Class: IX
SESSION : 2022-2023
SUBJECT: Mathematics
SAMPLE QUESTION PAPER - 2
with SOLUTION

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 π =22/7 wherever required if not stated.

Section A

1. x = 2, y = -1 is a solution of the linear equation **[1]**

   a) 2x + y = 0 b) x + 2y = 0

   c) x + 2y = 4 d) 2x + y = 5

2. The value of $(x^{a-b})^{a+b} \times (x^{b-c})^{b+c} \times (x^{c-a})^{c+a}$ is **[1]**

   a) 3 b) 2

   c) 1 d) 0

3. Abscissa of a point is positive in: **[1]**

   a) quadrant I and IV b) quadrant II and III

   c) quadrant I only d) quadrant IV only

4. The linear equation 3x - 5y = 15 has **[1]**

   a) no solution b) infinitely many solutions

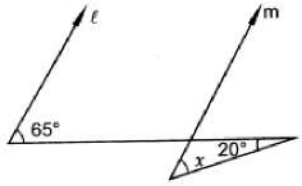
   c) a unique solution d) two solutions

5. The side faces of a pyramid are **[1]**

   a) Squares b) Trapeziums

   c) Polygons d) Triangles

6. In Fig. if lines l and m are parallel, then x = **[1]**



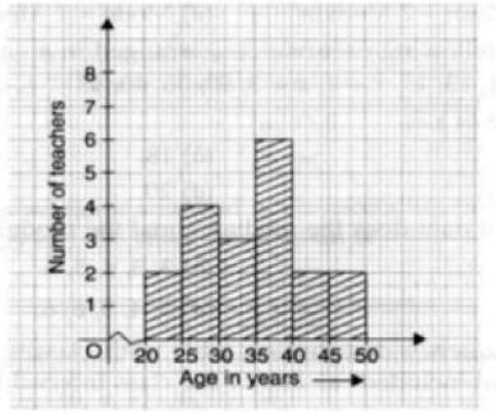
a) 85°

b) 20°

c) 65°

d) 45°

7. The graph given below shows the frequency distribution of the age of 22 teachers in a school. The number of teachers whose age is less than 40 years is **[1]**



a) 17

b) 16

c) 15

d) 14

8. If x-1 is the factor of p(x) = $x^3 - 23x^2 + kx - 120$, then the value of 'k' is **[1]**

a) 120

b) 124

c) 142

d) 140

9. The opposite sides of a quadrilateral have **[1]**

a) two common points

b) no common point

c) one common point

d) infinitely many common points

10. A linear equation in two variables is of the form ax + by + c = 0, where **[1]**

a) $a \neq 0$ and $b = 0$

b) $a = 0$ and $b = 0$

c) $a \neq 0$ and $b \neq 0$

d) $a = 0$ and $b \neq 0$

11. The bisectors of the angles of a Parallelogram enclose a **[1]**

a) Parallelogram

b) Rectangle

c) Rhombus

d) Square

12. In $\triangle ABC$, $\angle B = \angle C$ and ray AX bisects the exterior angle $\angle DAC$. If $\angle DAX = 70°$, then $\angle ACB =$ **[1]**

a) 55°
b) 35°
c) 70°
d) 90°

13. ABCD is a cyclic quadrilateral such that $\angle ADB = 30°$ and $\angle DCA = 80°$, then $\angle DAB =$ **[1]**

a) 125^o
b) 70^o
c) 100^o
d) 150^o

14. When $p(x) = x^3 - ax^2 + x$ is divided by $(x - a)$, the remainder is **[1]**

a) 0
b) a
c) 2a
d) 3a

15. When simplified $(x^{-1} + y^{-1})^{-1}$ is equal to **[1]**

a) xy
b) x + y
c) $\frac{xy}{x+y}$
d) $\frac{x+y}{xy}$

16. If the measures of angles of a triangle are in the ratio of 3 : 4 : 5, what is the measure of the smallest angle of the triangle? **[1]**

a) 60°
b) 45°
c) 30°
d) 25°

17. The value of $(a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$ is **[1]**

a) 3(a + b)(b + c)(c + a)(a - b)(b - c)(c - a)
b) 3(a - b)(b - c)(c - a)
c) 3(a + b)(b + c)(c + a)
d) none of these

18. **Assertion (A):** The side of an equilateral triangle is 6 cm then the height of the triangle is 9 cm. **[1]**

Reason (R): The height of an equilateral triangle is $\frac{\sqrt{3}}{2}a$.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

19. The height of a conical vessel is 3.5 cm. If its capacity is 3.3 litres of milk, then **[1]**

the diameter of its base is

a) 35 cm.
b) 15 cm.
c) 30 cm.
d) 60 cm.

