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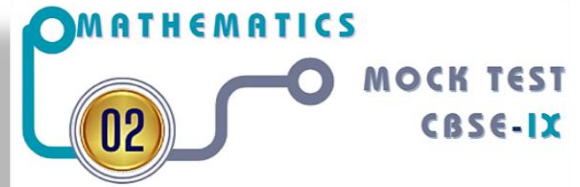
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**Time Allowed: 3 hours**

**Maximum Marks: 80**

**General Instructions:**

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

**Section A**

1. Rationalisation of the denominator of  $\frac{1}{\sqrt{5}+\sqrt{2}}$  gives [1]
  - a)  $\sqrt{5} + \sqrt{2}$
  - b)  $\sqrt{5} - \sqrt{2}$
  - c)  $\frac{1}{\sqrt{10}}$
  - d)  $\frac{\sqrt{5}-\sqrt{2}}{3}$
2. If (4, 19) is a solution of the equation  $y = ax + 3$ , then a = [1]
  - a) 4
  - b) 6
  - c) 3
  - d) 5
3. P(5, -7) be a point on the graph. Draw the  $PM \perp y$ -axis. The coordinates of M are [1]
  - a) (0, -7)
  - b) (0, 0)
  - c) (-7, 0)
  - d) (-7, 5)

4. To draw a histogram to represent the following frequency distribution : [1]

Class interval	5-10	10-15	15-25	25-45	45-75
Frequency	6	12	10	8	15

The adjusted frequency for the class 25-45 is

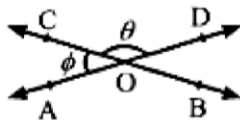
- a) 6
  - b) 5
  - c) 2
  - d) 3
5. If the line represented by the equation  $3x + ky = 9$  passes through the points (2, 3), then the value of k is [1]

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

6. In ancient India, the shapes of altars used for household rituals were [1]

- a) triangles and rectangles  
 b) trapeziums and pyramids  
 c) squares and circles  
 d) rectangles and squares

7. In the given figure, straight lines AB and CD intersect at O. If  $\angle AOC = \phi$ ,  $\angle BOC = \theta$  and  $\theta = 3\phi$ , then  $\phi = ?$  [1]



- a)  $40^\circ$   
 b)  $30^\circ$   
 c)  $45^\circ$   
 d)  $60^\circ$

8. In which of the following figures are the diagonals equal? [1]

- a) Rhombus  
 b) Rectangle  
 c) Parallelogram  
 d) Trapezium

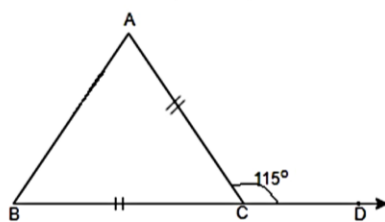
9. If  $x + 1$  is a factor of the polynomial  $2x^2 + kx$ , then  $k =$  [1]

- a) -3  
 b) 4  
 c) -2  
 d) 2

10.  $x = 2, y = 5$  is a solution of the linear equation [1]

- a)  $5x + y = 7$   
 b)  $x + y = 7$   
 c)  $5x + 2y = 7$   
 d)  $x + 2y = 7$

11. In the adjoining figure,  $BC = AC$ . If  $\angle ACD = 115^\circ$ , the  $\angle A$  is [1]

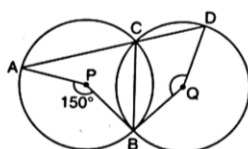


- a)  $50^\circ$   
 b)  $65^\circ$   
 c)  $57.5^\circ$   
 d)  $70^\circ$

12. Diagonals of a quadrilateral ABCD bisect each other. If  $\angle A = 45^\circ$ , then  $\angle B =$  [1]

- a)  $125^\circ$   
 b)  $115^\circ$   
 c)  $120^\circ$   
 d)  $135^\circ$

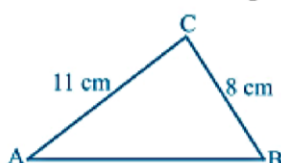
13. In the given figure, P and Q are centers of two circles intersecting at B and C. ACD is a straight line. Then, the measure of  $\angle BQD$  is [1]



- a)  $130^\circ$   
c)  $105^\circ$
- b)  $150^\circ$   
d)  $115^\circ$
14. An irrational number between 2 and 2.5 is [1]  
a)  $\sqrt{5}$   
c)  $\sqrt{22.5}$
- b)  $\sqrt{11}$   
d)  $\sqrt{12.5}$
15. Express  $y$  in terms of  $x$  in the equation  $5y - 3x - 10 = 0$ . [1]  
a)  $y = \frac{3-10x}{5}$   
c)  $y = \frac{3x-10}{5}$
- b)  $y = \frac{3+10x}{5}$   
d)  $y = \frac{3x+10}{5}$
16. If the sides of a triangle are produced in order, then the sum of the three exterior angles so formed is [1]  
a)  $90^\circ$   
c)  $180^\circ$
- b)  $270^\circ$   
d)  $360^\circ$
17.  $x + 1$  is a factor of the polynomial [1]  
a)  $x^3 + 2x^2 - x - 2$   
c)  $x^3 - 2x^2 + x + 2$
- b)  $x^3 + 2x^2 - x + 2$   
d)  $x^3 + 2x^2 + x - 2$
18. If a solid sphere of radius  $r$  is melted and cast into the shape of a solid cone of height  $r$ , then the radius of the base of the cone is [1]  
a)  $3r$   
c)  $2r$
- b)  $r$   
d)  $4r$
19. **Assertion (A):** The side of an equilateral triangle is 6 cm then the area of the triangle is  $9\text{ cm}^2$ . [1]  
**Reason (R):** All the sides of an equilateral triangle are equal.  
a) Both A and R are true and R is the correct explanation of A.  
c) A is true but R is false.
- b) Both A and R are true but R is not the correct explanation of A.  
d) A is false but R is true.
20. **Assertion (A):** For all values of  $k$ ,  $(-\frac{3}{2}, k)$  is a solution of the linear equation  $2x + 3 = 0$ . [1]  
**Reason (R):** The linear equation  $ax + b = 0$  can be expressed as a linear equation in two variables as  $ax + y + b = 0$ .  
a) Both A and R are true and R is the correct explanation of A.  
c) A is true but R is false.
- b) Both A and R are true but R is not the correct explanation of A.  
d) A is false but R is true.

