  
 (a)  $\frac{\sqrt{3}h}{2}$                                       (b)  $\frac{h}{\sqrt{3}}$   
 (c)  $\frac{2h}{\sqrt{3}}$                                       (d)  $\sqrt{3}h$
- (v) If angle of depression of Dev to Colin is  $60^\circ$ , what is the height of Dev from base of hill ?  
 (a)  $h$     (b)  $2h$   
 (c)  $3h$     (d)  $4h$

Ans :

(i) The angle of elevation of an object as seen by an observer is the angle between the horizontal and the line from the object to the observer's eye (the line of

sight). In our case clearly  $(\angle b, \angle e, \angle f)$  are angle of depression.  
 Thus (b) is correct option.  
 (ii) If the object is below the level of the observer, then the angle between the horizontal and the observer's line of sight is called the angle of depression. In our case clearly  $(\angle a, \angle c, \angle d)$  are angle of depression.  
 Thus (c) is correct option.  
 (iii) We make the figure as given below.  
 Here  $\angle OAC = 60^\circ$  is angle of elevation.



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

$$OA = \frac{h}{\sqrt{3}}$$

Thus (b) is correct option.

(iv) Here  $\angle OBC = \angle MCB = 30^\circ$

$$\frac{h}{OB} = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

$$OB = \sqrt{3}h$$

$$AB = OB - OA$$

$$= \sqrt{3}h - \frac{h}{\sqrt{3}}$$

$$= \frac{1}{\sqrt{3}}(3h - h) = \frac{2h}{\sqrt{3}}$$

Thus (c) is correct option.

(v) Here  $\angle DCM = 60^\circ$

Now, 
$$\frac{DM}{CM} = \tan 60^\circ = \sqrt{3}$$

$$DM = \sqrt{3}CM$$

But 
$$CM = OB = \sqrt{3}h$$

Thus 
$$DM = \sqrt{3} \cdot \sqrt{3}h = 3h$$

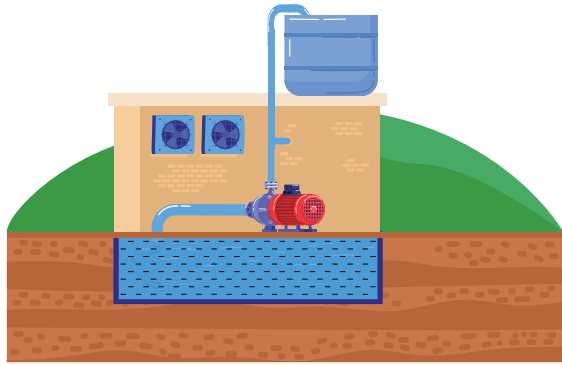
Height of Dev from Bhawani,

$$= DB = DM + MB = 3h + h = 4h$$

Thus (d) is correct option.

20. Underground water tank is popular in India. It is usually used for large water tank storage and can be built cheaply using cement-like materials. Underground water tanks are typically chosen by people who want to save space. The water in the underground tank is not affected by extreme weather conditions. The underground tanks maintain cool temperatures in both winter and summer. Electric

pump is used to move water from the underground tank to overhead tank.



Ramesh has build recently his house and installed a underground tank and overhead tank. Dimensions of tanks are as follows :

Underground Tank : Base 2 m × 2 m and Height 1.1 m.  
Overhead tank : Radius 50 cm and Height 175 cm

- (i) What is the capacity of the underground tank ?  
(a) 2200 litres                      (b) 44000 litres  
(c) 4400 litres                      (d) 22000 litres
- (ii) What is the ratio of the capacity of the underground tank to the capacity of the overhead tank?  
(a) 1.75                                  (b) 1.25  
(c) 2.5                                    (d) 3.2
- (iii) If curved part of overhead tank need to be painted to save it from corrosion, how much area need to be painted?  
(a) 5.5 m<sup>2</sup>                              (b) 3.3 m<sup>2</sup>  
(c) 2.5 m<sup>2</sup>                              (d) 4.5 m<sup>2</sup>
- (iv) If water is filled in the overhead tank at the rate of 11 litre per minute, the tank will be completely filled in how much time?  
(a) 65 minutes                        (b) 62.5 minutes  
(c) 130 minutes                        (d) 125 minutes
- (v) If the amount of water in the underground tank, at an instant, is 2400 litres , then the water level in the underground tank at that instant is  
(a) 60 cm                                (b) 50 cm  
(c) 70 cm                                (d) 65 cm