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.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

Section B

21. Find the zeroes of the polynomial g(x) = 3 - 6x. **[2]**

22. If the area of an equilateral triangle is $81\sqrt{3}$ cm^2, find its perimeter. **[2]**

23. The volume of a hemisphere is $2425\frac{1}{2}cm^3$. Find its curved surface area. (Useπ = 22/7) **[2]**

24. Express the linear equation in the form ax + by + c = 0 and indicate the values of a, b and c in -2x + 3y = 6. **[2]**

OR

Find whether (2, 0) is the solution of the equation x – 2y = 4 or not?

25. Give possible expressions for the length and breadth of the following rectangle whose area is given by $25a^2$ - 35a + 12. **[2]**

OR

If a, b, c are all non-zero and a + b + c = 0, prove that $\frac{a^2}{bc} + \frac{b^2}{ca} + \frac{c^2}{ab} = 3$.

Section C

26. Find the value of k, if x - 1 is a factor of p(x) in : $p(x) = 2x^2 + kx + \sqrt{2}$ **[3]**

27. Find the values of a and b in each of $\frac{\sqrt{2}+\sqrt{3}}{3\sqrt{2}-2\sqrt{3}} = 2 - b\sqrt{6}$ **[3]**

28. The cost of leveling the ground in the form of a triangle having the sides 51m, 37m and 20m at the rate of Rs.3 per m^2 is Rs.918. State whether the statement is true or false and justify your answer. **[3]**

OR

The perimeter of a triangular field is 540 m and its sides are in the ratio 25 : 17 : 12. Find the area of the triangle.

29. BE and CF are two equal altitudes of a triangle ABC. Using RHS congruence rule, prove that a triangle ABC is isosceles. **[3]**

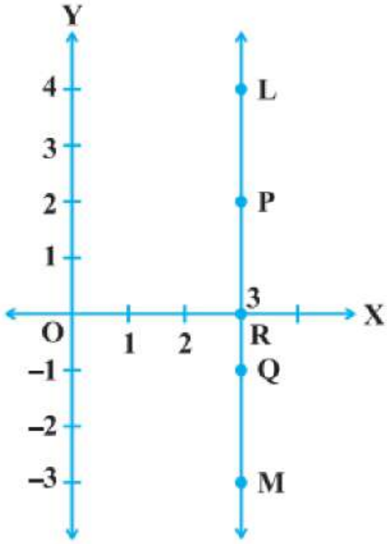
OR

ABC is an isosceles triangle with AB = AC and BD and CE are its two medians. Show that BD = CE.

30. Find at least 3 solutions for the following linear equation in two variables: **[3]**

$2x + 3y = 4$

31. In Figure, LM is a line parallel to the y-axis at a distance of 3 units. **[3]**



i. What are the coordinates of the points P, R and Q?

ii. What is the difference between the abscissa of the points L and M?

Section D

32. In a line segment AB point C is called a mid-point of line segment AB, prove that every line segment has one and only one mid-point. **[5]**

33. If $a = 3 + 2\sqrt{2}$, then find the value of: **[5]**

i. $a^2 + \frac{1}{a^2}$

ii. $a^3 + \frac{1}{a^3}$

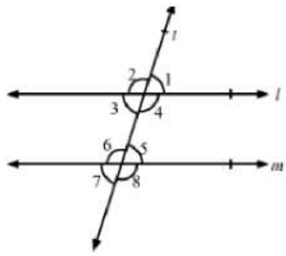
OR

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, $\frac{3+\sqrt{5}}{3-\sqrt{5}}$.

34. Draw a histogram for the frequency distribution of the following data: **[5]**

Class interval	8-13	13-18	18-23	23-28	28-33	33-38	38-43
Frequency	320	780	160	540	260	100	80

35. In the given figure, l || m and a transversal t cuts them. If $\angle 1 : \angle 2 = 2 : 3$, find the measure of each of the marked angles. **[5]**



OR

If the $\angle XYZ = 64^\circ$ and XY is produced to point P. Draw a figure from the given information. If ray YQ bisects ∠ZYP, find ∠ XYQ and reflex ∠QYP.

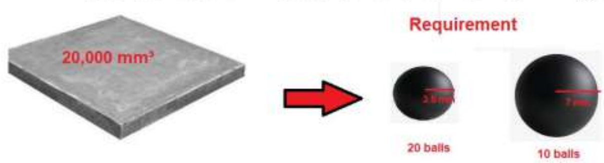
Section E

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

In Agra in a grinding mill, there were installed 5 types of mills. These mills used steel balls of radius 5 mm, 7 mm, 10 mm, 14 mm and 16 mm respectively. All the balls were in the spherical shape.

For repairing purpose mills need 10 balls of 7 mm radius and 20 balls of 3.5 mm radius. The workshop was having 20000 mm^3 steel.