**Section B**

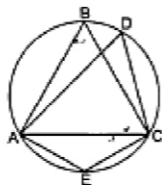
21. Find the area of a triangle, two sides of which are 8 cm and 11 cm and the perimeter is 32 cm. [2]



22. Prove the exterior angle formed by producing a side of a cyclic quadrilateral is equal to the interior opposite angle. [2]



23. A right triangle ABC with sides 5 cm, 12 cm and 13 cm is revolved about the side 12 cm. Find the volume of the solid so obtained. [2]
24. In the given figure,  $\triangle ABC$  is an equilateral. Find [2]
- $\angle ADC$
  - $\angle AEC$



OR

Prove that a diameter of a circle which bisects a chord of the circle also bisects the angle subtended by the chord at the centre of the circle.

25. Find whether the given equation have  $x = 2, y = 1$  as a solution: [2]
- $$2x + 5y = 9$$

OR

The following values of  $x$  and  $y$  are thought to satisfy a linear equation :

$x$	1	2
$y$	1	3

**Section C**

26. Find the values of  $a$  and  $b$  in each of  $\frac{\sqrt{2}+\sqrt{3}}{3\sqrt{2}-2\sqrt{3}} = a - b\sqrt{6}$  [3]
27. Factorise :  $x^3 - 23x^2 + 142x - 120$  [3]
28. The perimeter of an isosceles triangle is 32 cm. The ratio of the equal side to its base is 3: 2. Find the area of the triangle. [3]

OR

The perimeter of a triangle is 480 meters and its sides are in the ratio of 1:2:3. Find the area of the triangle?

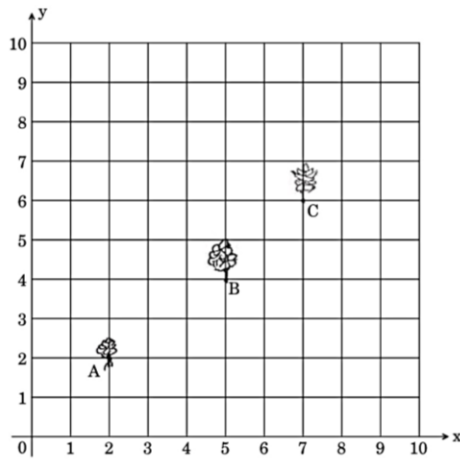
29. Find solutions of the form  $x = a, y = 0$  and  $x = 0, y = b$  for the following pairs of equations. Do they have any common such solution? [3]
- $$5x + 3y = 15 \text{ and } 5x + 2y = 10$$
30. If two isosceles triangles have a common base, prove that the line joining their vertices bisects them at right angles. [3]

OR

$S$  is any point on side  $QR$  of a  $\triangle PQR$ . Show that:  $PQ + QR + RP > 2PS$ .

31. Seema has a  $10 \text{ m} \times 10 \text{ m}$  kitchen garden attached to her kitchen. She divides it into a  $10 \times 10$  grid and wants to grow some vegetables and herbs used in the kitchen. She puts some soil and manure in that and sows a green chilly plant at  $A$ , a coriander plant at  $B$  and a tomato plant at  $C$ . [3]
- Her friend Kusum visited the garden and praised the plants grown there. She pointed out that they seem to be in

a straight line. See the below diagram carefully and answer the following questions :



- Write the coordinates of the points A, B, and C taking the  $10 \times 10$  grid as coordinate axes.
- By distance formula or some other formula, check whether the points are collinear.

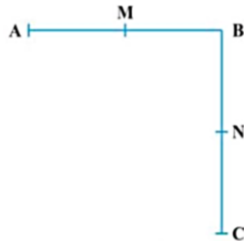
**Section D**

32. It being given that  $\sqrt{3} = 1.732$ ,  $\sqrt{5} = 2.236$ ,  $\sqrt{6} = 2.449$  and  $\sqrt{10} = 3.162$ , find upto three places of decimal, [5]  
 $\frac{3+\sqrt{5}}{3-\sqrt{5}}$

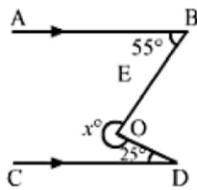
OR

Simplify:  $\frac{7\sqrt{3}}{\sqrt{10}+\sqrt{3}} - \frac{2\sqrt{5}}{\sqrt{6}+\sqrt{5}} - \frac{3\sqrt{2}}{\sqrt{15}+3\sqrt{2}}$

33. i.  $AB = BC$ , M is the mid-point of AB and N is the mid-point of BC. Show that  $AM = NC$ . [5]  
 ii.  $BM = BN$ , M is the mid-point of AB and N is the mid-point of BC. Show that  $AB = BC$ .

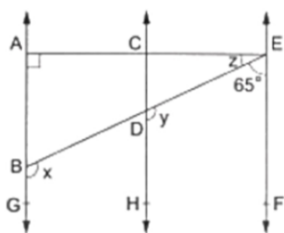


34. In each of the figures given below,  $AB \parallel CD$ . Find the value of  $x^\circ$  [5]



OR

In the given figure,  $AB \parallel CD \parallel EF$ ,  $\angle DBG = x$ ,  $\angle EDH = y$ ,  $\angle AEB = z$ ,  $\angle EAB = 90^\circ$  and  $\angle BEF = 65^\circ$ . Find the values of  $x$ ,  $y$  and  $z$ .