**Ans :**

(i) Volume of underground tank,

$$lbh = 2 \times 2 \times 1.1 = 4.4 \text{ m}^3$$

Since 1 m<sup>3</sup> is equal to 1000 litres,

$$4.4 \text{ m}^3 = 4.4 \times 1000 = 4400 \text{ litres}$$

Thus (c) is correct option.

(ii) Radius of overhead is 50 cm i.e.  $\frac{1}{2}$  meter and height is 175 cm i.e.  $1.75 = \frac{7}{4}$  metre.

Thus volume of overhead tank,

$$\pi r^2 h_{cy} = \frac{22}{7} \times \frac{1}{2} \times \frac{1}{2} \times \frac{7}{4} = \frac{11}{8} \text{ m}^3$$

$$\frac{\text{Capacity of sump}}{\text{Capacity of Overhead tank}} = \frac{lbh}{\pi r^2 h_{cy}} = \frac{4.4}{\frac{11}{8}} = 3.2$$

Thus (d) is correct option.

(iii) C.S.A. of cylindrical tank

$$2\pi r h_{cy} = 2 \times \frac{22}{7} \times \frac{1}{2} \times \frac{7}{4} = 5.5 \text{ m}^2$$

Thus (a) is correct option.

(iv) Volume of water in cylindrical tank is  $\frac{11}{8} \text{ m}^3$ .

$$\frac{11}{8} \text{ m}^3 = \frac{11}{8} \times 1000 \text{ litres}$$

Thus time taken to fill tank,

$$= \frac{11}{8} \times 1000 \times \frac{1}{11} = 125 \text{ minutes}$$

Thus (d) is correct option.

(v) Volume of water in underground tank

$$= 2400 \text{ litres} = 2.4 \text{ m}^3$$

Then,

$$V = lbh_1$$

$$2 \times 2 \times h_1 = 2.4$$

$$h_1 = \frac{2.4}{2 \times 2} = 0.6 \text{ m} = 60 \text{ cm}$$

Thus (a) is correct option.

## Part - B

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

21. Find the value of  $k$  for which the roots of the equations  $3x^2 - 10x + k = 0$  are reciprocal of each other.

**Ans :**

[Board 2019 Delhi]

We have  $3x^2 - 10x + k = 0$

Comparing the given equation with  $ax^2 + bx + c = 0$  we get  $a = 3, b = -10, c = k$

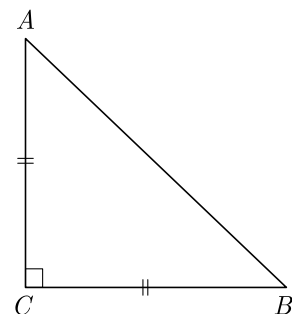
Let one root be  $\alpha$  so other root is  $\frac{1}{\alpha}$ .

Now product of roots  $\alpha \times \frac{1}{\alpha} = \frac{c}{a}$

$$1 = \frac{k}{3} \Rightarrow k = 3$$

Hence, value of  $k$  is 3.

22. In Figure,  $ABC$  is an isosceles triangle right angled at  $C$  with  $AC = 4$  cm, Find the length of  $AB$ .



**Ans :**

[Board 2019 OD]

Since  $ABC$  is an isosceles triangle right angled at  $C$ ,

$$AC = BC = 4 \text{ cm}$$

$$\angle C = 90^\circ$$

Using Pythagoras theorem in  $\Delta ABC$  we have,

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

$$= 4^2 + 4^2$$

$$= 16 + 16 = 32$$

$$AB = 4\sqrt{2} \text{ cm}$$

23. Prove that  $\sqrt{\frac{1 - \sin \theta}{1 + \sin \theta}} = \sec \theta - \tan \theta$ .

Ans :

