Total No. of Questions : 26] [Total Printed Pages : 3

Mathematics-10th

Time : 3 Hrs.] **[M.M. : 100**

Instructions : 1. All questions are compulsory. 2. Q.1 to Q. 5 are objective type questions carry 5 marks. 3. Q. No. 6 to 26 have internal choice. 4. Q. No. 6 to 10 carry 2 marks. 5. Q. No. 11 to 14 carry 3 marks. 6. Q. No. 15 to 21 carry 4 marks. 7. Q. No. 22 to 26 carry 5 marks.

Section A

Q.1. Choose the correct answer : 5

(1) The zeroes of the polynomial $x^2 + 3x - 10$ are

(a) both positive (b) both negative

(c) One positive and one negative

(d) both equal.

(2) In a pair of linear equations in two variables is consistent, then lines representing it are :

(a) always intersecting

(b) always coincident

(c) Parallel

(d) Intersecting or concident

(3) If $\text{Cos}\theta = \frac{1}{2}$, then the value of $\frac{\cot\theta + \tan\theta}{\text{cosec}\theta}$ is :

(a) 1 (b) 3 (c) 4 (d) 2

(4) The angle of depression of an object viewed is the angle formed by the line of sight with the

(a) vertical when it is above the horizontal level.

(b) horizontal when it is above the horizontal level.

(c) vertic when it is below the horizontal level.

(d) horizontal when it is below the horizontal

(5) PQ is a tangent to a circle at point P, centre of circle is O. If ΔOPQ is an isosceles triangle, the $\angle QOP$ is

(a) 30° (b) 60° (c) 45° (d) 90°

Q.2. Fill in the blanks : 5

(1) The roots of the quadratic equation $x^2 - 2x + 1 = 0$ are ..... .

(2) If $\tan x = \sin 45^\circ \cos 45^\circ + \sin 30^\circ$ then x equals ..... .

(3) A circle can have .... paralled tangents at the most.

(4) The mean of first ten odd natural numbers is ....

(5) The probability of getting a prime number in a single throw of a die is ....

Q.3. Match the columns : 5

	(A)		**(B)**
(1)	Two consecutive positve integers	(a)	$s = \frac{n}{2}(a+l)$
(2)	The sum of all terms of the A.P.	(b)	$\tan^4 A + \tan^2 A$
(3)	Distance between (a, b) (–a, –b)	(c)	$x, x+2$
(4)	$\sec^4 A - \sec^2 A$ is equal to	(d)	$\pi(r_1 + r_2)\ \ell$
(5)	Curved surface area of the frustum of a cone	(e)	$2\sqrt{a^2 + b^2}$

Q.4. Answer in one word/one sentence : 5

(1) The sum of digit number is 9. If the digits of the number are interchanged, then the obtained number is increased by 9. What is the number?

(2) For what value of P are 2 P + 1, 13, 5P – 3 three consecutive terms of an AP?

(3) If $\cos\theta = \frac{a}{2}$, then what is the value cosecθ?

(4) Find the perimeter of a quadrant of a circle of radius 7 cm.

(5) Which is not a measure of central tendency?

Q.5. Write True or False : 5

(1) The HCF of given numbers is not greater than any of the numbers.

(2) The zeroes of the polynomial $x^2 + 22x + 105$ are both negative.

(3) Two figures having the same shape but not necessarily the same size are called similar figures.

(4) Sin (A+B) = Sin A + Sin B

(5) Area of a sector of a circle with radius r and angle with degrees measure $\theta = \frac{\theta}{360^\circ} \times \pi r^2$

Section B

Q.6. Find the LCM and HCF of 8, 9 and 25 integeres by applying the prime factorisation method. 2

OR

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

Q.7. If the sum of the zeroes of the 2 polynomial $p(x) = (k^2 - 14)x^2 - 2x - 4$ is 1, then find the value of k. 2

OR

Q. Find the zeroes of the polynomial $x^2 - 3$ and verify the relationship between the zeroes and the coefficients.

Q.8. Find the distance between the (2, 3), (4, 1) pairs of points. 2

OR

Q. Find the relationship between x and y, if the points (x, y), (1, 2) and (7, 0) are collinear.

Q.9. If P(E) = 0.05, what is the probability of not `E'? 2

OR

A bag contains lemon flavoured candies only Malini takes out one candy without looking into the bag. What is the probability that she takes out an orange flavoured candy?

Q.10. Have this experiment equally likely outcomes? Explain. 2

A player attempts to shoot a basketball. She/he shoots or misses the shot.

OR

Q. Suppose you drop a die at random on the rectangular region shown in the figure below. What is the probability that it will land inside the circle with diameter 1 m?

Q.11. Find the coordinates of the points of trisection of the line segment joining (4, –1) and (–2, –3). 3

OR

Find the area of rhombus if its vartices are (3, 0), (4, 5), (–1, 4) and (–2, –1) takes in order.

Q.12. If ∠A and ∠B are acute angles such that cos A = Cos B, then show that ∠A = ∠B. 3

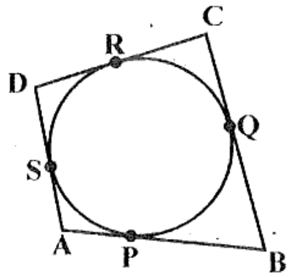
OR

If sec 4 A = cosec (A – 20°), where 4A is an acute angle, find the value of A.

Q.13. Two concentric circles are or raddii 5 cm and 3 cm. Find the length of the chord of the larger circle. Which touches the smallesr circle. 3

OR

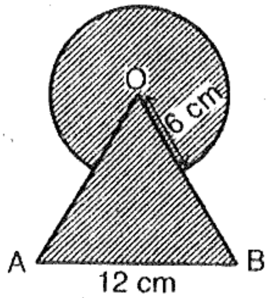
A quadrilateral ABCD is drawn to circumscribe a circle (See figure).



Prove that

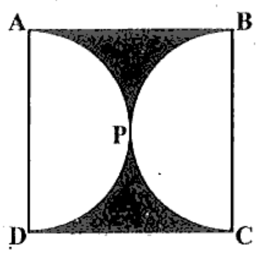
AB + CD = AD + BC

Q.14. Find the area of the shaded region in the figure, where a circular are of radius 6 cm has been drawn with vertex O of an equilateral triangle OAB of side 12 cm as centre. 3



OR

Q. Find the area of the shaded region in the figure, If ABCD is a square of side 14 cm and APD and BPC are semicircles.



Q.15. Prove that the $6 + \sqrt{2}$ is irrational. 4

OR

Prove that $n^2 - n$ divisible by 2 for every positive integer n.

Q.16. If two zeroes of the polynomial $x^4 - 6x^3 - 26x^2 + 138x - 35$ are $2 \pm \sqrt{3}$ find other zeroes. 4

OR

On dividing the polynomial $2x^3 + 4x^2 + 5x + 7$ by a polynomial g(x), the quotient and the remainder were 2x and 7–5 x respectively.

Find g(x).