35. The following data gives the amount of manure (in thousand tonnes) manufactured by a company during some years: [5]

--	--	--	--	--	--	--

Year	1992	1993	1994	1995	1996	1997
Manure (in thousand tonnes)	15	35	45	30	40	20

- Represent the above data with the help of a bar graph.
- Indicate with the help of the bar graph the year in which the amount of manufactured by the company was maximum.
- Choose the correct alternative :  
 The consecutive years during which there was maximum decrease in manure production are:
  - 1994 and 1995
  - 1992 and 1993
  - 1996 and 1997
  - 1995 and 1996

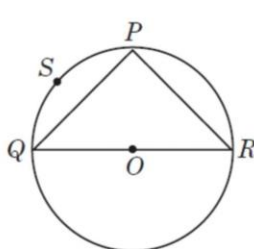
**Section E**

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

[4]

Sanjay and his mother visited in a mall. He observes that three shops are situated at P, Q, R as shown in the figure from where they have to purchase things according to their need. Distance between shop P and Q is 8 m and between shop P and R is 6 m.

Considering O as the center of the circles.



- Find the Measure of  $\angle QPR$ .
- Find the radius of the circle.
- Find the Measure of  $\angle QSR$ .

**OR**

Find the area of  $\Delta PQR$ .

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

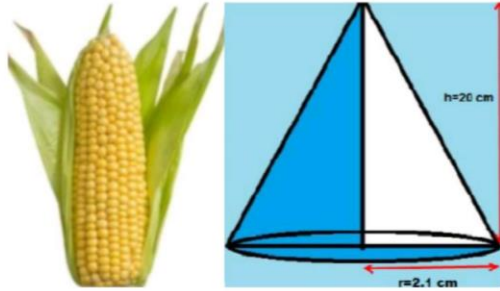
[4]

Once upon a time in Ghaziabad was a corn cob seller. During the lockdown period in the year 2020, his business was almost lost.

So, he started selling corn grains online through Amazon and Flipcart. Just to understand how many grains he will have from one corn cob, he started counting them.

Being a student of mathematics let's calculate it mathematically. Let's assume that one corn cob (see Fig.),

shaped somewhat like a cone, has the radius of its broadest end as 2.1 cm and length as 20 cm.



- (i) Find the curved surface area of the corn cub.
- (ii) What is the volume of the corn cub?
- (iii) If each  $1 \text{ cm}^2$  of the surface of the cob carries an average of four grains, find how many grains you would find on the entire cob?

**OR**

How many such cubs can be stored in a carton of size  $20 \text{ cm} \times 25 \text{ cm} \times 20 \text{ cm}$ .

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

[4]

Harish makes a poster in the shape of a parallelogram on the topic SAVE ELECTRICITY for an inter-school competition as shown in the follow figure.



- (i) If  $\angle A = (4x + 3)^\circ$  and  $\angle D = (5x - 3)^\circ$ , then find the measure of  $\angle B$ .
- (ii) If  $\angle B = (2y)^\circ$  and  $\angle D = (3y - 6)^\circ$ , then find the value of  $y$ .
- (iii) If  $\angle A = (2x - 3)^\circ$  and  $\angle C = (4y + 2)^\circ$ , then find how  $x$  and  $y$  relate.

**OR**

If  $AB = (2y - 3)$  and  $CD = 5 \text{ cm}$  then what is the value of  $y$ ?



Section A

1.

(d)  $\frac{\sqrt{5}-\sqrt{2}}{3}$

**Explanation:**  $\frac{1}{\sqrt{5}+\sqrt{2}}$   
 $= \frac{\sqrt{5}-\sqrt{2}}{(\sqrt{5}+\sqrt{2})(\sqrt{5}-\sqrt{2})}$   
 $= \frac{\sqrt{5}-\sqrt{2}}{3}$

2. (a) 4

**Explanation:** Given, (4, 19) is a solution of the equation  $y=ax+3$   
 $=19 = 4a + 3$   
 $= a = 4$

3. (a) (0, -7)

**Explanation:** Here, PM Perpendicular to y-axis.  
 So point M lies on the y-axis, and for any point on y-axis always the value of  $x = 0$ .  
 So Co-ordinate of M = (0, -7).

4.

(c) 2

**Explanation:** Adjusted frequency =  $\left(\frac{\text{frequency of the class}}{\text{width of the class}}\right) \times 5$   
 Therefore, Adjusted frequency of 25 - 45 =  $\frac{8}{20} \times 5 = 2$

5.

(b) 1

**Explanation:** If the line represented by the equation  $3x + ky = 9$  passes through the points (2, 3) then (2, 3) will satisfy the equation  $3x + ky = 9$   
 $3(2) + 3k = 9$   
 $\Rightarrow 6 + 3k = 9$   
 $\Rightarrow 3k = 9 - 6$   
 $\Rightarrow 3k = 3$   
 $\Rightarrow k = 1$

6.

(c) squares and circles

**Explanation:** In ancient India, squares and circular altars were used for household rituals. The geometry of the Vedic period originated with the construction of altars (or vedis) and fireplaces for performing Vedic rites. Square and circular altars were used for household rituals, while altars, whose shapes were combinations of rectangles, triangles and trapeziums, were required for public worship.

7.

(c)  $45^\circ$

**Explanation:** We have:  
 $\theta + \phi = 180^\circ$  [ $\because$  AOD is a straight line]  
 $\Rightarrow 3\phi + \phi = 180^\circ$  [ $\because \theta = 3\phi$ ]  
 $\Rightarrow 4\phi = 180^\circ$   
 $\Rightarrow \phi = 45^\circ$

8.

(b) Rectangle

**Explanation:** Rectangle is the correct answer. As we know that from all the quadrilaterals given in other options, diagonals of a rectangle are equal.

9.

(d) 2

**Explanation:** If  $p(x) = x + 1$  is a factor of  $2x^2 + kx$ , then

$$p(-1) = 0$$

$$\Rightarrow 2(-1)^2 + k(-1) = 0$$

$$\Rightarrow 2 - k = 0$$

$$\Rightarrow k = 2$$

10.

(b)  $x + y = 7$

**Explanation:**  $x = 2$  and  $y = 5$  satisfy the given equation.

11.

