Grade 10 Kerala Mathematics 2022

TIME : $2\frac{1}{2}$Hours **Total Score : 80**

INSTRUCTIONS:

Read the following instructions carefully and follow them:

1. Read each question carefully before answering.
2. Give explanations wherever necessary.
3. First 15 minutes is cool-off time. You may use this time to read the questions and plan your answers.
4. No need to simplify irrationals like $\sqrt{2}$, $\sqrt{3}$, π etc, using approximations unless you are asked to do so.

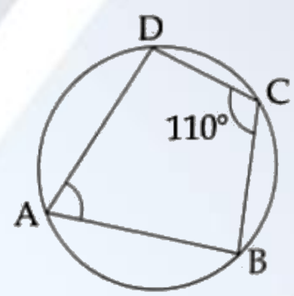
Questions from 1 to 10 carries 1 score each.
(A) Answer any 4 questions from 1 to 6 .

Q1. What is the common difference of the Arithmetic sequence 3,7,11, … ...

Solution:

d = 7 – 3 = 4 (Common Difference)

Q2.



In the figure $\angle C = 110°$. Find the measure of $\angle A$.

Solution:

$\angle A = 180° - 110° = 70°$(Sum of opposite angles in a cyclic quadrilateral = 180°)

Q3. A box contains 7 white balls and 3 black balls. If a ball is taken from it, what is the probability of it being black ?

Solution:

Total Number of balls = 10

Number of black balls = 3

The probability of drawing a black ball is: $\frac{3}{10}$

Q4. Find the distance between the points (0,0) and (4,0).

Solution:

Both the points (0,0) and (4,0) lies on x-axis so, the distance between them = $4 - 0 = 4$ units

Q5. From the circle of radius 12 centimetres, a sector of central angle 90° is cut out and made into a cone. What is the base radius of this cone?

Solution:

Arc length of the sector $= \frac{90^\circ}{360^\circ} \times 2\pi \times 12 = 6\pi$ cm.

Since this forms the base circumference of the cone, $2\pi R = 6\pi$.

Solving for R, we get $R = 3$ cm.

Q6. If $(x - 1)$ is a factor of the polynomial $\mathrm{p}(x)$, write $\mathrm{p}(1)$.

Solution:

Since $(x - 1)$ is a factor of $p(x)$, we have $p(1) = 0$.

(B) Answer all questions from 7 to 10. Choose the correct answer from the brackets.

Q7. What is the value of $\tan x$ if $x = 30^\circ$?

$\left(\frac{1}{2}; \frac{1}{\sqrt{2}}; \frac{1}{\sqrt{3}}; \sqrt{3}\right)$

Solution:

The value of $\tan 30^\circ$ is $\frac{1}{\sqrt{3}}$

Q8. If the perimeter of a triangle is 24 centimetres and its inradius is 2 centimetres, find its area in square centimetres.

(12; 20; 24; 26)

Solution:

The area of the triangle is given by:

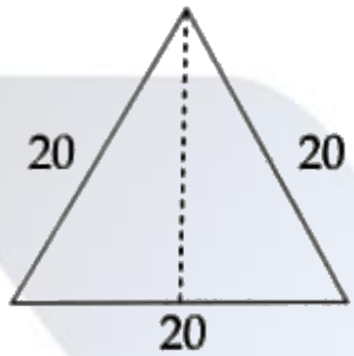
Area = inradius × semi-perimeter

Semi-perimeter, $s = \frac{24}{2} = 12$ cm

Area $= 2 \times 12 = 24\ \text{cm}^2$

Thus, the area is $24\ \text{cm}^2$.

Q9. The lateral faces of a square pyramid are equilateral triangles. If the length of one base edge is 20 centimetres, what will be the measure of its slant height in centimetres?



$(10; 10\sqrt{2}; 10\sqrt{3}; 20)$

Solution:

The slant height is the altitude of the equilateral triangle with side 20 cm .

Using the formula, Altitude $= \frac{\sqrt{3}}{2} \times 20 = 10\sqrt{3}$ cm.

Thus, the slant height is $10\sqrt{3}$ cm$(\approx 17.32$ cm$)$.

Q10. The equation of a line is $2x + y = 5$ if the x co-ordinate of a point on this line is 2 , what is the y co-ordinate of this point?

$(0; 1; -1; 2)$

Solution:

Substituting $x = 2$ in the equation $2x + y = 5$:

$2(2) + y = 5$

$4 + y = 5 \Rightarrow y = 1$

Thus, the y-coordinate is 1 .

Questions from 11 to 18 carries 2 scores each.

(A) Answer any three questions from 11 to 15.

Q11. 5,8,11, ... is an arithmetic sequence.

(a) What is 20^{th} term ?

(b) What is the algebraic expression for this sequence ?

Solution:

Given arithmetic sequence: 5,8,11, ...

First term, $a = 5$ and common difference, $d = 8 - 5 = 3$.

(a) Using the formula $a_n = a + (n-1)d$:

$a_{20} = 5 + (20 - 1) \times 3 = 5 + 57 = 62$

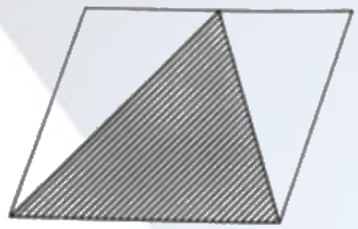
So, the 20th term is 62 .