This 20000 mm^3 steel was melted and 10 balls of 7 mm radius and 20 balls of 3.5 mm radius were made and the remaining steel was stored for future use.



(i) What was the volume of one ball of 3.5 mm radius?

(ii) What was the surface area of one ball of 3.5 mm radius?

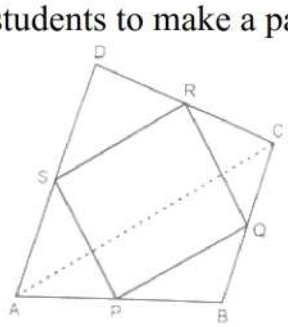
OR

How much steel was kept for future use?

(iii) What was the volume of 10 balls of radius 7 mm?

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

Modern curricula include several problem-solving strategies. Teachers model the process, and students work independently to copy it. Sheela Maths teacher of class 9^{th} wants to explain the properties of parallelograms in a creative way, so she gave students colored paper in the shape of a quadrilateral and then ask the students to make a parallelogram from it by using paper folding.



(i) How can a parallelogram be formed by using paper folding?

(ii) If $\angle RSP = 30^o$, then find $\angle RQP$.

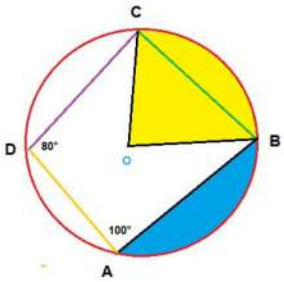
OR

If SP = 3 cm, Find the RQ.

(iii) If $\angle RSP = 50^o$, then find $\angle SPQ$?

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

There was a circular park in Defence colony at Delhi. For fencing purpose poles A, B, C and D were installed at the circumference of the park.
Ram tied wires From A to B, B to C and C to D, and he managed to measure the $\angle A = 100°$ and $\angle D = 80°$
Point O in the middle of the park is the center of the circle.



(i) Name the quadrilateral ABCD.

(ii) What is the value of $\angle C$?

(iii) What is the value of $\angle B$.

OR

Write any three properties of cyclic quadrilateral?

SOLUTION

Section A

1. **(b)** x + 2y = 0

   Explanation: 2 + 2(-1) = 2 - 2 = 0
2. **(c)** 1

   Explanation: $\left(x^{a-b}\right)^{a+b} \times \left(x^{b-c}\right)^{b+c} \times \left(x^{c-a}\right)^{c+a}$

   $\Rightarrow x^{a^2-b^2} \times x^{b^2-c^2} \times x^{c^2-a^2}$

   $\Rightarrow x^{a^2-b^2+b^2-c^2+c^2-a^2}$

   $\Rightarrow x^0 = 1$
3. **(a)** quadrant I and IV

   Explanation: Abscissa means x-corrdinate.

   In quadrant I and IV, the value of x is positive.

   Thus, the abscissa of a point is positive in quadrant I and IV.
4. **(b)** infinitely many solutions

   Explanation:

   Given linear equation: 3x - 5y = 15 Or, $x = \frac{5y+15}{3}$

   When y = 0, $x = \frac{15}{3} = 5$

   When y = 3, $x = \frac{30}{3} = 10$

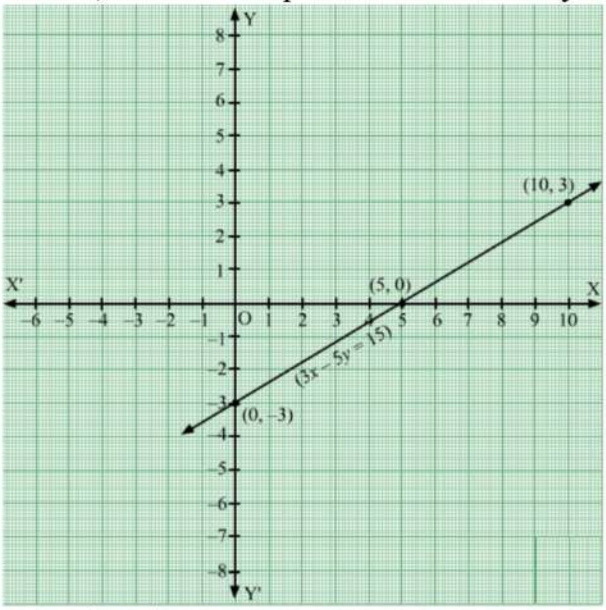
   When y = -3, $x = \frac{0}{3} = 0$

xx	5	10	0
yy	0	3	-3

   Plot the points A(5,0) , B(10,3) and C(0,−3). Join the points and extend them in both the directions.

   We get infinite points that satisfy the given equation.

   Hence, the linear equation has infinitely many solutions.