(c)  $57.5^\circ$

**Explanation:** As  $BC = AC$ , therefore triangle ABC is an isosceles triangle.

Given  $\angle ACD = 115^\circ$ ,  $\angle ACB = 180 - 115 = 65^\circ$  (Linear Pair)

As  $AC = BC$ , therefore  $\angle A = \angle B$

As sum of all the three angles of a triangle is  $180^\circ$

Therefore,  $\angle A + \angle B + \angle ACB = 180^\circ$

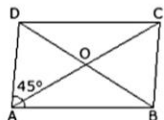
$$\angle A = \angle B = 57.5$$

12.

(d)  $135^\circ$

**Explanation:**

Given,



ABCD is a quadrilateral

$$\angle A = 45^\circ,$$

$\therefore$  diagonals of quadrilateral bisect each other hence ABCD is a parallelogram,

$$\Rightarrow \angle A + \angle B = 180^\circ$$

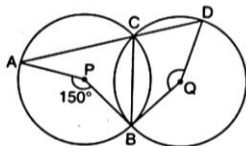
$$\Rightarrow 45^\circ + \angle B = 180^\circ$$

$$\Rightarrow \angle B = 180^\circ - 45^\circ = 135^\circ$$

13.

(b)  $150^\circ$

**Explanation:**



$\angle APB = 150^\circ$ , so,  $\angle ACB = 75^\circ$  {Angle subtended by an arc at centre is twice the angle subtended at any point on circumference}

Now, ACD is straight line, so,  $\angle ACB + \angle DCB = 180^\circ$

$$\angle DCB = 180 - 75 = 105^\circ$$

Now, angle subtended by arc BD on centre is twice of  $\angle DCB = 2 \times 105 = 210^\circ$

$$\text{Now, } \angle BQD = 360^\circ - 210^\circ = 150^\circ$$

14. (a)  $\sqrt{5}$

**Explanation:**  $\sqrt{5} = 2.23606797749978969$ , Which is a non-terminating and non-repeating decimal therefore it is an irrational and also lies between 2 and 2.5

15.

(d)  $y = \frac{3x+10}{5}$

**Explanation:**  $5y - 3x - 10 = 0$

$5y - 3x = 10$

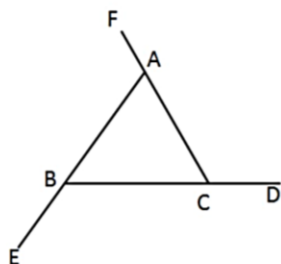
$5y = 10 + 3x$

$y = \frac{10+3x}{5}$

16.

(d)  $360^\circ$

**Explanation:**



In  $\triangle ABC$

$\angle A + \angle B + \angle C = 180^\circ$

Now,  $\angle FAB = 180^\circ - \angle A \dots(i)$

$\angle DCA = 180^\circ - \angle C \dots(ii)$

$\angle EBC = 180^\circ - \angle B \dots(iii)$

Adding equations (i), (ii) and (iii)

$\angle FAB + \angle DCA + \angle EBC = 180^\circ - \angle A + 180^\circ - \angle C + 180^\circ - \angle B$

$= 540^\circ - (\angle A + \angle B + \angle C)$

$= 540^\circ - 180^\circ$

$\Rightarrow$  Sum of All exterior angles =  $360^\circ$

17.

(a)  $x^3 + 2x^2 - x - 2$

**Explanation:**  $x^3 + 2x^2 - x - 2$

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

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

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

18.

(c)  $2r$

**Explanation:** Volume of a sphere =  $(4/3)\pi r^3$

Volume of a solid cone =  $(1/3)\pi r^2 h$

Given, solid sphere of radius  $r$  is melted and cast into the shape of a solid cone of height  $r$

Let the base radius be  $A$ .

$\Rightarrow (4/3)\pi r^3 = (1/3)\pi \times A^2 \times r$

$\Rightarrow A = 2r$

19.

(d) A is false but R is true.

**Explanation:**  $s = \frac{6+6+6}{2} = \frac{18}{2} = 9$  cm

Area =  $\sqrt{9(9-6)(9-6)(9-6)}$

$= \sqrt{9 \times 3 \times 3 \times 3} = 9\sqrt{3}$  cm<sup>2</sup>

20.

(c) A is true but R is false.

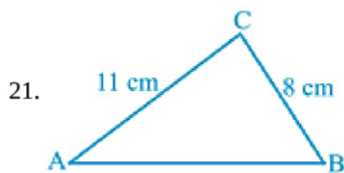
**Explanation:**  $(-\frac{3}{2}, k)$  is a solution of  $2x + 3 = 0$

$2 \times (-\frac{3}{2}) + 3 = -3 + 3 = 0$

$(-\frac{3}{2}, k)$  is the solution of  $2x + 3 = 0$  for all values of  $k$ .

Also  $ax + b = 0$  can be expressed as a linear equation in two variables as  $ax + 0 \cdot y + b = 0$ .

**Section B**



Let  $a, b, c$  be the sides of the given triangle and  $2s$  be its perimeter such that  $a = 8$  cm,  $b = 11$  cm and  $2s = 32$  cm i.e.  $s = 16$  cm

Now,

$$a + b + c = 2s$$

$$\Rightarrow 8 + 11 + c = 32$$

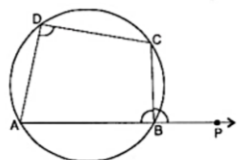
$$\Rightarrow c = 13$$

$$\therefore s - a = 16 - 8 = 8, s - b = 16 - 11 = 5 \text{ and } s - c = 16 - 13 = 3$$

$$\text{Hence, Area of given triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$= \sqrt{16 \times 8 \times 5 \times 3} = 8\sqrt{30} \text{ cm}^2$$

22. Given: ABCD is a cyclic quadrilateral whose side AB is produced to P to form exterior  $\angle CBP$ .



To prove:  $\angle CBP = \text{Interior opposite } \angle ADC$

Proof :  $\because$  ABCD is a cyclic quadrilateral

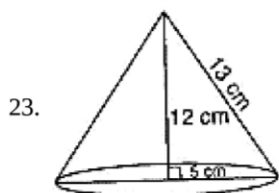
$$\therefore \angle ADC + \angle ABC = 180^\circ \quad (1)$$