Q.17. The coach of a cricket team buys 7 bats and 6 balls for Rs. 3,800. Later, she buys 3 bats and 5 balls for Rs. 1750. Find the cost of each bat and each balls. By substitution method. 4

OR

Q. A train covered a certain distance at a uniform speed. If the train would have been 10 km/h faster, it would have taken 2 hours less than the scheduled time. And, if the train were

slower by 10 km/h, it would have taken 3 hours more than the scheduled time. Find the distance covered by the train.

Q.18. How many terms of the AP : 9, 17, 25, ... must be taken to give a sum of 636? 4

OR

Q. The sum of the third and the seventh terms of an AP is 6 and their product is 8. Find the sum of first sixteen terms of the A.P.

Q.19. If AD and PM are medians of triangles ABC and PQR respectively, where ⇒ $\Delta ABC \sim PQR$, Prove that $\frac{AB}{PQ} = \frac{AD}{PM}$ 4

OR

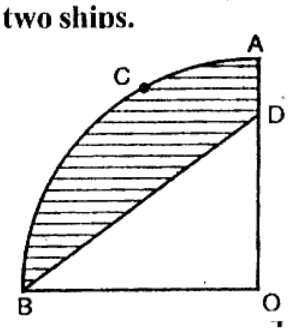
Q. If the area of two similar triangles are equal, prove that they are congruent.

Q.20. From a point on the ground the angles of elevation of the bottom and top of a transmission tower fixed of the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower. 4

OR

As observed from the top of a 75 m tall light house, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same side of the light house, find the distance between the two ships.

Q.21. In the figure, OACB is a quadrant of a circle with centre O and radius 3.5 cm. If OD = 2 cm, find the area of the (i) quadrant OACB, (ii) shaded region. 4



OR

Q. A chord of a circle of radius 12 cm subtends an angle of 120° at the centre. Find the area of the corresponding segment of the circle.

Q. 22. Is the following situation possible? If so, determine their present ages. 5

The sum of the ages of two friends is 20 years. Foru years ago, the product of their ages in years was 48.

OR

Sum of the areas of two squares is $468 m^2$. If the difference of their perimeters is 24 m, find the sides of the two squares.

Q.23. Write the other trigonometric ratios of A in terms of Sec A. 5

OR

Prove that : (Sec A + tan A) (1 – sin A), = cos A

Q.24. Draw a circle of radius 6 cm. from a point 10 cm away from its centre, construct the pair of tangents to the circle and measure their lengths. 5

OR

Draw a circle with the help of a bangle. Take a point outside the circle. Construct the pair of tangents from this point to the circle.

Q.25. A former connects a pipe of internal diameter 20 cm from a canal into a cylindrical tank in his field, which is 10 m diameter and 2 m deep. If water flows through the pipe at the rate of 3 km/h, in how much time will the tank be filled? 5

OR

Derive the formula for the volume of the fustum of a cone using the symbols as explained.

Q. 26. The table below shows the daily expenditure on food of 25 house holds in a locality. 5

Daily expenditure (in Rs.)	100–150	150–200	200–250	250–300	300–350
No. of households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

OR

Q. The following frequency distribution give the monthly consumption of electricity of 68 consumers of a locaity. Find the median, mean and mode of the data and compare them.

Monthly consumption (in units)	Number of consumers
65–85	4
85–105	5
105–125	13
125–145	20
145–165	14
165–185	8
185–205	4

Answer : GBI / MAE S3

Section A

Ans. 1. (1) (c), (2)–(d), 3. (d), 4. (d), 5.(c)

Ans.2. (1) 1, 1, (2) 45°, (3) two, (4) 10, (5) $\frac{1}{2}$

Ans.3. 1. (c), 2. (a), 3. (e), 4. (b), 5. (d)

Ans.4. (1) 45, (2) 4, (3) $\frac{b}{\sqrt{b^2 - a^2}}$ (4) 25 cm, (5) Range.

Ans. 5.(1) True, (2) False (3) True (d) False (5) True.

Section B

Q.6. Find the LCM and HCF of 8, 9 and 25 integeres by applying the prime factorisation method. **2**

Ans. First we find the prime factorisation

$8 = 1 \times 2 \times 2 \times 2 = 2^3$

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

$25 = 1 \times 5 \times 5 = 5^2$

L.C.M. = .$8 \times 9 \times 25 = 1800$

H.C.F. = 1

OR

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

Sol. We have $7 \times 11 \times 13 + 13$

$= 13 \times (7 \times 11 + 1)$

$= 13 \times (77 + 1) = 13 \times 78$

Therefore it is a composite number.

Again we have $7 \times 6 \times 5 \times 4 \times 3 \times 1 + 5$

$= 5 \times (7 \times 6 \times 4 \times 3 \times 1 + 1)$

So, it is a composite number.

Q.7. If the sum of the zeroes of the 2 polynomial $p(x) = (k^2 - 14)x^2 - 2x - 4$ is 1, then find the value of k. **2**

Sol. Comparing the polynomial p(x) with $ax^2 + bx + c$, we have

$a = k^2 - 14, b = -2, c = -4$

Now, Sum of zeroes = 1

then, $\frac{-b}{a} = 1$

and $\frac{2}{k^2 - 14} = 1 \Rightarrow k^2 - 14 = 2$

$k^2 = 2 + 14 = 16$

$k = \pm 4$

OR

Q. Find the zeroes of the polynomial $x^2 - 3$ and verify the relationship between the zeroes and the coefficients.

Sol : We know that, $a^2 - b^2 = (a + b)(a - b)$

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

So, the value of $x^2 - 3$ is zeroes when $x = \sqrt{3}$ or $x = \sqrt{3}$

Therefore, the zeroes of $x^2 - 3$ are $\sqrt{3}$ and $-\sqrt{3}$,

Now,

Sum of zeroes $= \sqrt{3} - \sqrt{3} = 0$

$$= \frac{-(\text{coefficient of } x)}{\text{coefficient of } x^2}$$

Product of zeroes $= (\sqrt{3})(-\sqrt{3}) = -3 = \frac{-3}{1}$

$$= \frac{\text{cos tent term}}{\text{coefficient of } x^2}$$

Q.8. Find the distance between the (2, 3), (4, 1) pairs of points. **2**

Sol. (i) Let P(2, 3) and Q(4, 1) be the given points.

Here, $x_1 = 2, y_1 = 3$ and $x_2 = 4, y_2 = 1$.

$\therefore \quad PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

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

$\Rightarrow \quad PQ = \sqrt{4+4} = \sqrt{8} = 2\sqrt{2}$

OR

Q. Find the relationship between x and y, if the points (x, y), (1, 2) and (7, 0) are collinear.

Sol. The points A(x, y), B(1, 2) and C(7, 0) will be collinear, if

$x(2 - 0) + 1(0 - y) + 7(y - 2) = 0$

$\Rightarrow \quad 2x - y + 7y - 14 = 0$

$\Rightarrow \quad 2x + 6y - 14 = 0$

$\Rightarrow \quad x + 3y - 7 = 0$

which is the required relation between x and y.