5. **(d)** Triangles

   Explanation: because when we connect base edge and apex it forms a triangle.
6. **(d)** 45°

   Explanation: l ∥ m

Let transversal be n and $\angle 1 = 65^o$

$\angle 2 = 20^o$

$\angle 3 = x$

Since,

$l \parallel m$ and n cuts them so,

$\angle 1 + \angle 4 = 180^o$ (Co. interior angle)

$65^o + \angle 4 = 180^o$

$\angle 4 = 115^o$ (i)

$\angle 4 = \angle 5 = 115^o$ (Vertically opposite angle)

$\angle 2 + \angle 5 + \angle 3 = 180^o$

$20^o + 115^0 + x = 180^o$

$x = 45^o$

7. **(c)** 15

Explanation: Add the values corresponding to the height of the bar before 40.

$6 + 3 + 4 + 2 = 15$

8. **(c)** 142

Explanation: If x - 1 is a factor of p(x), then

$p(1) = 0$

$(1)^3 - 23\,(1)^2 + k\,(1) - 120 = 0$

$1 - 23 + k - 120 = 0$

$1 - 143 + k = 0$

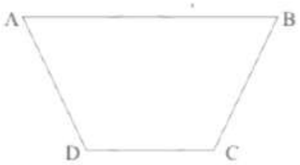
$-142 + k = 0$

$k = 142$

9. **(b)** no common point

Explanation:

We can look at a quadrilateral as:



The opposite sides of the above quadrilateral AB and CD have no point in common.

10. **(c)** $a \neq 0$ and $b \neq 0$

Explanation: A linear equation in two variables is of the form $ax + by + c = 0$ as a and b are coefficient of x and y

so if $a = 0$ and $b = 0$ or either of one is zero in that case the equation will be one variable or their will be no equation respectively.

therefore when $a \neq 0$ and $b \neq 0$ then only the equation will be in two variable

11. **(b)** Rectangle

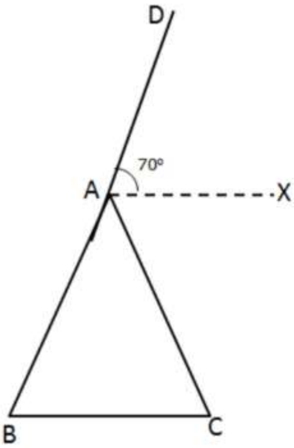
Explanation: Let ABCD be a parallelogram. angle A + angle D = 180 (co-interior angles)

$\frac{1}{2}$ of (angle A + angle D) = 90.

Triangle formed by bisectors of angle A and angle D, have sum of two angles equals to 90 therefore, remaining angle is of 90. similarly, we can prove that other angles formed are of 90 each by bisectors of angles of ABCD. The quadrilateral formed by angle bisectors of ABCD has all angles equal to 90 (Vertically opposite angles). A quadrilateral with all right angles is a Rectangle.

12. **(c)** 70°

Explanation:



AX is bisector of ∠DAC

$\Rightarrow \angle DAX = \angle XAC = 70°$

$\Rightarrow \angle DAC = 2 \times 70 = 140°$

Now, ∠A = 180° - ∠DAC = 180°c- 180° = 40°

In △ABC

∠A + ∠B + ∠C = 180°

⇒ 40° + ∠B + ∠C= 180°

⇒ 40° + ∠C + ∠C = 180° ...(∠B = ∠C)

⇒ $2\angle C$ = 140°

⇒ $\angle C$ = 70°

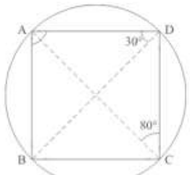
i.e. ∠ACB = 70°

13. **(b)** 70^o

Explanation:

It is given that ABCD is cyclic quadrilateral ∠ADB = 90^o and ∠DCA = 80^o. We have to find ∠DAB.

We have the following figure regarding the given information



∠BDA = ∠BCA = 30^o (Angle in the same segment are equal)

Now, since ABCD is a cyclic quadrilateral

So, ∠DAB + ∠BCD = 180^o

∠DAB + ∠BCA + ∠DCA = 180^o [∠BCD = ∠BCA + ∠DCA]

∠DAB + 30^o + 80^o = 180^o

∠DAB = 180^o - 110^o

∠DAB = 70^o

14. **(b)** a

Explanation: By remainder theorem, when p(x) = $x^3 - ax^2 + x$ is divided by (x - a), then the remainder = p(a)

Putting x = a in p(x), we get

$p(a) = a^3 - a \times a^2 + a = a^3 - a^3 + a = a$

$\therefore$ Remainder = a

15. **(c)** $\frac{xy}{x+y}$

Explanation: $(x^{-1} + y^{-1})^{-1}$

$= (\frac{1}{x} + \frac{1}{y})^{-1}$

$= (\frac{y+x}{xy})^{-1}$

$= \frac{xy}{x+y}$

16. **(b)** 45°

Explanation: The measures of angles of a triangle are in ratio 3: 4: 5.