(b) General term:

$a_n = 5 + (n - 1) \times 3 = 3n + 2$

Thus, the algebraic expression is $3n + 2$.

Q12. A triangle is drawn by joining the mid-point of one side of a parallelogram and the endpoints of the opposite side. The triangle is shaded as shown in the figure.



(a) What is the area of the triangle, if the area of the parallelogram is 50 square centimetres ?

(b) Find the probability of a dot put without looking, to be within the triangle.

Solution:

(a) The shaded triangle is formed by joining the midpoint of one side and the endpoints of the opposite side of the parallelogram. This creates a triangle that occupies half of the parallelogram's area.

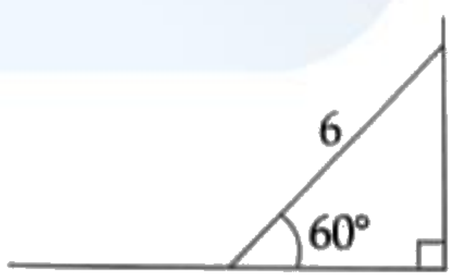
$$\text{Area of triangle } = \frac{1}{2} \times 50 = 25 \text{ cm}^2$$

(b) The probability of randomly placing a dot in the shaded region is given by:

$$\text{Probability } = \frac{\text{Area of shaded region}}{\text{Area of parallelogram}} = \frac{25}{50} = 0.5$$

So, the probability is $\frac{1}{2}$ or 0.5 .

Q13.



A ladder leans against a wall. The ladder makes an angle 60° with the floor. Length of the ladder is 6 metres.

(a) What is the height of the top of the ladder from the ground?
(b) How far is the foot of the ladder from the wall?

Solution:

(a) The height of the top of the ladder from the ground is the opposite side in the right triangle. Using

$$\sin 60^\circ = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\sin 60^\circ = \frac{h}{6}$$

$$\frac{\sqrt{3}}{2} = \frac{h}{6}$$

$$h = 6 \times \frac{\sqrt{3}}{2} = 3\sqrt{3}$$

So, the height is $3\sqrt{3}$ meters.

(b) The distance of the foot of the ladder from the wall is the adjacent side in the right triangle. Using

$$\cos 60^\circ = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\cos 60^\circ = \frac{d}{6}$$

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

$$d = 6 \times \frac{1}{2} = 3$$

So, the foot of the ladder is 3 meters from the wall.

Q14. Write the second degree polynomial $x^2 + x$ as the product of two first degree polynomials.

Solution:

To express $x^2 + x$ as the product of two first-degree polynomials, factor out the common term:

$$x^2 + x = x(x + 1)$$

So, the required factorization is $x(x + 1)$.

Q15. The weight of 7 pupils in a class are given (in kilograms). Find the median weight.

35,43,38,45,32,44,42

Solution:

Arrange the weights in ascending order:

32,35,38,42,43,44,45

Since there are 7 values (odd count), the median is the middle value:

Median $= 42$

So, the median weight is 42 kg .

(B) Answer any 2 questions from 16 to 18

Q16. The algebraic expression for the sum of n terms of an arithmetic sequence is $n^2 + n$.

(a) Find the first term of this arithmetic sequence.

(b) Find the sum of first 10 terms of this arithmetic sequence.

Solution:

(a) First Term

The first term a_1 is found by substituting $n = 1$ in S_n

$a_1 = S_1 = 1^2 + 1 = 2$

So, the first term is 2 .

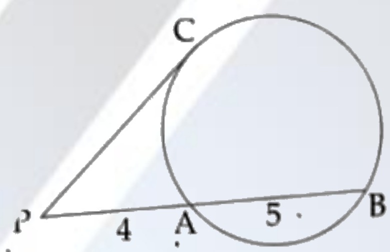
(b) Sum of the First 10 Terms

Substituting $n = 10$ in S_n :

$S_{10} = 10^2 + 10 = 100 + 10 = 110$

So, the sum of the first 10 terms is 110.

Q17.



In the figure PA = 4 centimetres, AB = 5 centimetres and PC is a tangent to the circle. Find the length of PC.

Solution:

Using the tangent-secant theorem (Power of a Point Theorem), which states:

$PA \times PB = PC^2$

Given:

$PA = 4 \text{ cm},\ AB = 5 \text{ cm} \Rightarrow PB = PA + AB = 4 + 5 = 9 \text{ cm}$

Substituting in the formula:

$4 \times 9 = PC^2$

$36 = PC^2$

$PC = \sqrt{36} = 6 \text{ cm}$

So, the length of PC is 6 cm .

Q18. Find the coordinates of the point which divides the line joining the points (1,2) and (7,5) in the ratio 2: 1.

Solution:

Using the section formula, which states that the coordinates of a point dividing the line joining (x_1, y_1) and (x_2, y_2) in the ratio $m : n$ are:

$$\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

Given points: (1,2) and (7,5), and ratio 2: 1, we substitute:

$$x = \frac{(2 \times 7) + (1 \times 1)}{2+1} = \frac{14+1}{3} = \frac{15}{3} = 5$$

$$y = \frac{(2 \times 5) + (1 \times 2)}{2+1} = \frac{10+2}{3} = \frac{12}{3} = 4$$

So, the required point is (5,4).