Q.9. If P(E) = 0.05, what is the probability of not `E'? **2**

Sol. Since $P(E) + P(\text{not } E) = 1$, therefore

$P(\text{not } E) = 1 - P(E) = 1 - 0.05 = 0.95$

OR

A bag contains lemon flavoured candies only Malini takes out one candy without looking into the bag. What is the probability that she takes out an orange flavoured candy?

Sol. (i) Since no outcome gives an orange flavoured candy, therefore it is an impossible events. So, its probability is 0.

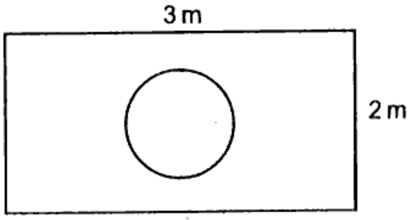
Q.10. Have this experiment equally likely outcomes? Explain. **2**

A player attempts to shoot a basketball. She/he shoots or misses the shot.

Sol. In this experiment "We are not justified to assume that each outcome is as likely to occur as the other. Thus, the experiment has no equally likely outcomes.

OR

Q. Suppose you drop a die at random on the rectangular region shown in the figure below. What is the probability that it will land inside the circle with diameter 1 m?



Sol. Total area of the figure, i.e., rectangle = 3 m × 2 m = 6 m²

$$\text{Area of the circle} = \pi r^2 = \pi\left(\frac{1}{2}m\right)^2 = \frac{\pi}{4}\ m^2$$

$\therefore$ Probability (die to land inside the circle)

$$= \frac{\pi/4}{6} = \frac{\pi}{24}$$

Q.11. Find the coordinates of the points of trisection of the line segment joining (4, –1) and (–2, –3). **3**

Sol. Let P and Q be the points of trisection of the line segment joining A(4, –1) and B(–2, – 3). Then, AP = PQ = QB = k (say). Then

$$PB = PQ + QB = 2k$$

and $AQ = AP + PQ = 2k$

$\Rightarrow\quad AP : PB = k : 2k = 1 : 2$

and $AQ : QB = 2k : k = 2 : 1$

Thus, P divides AB internally in the ratio 1 : 2, while Q divides AB internally in the ratio 2 : 1. Thus, the coordinates of P are

$$\left(\frac{1\times(-2)+2\times 4}{1+2}, \frac{1\times(-3)+2\times(-1)}{1+2}\right)$$

$$= \left(\frac{-2+8}{3}, \frac{-3-2}{3}\right)$$

$$= \left(2, \frac{-5}{3}\right)$$

and the coordinates of Q are

$$\left(\frac{2\times(-2)+1\times 4}{2+1}, \frac{2\times(-3)+1\times(-1)}{2+1}\right)$$

$$= \left(\frac{-4+4}{3}, \frac{-6-1}{3}\right)$$

$$= \left(0, \frac{-7}{3}\right)$$

Therefore, the two points of trisection are

$$\left(2, \frac{-5}{3}\right) \text{ and } \left(0, \frac{-7}{3}\right)$$

OR

Find the area of rhombus if its vartices are (3, 0), (4, 5), (–1, 4) and (–2, –1) takes in order.

Sol. Suppose A(3, 0), B(4, 5), C(–1, 4) and D(–2, – 1) be the vertices of the rhombus ABCD.

$$\text{Diagonal } AC = \sqrt{(-1-3)^2+(4-0)^2}$$

$$= \sqrt{16+16} = 4\sqrt{2}$$

$$\text{and diagonal } BD = \sqrt{(-2-4)^2+(-1-5)^2}$$

$$= \sqrt{36+36} = 6\sqrt{2}$$

$\therefore$ Area of the rhombus ABCD

$$= \frac{1}{2} \times (\text{Product of lengths of diagonals})$$

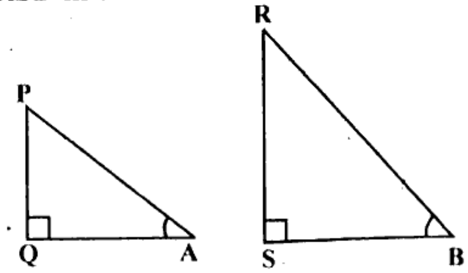
$$= \frac{1}{2} \times AC \times BD$$

$$= \frac{1}{2} \times 4\sqrt{2} \times 6\sqrt{2} \text{ sq. units}$$

= 24 sq. units

Q.12. If ∠A and ∠B are acute angles such that cos A = Cos B, then show that ∠A = ∠B. **3**

Sol. Let us consider two right triangles PQA and RSB in which cos A = cos B



We have :

$$\cos A = \frac{QA}{PA}$$

$$\text{and } \cos B = \frac{SB}{RB}$$

Thus, it is given that

$$\frac{QA}{PA} = \frac{SB}{RB}$$

So, $\frac{QA}{SB} = \frac{PA}{RB} = k$ (say) ...(1)

Now, by Pythagoras Theorem,

$$PQ = \sqrt{PA^2 - QA^2}$$

and $$RS = \sqrt{RB^2 - SB^2}$$

$$\Rightarrow \quad \frac{PQ}{RS} = \frac{\sqrt{PA^2 - QA^2}}{\sqrt{RB^2 - SB^2}}$$

$$= \frac{\sqrt{k^2RB^2 - k^2SB^2}}{\sqrt{RB^2 - SB^2}}$$

$$\Rightarrow \quad \frac{PQ}{RS} = \frac{k\sqrt{RB^2 - SB^2}}{\sqrt{RB^2 - SB^2}} = k$$

..(2)

Therefore, from (1) and (2), we have :

$$\frac{QA}{SB} = \frac{PA}{RB} = \frac{PQ}{RS}$$

Hence, $\Delta PQA \sim \Delta RSB$ [SSS similarity]

Therefore, $\angle A = \angle B$

[Corresponding angles]

OR

If sec 4 A = cosec (A – 20°), where 4A is an acute angle, find the value of A.

Sol. Given that

$$\sec 4A = \text{cosec}\,(A - 20^\circ). \quad ...(1)$$

$\Rightarrow \text{cosec}\,(90^\circ - 4A) = \text{cosec}\,(A - 20^\circ)$

$\{\because \text{Sec}\,4A = \text{cosec}\,(90 - 4A)\}$

Since $(90^\circ - 4A)$ and $(A - 20^\circ)$ are both acute angles, therefore

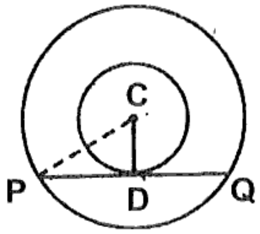
$$90^\circ - 4A = A - 20^\circ$$

$\Rightarrow \quad -4A - A = -20^\circ - 90^\circ$

$\Rightarrow \quad -5A = -110^\circ \Rightarrow A = 22^\circ$

Q.13. Two concentric circles are or raddii 5 cm and 3 cm. Find the length of the chord of the larger circle. Which touches the smallesr circle. 3

Sol. Let C be the common centre of two concentric circles, and let PQ be a chord of the larger circle touching the smaller circle at D.



Join CD.

Since CD is the radius of the smaller circle and PQ is tangent to this circle at D therefore

$CD \perp PQ$

We know that the perpendicular drawn from the centre of a circle to any chord of the circle bisects the chord.