Let the angles be 3x, 4x and 5x.

In any triangle, sum of all angles = 180°

$\Rightarrow 3x + 4x + 5x = 180°$

$\Rightarrow 12x = 180°$

$\Rightarrow x = 15°$

So, smallest angle = $3 \times 15° = 45°$

17. **(a)** 3(a + b)(b + c)(c + a)(a - b)(b - c)(c - a)

Explanation: $(a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$

Here,

$a^2 - b^2 + b^2 - c^2 + c^2 - a^2 = 0$

Therefore,

$(a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$

$= 3(a^2 - b^2)(b^2 - c^2)(c^2 - a^2)$ [Since $x^3 + y^3 + z^3 = 3xyz$ if $x + y + z = 0$]

$(a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3$

$= 3(a + b)(b + c)(c + a)(a - b)(b - c)(c - a)$

18. **(d)** A is false but R is true.

Explanation: The height of the triangle,

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

$9 = \frac{\sqrt{3}}{2}a$

$a = \frac{9 \times 2}{\sqrt{3}} = \frac{18}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{18\sqrt{3}}{3} = 6\sqrt{3}$ cm

19. **(d)** 60 cm.

Explanation: 1 litre = 1000 cm^3

So, 3.3 litre = 3300 cm^3 = volume of conical vessel

Thus, Volume of conical vessel = $\frac{1}{3}\pi r^2 h = 3300$

$\frac{1}{3} \times \frac{22}{7} \times r^2 \times 3.5 = 3300$

$r^2 = \frac{3300 \times 21}{22 \times 3.5}$

$r^2 = 900$

r = 30 cm

So, diameter = 2r = 60 cm

20. **(c)** A is true but R is false.

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

$2 \times \left(-\frac{3}{2}\right) + 3$ = -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·y + b = 0.

Section B

21. Solving the equation g(x) = 0, we get

3 - 6x = 0, which gives us $x = \frac{1}{2}$

So, $\frac{1}{2}$ is a zero of the polynomial 3 - 6x.

22. Let the side of an equilateral triangle is *a* cm.

Area of an equilateral triangle $= \frac{\sqrt{3}}{4}a^2$

$\frac{\sqrt{3}}{4}a^2 = 81\sqrt{3}$

$\Rightarrow a^2 = 81 \times 4$

$\Rightarrow$ a = 18 cm

$\therefore$ Perimeter of equilateral triangle = 3a = 3 × 18 = 54 cm.

23. As, volume of hemisphere = $2425\frac{1}{2}cm^3$

$\Rightarrow \frac{2}{3}\pi r^3 = 2425\frac{1}{2}$

$\Rightarrow \frac{2}{3} \times \frac{22}{7}r^3 = \frac{4851}{2}$

$\Rightarrow r^3 = \frac{4851 \times 3 \times 7}{2 \times 2 \times 22}$

$\Rightarrow r^3 = \frac{441 \times 3 \times 7}{2 \times 2 \times 2}$

$\Rightarrow r^3 = \frac{21^3}{2^3}$

$\Rightarrow r = \frac{21}{2}cm$

So, the curved surface area of the hemisphere $= 2\pi r^2$

$= 2 \times \frac{22}{7} \times \frac{21}{2} \times \frac{21}{2} = 693\text{cm}^2$

24. We need to express the linear equation $-2x + 3y = 6$ in the form ax + by + c = 0 and indicate the values of a, b and c.

$-2x + 3y = 6$ can also be written as $-2x + 3y - 6 = 0$.

We need to compare the equation $-2x + 3y - 6 = 0$ with the general equation ax + by + c = 0, to get the values of a, b and c.

Therefore, we can conclude that $a = -2, b = 3$ and $c = -6$

OR

x-2y=4

Put x = 2 and y = 0 in given equation, we get

x – 2y = 2 – 2(0) = 2 – 0 = 2, which is not 4.

$\therefore$ (2, 0) is not a solution of given equation.

25. $25a^2 - 35a + 12$

$= 25a^2 - 20a - 15a + 12$

= 5a(5a - 4) - 3(5a - 4)

= (5a - 4)(5a - 3)

$\therefore$ The possible expressions for the length and breadth of the rectangle are 5a - 3 and 5a - 4.

OR

Given, $\frac{a^2}{bc}+\frac{b^2}{ca}+\frac{c^2}{ab}=3$

L.H.S. $\frac{a^2}{bc}+\frac{b^2}{ca}+\frac{c^2}{ab}=\frac{a^3+b^3+c^3}{abc}$

We know that, if $a+b+c=0$, then $a^3+b^3+c^3=3abc$

$=\frac{3abc}{abc}$

= 3

= R.H.S.