Questions from 19 to 25 carries 4 scores each.

(A) Answer any three questions from 19 to 23.

Q19. Draw a triangle of circumradius 3 centimetres and two of its angles 50° and 60°.

Solution:

Steps of construction:

1.Draw a circle with centre O and having radius 3 cm .

2.To make the three points A, B, and C in the circle, join A to the centre of the circle O.

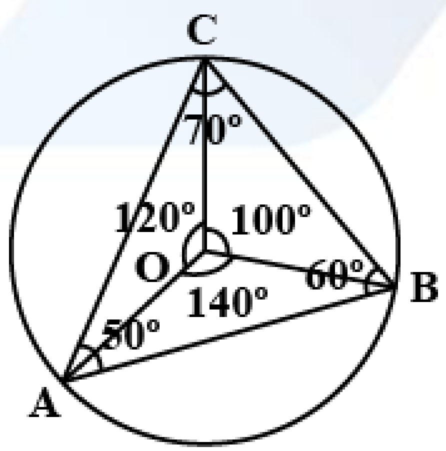
3.If m∠BAC is to be 50°, m$\angle BOC$ should be 100°.

4.If m$\angle ABC$ is to be 60°, m$\angle AOC$ should be 120°.

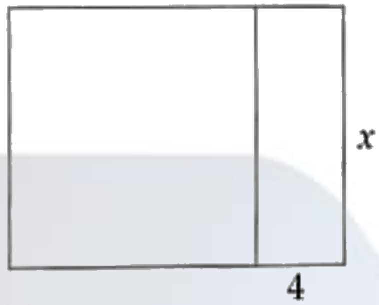
5.If m$\angle ACB$ is to be 70°, m$\angle AOB$ should be 140°.

6.Join the points B and C such that m$\angle AOC = 100°$ and m$\angle BOC = 120°$

Thus, △ ABC is the required triangle.



Q20.



A strip of width 4 centimetres is attached to one side of a square to form a rectangle. The area of the new rectangle is 77 square centimetres.

(a) If we take the width of the new rectangle as x, what will be its length ?

(b) Find the measure of the side of the square by constructing an equation.

Solution:

(a)Width $= x$ cm

Length $= x + 4$ cm

(b)Given that the area of the rectangle is 77 cm^2, we form the equation:

$x(x+4) = 77$

$x^2 + 4x = 77$

Adding 4 on both sides:

$x^2 + 4x + 4 = 81$

Rewriting as a perfect square:

$(x+2)^2 = 9^2$

Taking square root:

$x + 2 = 9$

$x = 7$

Thus, the side of the square is 7 cm

Q21. Draw a circle of radius 2.5 centimetres and mark a point 6 centimetres away from the centre of the circle. Draw tangents to the circle from this point.

Solution:

Step of Construction:

1.Draw a line segment OT = 6 cm.

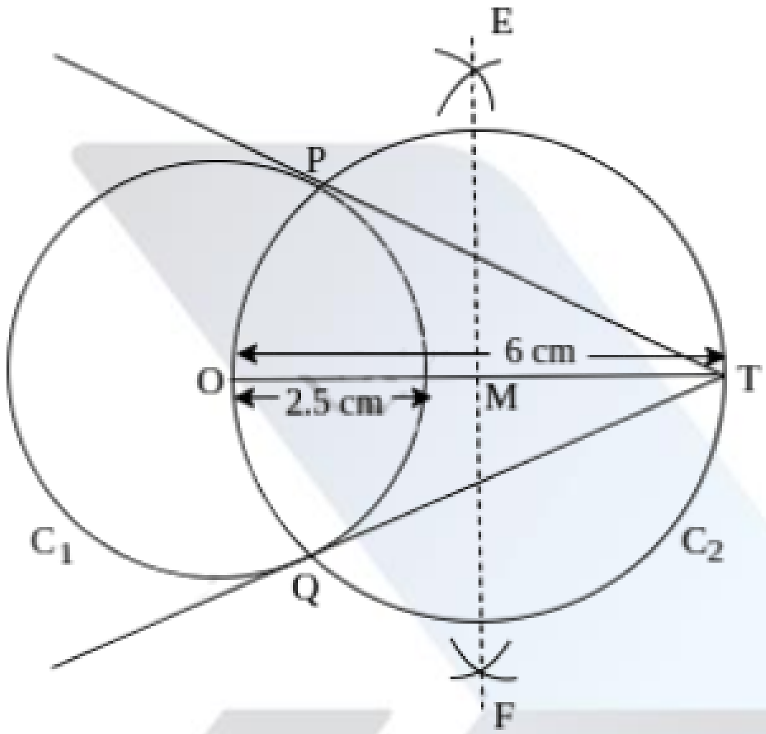
2.Draw a circle of radius 2.5 cm taking O as centre.

3.Draw a perpendicular bisector EF of OT which meets OT at M.

4.Taking MT as radius and M as centre, draw a circle C_2 which intersects C_1 at P and Q.

5.Join TP and TQ.

6.Hence, TP and TQ are the required tangents.