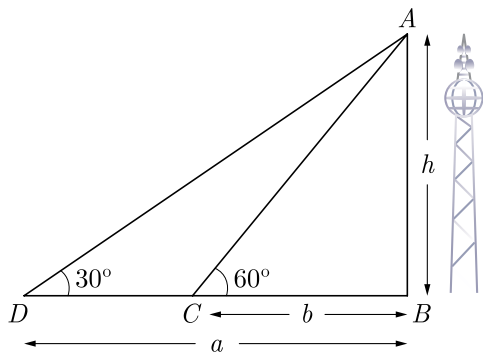
$$\begin{aligned} \text{LHS} &= \sqrt{\frac{1 - \sin \theta}{1 + \sin \theta}} = \sqrt{\frac{(1 - \sin \theta)(1 - \sin \theta)}{(1 + \sin \theta)(1 - \sin \theta)}} \\ &= \sqrt{\frac{(1 - \sin \theta)^2}{1 - \sin^2 \theta}} = \sqrt{\frac{(1 - \sin \theta)^2}{\cos^2 \theta}} \\ &= \frac{1 - \sin \theta}{\cos \theta} = \frac{1}{\cos \theta} - \frac{\sin \theta}{\cos \theta} \\ &= \sec \theta - \tan \theta = \text{RHS} \end{aligned}$$

Hence Proved

24. If the angles of elevation of the top of a tower from two points distant  $a$  and  $b$  ( $a > b$ ) from its foot and in the same straight line from it are respectively  $30^\circ$  and  $60^\circ$ , then find the height of the tower.

Ans : [Board Term-2 2014]

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



From  $\Delta ABD$ ,  $\frac{h}{a} = \tan 30^\circ$   
 $h = a \times \frac{1}{\sqrt{3}} = \frac{a}{\sqrt{3}}$  ... (1)

From  $\Delta ABC$ ,  $\frac{h}{b} = \tan 60^\circ$   
 $h = b \times \sqrt{3} = b\sqrt{3}$  ... (2)

From (1) we get  $a = \sqrt{3} h$

From (2) get  $b = \frac{h}{\sqrt{3}}$

Thus  $a \times b = \sqrt{3} h \times \frac{h}{\sqrt{3}}$

$$\begin{aligned} ab &= h^2 \\ h &= \sqrt{ab} \end{aligned}$$

Hence, the height of the tower is  $\sqrt{ab}$ .

25. If a pair of dice is thrown once, then what is the probability of getting a sum of 8?

Ans : [Board 2020 Delhi Basic]

Number of possible outcomes,

$$n(S) = 6^2 = 36$$

The favourable outcomes are (sum of getting 8)  $\{(2, 6), (3, 5), (4, 4), (5, 3), (6, 2)\}$  i.e. 5 outcomes.

Number of favourable outcome,

$$n(E) = 5$$

Probability (getting sum of 8),

$$P(E) = \frac{n(E)}{n(S)} = \frac{5}{36}$$



h278



i109



o173

or

A die thrown once. What is the probability of getting an even prime number?

Ans : [Board 2020 Delhi Standard]

Total possible outcomes of die is 6.

$$n(S) = 6$$

Favourable outcomes is only 2 i.e. there is one possible outcome.

$$n(E) = 1$$

$P$  (getting an even prime number),

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



o174

26. A pair of dice is thrown once. What is the probability of getting a doublet?

Ans : [Board 2020 Delhi Standard]

There are total  $6^2 = 36$  possible outcomes. Thus

$$n(S) = 36$$

Favourable outcomes are (1, 1), (2, 2), (3, 3), (4, 4), (5, 5) and (6, 6).

Number of favourable outcomes,

$$n(E) = 6$$

$P$ (getting doublet),

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



o178

or

A die is thrown once. What is the probability of getting a prime number.