Section C

26. $p(x)=2x^2+kx+\sqrt{2}$

We know that according to the factor theorem

$p(a)=0$, if $x-a$ is a factor of $p(x)$

We conclude that if $(x-1) is a factor of p(x)=2x^2+kx+\sqrt{2}$ then $p(1)=0$

$p(1)=2(1)^2+k(1)+\sqrt{2}=0$, or

$2+k+\sqrt{2}=0$

$k=-(2+\sqrt{2})$.

Therefore, we can conclude that the value of k is $-(2+\sqrt{2})$

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

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

$=\frac{6+2\sqrt{6}+3\sqrt{6}+6}{18-12}$

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

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

28. True, Let a = 51m, b = 37m, c = 20m

$s=\frac{a+b+c}{2}=\frac{51+37+20}{2}=\frac{108}{2}=54$m

$\therefore$ Area of triangular ground $=\sqrt{s(s-a)(s-b)(s-c)}$

$=\sqrt{54(54-51)(54-37)(54-20)}$

$=\sqrt{54\times3\times17\times34}$

$=\sqrt{9\times3\times2\times3\times17\times17\times2}$

$= 3 \times 3 \times 2 \times 17$

$= 306\ m^2$

Cost of leveling the ground = Rs.3 $\times$ 306 = Rs.918.

Hence the cost of leveling the ground in the form of a triangle is Rs 918.

OR

The sides of the triangle field are in the ratio 25:17:12.

Let the sides of triangle be 25x, 17x and 12x.

Perimeter of this triangle = 540 m

25x + 17x + 12x = 540 m

54x = 540 m

x = 10 m

Sides of triangle will be 250 m, 170 m, and 120 m

Semi-perimeter (s) = $\frac{Perimeter}{2}=\frac{540}{2}$ = 270 m

By Heron's formula:

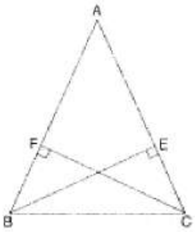
Area of triangle = $\sqrt{s(s-a)(s-b)(s-c)}$

$=\sqrt{270(270-120)(270-170)(270-250)}$

$= \sqrt{270 \times 150 \times 100 \times 20}$

$= 9000\ m^2$

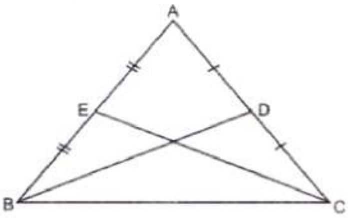
So, area of the triangle is 9000 m^2.

29. 

Given: BE and CF are two equal altitudes of a triangle ABC.
To Prove: △ABC is isosceles.
Proof : In right △BEC and right △CFB
side BE = side CF ...[Given]
BC = CB ...[Common]
△BEC = △CFB ...[By RHS rule]
∴ ∠BCE = ∠CBF ...[c.p.c.t.]
∴ AB = AC ...[Sides opposite to equal angles of a triangle are equal]
∴ △ABC is isosceles.

OR

Given: ΔABC with AB = AC



And AD = CD, AE = BE.
To prove: BD = CE
Proof: In ΔABC we have
AB = AC [Given]
$\Rightarrow \frac{1}{2}AB = \frac{1}{2}AC$
⇒ AE = AD
[∵ D is the mid-point of AC and E is the mid-point of AB]
Now, in ΔABD and ΔACE, we have
AB = AC [Given]
$\angle A = \angle A$ (Common angle]
AE = AD [Proved above]
SO, by SAS criterion of congruence, we have
$\Delta ABD \cong \Delta ACE$
⇒ BD = CE [CPCT]
Hence, proved.

30. 2x + 3y = 4
⇒ 3y = 4 – 2x
$\Rightarrow y = \frac{4-2x}{3}$
Put x = 0, then $y = \frac{4-2(0)}{3} = \frac{4}{3}$
put x = 1, then $y = \frac{4-2(1)}{3} = \frac{2}{3}$
Put x = 2, then $y = \frac{4-2(2)}{3} = 0$

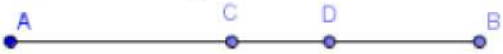
Put x = 3, then $y = \frac{4-2(3)}{3} = \frac{-2}{3}$

$\therefore (0, \frac{4}{3}), (1, \frac{2}{3}), (2, 0)$ and $(3, \frac{-2}{3})$, are the solutions of the equation 2x + 3y = 4.