Q22. Find the surface area of a cone having base radius 9 centimetres and height 12 centimetres.

Solution:

Given:

Base radius $(r) = 9$ cm

Height $(h) = 12$ cm

First, find the slant height (l) using the Pythagorean theorem:

$l = \sqrt{r^2 + h^2} = \sqrt{9^2 + 12^2} = \sqrt{81 + 144} = \sqrt{225} = 15$ cm

Now, the surface area of the cone is given by:

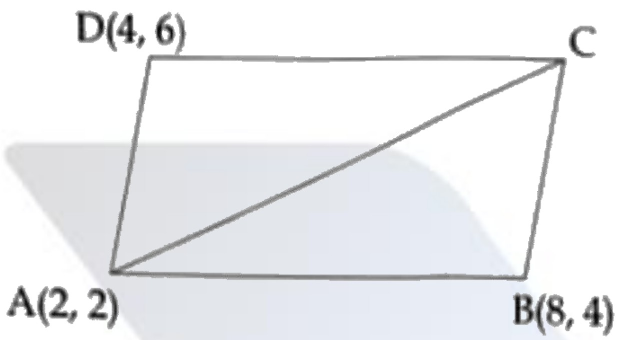
Surface Area $= \pi r(r + l)$

$= \pi \times 9(9 + 15) = \pi \times 9 \times 24$

$= 216\pi \text{ cm}^2$

Thus, the surface area of the cone is $216\pi \text{ cm}^2$ or approximately 678.24 cm^2.

Q23.



The coordinates of three vertices of a parallelogram are given.
(a) Find the coordinates of the vertex C.
(b) Find the coordinates of the midpoint of the diagonal AC .

Solution:

Given points:
$A(2,2), B(8,4), D(4,6)$.
Let $C(x, y)$ be the unknown vertex.
(a) Find the coordinates of C
In a parallelogram, the diagonals bisect each other. Using the midpoint formula:
$\text{ Midpoint of AC} = \text{ Midpoint of BD}$
Midpoint of BD :
$$\left(\frac{4+8}{2}, \frac{6+4}{2}\right) = \left(\frac{12}{2}, \frac{10}{2}\right) = (6,5)$$
Midpoint of AC :
$$\left(\frac{2+x}{2}, \frac{2+y}{2}\right) = (6,5)$$
Equating coordinates:
$$\frac{2+x}{2} = 6 \Rightarrow 2+x = 12 \Rightarrow x = 10$$
$$\frac{2+y}{2} = 5 \Rightarrow 2+y = 10 \Rightarrow y = 8$$
Thus, $C(10,8)$.
(b) Find the midpoint of diagonal AC
Midpoint formula:
$$\left(\frac{2+10}{2}, \frac{2+8}{2}\right) = \left(\frac{12}{2}, \frac{10}{2}\right) = (6,5)$$
Thus, midpoint of $AC = (6,5)$.

(B) Answer any one of the questions 24, 25.

Q24. A box contains four slips numbered 1,2,3,4 and another box contains five slips numbered 5,6,7,8,9. If one slip is taken from each box.

(a) How many number pairs are possible?

(b) What is the probability of both being odd?

(c) What is the probability of getting the sum of the numbers 10 ?

Solution:

Given:

Box 1 contains slips numbered 1, 2, 3, 4 (4 slips).

Box 2 contains slips numbered 5, 6, 7, 8, 9 (5 slips).

Each number pair consists of one number from each box.

(a) Total number of number pairs

Each number from the first box can pair with any number from the second box:

$4 \times 5 = 20$

Thus, the total number of number pairs is 20 .

(b) Probability of both numbers being odd

Odd numbers in Box 1: {1, 3) (2 choices).

Odd numbers in Box 2: {5,7,9} (3 chaices).

Total favorable outcomes $= 2 \times 3 = 6$.

Probability:

$$\frac{6}{20} = \frac{3}{10}$$

Thus, the probability is $\frac{3}{10}$.

(c) Probability of getting a sum of 10

Find pairs where the sum is 10 :

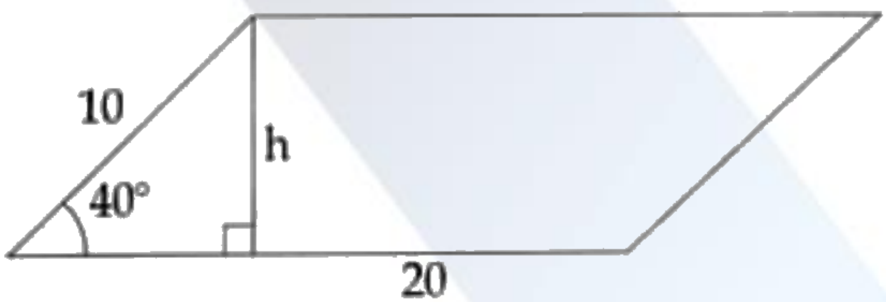
Number from Box 1	Number from Box 2	Sum
1	9	10
2	8	10
3	7	10
4	5	10

There are 4 favorable outcomes.
Probability:

$$\frac{4}{20}=\frac{1}{5}$$

Thus, the probability is $\frac{1}{5}$.

Q25.