So, $CD \perp PQ$ and $PD = DQ$

In right Δ PDC we have :

$$CP^2 = PD^2 + DC^2$$

or $5^2 = PD^2 + 3^2$

or $PD^2 = 5^2 - 3^2$

$= 25 - 9 = 16$

or $PD = \sqrt{16} = 4$

Now, $PQ = 2PD$ $[\because AP = BP]$

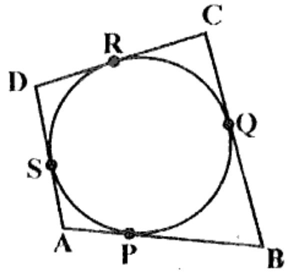
$= 2 \times 4 = 8$

Hence, the length of the chord of the larger circle which touches the smaller circle is 8 cm.

OR

A quadrilateral ABCD is drawn to circumscribe a circle (See figure).

Prove that AB + CD = AD + BC



Sol. Suppose the quadrilateral ABCD be drawn to circumscribe a circle as shown in figure.

Since lengths of two tangents drawn from an external point to a circle are equal, therefore

AP = AS ...(1)

BP = BQ ...(2)

DR = DS ...(3)

CR = CQ ...(4)

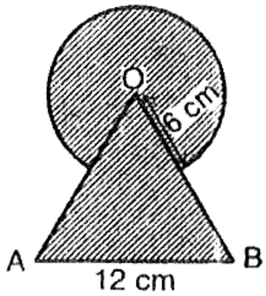
Adding (1), (2), (3), (4) we have

(AP + BP) + (CR + RD) = (BQ + QC) + (DS + SA)

$\Rightarrow$ AB + CD = BC + DA

Hence proved

Q.14. Find the area of the shaded region in the figure, where a circular are of radius 6 cm has been drawn with vertex O of an equilateral triangle OAB of side 12 cm as centre. 3



Sol. Area of the circular portion

= Area of the circle – Area of the sector

$$= \pi r^2 - \frac{60^\circ}{360^\circ}\pi r^2 = \pi r^2\left(1 - \frac{1}{6}\right)$$

$$= \frac{5}{6}\pi r^2,$$

$$= \left(\frac{5}{6}\times\frac{22}{7}\times 36\right)\ \text{cm}^2 = \frac{660}{7}\ \text{cm}^2$$

{r = 6 cm},

Also, Area of the equilateral Δ OAB

$$= \frac{\sqrt{3}}{4}\ (\text{side})^2 = \left(\frac{\sqrt{3}}{4}\times 144\right)\ \text{cm}^2$$

{side = 12 cm }

$$= 36\sqrt{3}\ \text{cm}^2$$

∴ Area of the shaded region

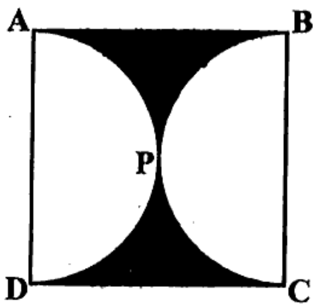
= Area of circular portion

+ Area of the equilateral triangle

$$= \left(\frac{660}{7} + 36\sqrt{3}\right)\ \text{cm}^2$$

OR

Q. Find the area of the shaded region in the figure, If ABCD is a square of side 14 cm and APD and BPC are semicircles.



Sol. Area of the square

ABCD = $(14)^2$ cm²

= 196 cm²

Diameter of the semicircles = AD or BC = 14 cm

∴ Radius of each semicircle = $\frac{14}{2}$ cm = 7 cm

∴ Area of the both semicircular regions

$$= 2\times\frac{1}{2}\pi r^2 = \pi r^2$$

$$= \left(\frac{22}{7}\times 49\right)\ \text{cm}^2 = 154\ \text{cm}^2$$

∴ Area of the shaded regions

= Area of the square ABCD

– Area of the both semicircular regions

= (196 – 154) cm² = 42 cm².

Q.15. Prove that the $6+\sqrt{2}$ is irrational.4

Sol. (iii) Suppose to the contrary, that $6+\sqrt{2}$ is rational.

Then $6+\sqrt{2} = \frac{p}{q}$

Where p and q are integers, q ≠ 0

$$\Rightarrow 6 - \frac{p}{q} = \sqrt{2}$$

$$\Rightarrow \sqrt{2} = 6 - \frac{p}{q}$$

Since p and q are integers, we get $6 - \frac{p}{q}$ is rational, and so $\sqrt{2}$ is rational.

OR

Prove that $n^2 - n$ divisible by 2 for every positive integer n.

Sol. Let n be a positive integer. Then,

n = 2q or 2q + 1

Wher q is some integer.

Now, when n = 2q

then, $n^2 - n = (2q - 1)$

$= 2q(2q - 1)$

$= 2q'$ where q 1 = q(2q – 1)

And, n = 2q + 1

then, $n^2 - n = n(n - 1)$

$= 2q + 1)(2q + 1 - 1)$

$= 2q(2q + 1)$

$= 2q'$, where $q' = q(2q + 1)$

∴ $n^2 - n$ is divisible by 2

Therefore, $n^2 - n$ is divisible by 2 for every positive integer n.

Q.16. If two zeroes of the polynomial $x^4 - 6x^3 - 26x^2 + 138x - 35$ are $2 \pm\sqrt{3}$ find other zeroes. 4

Sol. It is given that $2\pm\sqrt{3}$ are two zeroes of the polynomial $p(x) = x^4 - 6x^3 - 26x^2 + 138x - 35$

Let $x = 2\pm\sqrt{3}$ Then $x - 2 = \pm\sqrt{3}$

On Squaring, we have

$x^2 - 4x + 4 = 3, \Rightarrow x^2 - 4x + 1 = 0$

We have

$$x^2 - 2x - 35$$

$$x^2 - 4x + 1 \,\big)\ x^4 - 6x^3 - 26x^2 + 138x - 35$$

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

$$-\quad +\quad -$$

$$-2x^3 - 27x^2 + 138x$$

$$-2x^3 + 8x^2 - 2x$$

$$+\quad -\quad +$$

$$-35x^2 + 140x - 35$$

$$-35x^2 + 140x - 35$$

$$+\quad -\quad +$$

$$0$$

$$\therefore\ p(x) = x^4 - 6x^3 - 26x^2 + 138x - 35$$

$$= (x^2 - 4x + 1)(x^2 - 2x - 35)$$

$= (x^2 - 4x + 1)(x^2 - 7x + 5x - 35)$

$= (x^2 - 4x + 1)(x(x-7) + 5t(x-7)]$

$= (x^2 - 4x + 1)(x+5)(x-7)$

So, (x+5) and (x–7) are other factors of p(x).

$\therefore$ – 5 and 7 are other zeroes of the given polynomial.

OR

On dividing the polynomial $2x^3 + 4x^2 + 5x + 7$ by a polynomial g(x), the quotient and the remainder were 2x and 7–5 x respectively.

Find g(x).