Ans : [Board 2020 OD Standard]

There are 6 possible outcome for a die.

$$n(S) = 6$$

Favourable outcome are 1 and 2 i.e. two outcome.

$$n(E) = 2$$

$P$  (number less than 3),

$$P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$$



o179

27. Verify whether 2, 3 and  $\frac{1}{2}$  are the zeroes of the polynomial  $p(x) = 2x^3 - 11x^2 + 17x - 6$ .

Ans : [Board Term-1 2013, LK-59]

If 2, 3 and  $\frac{1}{2}$  are the zeroes of the polynomial  $p(x)$ , then these must satisfy  $p(x) = 0$

$$(1) 2, \quad p(x) = 2x^3 - 11x^2 + 17x - 6$$

$$\begin{aligned} p(2) &= 2(2)^3 - 11(2)^2 + 17(2) - 6 \\ &= 16 - 44 + 34 - 6 \\ &= 50 - 50 \end{aligned}$$

or  $p(2) = 0$

$$(2) 3, \quad p(3) = 2(3)^3 - 11(3)^2 + 17(3) - 6$$

$$\begin{aligned} &= 54 - 99 + 51 - 6 \\ &= 105 - 105 \end{aligned}$$

or  $p(3) = 0$

$$(3) \frac{1}{2} \quad p\left(\frac{1}{2}\right) = 2\left(\frac{1}{2}\right)^3 - 11\left(\frac{1}{2}\right)^2 + 17\left(\frac{1}{2}\right) - 6$$



b125

$$= \frac{1}{4} - \frac{11}{4} + \frac{17}{2} - 6$$

or  $p\left(\frac{1}{2}\right) = 0$

Hence, 2, 3, and  $\frac{1}{2}$  are the zeroes of  $p(x)$ .

28. Solve the following quadratic equation for  $x$  :

$$x^2 + \left(\frac{a}{a+b} + \frac{a+b}{a}\right)x + 1 = 0$$

Ans : [Board Term-2 OD 2016]

We have  $x^2 + \left(\frac{a}{a+b} + \frac{a+b}{a}\right)x + 1 = 0$

$$x^2 + \frac{a}{a+b}x + \frac{a+b}{a}x + 1 = 0$$

$$x\left(x + \frac{a}{a+b}\right) + \frac{a+b}{a}\left(x + \frac{a}{a+b}\right) = 0$$

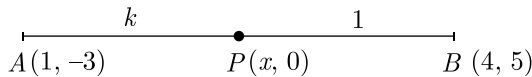
$$\left(x + \frac{a}{a+b}\right)\left(x + \frac{a+b}{a}\right) = 0$$

Thus  $x = \frac{-a}{a+b}, \frac{-(a+b)}{a}$

29. Find the ratio in which the segment joining the points  $(1, -3)$  and  $(4, 5)$  is divided by  $x$ -axis? Also find the coordinates of this point on  $x$ -axis.

Ans : [Board 2019 Delhi]

Let the required ratio be  $k : 1$  and the point on  $x$ -axis be  $(x, 0)$ .



Here,  $(x_1, y_1) = (1, -3)$

and  $(x_2, y_2) = (4, 5)$

Using section formula  $y$  coordinate, we obtain,

$$y = \frac{my_2 + ny_1}{m+n}$$

$$0 = \frac{k \times 5 + 1 \times 1(-3)}{k+1}$$

$$0 = 5k - 3$$

$$5k = 3 \Rightarrow k = \frac{3}{5}$$

Hence, the required ratio is  $\frac{3}{5}$  i.e 3:5.

Now, again using section formula for  $x$ , we obtain

$$x = \frac{mx_2 + nx_1}{m+n}$$

$$x = \frac{k \times (4) + 1 \times 1}{k+1}$$

$$= \frac{\frac{3}{5}(4) + 1}{\frac{3}{5} + 1} = \frac{12+5}{3+5} = \frac{17}{8}$$

Co-ordinate of  $P$  is  $\left(\frac{17}{8}, 0\right)$ .

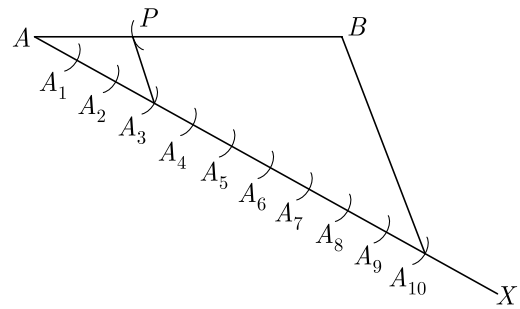
30. Draw a line segment of length 5 cm and divide it in the ratio 3 : 7.