$\because$  Opposite angles of a cyclic quadrilateral are supplementary

$$\text{Also, } \angle ABC + \angle CBP = 180^\circ \quad \dots(2) \text{ [Linear Pair Axiom]}$$

From (1) and (2), we have

$$\angle ABC + \angle CBP = \angle ABC + \angle ADC$$



The solid obtained will be a right circular cone whose radius of the base is 5 cm. and height is 12 cm

$$\therefore r = 5 \text{ cm, } h = 12 \text{ cm}$$

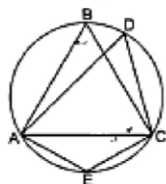
$$\therefore \text{Volume} = \frac{1}{3} \pi r^2 h$$

$$= \frac{1}{3} \times \pi \times (5)^2 \times 12 \text{ cm}^3$$

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

The volume of the solid so obtained is  $100\pi \text{ cm}^3$

24. Here it is given that  $\triangle ABC$  is an equilateral triangle,



i. As ABC is equilateral, we have

$$\angle ABC = 60^\circ$$

$$\angle ADC = \angle ABC \dots\dots\dots(\text{Angles in the same segment})$$

$$\therefore \angle ADC = 60^\circ$$



ii.  $\angle ABC + \angle AEC = 180^\circ$  .....(Opposite angles of cyclic quadrilateral)  
 $60^\circ + \angle AEC = 180^\circ$   
 $\Rightarrow \angle AEC = 180^\circ - 60^\circ = 120^\circ$

OR

Given that, PQ is a diameter of circle which bisects chord AB to C

To prove: PQ bisects  $\angle AOB$

Proof: In  $\triangle AOC$  and  $\triangle BOC$ ,

OA = OB (Radius of circle)

OC = OC (Common)

AC = BC (Given)

Then,  $\triangle AOC \cong \triangle BOC$  (By SSS congruence rule)

$\angle AOC = \angle BOC$  (By c.p.c.t)

Hence, PQ bisects  $\angle AOB$ .

25. For  $x = 2, y = 1,$

L.H.S. =  $2x + 5y$

=  $2(2) + 5(1)$

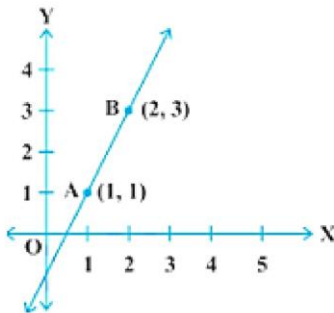
=  $4 + 5 = 9$

= R.H.S.

$\therefore x = 2, y = 1$  is a solution of  $2x + 5y = 9$

OR

From the table, we get two points A (1,1) and B (2,3) which lie on the graph of the linear equation Obviously, the graph will be a straight line so we first plot the points A and B and join them as shown in the fig from the fig we see that the graph cuts the x axis at the point  $(\frac{1}{2}, 0)$  and y - axis at the point (0, -1)



**Section C**

$$26. \text{LHS} = \frac{\sqrt{2}+\sqrt{3}}{3\sqrt{2}-2\sqrt{3}} = \frac{\sqrt{2}+\sqrt{3}}{3\sqrt{2}-2\sqrt{3}} \times \frac{3\sqrt{2}+2\sqrt{3}}{3\sqrt{2}+2\sqrt{3}}$$

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

$$= \frac{(3\sqrt{2})^2 - (2\sqrt{3})^2}{6+2\sqrt{6}+3\sqrt{6}+6}$$

$$= \frac{18-12}{6+5\sqrt{6}} = 2 + \frac{5\sqrt{6}}{6}$$

Now,  $a - b\sqrt{6} = 2 + \frac{5}{6}\sqrt{6}$

$a = 2$

$b = -\frac{5}{6}$

27. Let  $p(x) = x^3 - 23x^2 + 142x - 120$

We shall now look for all the factors of -120. Some of these are  $\pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, \pm 8, \pm 10, \pm 12, \pm 15, \pm 20, \pm 24, \pm 30, \pm 60$ .

By hit and trial, we find that  $p(1) = 0$ . Therefore,  $x - 1$  is a factor of  $p(x)$ .

Now we see that  $x^3 - 23x^2 + 142x - 120 = x^3 - x^2 - 22x^2 + 22x + 120x - 120$

=  $x^2(x-1) - 22x(x-1) + 120(x-1)$

=  $(x-1)(x^2 - 22x + 120)$  [Taking  $(x-1)$  common]

Now  $x^2 - 22x + 120$  can be factorised either by splitting the middle term or by using the Factor theorem. By splitting the middle

term, we have:  $x^2 - 22x + 120 = x^2 - 12x - 10x + 120$

=  $x(x-12) - 10(x-12)$

$$= (x - 12)(x - 10)$$

$$\text{Therefore, } x^3 - 23x^2 - 142x - 120 = (x - 1)(x - 10)(x - 12)$$

28. As the sides of the equal to the base of an isosceles triangle is 3 : 2, so let the sides of an isosceles triangle be  $3x$ ,  $3x$  and  $2x$ .

$$\text{Now, perimeter of triangle} = 3x + 3x + 2x = 8x$$

$$\text{Given Perimeter of triangle} = 32 \text{ m}$$

$$\therefore 8x = 32; x = 32 \div 8 = 4$$

So, the sides of the isosceles triangle are  $(3 \times 4) \text{ cm}$ ,  $(3 \times 4) \text{ cm}$ ,  $(2 \times 4) \text{ cm}$  i.e., 12 cm, 12 cm and 8cm

$$\therefore s = \frac{12+12+8}{2} = \frac{32}{2} = 16 \text{ cm}$$

$$= \sqrt{16(16 - 12)(16 - 12)(16 - 8)}$$

$$= \sqrt{16 \times 4 \times 4 \times 8} = \sqrt{4 \times 4 \times 4 \times 4 \times 4 \times 2}$$

$$= 4 \times 4 \times 2\sqrt{2} = 32\sqrt{2} \text{ cm}^2$$

OR

Let the sides of the triangle be  $x, 2x, 3x$

$$\text{Perimeter of the triangle} = 480 \text{ m}$$

$$\therefore x + 2x + 3x = 480 \text{ m}$$

$$6x = 480 \text{ m}$$

$$x = 80 \text{ m}$$

$\therefore$  The sides are 80m, 160m, 240m

so,

$$S = \frac{80+160+240}{2} = \frac{480}{2}$$

$$= 240 \text{ m}$$

And,

$$\therefore \text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)} \text{ sqm}$$

$$= \sqrt{240(240 - 80)(240 - 160)(240 - 240)} \text{ sqm}$$

$$= 0 \text{ sq m}$$

$\therefore$  Triangle doesn't exist with the ratio 1:2:3 whose perimeter is 480 m.