Sol. By division algorithm for polynomials,

dividend = divisor x quotient + remainder

$2x^3 + 4x^2 + 5x + 7 = \{g(x)\}(2(x)) + (7-5x)$

$g(x) \times 2(x) = 2x^3 + 4x^2 + 5x + 7 - (7 - 5x)$

$g(x) \times 2(x) = 2x^3 + 4x^2 + 5x + 7 - 7 + 5x$

$g(x) \times 2(x) = 2x^3 + 4x^2 + 10x$

$g(x) \times 2(x) = (2x)(x^2 + 2x + 5)$

$g(x) = x^2 + 2x + 5$

Q.17. The coach of a cricket team buys 7 bats and 6 balls for Rs. 3,800. Later, she buys 3 bats and 5 balls for Rs. 1750. Find the cost of each bat and each balls. By substitution method.4

Sol. Suppose the cost of one bat and one ball be Rs x and Rs y respectively. Then,

$7x + 6y = 3800$ ....(1)

and $3x + 5y = 1750$ ....(2)

From (2), $5y = 1750 - 3x$ or $y = \frac{1750 - 3x}{5}$

Substituting $y = \frac{1750 - 3x}{5}$ in (1), we get

$7x + 6\left(\frac{1750 - 3x}{5}\right) = 3800$ or $35x + 10500 - 18x = 19000$

$\Rightarrow$ $17x = 19000 - 10500$ or $17x = 8500$

$\Rightarrow$ $x = \frac{8500}{17} = 500$

Putting $x = 500$ in (2), we get

$3(500) + 5y = 1750 \Rightarrow 5y = 1750 - 1500$

$\Rightarrow$ $5y = 250 \Rightarrow y = \frac{250}{5} = 50$

Therefore the cost of one bat is Rs 500 and the cost of one ball is Rs 50.

OR

Q. A train covered a certain distance at a uniform speed. If the train would have been 10 km/h faster, it would have taken 2 hours less than the scheduled time. And, if the train were slower by 10 km/h, it would have taken 3 hours more than the scheduled time. Find the distance covered by the train.

Sol. Suppose the original speed of the train be x km/h and the time taken to complete the journey be y hours.

Then, the distance covered = xy km

Case I : When speed = (x+10) km/h

and time taken = (y–2) hours

In this case, distance = (x+10) (y–2)

$\Rightarrow$ $xy = (x+10)(y-2)$

$\Rightarrow$ $xy = xy - 2x + 10y - 20$

$\Rightarrow$ $2x - 10y + 20 = 0$ ..(1)

Case II : When speed = (x–10) km/h

and tiem taken = (y+3) hours

In this case, distance = (x–10) (y+3)

$\Rightarrow$ $xy = (x-10)(y+3)$

$\Rightarrow$ $xy = xy + 3x - 10y - 30$

$\Rightarrow$ $3x - 10y - 30 = 0$ ..(2)

Subtracting (1) from (2), we have

$x - 50 = 0$ or $x = 50$

Putting x = 50 in (1), we have

$100 - 10y + 20 = 0 \Rightarrow -10y = -120$

$\Rightarrow$ $y = 12$

$\therefore$ The original speed of the train = 50 km/h

The time taken to complete the journey = 12 hours

$\therefore$ The length of the journey = Speed × Time

$= (50 \times 12)$ km

$= 600$ km

Q.18. How many terms of the AP : 9, 17, 25, ... must be taken to give a sum of 636? 4

Sol. Suppose the first term be a = 9 and common difference be d = 17 – 9 = 8. Suppose the sum of n terms be 636. Then,

$S_n = 636$

$\Rightarrow \frac{n}{2}[2a + (n-1)d] = 636$

$\Rightarrow \frac{n}{2}[2 \times 9 + (n-1)8] = 636$

$\Rightarrow \frac{n}{2}(18 + 8n - 8) = 636$

$\Rightarrow \frac{n}{2}(8n + 10) = 636$

$\Rightarrow n(4n + 5) = 436 \Rightarrow 4n^2 + 5n - 636 = 0$

$\therefore \quad n = \frac{-5 \pm \sqrt{25 - 4 \times 4 \times (-636)}}{2 \times 4}$

$n = \frac{-5 \pm \sqrt{25 + 10176}}{8} = \frac{-5 \pm \sqrt{10201}}{8}$

$$n=\frac{-5\pm 101}{8}=\frac{96}{8},\frac{-106}{8}$$

$$n=12,\ \frac{-53}{4}$$

Since in cannot be negative, therefore

n = 12.

Thus, the sum of 12 terms is 636.

Q. The sum of the third and the seventh terms of an AP is 6 and their product is 8. Find the sum of first sixteen terms of the A.P.

Sol. Suppose the AP be a – 4d, a – 3d, a – 2d, a – d, a, a + d, a + 2d, a + 3d, ..

Then, $a_3 = a - 2d,\ a_7 = a - 2d$

So, $a_3 + a_7 = a - 2d + a - 2d = 6$

$\Rightarrow$ $2a = 6$ or $a = 3$ ...(1)

Also, $(a - 2d)(a + 2d) = 8$

So, $a^2 - 4d^2 = 8$ or $4d^2 = a^2 - 8$

$\Rightarrow$ $4d^2 = (3)^2 - 8 = 9 - 8 = 1$

$$\Rightarrow \quad d^2=\frac{1}{4}\Rightarrow d=\pm\frac{1}{2}$$

Taking $d=\frac{1}{2}$, we have

$$S_{16}=\frac{16}{2}\left[2\times(a-4d)+(16-1)\times d\right]$$

$$\Rightarrow \quad S_{16}=8\left[2\times\left(3-4\times\frac{1}{2}\right)+15\times\frac{1}{2}\right]$$

$$\Rightarrow \quad S_{16}=8\left[2+\frac{15}{2}\right]=8\times\frac{19}{2}=76$$

Taking $d=\frac{1}{2}$, we have

$$S_{16}=\frac{16}{2}\left[2\times(a-4d)+(16-1)\times d\right]$$

$$\Rightarrow S_{16}=8\left[2\times\left(3-4\times\left(-\frac{1}{2}\right)\right)+15\times\left(-\frac{1}{2}\right)\right]$$

$$\Rightarrow S_{16}=8\left[2\times 5-\frac{15}{2}\right]$$

$$\Rightarrow S_{16}=8\left[\frac{20-15}{2}\right]=8\times\frac{5}{2}=20$$

$\therefore S_{16}=20, 76$

Q.19. If AD and PM are medians of triangles ABC and PQR respectively, where $\Rightarrow$ ΔABC~PQR, Prove that $\frac{AB}{PQ}=\frac{AD}{PM}$ **4**

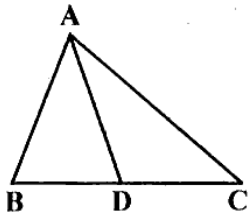
Sol. Given AD and PM are the medians of Δs ABC and PQR respectively, where