31. Given LM is a line parallel to the Y-axis and its perpendicular distance from Y-axis is 3 units.
   i. Coordinate of point P = (3,2)
   Coordinate of point Q = (3,-1)
   Coordinate of point R = (3, 0) [since its lies on X-axis, so its y coordinate is zero].
   ii. Abscissa of point L = 3, abscissa of point M=3
   $\therefore$ Difference between the abscissa of the points L and M = 3 – 3 = 0

Section D

32. We need to prove that every line segment has one and only one mid-point. Let us consider the given below line segment AB and assume that C and D are the mid-points of the line segment AB



If C is the mid-point of line segment AB, then
AC = CB.
An axiom of the Euclid says that "If equals are added to equals, the wholes are equal."
AC + AC = CB + AC....(i)
From the figure, we can conclude that CB + AC will coincide with AB.
An axiom of the Euclid says that "Things which coincide with one another are equal to one another." AC + AC = AB....(ii)
An axiom of the Euclid says that "Things which are equal to the same thing are equal to one another."
Let us compare equations (i) and (ii), to get
AC + AC = AB, or 2AC = AB.(iii)
If D is the mid-point of line segment AB, then
AD = DB.
An axiom of the Euclid says that "If equals are added to equals, the wholes are equal."
AD + AD = DB + AD....(iv)
From the figure, we can conclude that DB + AD will coincide with AB.
An axiom of the Euclid says that "Things which coincide with one another are equal to one another."
AD + AD = AB....(v)
An axiom of the Euclid says that "Things which are equal to the same thing are equal to one another."
Let us compare equations (iv) and (v), to get
AD + AD = AB, or
2AD = AB....(vi)
An axiom of the Euclid says that "Things which are equal to the same thing are equal to one another." Let us compare equations (iii) and (vi), to get
2AC = 2AD.
An axiom of the Euclid says that "Things which are halves of the same things are equal to one another." AC = AD.
Therefore, we can conclude that the assumption that we made previously is false and a line segment has one and only one mid-point.

33. i. Given, $a = 3 + 2\sqrt{2}$
   and $\frac{1}{a} = \frac{1}{3+2\sqrt{2}}$

Now, $\frac{1}{a}=\frac{1}{3+2\sqrt{2}}\times\frac{3-2\sqrt{2}}{3-2\sqrt{2}}=\frac{3-2\sqrt{2}}{3^2-(2\sqrt{2})^2}=\frac{3-2\sqrt{2}}{9-8}$

$\therefore \quad \frac{1}{a}=3-2\sqrt{2}$

$a+\frac{1}{a}=3+2\sqrt{2}+3-2\sqrt{2}=6$

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

$6^2=a^2+\frac{1}{a^2}+2$

$\Rightarrow \quad a^2+\frac{1}{a^2}=36-2$

$\Rightarrow \quad a^2+\frac{1}{a^2}=34$

ii. Now,

$\left(a+\frac{1}{a}\right)^3=a^3+\frac{1}{a^3}+3\times a^2\times\frac{1}{a}+3\times a\times\frac{1}{a^2}$

$\Rightarrow\left(a+\frac{1}{a}\right)^3=\left(a^3+\frac{1}{a^3}\right)+3\left(a+\frac{1}{a}\right)$

$6^3=a^3+\frac{1}{a^3}+3\times 6$

$\Rightarrow a^3+\frac{1}{a^3}$

$=216-18=198$

OR

$\frac{3+\sqrt{5}}{3-\sqrt{5}}$

$=\frac{3+\sqrt{5}}{3-\sqrt{5}}\times\frac{3+\sqrt{5}}{3+\sqrt{5}}$

$=\frac{(3+\sqrt{5})^2}{3^3-\sqrt{5}^2}$ [$a^2 - b^2 = (a + b)(a - b)$]

$=\frac{3^2+2\times3\sqrt{5}+\sqrt{5}^2}{9-5}$

$=\frac{9+6\sqrt{5}+5}{4}$

$=\frac{14+6\sqrt{5}}{4}$

$=\frac{7+3\sqrt{5}}{2}$

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

$\frac{7+3\times2.236}{2}$

$=\frac{7+6.708}{2}$

$=\frac{13.708}{2}$

= 6.854

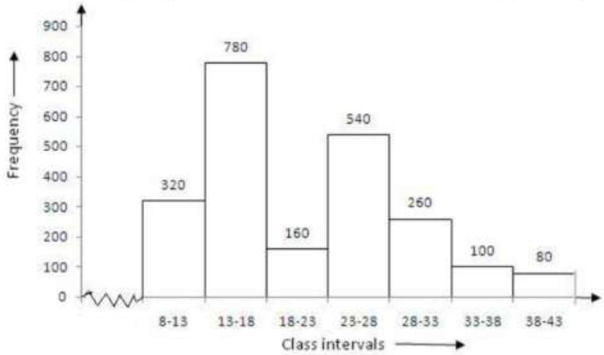
34. Given frequency distribution is as below:

Class interval	8-13	13-18	18-23	23-28	28-33	33-38	38-43
Frequency	320	780	160	540	260	100	80

Clearly, the given frequency distribution is in the exclusive form.