$$29. 5x + 3y = 15$$

Put  $x = 0$ , we get

$$5(0) + 3y = 15$$

$$\Rightarrow 3y = 15$$

$$\Rightarrow y = \frac{15}{3} = 5$$

$\therefore (0, 5)$  is a solution.

$$5x + 3y = 15$$

Put  $y = 0$ , we get

$$5x + 3(0) = 15$$

$$\Rightarrow 5x = 15$$

$$\Rightarrow x = \frac{15}{5} = 3$$

$\therefore (3, 0)$  is a solution.

$$5x + 2y = 10$$

Put  $x = 0$ , we get

$$5(0) + 2y = 10$$

$$\Rightarrow 2y = 10$$

$$\Rightarrow y = \frac{10}{2} = 5$$

$\therefore (0, 5)$  is a solution.

$$5x + 2y = 10$$

Put  $y = 0$ , we get

$$5x + 2(0) = 10$$

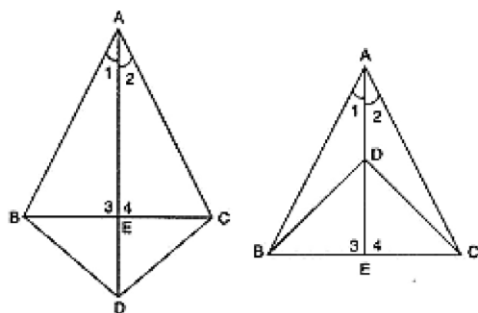
$$\Rightarrow 5x = 10$$

$$\Rightarrow x = \frac{10}{5} = 2$$

$\therefore (2, 0)$  is a solution.

The given equations have a common solution  $(0, 5)$ .

30. In  $\triangle ABD$  and  $\triangle ACD$



$AB = AC, BD = CD \dots$  [Given]

$AD = AD \dots$  [Common]

$\therefore \triangle ABD \cong \triangle ACD \dots$  [SSS axiom]

$\therefore \angle 1 = \angle 2 \dots$  [c.p.c.t.]

In  $\triangle ABE$  and  $\triangle ACE$ ,

$AB = AC \dots$  [Given]

$AE = AE \dots$  [Common]

$\angle 1 = \angle 2 \dots$  [As proved above]

$\therefore \triangle ABE \cong \triangle ACE \dots$  [SAS axiom]

$\therefore BE = CE \dots$  [c.p.c.t.]

and  $\angle 3 = \angle 4 \dots$  [c.p.c.t.]

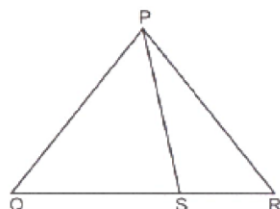
But  $\angle 3 + \angle 4 = 180^\circ \dots$  [Linear pair axiom]

$\therefore \angle 3 = \angle 4 = 90^\circ$

Hence, AD bisects BC at right angles.

OR

Given: A Point S on side QR of  $\triangle PQR$ .



To prove:  $PQ + QR + RP > 2PS$

Proof: In  $\triangle PQS$ , we have

$PQ + QS > PS \dots (1)$

[ $\because$  Sum of the length of any two sides of a triangle must be greater than the third side]

Now, in  $\triangle PSR$ , we have

$RS + RP > PS \dots (2)$

[ $\because$  Sum of the length of any two sides of triangle must be greater than the third side]

Adding (1) and (2), we get

$PQ + QS + RS + RP > 2PS$

$\Rightarrow PQ + QR + RP > 2PS$

Hence, proved.

31. i. A(2, 2)

B(5, 4)

C(7, 6)

ii.  $AB = \sqrt{(5-2)^2 + (4-2)^2}$

$= \sqrt{9+4}$

$= \sqrt{13}$

$BC = \sqrt{(7-5)^2 + (6-4)^2}$

$= \sqrt{4+4}$

$= 2\sqrt{2}$

$$\begin{aligned} AC &= \sqrt{(7-2)^2 + (6-2)^2} \\ &= \sqrt{25 + 16} \\ &= \sqrt{41} \end{aligned}$$

$$\therefore AB + BC = \sqrt{13} + 2\sqrt{2}$$

$$AC = \sqrt{41}$$

$$\therefore AB + BC \neq AC$$

$\therefore$  A, B, C are not collinear

**Section D**

$$\begin{aligned} 32. \frac{3+\sqrt{5}}{3-\sqrt{5}} &= \frac{3+\sqrt{5}}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}} \\ &= \frac{(3+\sqrt{5})^2}{3^2-\sqrt{5}^2} [a^2-b^2=(a+b)(a-b)] \\ &= \frac{3^2+2 \times 3\sqrt{5}+\sqrt{5}^2}{9-5} \\ &= \frac{9+6\sqrt{5}+5}{4} \\ &= \frac{14+6\sqrt{5}}{4} \\ &= \frac{7+3\sqrt{5}}{2} \end{aligned}$$

Substituting the value  $\sqrt{5}$  we get,

$$\begin{aligned} &\frac{7+3 \times 2.236}{2} \\ &= \frac{7+6.708}{2} \\ &= \frac{13.708}{2} \\ &= 6.854 \end{aligned}$$