Δ ABC ~ Δ PQR

We have to Prove : $\frac{AB}{PQ}=\frac{AD}{PM}$

Proof : In Δs ABD and PQM, we have

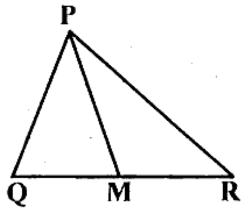
$\angle B = \angle Q$ [∵ Δ ABC ~ Δ PQR]



and $\frac{AB}{PQ}=\frac{\frac{1}{2}BC}{\frac{1}{2}QR}$

[Since AD and PM are the medians to BC and QR respectively and $\frac{AB}{PQ}=\frac{BC}{QR}$]

$\Rightarrow$ $\frac{AB}{PQ}=\frac{BC}{QR}$



∴ By SAS criterion of similarity,

Δ ABD ~ Δ PQM

$$\Rightarrow \quad \frac{AB}{PQ}=\frac{BD}{QM}=\frac{AD}{PM}\Rightarrow\frac{AB}{PQ}=\frac{AD}{PM}$$

OR

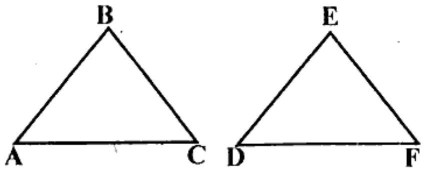
Q. If the area of two similar triangles are equal, prove that they are congruent.

Sol. Given : Two Δs ABC and DEF such that

Δ ABC ~ Δ DEF

andArea (Δ ABC) = ARea (Δ DEF)

We have to prove : Δ ABC ≅ Δ DEF



Prof : Δ ABC ≅ Δ DEF

$\Rightarrow \angle A = \angle D, \angle B = \angle E, \angle C = \angle F$

and $\frac{AB}{DE}=\frac{BC}{EF}=\frac{AC}{DF}$

To establish Δ ABC ≅ Δ DEF, it is sufficient to prove that

AB = DE, BC = EF and AC = DF

Now, Area (Δ ABC) = Area (Δ DEF)

$$\Rightarrow \frac{\text{area}(\Delta AOB)}{\text{area}(\Delta COD)}=1$$

$$\Rightarrow \frac{AB^2}{DE^2} = \frac{BC^2}{EF^2} = \frac{AC^2}{DF^2} = 1$$

$$\Rightarrow \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF} = 1$$

$\Rightarrow AB = DE, BC = EF, AC = DF$

Hence, $\Delta ABC \cong \Delta DEF$ [By SSS]

Q.20. From a point on the ground the angles of elevation of the bottom and top of a transmission tower fixed of the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower. 4

Sol. Let BC be the building of height 20 m and CD be the tower of height x metres.

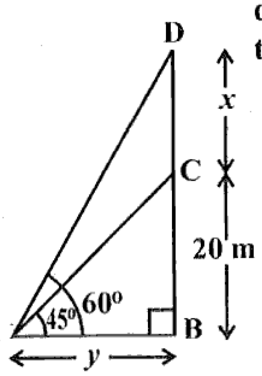
Let A be a point on the ground at a distance of y metres away from the foot B of the building.

In ΔABC, we have

$$\frac{BC}{AB} = \tan 45^\circ . \Rightarrow \frac{20}{y} = 1$$

$\Rightarrow$ y = 20 i.e., AB = 20 m

In ΔABD, we have



$$\frac{BD}{AB} = \tan 60^\circ$$

$$\Rightarrow \frac{20 + x}{20} = \sqrt{3}$$

$\Rightarrow 20 + x = 20\sqrt{3}$

$\Rightarrow x = 20(\sqrt{3} - 1)$

$\Rightarrow x = 20(1.732 - 1)$

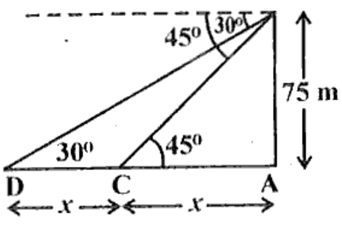
$= 20 \times 0.732 = 14.64$

Hence, the height of the tower is 14.64 metres.

OR

As observed from the top of a 75 m tall light house, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same side of the light house, find the distance between the two ships.

Sol. Suppose AB be the lighthouse of height 75 m and let two ships be at C and D such that their angles of depression from B are 45° and 30° respectively.



Suppose AC = x and CD = y.

In ΔABC, we have :

$$\frac{AB}{AC} = \tan 45^\circ.$$

$$\Rightarrow \frac{75}{x} = 1$$

$\Rightarrow x = 75$ ...(1)

in ΔABD, we have :

$$\frac{AB}{AD} = \tan 30^\circ \Rightarrow \frac{75}{x+y} = \frac{1}{\sqrt{3}}$$

$\Rightarrow x + y = 75\sqrt{3}$ ...(2)

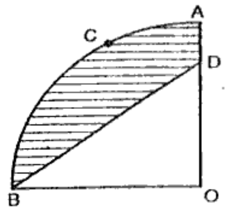
From (1) and (2), we have :

$75 + y = 75\sqrt{3} \Rightarrow y = 75(\sqrt{3} - 1)$

$\Rightarrow y = 75(1.732 - 1) = 75 \times 0.732 = 54.9$m

Hence, the distance between the two ships is 54.9 metres.

Q.21. In the figure, OACB is a quadrant of a circle with centre O and radius 3.5 cm. If OD = 2 cm, find the area of the



(i) quadrant OACB,

(ii) shaded region.

Sol. (i) Area of quadrant OACB

$$= \frac{1}{4}\pi r^2$$

$$= \frac{1}{4} \times \frac{22}{7} \times (3.5)^2 \text{ cm}^2 \quad \{\because r = 3.5\}$$

$$= \frac{1}{4} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \text{ cm}^2$$

$$= \frac{77}{8} \text{ cm}^2$$

(ii) Area of ΔAOD

$$= \frac{1}{2} \text{ Base} \times \text{Height}$$

$$= \frac{1}{2}(OB \times OD)$$

$$= \frac{1}{2}(3.5 \times 2) \text{ cm}^2$$

{OB = 3.5 cm OD = 2 cm

$$= \frac{7}{2} \text{ cm}^2$$

Hence, area of the shaded region

= Area of quadrant − Area of ΔBOD

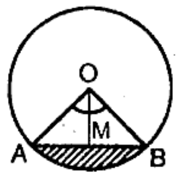
$$= \left(\frac{77}{8} - \frac{7}{2}\right) \text{cm}^2 = \left(\frac{77-28}{8}\right) \text{cm}^2$$

$$= \frac{49}{8} \text{ cm}^2 = 6.125 \text{ cm}^2$$

OR

Q. A chord of a circle of radius 12 cm subtends an angle of 120° at the centre.Find the area of the corresponding segment of the circle.

Sol. Here, r = 12 cm and θ = 120°



Area of the corresponding segment of the circle

= Area of the minor segmen..