Ans : [Board Term-2 2015]

Step of Construction :

1. Draw a line segment  $AB$  of length 5 cm.
2. Draw any ray  $AX$  making an acute angle with  $AB$ .

3. Mark ten points  $A_1, A_2, A_3, \dots, A_{10}$  on  $AX$  such that  $AA_1 = A_1A_2 = \dots = A_9A_{10}$ .
4. Join  $BA_{10}$ .
5. At point  $A_3$  draw a line  $PA_3$  parallel to  $BA_{10}$ . Hence  $AP : PB = 3 : 7$



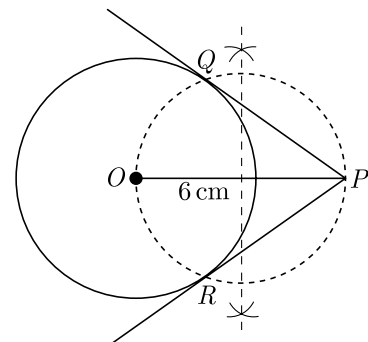
or

Draw a circle of radius 3.5 cm. From a point  $P$ , 6 cm from its centre, draw two tangents to the circle.

Ans : [Board 2020 OD Standard]

Step of construction :

1. Draw a line segment  $OP$  of length 6 cm.
2. From the point  $O$ , draw a circle of radius = 3.5 cm.
3. Draw a perpendicular bisector of  $OP$ . Let  $M$  be the mid point of  $OP$ .
4. Taking  $M$  as centre and  $OM$  as radius draw a circle.
5. This circle intersects the given circle at  $Q$  and  $R$ .
6. Join  $PQ$  and  $PR$ , which are tangents to the circles.



31. The angles of depression of the top and bottom of a 50 m high building from the top of a tower are  $45^\circ$  and  $60^\circ$  respectively. Find the height of the tower and the horizontal distance between the tower and the building. (Use  $\sqrt{3} = 1.73$ )

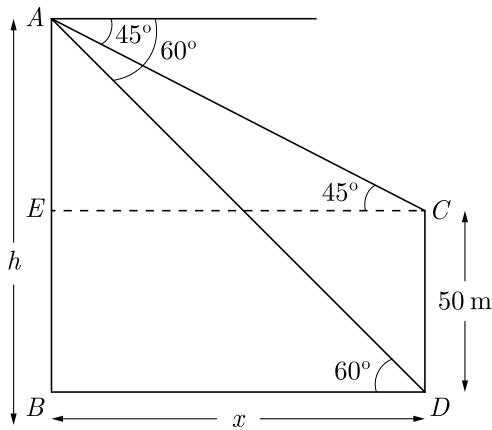
Ans : [Board Term-2 Delhi 2016]

As per given in question we have drawn figure below. Here  $AC$  is tower and  $DC$  is building.



i127





We have  $\tan 45^\circ = \frac{h - 50}{x}$   
 $x = h - 50$  ... (1)

and  $\tan 60^\circ = \frac{h}{x}$   
 $\sqrt{3} = \frac{h}{x}$   
 $x = \frac{h}{\sqrt{3}}$  ... (2)

From (1) and (2) we have

$$h - 50 = \frac{h}{\sqrt{3}}$$

$$\sqrt{3}h - 50\sqrt{3} = h$$

$$\sqrt{3}h - h = 50\sqrt{3}$$

$$h(\sqrt{3} - 1) = 50\sqrt{3}$$

$$h = \frac{50\sqrt{3}}{\sqrt{3} - 1} = \frac{50(3 + \sqrt{3})}{2}$$

$$= 25(3 + \sqrt{3})$$

$$= 75 + 25\sqrt{3} = 118.25 \text{ m}$$

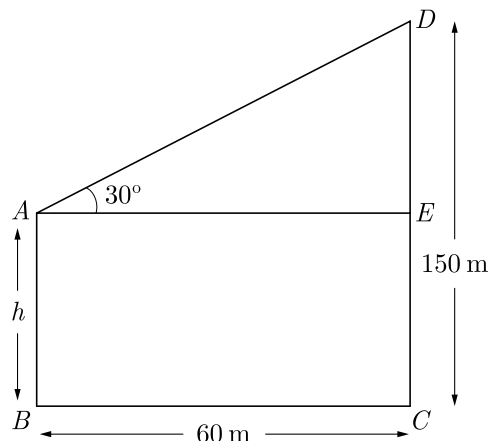
Thus  $h = 118.25 \text{ m}$ .

or

The horizontal distance between two towers is 60 m. The angle of elevation of the top of the taller tower as seen from the top of the shorter one is  $30^\circ$ . If the height of the taller tower is 150 m, then find the height of the shorter tower.