OR

$$\begin{aligned} \text{Given, } &\frac{7\sqrt{3}}{\sqrt{10+\sqrt{3}}} - \frac{2\sqrt{5}}{\sqrt{6+\sqrt{5}}} - \frac{3\sqrt{2}}{\sqrt{15+3\sqrt{2}}} \\ &= \frac{7\sqrt{3}}{\sqrt{10+\sqrt{3}}} \times \frac{\sqrt{10-\sqrt{3}}}{\sqrt{10-\sqrt{3}}} - \frac{2\sqrt{5}}{\sqrt{6+\sqrt{5}}} \times \frac{\sqrt{6-\sqrt{5}}}{\sqrt{6-\sqrt{5}}} - \frac{3\sqrt{2}}{\sqrt{15+3\sqrt{2}}} \times \frac{\sqrt{15-3\sqrt{2}}}{\sqrt{15-3\sqrt{2}}} \\ &= \frac{7\sqrt{3}(\sqrt{10-\sqrt{3}})}{(\sqrt{10})^2-(\sqrt{3})^2} - \frac{2\sqrt{30}-2 \times 5}{(\sqrt{6})^2-(\sqrt{5})^2} - \frac{3\sqrt{30}-18}{(\sqrt{15})^2-(3\sqrt{2})^2} \\ &= \frac{7(\sqrt{30}-3)}{10-3} - \frac{(2\sqrt{30}-10)}{6-5} - \frac{3\sqrt{30}-18}{15-18} \\ &= \sqrt{30} - 3 - (2\sqrt{30} - 10) - (6 - \sqrt{30}) \\ &= \sqrt{30} - 3 - 2\sqrt{30} + 10 - 6 + \sqrt{30} \\ &= 10 - 9 + 2\sqrt{30} - 2\sqrt{30} = 1 \end{aligned}$$

33. i. From the above figure, We have  $AB = BC \dots (1)$  [Given]

Now, A, M, B are the three points on a line, and M lies between A and B such that M is the mid point of AB [Given], then

$AM + MB = AB \dots (2)$  Also B, N, C are three points on a line such that N is the mid point of BC [Given]

Similarly,  $BN + NC = BC \dots (3)$

So, we get  $AM + MB = BN + NC$

From (1), (2), (3) and Euclid's first axiom

Since M is the mid-point of AB and N is the mid-point of BC, therefore

$$2AM = 2NC \text{ i.e. } AM = NC$$

Hence,  $AM = NC$ . Proved

Using axiom 6, things which are double of the same thing are equal to one another.

ii. From the above figure, We have  $BM = BN \dots (1)$  [ Given ]

As M is the mid-point of AB [Given], so that

$$BM = AM \dots (2)$$

And N is the mid-point of BC [Given]

$$BN = NC \dots (3)$$

From (1), (2) and (3) and Euclid's first axiom, we get

$$AM = NC \dots (4)$$

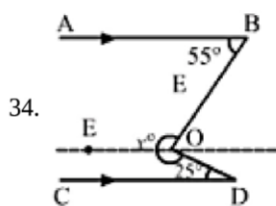
Adding (4) and (1), we get

$$AM + BM = NC + BN$$

Hence,  $AB = BC$  Proved

[By axiom 2 if equals are added to equals, the wholes are equal]





Draw  $EO \parallel AB \parallel CD$

Then,  $\angle EOB + \angle EOD = x^\circ$

Now,  $EO \parallel AB$  and  $BO$  is the transversal.

$\therefore \angle EOB + \angle ABO = 180^\circ$  [Consecutive Interior Angles]

$$\Rightarrow \angle EOB + 55^\circ = 180^\circ$$

$$\Rightarrow \angle EOB = 125^\circ$$

Again,  $EO \parallel CD$  and  $DO$  is the transversal.

$\therefore \angle EOD + \angle CDO = 180^\circ$  [Consecutive Interior Angles]

$$\Rightarrow \angle EOD + 25^\circ = 180^\circ$$

$$\Rightarrow \angle EOD = 155^\circ$$

Therefore,

$$x^\circ = \angle EOB + \angle EOD$$

$$x^\circ = (125 + 155)^\circ$$

$$x^\circ = 280^\circ$$

OR

$EF \parallel CD$  and  $ED$  is the transversal.

$\therefore \angle FED + \angle EDH = 180^\circ$  [co-interior angles]

$$\Rightarrow 65^\circ + y = 180^\circ$$

$$\Rightarrow y = (180^\circ - 65^\circ) = 115^\circ.$$

Now  $CH \parallel AG$  and  $DB$  is the transversal

$\therefore x = y = 115^\circ$  [corresponding angles]

Now,  $ABG$  is a straight line.

$\therefore \angle ABE + \angle EBG = 180^\circ$  [sum of linear pair of angles is  $180^\circ$ ]

$$\Rightarrow \angle ABE + x = 180^\circ$$

$$\Rightarrow \angle ABE + 115^\circ = 180^\circ$$

$$\Rightarrow \angle ABE = (180^\circ - 115^\circ) = 65^\circ$$

We know that the sum of the angles of a triangle is  $180^\circ$ .

From  $\triangle EAB$ , we get

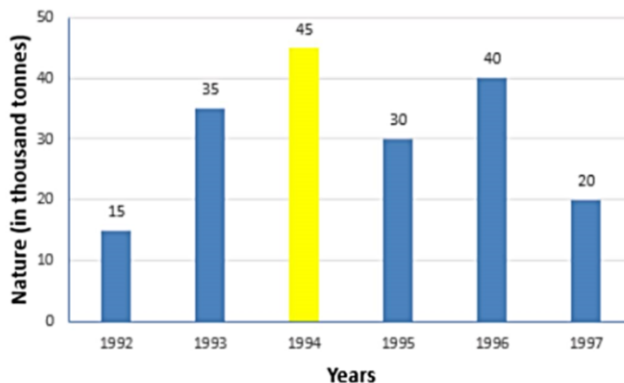
$$\angle EAB + \angle ABE + \angle BEA = 180^\circ$$

$$\Rightarrow 90^\circ + 65^\circ + z = 180^\circ$$

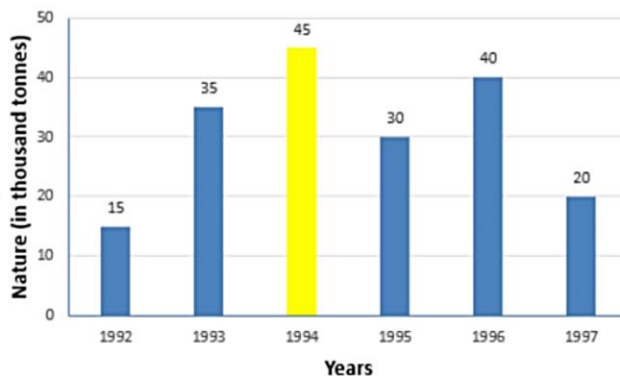
$$\Rightarrow z = (180^\circ - 155^\circ) = 25^\circ$$

$$\therefore x = 115^\circ, y = 115^\circ \text{ and } z = 25^\circ$$

35. i. The bar graph is given below.



ii. Max. is shown by yellow colour.