Two sides of a parallelogram are 20 centimetres and 10 centimetres. If the angle between them is 40°,

(a) What is the height of the parallelogram?

(b) Find the area of the parallelogram.

$(\sin\ 40=0.64; \cos\ 40=0.77; \tan\ 40=0.84)$

Solution:

Given:

Sides of the parallelogram: 20 cm and 10 cm

Angle between them: 40°

Given values: $\sin\ 40^{\circ}=0.64, \cos\ 40^{\circ}=0.77, \tan\ 40^{\circ}=0.84$

(a) Finding the height of the parallelogram

The height h is the perpendicular distance from the opposite side to the base 20 cm

Using the formula:

$h=10\times\sin\ 40^{\circ}$

$h=10\times0.64=6.4\text{ cm}$

Thus, the height of the parallelogram is 6.4 cm .

(b) Finding the area of the parallelogram

Area $=$ Base $\times$ Height

Area $=20\times6.4$

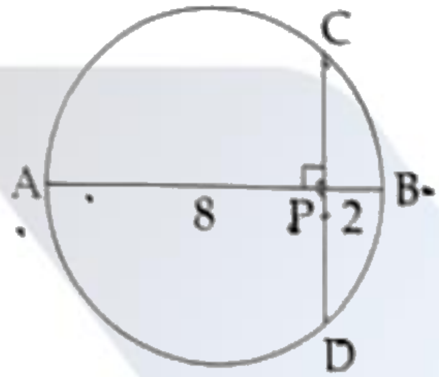
$=128\text{ cm}^2$

Thus, the area of the parallelogram is 128 cm^2.

Questions from 26 to 32 carries 6 scores each.

(A) Answer any three questions from 26 to 29.

Q26. (a)



In the figure AB is the diameter of the circle. Line CD is perpendicular to AB . AP $=$ 8 centimetres and PB $=$ 2 centimetres. Find the length of PC .

Solution:

Since AB is the diameter, the center O is the midpoint of AB.

$$\text{Radius } = \frac{\text{Diameter}}{2} = \frac{AP + PB}{2} = \frac{8+2}{2} = 5 \text{ cm}$$

Using the perpendicular theorem in a circle,

$OP^2 + PC^2 = \text{ Radius }^2$

$(5-2)^2 + PC^2 = 5^2$

$3^2 + PC^2 = 25$

$9 + PC^2 = 25$

$PC^2 = 16$

$PC = 4 \text{ cm}$

Thus, the length of PC is 4 cm .

(b)Draw a rectangle of sides 5 centimetres and 3 centimetres. Draw a square of the same area.

Solution:

Draw a rectangle $PQRS$ in the given measurement.

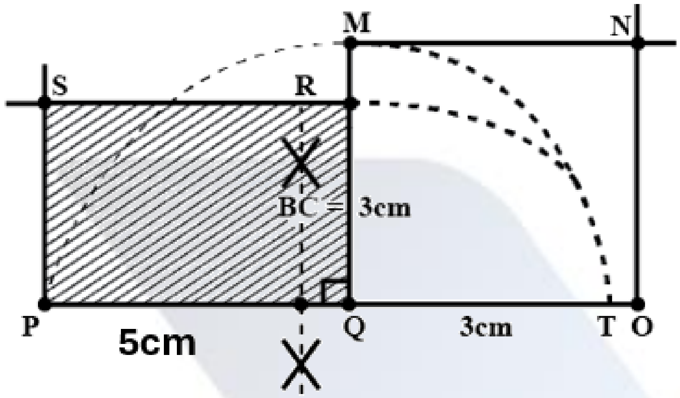
PQ produced up to T as $QT = 3$ cm.

Draw a perpendicular bisector of the lime PT, meet Q on PT.

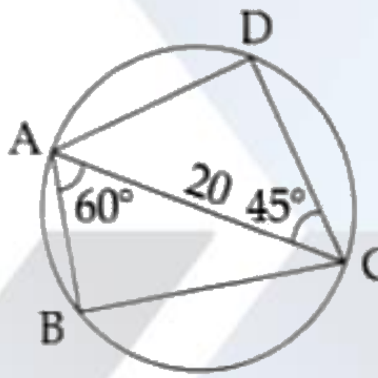
Produce QR meet the semicircle at M.

Draw the square $QMNO$ as $QM = MN = ON = QO$.

Hence $QMNO$ be the required square.



Q27.



In the figure AC is the diameter of the circle. Given that AC = 20 centimetres, ∠BAC = 60° and ∠ACD = 45°.

(a) What is the measure of ∠ADC ?

(b) Find the perimeter of the quadrilateral $ABCD$.

Solution:

(a) Finding ∠ ADC

We are given:

AC is the diameter, so ∠ADC = 90° (angle in a semicircle).

Thus, ∠ADC = 90°.

(b) Finding the Perimeter of Quadrilateral ABCD

Step 1: Finding AB and BC

Since AC is the diameter, $\triangle ABC$ is a right-angled triangle at B.