= Area of sector OAB – Area of Δ OAB ...(1)

Now area of sector OAB

$$= \frac{120^o}{360^o} \times 3.14 \times 12^2 \text{ cm}^2 = 3.14 \times 48 \text{ cm}^2 \quad ...(2)$$

For area of Δ OAB, draw OM ⊥ AB. So, AM = BM and ∠AOM = ∠BOM = 60°

Now, $\frac{OM}{OA} = \cos 60^o$

$\Rightarrow \quad OM = OA \cos 60^o$

$\Rightarrow \quad OM = 2 \times \frac{1}{2} \text{ cm} = 6 \text{ cm.}$

Again, $\frac{AM}{OM} = \sin 60^o.$

$\Rightarrow \quad AM = OA \sin 60^o = 12 \times \frac{\sqrt{3}}{2} \text{ cm} = 6\sqrt{3} \text{ cm}$

$\Rightarrow \quad AB = 2AM = 2 \times 6\sqrt{3} \text{ cm} = 12\sqrt{3} \text{ cm}$

∴ area of Δ OAB

$$= \frac{1}{2} AB \times OM$$

$$= \frac{1}{2} \times 12\sqrt{3} \times 6 \text{ cm}^2$$

$$= 36\sqrt{3} \text{ cm}^2 \quad ...(3)$$

from (1), (2) and (3),

area of the minor segment

$= (3.14 \times 48 - 36\sqrt{3}) \text{ cm}^2$

$= (3.14 \times 48 - 36 \times 1.73) \text{ cm}^2$

$= 12(12.56 - 3 \times 1.73) \text{ cm}^2$

$= 12(12.56 - 5.19) \text{ cm}^2$

$= 12 \times 7.37 \text{ cm}^2$

$= 88.44 \text{ cm}^2$

Q. 22. Is the following situation possible? If so, determine their present ages. 5

The sum of the ages of two friends is 20 years. Foru years ago, the product of their ages in years was 48.

Sol. Suppose age of one of the friends = x years. Then, age of the other friend = 20 – x.

Four years ago,

age of one of the friends = (x – 4) years

and age of the other friend = (20 – x – 4) years = (16 – x) years

According to condition :

$$(x - 4)(16 - x) = 48$$

$$\Rightarrow 16x - x^2 - 64 + 4x = 48$$

$$\Rightarrow x^2 - 20x\ 112 = 0$$

Here, a = 1, b = – 20 and c = 112.

$$\therefore \quad D = b^2 - 4ac = (-20)^2 - 4 \times 1 \times 112 = 400 - 448 = -48 < 0$$

⇒ the given equation has no real roots.

Thus, the given situation is not possible.

OR

Sum of the areas of two suares is 468m². If the difference of their perimeters is 24 m, find the sides of the two squares.

Sol. Suppose the sides of the squares be x and y meters (x > y). According to question :

$$x^2 + y^2 = 468 \quad ...(1)$$

and $4x - 4y = 24$

i.e., $x - y = 6 \quad ...(2)$

Putting x = + 6 in (1), we have.

$$(y+6)^2 + y^2 = 468$$

$\Rightarrow \quad 2y^2 + 12y + 36 - 468 = 0$

$\Rightarrow \quad y^2 + 6y - 216 = 0$

$\Rightarrow \quad y^2 + 18y - 12y - 216 = 0$

$\Rightarrow \quad y(y+18) - 12(y+18) = 0$

$\Rightarrow \quad (y+18)(y-12) = 0$

$\Rightarrow \quad y = -18 \text{ or } y = 12$

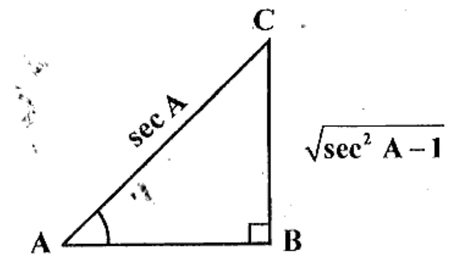
Since side cannot be negative, Therefore, y = 12.

$\therefore \quad x = y + 6 = 12 + 6 = 18$

∴ The sides of the squares are 18 m and 12 m.

Q.23. Write the other trigonometric ratios of A in terms of Sec A. 5

Sol. Consider a Δ ABC, in which ∠B = 90°. For ∠A, we have :



$$\therefore \quad \sec A = \frac{\text{Hyp}}{\text{Base}} = \frac{AC}{AB}$$

So, $\frac{AC}{AB} = \sec A = \frac{\sec A}{1}$

Let AB = 1 and AC = sec A

Then $BC = \sqrt{AC^2 - AB^2}$

$= \sqrt{\sec^2 A - 1}$

Now, $\sin A = \frac{BC}{AC} = \frac{\sqrt{\sec^2 A - 1}}{\sec A}$

$\cos A = \frac{AB}{AC} = \frac{1}{\sec A}$

$\tan A = \frac{BC}{AB} = \sqrt{\sec^2 A - 1}$

$\cot A = \frac{1}{\tan A} = \frac{1}{\sqrt{\sec^2 A - 1}}$

$\operatorname{cosec} A = \frac{1}{\sin A} = \frac{\sec A}{\sqrt{\sec^2 A - 1}}$

OR

Prove that : (Sec A + tan A) (1 – sin A), = cos A

Sol. $(\sec A + \tan A)(1 - \sin A)$

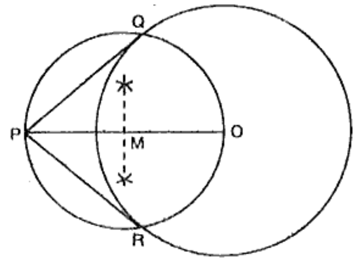
$= \left(\frac{1}{\cos A} + \frac{\sin A}{\cos A}\right)(1 - \sin A)$

$= \left(\frac{1 + \sin A}{\cos A}\right)(1 - \sin A)$

$= \frac{1 - \sin^2 A}{\cos A} = \frac{\cos^2 A}{\cos A} = \cos A$

Q.24. Draw a circle of radius 6 cm. from a point 10 cm away from its centre, construct the pair of tangents to the circle and measure their lengths. **5**

Sol. 1. First draw a circle of radius 6 cm. With O as centre



2. Mark a point P at a distance of 10 cm from the centre O.

3. Join O and P and bisect it. Let M be its mid–point of OP.

4. With M as centre and MP as radius, draw a circle which intersect the previous circle at Q and R.

5. Join PQ and PR. Then, PQ and PR are the required tangents.On measurement, PQ = PR = 8 cm.

Justification :

On joining OQ, we find that $\angle PQO = 90°$,

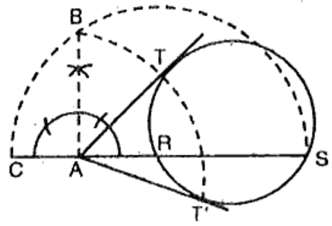
$\Rightarrow PQ \perp OQ$.

Since OQ is the radius of the givne circle, so PQ has to be a tangent to the circle.

OR

Draw a circle with the help of a bangle. Take a point outside the circle. Construct the pair of tangents from this point to the circle.

Sol. 1. First Draw a circle with the help of a bangle.



2. Draw a secant ARS from an external point A. Produce RA to C such that AR = AC.

3. Draw a semi–circle. with CS as diameter

4. At the point A, draw $AB \perp AS$, which is cutting the semi–circle at B.

5. Now draw an arc with A as centre and AB as radius, which intersect the given circle, in T and T'. Join AT and AT'. Then, AT and AT' are the required pair of tangents.