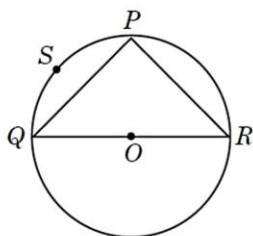


iii. (c) 1996 and 1997

**Section E**

36. Read the text carefully and answer the questions:

Sanjay and his mother visited in a mall. He observes that three shops are situated at P, Q, R as shown in the figure from where they have to purchase things according to their need. Distance between shop P and Q is 8 m and between shop P and R is 6 m. Considering O as the center of the circles.



(i) We know that angle in the semicircle =  $90^\circ$   
 Here QR is a diameter of circle and  $\angle QPR$  is angle in semicircle.

Hence  $\angle QPR = 90^\circ$

(ii)  $\angle QPR = 90^\circ$

$$\Rightarrow QR^2 = PQ^2 + PR^2$$

$$\Rightarrow QR^2 = 8^2 + 6^2$$

$$\Rightarrow QR = \sqrt{64 + 36}$$

$$\Rightarrow QR = 10 \text{ m}$$

(iii) Measure of  $\angle QSR = 90^\circ$

Angles in the same segment are equal.  $\angle QSR$  and  $\angle QPR$  are in the same segment.

OR

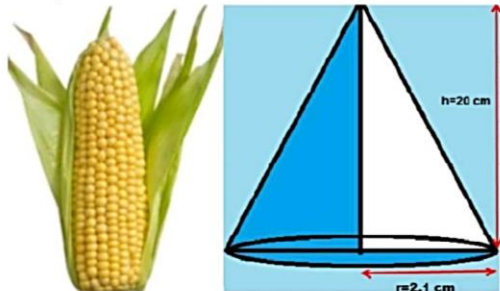
$$\text{Area } \Delta PQR = \frac{1}{2} \times PQ \times PR$$

$$\Rightarrow \text{Area } \Delta PQR = \frac{1}{2} \times 8 \times 6 = 24 \text{ sqm}$$

37. Read the text carefully and answer the questions:

Once upon a time in Ghaziabad was a corn cob seller. During the lockdown period in the year 2020, his business was almost lost. So, he started selling corn grains online through Amazon and Flipcart. Just to understand how many grains he will have from one corn cob, he started counting them.

Being a student of mathematics let's calculate it mathematically. Let's assume that one corn cob (see Fig.), shaped somewhat like a cone, has the radius of its broadest end as 2.1 cm and length as 20 cm.



(i) First we will find the curved surface area of the corn cob.

We have,  $r = 2.1$  and  $h = 20$

Let  $l$  be the slant height of the conical corn cob. Then,

$$l = \sqrt{r^2 + h^2} = \sqrt{(2.1)^2 + (20)^2} = \sqrt{4.41 + 400} = \sqrt{404.41} = 20.11 \text{ cm}$$

$\therefore$  Curved surface area of the corn cub =  $\pi r l$

$$= \frac{22}{7} \times 2.1 \times 20.11 \text{ cm}^2$$

$$= 132.726 \text{ cm}^2 = 132.73 \text{ cm}^2$$

(ii) The volume of the corn cub

$$= \frac{1}{3} \pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 2.1 \times 2.1 \times 20$$

$$= 92.4 \text{ cm}^3$$

(iii) Now

Total number of grains on the corn cob = Curved surface area of the corn cob  $\times$  Number of grains of corn on  $1 \text{ cm}^2$

Hence, Total number of grains on the corn cob =  $132.73 \times 4 = 530.92$

So, there would be approximately 531 grains of corn on the cob.

OR

Volume of a corn cub =  $92.4 \text{ cm}^3$

Volume of the cartoon =  $20 \times 25 \times 20 = 10,000 \text{ cm}^3$

Thus no. of cubs which can be stored in the cartoon

$$\frac{10000}{92.4} \approx 108 \text{ cubs}$$

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

Harish makes a poster in the shape of a parallelogram on the topic SAVE ELECTRICITY for an inter-school competition as shown in the follow figure.



(i) Since, ABCD is a parallelogram.

$\angle A + \angle D = 180^\circ$  (adjacent angles of a quadrilateral are equal)

$$(4x + 3)^\circ + (5x + 3)^\circ = 180^\circ$$

$$9x = 180^\circ$$

$$x = 20$$

$$\angle D = (5x - 3)^\circ = 97^\circ$$

$\angle D = \angle B$  (opposite angles of a parallelogram are equal)

Thus,  $\angle B = 97^\circ$

(ii)  $\angle B = \angle D$  (opposite angles of a parallelogram are equal)

$$\Rightarrow 2y = 3y - 6$$

$$\Rightarrow 2y - 3y = -6$$

$$\Rightarrow -y = -6$$

$$\Rightarrow y = 6$$

(iii)  $\angle A = \angle C$  (opposite angles of a parallelogram are equal)

$$\Rightarrow 2x - 3 = 4y + 2$$

$$\Rightarrow 2x = 4y + 5$$

$$\Rightarrow x = 2y + \frac{5}{2}$$

$$AB = CD$$

$$\Rightarrow 2y - 3 = 5$$

$$\Rightarrow 2y = 8$$

$$\Rightarrow y = 4$$

OR