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

Let  $AB$  and  $CD$  be two towers. Let the height of the shorter tower  $AB = h$ . As per given in question we have drawn figure below.



Here  $BC = AE = 60 \text{ m}$ ,  $DE = DC - EC = (150 - h)$

In  $\triangle AED$ ,  $\frac{DE}{AE} = \tan 30^\circ$

$$\frac{150 - h}{60} = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

$$150\sqrt{3} - h\sqrt{3} = 60$$

$$\sqrt{3}h = 150\sqrt{3} - 60$$

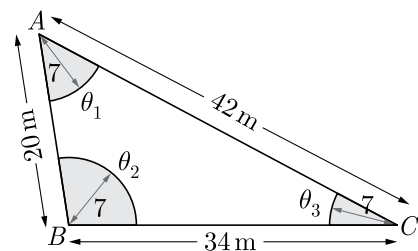
$$\sqrt{3}h = 150\sqrt{3} - 20\sqrt{3} \times \sqrt{3}$$

or  $h = (150 - 20\sqrt{3}) \text{ m}$

32. Three horses are tied each with 7 m long rope at three corners of a triangular field having sides 20 m, 34 m and 42 m. Find the area of the plot which can be grazed by the horses.

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

As per information given in question we have drawn the figure below.



Let  $\angle A = \theta_1$ ,  $\angle B = \theta_2$  and  $\angle C = \theta_3$ .

Now, area which can be grazed by the horses is the sum of the areas of three sectors with central angles  $\theta_1$ ,  $\theta_2$  and  $\theta_3$  each with radius  $r = 7 \text{ m}$ .

$$\frac{\pi r^2 \theta_1}{360^\circ} + \frac{\pi r^2 \theta_2}{360^\circ} + \frac{\pi r^2 \theta_3}{360^\circ} = \frac{\pi r^2}{360^\circ} (\theta_1 + \theta_2 + \theta_3) \dots (1)$$

From angle sum property of a triangle we have

$$\theta_1 + \theta_2 + \theta_3 = 180^\circ$$

Substituting above in equation (1) we have

$$\frac{\pi r^2 \theta_1}{360^\circ} + \frac{\pi r^2 \theta_2}{360^\circ} + \frac{\pi r^2 \theta_3}{360^\circ} = \frac{\pi r^2}{360^\circ} \times 180^\circ = \frac{\pi r^2}{2}$$

$$= \frac{22}{7} \times \frac{1}{2} \times (7)^2$$

$$= \frac{22}{7} \times \frac{1}{2} \times 7 \times 7$$

$$= 77 \text{ m}^2$$

Hence, the area grazed by the horses is  $77 \text{ m}^2$

33. If the median for the following frequency distribution is 28.5, find the value of  $x$  and  $y$  :

Class	Frequencies
0-10	5
10-20	$x$
20-30	20
30-40	15
40-50	$y$
50-60	5
Total	60

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

We prepare following cumulative frequency table to find median class.

C.I.	<i>f</i>	<i>c.f.</i>
0-10	5	5
10-20	<i>x</i>	<i>x</i> + 5
20-30	20	<i>x</i> + 25
30-40	15	<i>x</i> + 40
40-50	<i>y</i>	<i>x</i> + <i>y</i> + 40
50-60	5	<i>x</i> + <i>y</i> + 45
	$\sum f = 60$	

Since, median is 28.5 which lies between 20-30. Thus model class is 20-30.