Q.25. A former connects a pipe of internal diameter 20 cm from a canal into a cylindrical tank in his field, which is 10 m diameter and 2 m deep. If water flows through the pipe at the rate of 3 km/h, in how much time will the tank be filled?

Sol. We have Diameter of the pipe = 20 cm

Radius of the pipe= 10 cm

Length of water column per hour = 3 km

$= 3 \times 1000 \times 100$ cm

$= 300000$ cm

Volume of water flown in one hour

$= \pi \times 100 \times 300000 \text{ cm}^3$

Tank to be filled = Volume of cylinder

(with r = 5 m = 500 cm and h = 2 m = 200 cm)

$= \pi \times 500 \times 500 \times 200 \text{ cm}^3$

time required to fill the tank

$$= \frac{\text{Volume of tank}}{\text{Volume of water flown}}$$

$$= \frac{\pi \times 500 \times 500 \times 200}{\pi \times 100 \times 300000} \text{ hours}$$

$= \frac{5}{3}$ hours $= 1\frac{2}{3}$ hours

= 1 hour 40 minutes

= (60 + 40) minutes = 100 minutes.

OR

Derive the formula for the volume of the fustum of a cone using the symbols as explained.

Sol. We have Volume of the frustum RPQS

= Volume of the right circular cone OPQ

– Volume of the right circular cone ORS

$= \frac{1}{3}\pi r_1^2 h_1 - \frac{1}{3}\pi r_2^2 h_2$

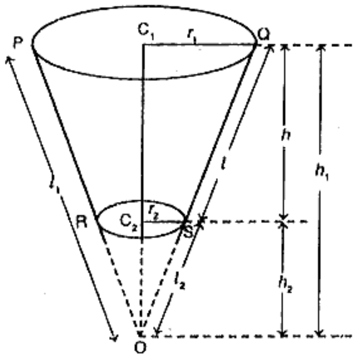
$= \frac{1}{3}\pi(r_1^2 h_1 - r_2^2 h_2)$ ...(1)

Now, since ΔOC_1Q and ΔOC_2S are similar, therefore

$$\frac{OQ}{OS} = \frac{QC_1}{SC_2} = \frac{OC_1}{OC_2}$$

$$\Rightarrow \frac{l_1}{l_2} = \frac{r_1}{r_2} = \frac{h_1}{h_2} \Rightarrow \frac{r_1}{r_2} = \frac{h + h_2}{h_2}$$

$$\Rightarrow \frac{r_1}{r_2} = \frac{h}{h_2} + 1 \Rightarrow \frac{h}{h_2} = \frac{r_1}{r_2} - 1$$



$$\Rightarrow h = \left(\frac{r_1}{r_2} - 1\right) h_2 = \left(\frac{r_1 - r_2}{r_2}\right) h_2 \text{ ...(2)}$$

Putting the value of h_1 in terms of r_1, r_2 and h_2 in eqn.

(1), we get

Volume of the frustum

$$= \frac{1}{3}\pi\left(r_1^2 \times \frac{r_1}{r_2} h_2 - r_2^2 h_2\right) = \frac{1}{3}\pi(r_1^3 - r_2^3)\frac{h_2}{r_2}$$

$$= \frac{1}{3}\pi(r_1^2 + r_2^2 + r_1 r_2)(r_1 - r_2)\frac{h_2}{r_2}$$

$$= \frac{1}{3}\pi(r_1^2 + r_2^2 + r_1 r^2)h \ \{\text{from (2)}\}$$

Q. 26. The table below shows the daily expenditure on food of 25 house holds in a locality. **5**

Daily expenditure (in Rs)	No. of households
100 – 150	4
150 – 200	5
200 – 250	12
250 – 300	2
300 – 350	2

Find the mean daily expenditure on food by a suitable method.

Sol. Let the assumed mean, A = 225, class size, h = 50. Then

$$u_i = \frac{x_i - A}{h} = \frac{x_i - 225}{50}$$

Daily expenditue (in Rs)	Mid–value (x_i)	Frequency (f_i)	$u_i = \frac{x_i - 225}{50}$	$f_i u_i$
100–150	125	4	–2	–8
150–200	175	5	–1	–5
200–250	225	12	0	0
250–300	275	2	1	2
300–350	325	2	2	4
Total		25		–7

$\because \quad \bar{x} = A + h\frac{\sum f_i u_i}{\sum f_i}$

$\therefore \quad \bar{x} = 225 + 50 \times \frac{-7}{25}$

$\Rightarrow \quad \bar{x} = 225 - 14 = 211$

Hence, the mean daily expenditure on food is ₹ 211.

OR

Q. The following frequency distribution give the monthly consumption of electricity of 68 consumers of a locaity.Find the median, mean and mode of the data and compare them.

Monthly consumption (in units)	Number of consumers
65– 85	4
85 – 105	5
105 – 125	13
125– 145	20
145 – 165	14
165 – 185	8
185 – 205	4

Sol. First, we prepare the table to compute the median :

Monthly consumption (in units)	Number of consumers i.e., frequency	Cumulative frequency
65 – 85	4	4
85 – 105	5	9
105 – 125	13	22
125–145	20	42
125 – 165	14	56
165 – 185	8	64
185 – 205	4	68
Total	68	

Here n = 68 $\therefore \frac{n}{2} = \frac{68}{2} = 34$ which is include in the comulative frequency, 42

So, 125 – 145 is the median class

$\therefore \frac{n}{2} = 34, l = 125$, c.f. = 22, f = 20 and h = 20.

$$\because \quad \text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h,$$

$$\therefore \quad \text{Median} = 125 + \left(\frac{34 - 22}{20}\right) \times 20$$

$\Rightarrow$ Median = 125 + 12 = 137 units

To calculate mean,

Let the assumed mean, A = 135 and class size, h = 20.

Then, $u_i = \frac{x_i - A}{h} = \frac{x_i - 135}{20}$

Class interval	Mid–value (x_i)	Freq–uency (f_i)	$u_i = \frac{x_i - 135}{20}$	$f_i u_i$
65 – 85	75	4	–3	–12
85 – 105	95	5	–2	–10
105 – 125	105	13	–1	–13
125 – 145	135	20	0	0
145 – 165	155	14	1	14
165 – 185	175	8	2	16
185 – 205	195	4	3	12
Total		68		7

$$\because \bar{x} = A + h \times \frac{\sum f_i u_i}{\sum f_i}, \bar{x} = 135 + 20 \times \frac{7}{68}$$

$\Rightarrow \quad \bar{x} = 135 + 2.05 = 137.05$

$\therefore$ Mean = 137.05 units

To calculate mode,

The class 125 – 145 has the maximum frequency. Therefore, this is the modal class.

Here, $l = 125$, h = 20, $f_1 = 20$, $f_0 = 13$ and $f_2 = 14$

$$\because \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$\therefore \text{Mode} = 125 + \frac{20 - 13}{40 - 13 - 14} \times 20$$

$$= 125 + \frac{7}{13} \times 20$$

$\Rightarrow$ Mode = 125 + 10.76 = 135.76

$\therefore$ Mode = 135.76 units