Using trigonometry in $\triangle ABC$:

$$AB = AC \times \sin(30^\circ) = 20 \times \frac{1}{2} = 10 \text{ cm}$$

$$BC = AC \times \cos(30^\circ) = 20 \times \frac{\sqrt{3}}{2} = 10\sqrt{3} \approx 17.32 \text{ cm}$$

Step 2: Finding CD and DA

Since $\triangle ACD$ is also a right-angled triangle at D :

$CD = AC \times \sin(45^\circ) = 20 \times \frac{1}{\sqrt{2}} = 10\sqrt{2} \approx 14.14$ cm

$DA = AC \times \cos(45^\circ) = 20 \times \frac{1}{\sqrt{2}} = 10\sqrt{2} \approx 14.14$ cm

Final Perimeter Calculation

$AB + BC + CD + DA = 10 + 10\sqrt{3} + 10\sqrt{2} + 10\sqrt{2}$

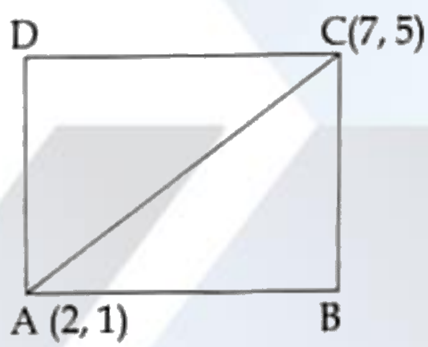
Approximating:

$10 + 17.32 + 14.14 + 14.14 = 55.6$ cm

Thus, the perimeter of quadrilateral $ABCD$ is:

$10 + 10\sqrt{3} + 20\sqrt{2} \approx 55.6$ cm

Q28.



The rectangle has sides parallel to the axes. The co-ordinates of one pair of opposite vertices are (2,1) and (7,5).

(a) Find the co-ordinates of the other two opposite vertices.

(b) Find the length and breadth of the rectangle.

(c) Find the length of the diagonal AC .

Solution:

(a) Finding the Other Two Opposite Vertices

Since the rectangle has sides parallel to the axes, the x-coordinates and y-coordinates of opposite vertices are swapped. The missing vertices will have the coordinates:

B (same x as C , same y as A): $B(7,1)$

D (same x as A , same y as C): $D(2,5)$

Thus, the other two vertices are $B(7,1)$ and $D(2,5)$.

(b) Finding the Length and Breadth of the Rectangle

Length (horizontal distance) = Difference in x-coordinates:

$AB = |7 - 2| = 5$ units

Breadth (vertical distance) = Difference in y-coordinates:
$AD = |5 - 1| = 4$ units
Thus, length = 5 units, breadth = 4 units.
(c) Finding the Length of Diagonal AC
Using the distance formula:
$AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Substituting $A(2,1)$ and $C(7,5)$:
$AC = \sqrt{(7-2)^2 + (5-1)^2}$
$= \sqrt{5^2 + 4^2}$
$= \sqrt{25 + 16}$
$= \sqrt{41} \approx 6.4$ units
Thus, the diagonal length is $\sqrt{41} \approx 6.4$ units.

Q29. The radius of a solid metal sphere is 6 centimetres.

(a) Find the volume of the sphere.
(b) This sphere is melted and recast into a solid cone of radius 6 centimetres. Find the height of the cone.

Solution:

(a) Finding the Volume of the Sphere
The volume of a sphere is given by the formula:
$V = \frac{4}{3}\pi r^3$
Substituting $r = 6$:
$V = \frac{4}{3}\pi(6)^3$
$= \frac{4}{3}\pi \times 216$
$= \frac{864}{3}\pi$
$= 288\pi \text{ cm}^3$
Thus, the volume of the sphere is $288\pi \text{ cm}^3$.
(b) Finding the Height of the Cone
The sphere is melted and recast into a cone.
Radius of the cone $R = 6$ cm.
Volume of the cone = Volume of the sphere.
The volume of a cone is given by:
$V = \frac{1}{3}\pi R^2 h$

Setting this equal to the volume of the sphere:

$$\frac{1}{3}\pi(6)^2h = 288\pi$$

$$\frac{1}{3}\pi \times 36 \times h = 288\pi$$

Cancel π from both sides:

$$\frac{36h}{3} = 288$$

$$12h = 288$$

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

Thus, the height of the cone is 24 cm .

(B) Answer any two questions from 30 to 32.

Q30. The product of a number and 5 more than that number gives 104.

(a) If we take the first number as ' x ', what will be the second number?

(b) Form a second degree equation using the given details.

(c) Find the number.

Solution:

(a) Finding the Second Number

Second number $= x + 5$

(b) Forming the Quadratic Equation

From the given condition:

$$x(x+5) = 104$$

$$x^2 + 5x = 104$$

$$x^2 + 5x - 104 = 0$$

Thus, the quadratic equation is:

$$x^2 + 5x - 104 = 0$$

(c) Finding the Number

Solving the quadratic equation:

$$x^2 + 5x - 104 = 0$$

Using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where $a = 1, b = 5, c = -104$.

$$x = \frac{-5 \pm \sqrt{5^2 - 4(1)(-104)}}{2(1)}$$

$$x = \frac{-5 \pm \sqrt{25 + 416}}{2}$$

$$x=\frac{-5\pm\sqrt{441}}{2}$$
$$x=\frac{-5\pm 21}{2}$$
Solving for both cases
$$x=\frac{-5+21}{2}=\frac{16}{2}=8$$
$$x=\frac{-5-21}{2}=\frac{-26}{2}=-13$$
Thus, the possible values of the number are 8 or -13 .