From table  $N = x + y + 45$   
 $60 = x + y + 45$   
 $x + y = 60 - 45 = 15 \quad \dots(1)$

Median,  $M_d = l + \left(\frac{\frac{N}{2} - F}{f}\right)h$   
 $28.5 = 20 + \frac{[30 - (x + 5)]}{20} \times 10$   
 $8.5 = \frac{25 - x}{2}$   
 $25 - x = 17 \Rightarrow x = 25 - 17 = 8$

From (1),  $y = 15 - 8 = 7$

Hence,  $x = 8$  and  $y = 7$



n220

**34.** For any positive integer  $n$ , prove that  $n^3 - n$  is divisible by 6.

**Ans :** [Board Term-1 2015, 2012]

We have  $n^3 - n = n(n^2 - 1)$   
 $= (n - 1)n(n + 1)$   
 $= (n - 1)n(n + 1)$



a143

Thus  $n^3 - n$  is product of three consecutive positive integers.

Since, any positive integers  $a$  is of the form  $3q, 3q + 1$  or  $3q + 2$  for some integer  $q$ .

Let  $a, a + 1, a + 2$  be any three consecutive integers.

**Case I :**  $a = 3q$

If  $a = 3q$  then,

$a(a + 1)(a + 2) = 3q(3q + 1)(3q + 2)$   
 Product of two consecutive integers  $(3q + 1)$  and  $(3q + 2)$  is an even integer, say  $2r$ .

Thus  $a(a + 1)(a + 2) = 3q(2r)$   
 $= 6qr$ , which is divisible by 6.

**Case II :**  $a = 3q + 1$

If  $a = 3q + 1$  then

$a(a + 1)(a + 2) = (3q + 1)(3q + 2)(3q + 3)$   
 $= (2r)(3)(q + 1)$   
 $= 6r(q + 1)$

which is divisible by 6.

**Case III :**  $a = 3q + 2$

If  $a = 3q + 2$  then

$a(a + 1)(a + 2) = (3q + 2)(3q + 3)(3q + 4)$   
 $= 3(3q + 2)(q + 1)(3q + 4)$

Here  $(3q + 2)$  and  $= 3(3q + 2)(q + 1)(3q + 4)$   
 $=$  multiple of 6 every  $q$   
 $= 6r$  (say)

which is divisible by 6. Hence, the product of three consecutive integers is divisible by 6 and  $n^3 - n$  is also divisible by 3.

**35.** Solve the following pair of linear equations graphically:  $2x + 3y = 12$  and  $x - y = 1$

Find the area of the region bounded by the two lines representing the above equations and  $y$ -axis.

**Ans :** [Board Term-1 2012, Set-58]

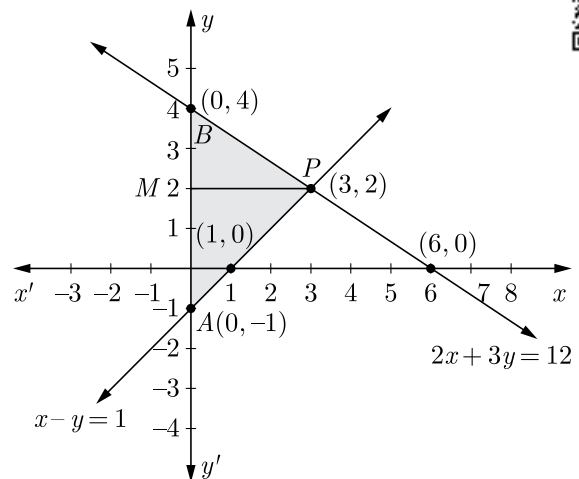
We have  $2x + 3y = 12 \Rightarrow y = \frac{12 - 2x}{3}$

<i>x</i>	0	6	3
<i>y</i>	4	0	2

We have  $x - y = 1 \Rightarrow y = x - 1$

<i>x</i>	0	1	3
<i>y</i>	1	0	2

Plotting the above points and drawing lines joining them, we get the following graph.



c128

Clearly, the two lines intersect at point  $p(3, 2)$ . Hence,  $x = 3$  and  $y = 2$

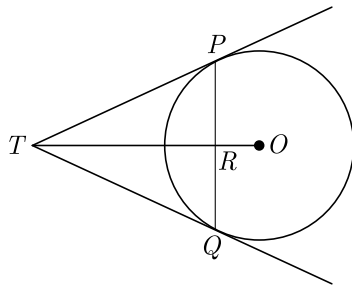
Area of shaded triangle region,

Area of  $\Delta PAB = \frac{1}{2} \times \text{base} \times \text{height}$   
 $= \frac{1}{2} \times AB \times PM$   
 $= \frac{1}{2} \times 5 \times 3$   
 $= 7.5$  square unit.