Q31. Consider the second degree polynomial $\mathrm{p}(x)=x^2-3x+5$.
(a) Find $p(1)$.
(b) Write one first degree factor of the polynomial $p(x)-p(1)$.
(c) Write $p(x)-p(1)$ as the product of two first degree factors and find the solutions of the equation $p(x)-p(1)=0$.

Solution:

(a) Find $p(1)$
Substituting $x-1$ in $p(x)$:
$p(1)=(1)^2-3(1)+5$
$=1-3+5-3$
So, $p(1)=3$.
(b) Write one first-degree factor of $p(x)-p(1)$
We compute $p(x)-p(1)$:
$p(x)-p(1)=(x^2-3x+5)-3$
$=x^2-3x+2$
Now, factorizing x^2-3x+2 :
$x^2-3x+2=(x-1)(x-2)$
So, one first-degree factor is $(x-1)$.
(c) Write $p(x)-p(1)$ as the Product of Two First-Degree Factors and Solve $p(x)-p(1)=0$
Since we already factorized:
$p(x)-p(1)=(x-1)(x-2)$
Setting it equal to zero:
$(x-1)(x-2)=0$
Solving for x :
$x-1=0$ or $x-2=0$
$x=1$ or $x=2$
So, the solutions of $p(x)-p(1)=0$ are $x=1$ and $x=2$.

Q32. The table below shows the households of an area sorted according to consumption of electricity.

Consumption (in units)	Number of households
$100 - 120$	4
$120 - 140$	8
$140 - 160$	7
$160 - 180$	10
$180 - 200$	6
$200 - 220$	4
$220 - 240$	6

(a) If the households are arranged according to the consumption of electricity, the consumption of which house is taken as median ?
(b) What is the consumption of 20^{th} household according to our assumption?
(c) What is the median consumption?

Solution:

Consumption (in units)	Number of Households (f)	Cumulative Frequency (CF)
$100 - 120$	4	4
$120 - 140$	8	12
$140 - 160$	7	19
$160 - 180$	10	29
$180 - 200$	6	35
$200 - 220$	4	39
$220 - 240$	6	45

Total number of households = 45

The median position is:

$$M = \frac{N}{2} = \frac{45}{2} = 22.5$$

(a) Identify the Median Class

The median consumption falls in the class: 160 – 180 units.

Since 23rd household falls in the class 160 – 180, this is the median class.

(b) Predict the Consumption of the 20th Household

The 20th household also falls in the 160 − 180 class.

$$X = L + \left(\frac{p - CF}{f}\right) \times h$$

Where:

X = Exact consumption of the 20th household

L = 160 (Lower boundary of class)

p = 20 (Household position)

CF = 19 (Cumulative frequency before this class)

f = 10 (Frequency of class)

h = 20 (Class width)

$$X = 160 + \left(\frac{20 - 19}{10}\right) \times 20$$

$$X = 160 + \left(\frac{1}{10} \times 20\right)$$

$$X = 160 + 2$$

$$X = 162$$

The exact consumption of the 20th household is 162 units.

(c) Find the Median Consumption

Using the median formula:

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

Substituting values:

$$\text{Median} = 160 + \left(\frac{22.5 - 19}{10}\right) \times 20$$

$$= 160 + \left(\frac{3.5}{10} \times 20\right)$$

$$= 160 + (0.35 \times 20)$$

$$= 160 + 7$$

$$= 167$$

The median consumption is 167 units.

Questions from 33 to 35 carries 8 scores each.
(A) Answer any two questions from 33 to 35 .

Q33. 6,10,14, ... is an arithmetic sequence.

(a) Find the sum of the first 15 terms of this arithmetic sequence.
(b) What is the difference between the first term and the 16^{th} term ?
(c) Find the difference between the sum of first 15 terms and sum of the next 15 terms.

Solution:

(a) Find the sum of the first 15 terms (S_{15})
The sum of the first n terms of an arithmetic sequence is given by:
$S_n=\frac{n}{2} \times[2 a+(n-1) d]$
For $n=15$:
$S_{15}=\frac{15}{2} \times[2(6)+(15-1) \times 4]$
$=\frac{15}{2} \times[12+56]$
$=\frac{15}{2} \times 68$
$=15 \times 34=510$
Thus, the sum of the first 15 terms is 510 .
(b) Find the difference between the first term and the 16th term
The general formula for the nth term of an arithmetic sequence is:
$T_n=a+(n-1) d$
For T_{16} :
$T_{16}=6+(16-1) \times 4$
$=6+60=66$
Now, the difference between the first term and the 16th term:
$T_{16}-T_1=66-6=60$
Thus, the required difference is 60 .
(c) Find the difference between the sum of the first 15 terms and the sum of the next 15 terms
The sum of the next 15 terms ($S_{16 \text{ to } 30}$) is calculated as:
$S_{16 \text{ to } 30}=S_{30}-S_{15}$
First, we find S_{30} :
$S_{30}=\frac{30}{2} \times[2(6)+(30-1) \times 4]$
$=15 \times[12+116]$
$=15 \times 128=1920$

Now,

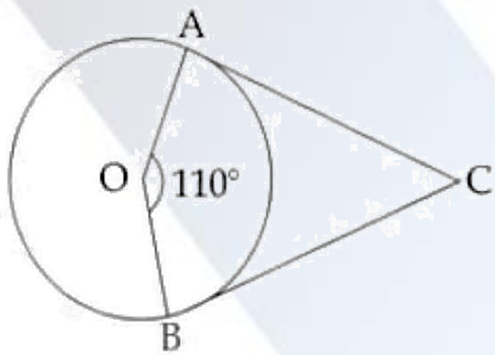
$S_{16 \text{ to } 30} = 1920 - 510 = 1410$

The required difference is:

$S_{16 \text{ to } 30} - S_{15} = 1410 - 510 = 900$

Thus, the required difference is 900 .

Q34. (a)



The two tangents AC and BC of the circle with centre O meets at C. What is the measure of ∠OAC ? If $\angle AOB = 110^\circ$ find the measure of $\angle ACB$.

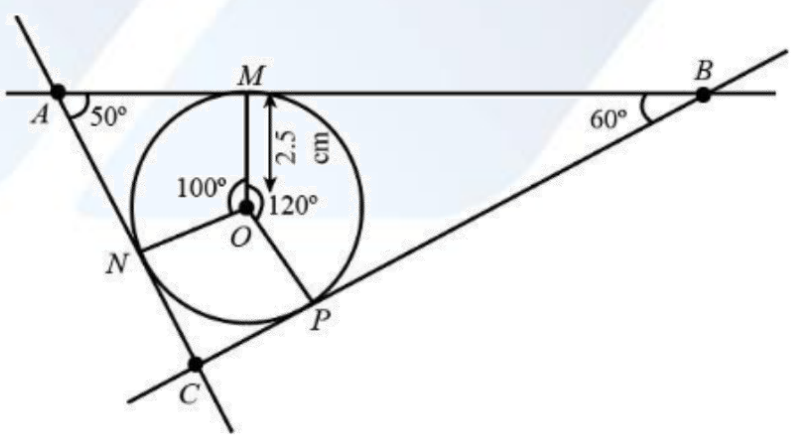
Solution:

(a) ∠OAC = 90°

∠ACB = 180° – 110° = 70°

(b)Draw a circle of radius 2.5 centimetres. Draw a triangle with angles 50°, 60°, 70° and all its sides are tangents to this circle.

Solution:



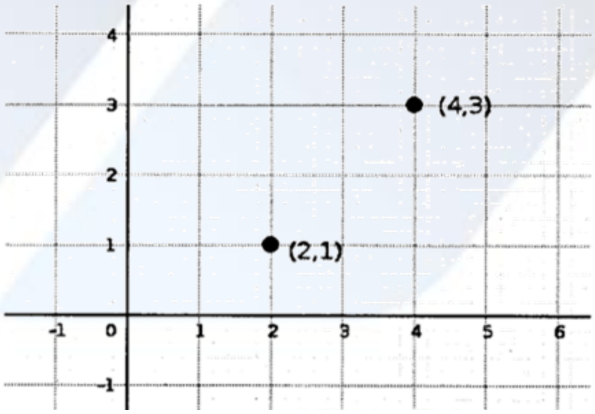
The step-by-step construction is given below:

1.First take a radius of 2.5 cm using the ruler scale and draw a circle taking O as the centre of the circle.
2.Now using the geometric property for the incircle of a triangle draw an angle $\angle MON$ of 100° at the centre of the circle O.
3.Draw two perpendicular lines at the segments OM and ON starting from points M and N respectively in such a way that they intersect each other at a point A.
4.Now draw another angle $\angle MOP$ of 120° at the line segment OM in the opposite direction to the earlier drawn angle in such a way that it intersects the circle at a point P.
5.Draw a perpendicular line on the line segment OP.
6.Now extend the perpendicular line of OP in such a way that it intersects the other two perpendiculars. Name the intersection points of the perpendiculars as B and C respectively.
Therefore, we have constructed a triangle $\triangle ABC$ having two angles of 50° and 60° with all its sides touching a circle with radius 2.5 cm .

Q35. (a)Draw the coordinate axes and mark the points (2,1) and (4,3).
(b) Find the slope of the line joining these points.
(c) The centre of a circle is (3,2) and the coordinates of one end of its diameter 3 is (1,2). Find the coordinates of the other end of the diameter.

Solution:

(a) Draw the figure as given below.



(b)Given points:
$A(2,1)$ and $B(4,3)$
Step 1: Formula for Slope
The slope m of a line passing through two points (x_1, y_1) and (x_2, y_2) is given by:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Step 2: Substituting Values

$$m = \frac{3 - 1}{4 - 2}$$

$$m = \frac{2}{2} = 1$$

The slope of the line joining the points (2,1) and (4,3) is 1 .

(c)Given:

Centre of the circle = (3,2)

One end of the diameter = (1,2)

Let the other end be (x, y)

Using the midpoint formula:

$$\left(\frac{1 + x}{2}, \frac{2 + y}{2}\right) = (3,2)$$

Solving, $x = 5$ and $y = 2$.

Thus, the other end of the diameter is (5,2).