**36.** From a point  $T$  outside a circle of centre  $O$ , tangents  $TP$  and  $TQ$  are drawn to the circle. Prove that  $OT$  is the right bisector of line segment  $PQ$ .

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

A circle with centre  $O$ . Tangents  $TP$  and  $TQ$  are drawn from a point  $T$  outside a circle as shown in figure below.



Since length of tangents from an external point to a circle are equal,

$$TP = TQ$$

Angle  $\angle TPR$  and  $\angle TQR$  are opposite angle of equal sides, thus

$$\angle TPR = \angle TQR$$

Now in  $\Delta PTR$  and  $\Delta QTR$

$$TP = TQ$$

$$TR = TR \quad (\text{Common})$$

$$\angle TPR = \angle TQR$$

Thus  $\Delta PTR \cong \Delta QTR$

and  $PR = QR$

and  $\angle PRT = \angle QRT$

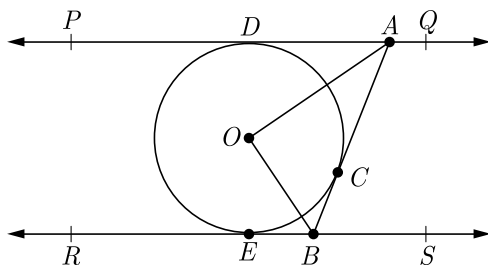
But  $\angle PRT + \angle QRT = 180^\circ$  as  $PQ$  is line segment,

$$\angle PRT = \angle QRT = 90^\circ$$

Therefore  $TR$  or  $OT$  is the right bisector of line segment  $PQ$ . Hence proved.

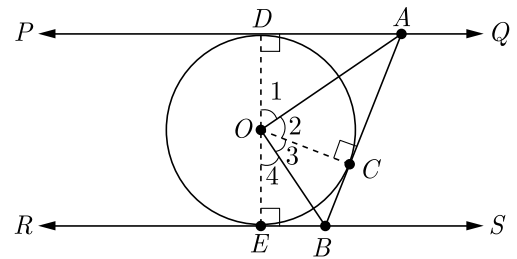
or

In Figure,  $PQ$  and  $RS$  are two parallel tangents to a circle with centre  $O$  and another tangent  $AB$  with point of contact  $C$  intersecting  $PQ$  at  $A$  and  $RS$  at  $B$ . Prove that  $\angle AOB = 90^\circ$ .



**Ans :** [Board 2019 OD STD, 2014, 2012]

We redraw the given figure as shown below.



In  $\Delta DOA$  and  $\Delta COA$ ,  $DA$  and  $AC$  are tangents drawn from common point,

Thus  $DA = AC$

Due to angle between tangent and radius,

$$\angle ODA = \angle OCA = 90^\circ$$

Due to radius of circle,

$$OD = OC$$

By SAS symmetry we have

$$\Delta DOA \cong \Delta COA$$

Hence, by CPCT,  $\angle 1 = \angle 2$

$$\text{i.e., } \angle DOA = \angle COA \quad \dots(1)$$

Similarly, by SAS

$$\Delta BOC \cong \Delta BOE$$

and by CPCT  $\angle 3 = \angle 4$

$$\text{i.e., } \angle COB = \angle BOE \quad \dots(2)$$

Now, angles on a straight line,

$$\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180^\circ$$

From equation (1) and (2) we have

$$2\angle 2 + 2\angle 3 = 180^\circ$$

$$\angle 2 + \angle 3 = 90^\circ$$

$$\text{i.e., } \angle AOC + \angle BOC = 90^\circ$$

$$\text{or } \angle AOB = 90^\circ \quad \text{Hence Proved}$$

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