We take class intervals along x-axis and frequency along y-axis . So , we get the required histogram.

Since the scale on X-axis starts at 8, a kink(break) is indicated near the origin to show that the graph is drawn to scale beginning at 8.



35. Given that ∠1 : ∠2 = 2 : 3

Let ∠1 = 2k and ∠2 = 3k, where k is some constant

Now, ∠1 and ∠2 form a linear pair

$\therefore \angle 1 + \angle 2 = 180^\circ$

$\Rightarrow 2k + 3k = 180^\circ$

$\Rightarrow 5k = 180^\circ$

$\Rightarrow k = 36^\circ$

$\therefore \angle 1 = 2k = 2 \times 36^\circ = 72^\circ$

$\angle 2 = 3k = 3 \times 36^\circ = 108^\circ$

Now,

$\angle 3 = \angle 1 = 72^\circ$ (Vertically opposite angles)

$\angle 4 = \angle 2 = 108^\circ$ (Vertically opposite angles)

It is given that, l || m and t is a transversal

$\therefore \angle 5 = \angle 1 = 72^\circ$ (Pair of corresponding angles)

$\angle 6 = \angle 2 = 108^\circ$ (Pair of corresponding angles)

$\angle 7 = \angle 1 = 72^\circ$ (Pair of alternate exterior angles)

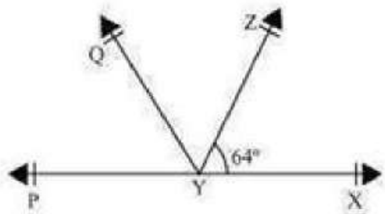
$\angle 8 = \angle 2 = 108^\circ$ (Pair of alternate exterior angles)

∠1 = ∠3 = ∠5=∠7 = 72°

and ∠2 = ∠4 = ∠6=∠8 = 108°

OR

We are given that ∠XYZ = 64°, XY is produced to P and YQ bisects ∠ZYP We can conclude the given below figure for the given situation:



We need to find ∠XYQ and reflex ∠QYP

From the given figure, we can conclude that ∠XYZ and ∠ZYP form a linear pair.

We know that sum of the angles of a linear pair is 180°.

∠XYZ + ∠ZYP = 180°

But ∠XYZ = 64°

⇒ 64° + ∠ZYP = 180°

⇒ ∠ZYP = 116°

Ray YQ bisects ∠ZYP,or

$\angle QYZ = \angle QYP = \frac{116^o}{2} = 58^o$

∠XYQ = ∠QYZ + ∠XYZ

$= 58^{o} + 64^{0} = 122^{o}$.

Reflex $\angle QYP = 360° - \angle QYP$

$= 360^{0} - 58^{0}$

$= 302^{0}$.

Therefore, we can conclude that $\angle XYQ = 122^{o}$ and Reflex $\angle QYP = 302^{o}$

Section E

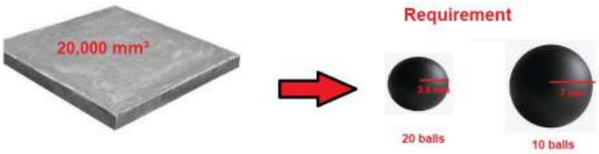
36. **Read the text carefully and answer the questions:**

In Agra in a grinding mill, there were installed 5 types of mills. These mills used steel balls of radius 5 mm, 7 mm, 10 mm, 14 mm and 16 mm respectively. All the balls were in the spherical shape.

For repairing purpose mills need 10 balls of 7 mm radius and 20 balls of 3.5 mm radius.

The workshop was having 20000 mm^3 steel.

This 20000 mm^3 steel was melted and 10 balls of 7 mm radius and 20 balls of 3.5 mm radius were made and the remaining steel was stored for future use.



(i) The radius of the ball= 3.5 mm

Volume of the ball

$= \frac{4}{3}\pi r^3$

$= \frac{4}{3} \times \frac{22}{7} \times 3.5 \times 3.5 \times 3.5$

$= 179.66 \text{ mm}^3$

(ii) Radius of one ball = 3.5 cm

The surface area of one ball

$= 4\pi r^2$

$= 4 \times \frac{22}{7} \times 3.5 \times 3.5$

$= 154 \text{ mm}^2$

OR

Volume of 10 balls of 7 mm = 14373.3 mm^3

Volume of 1 ball of 3.5 mm = 179.66 mm^3

Volume of 20 balls of 3.5 mm = 179.66 × 20= 3593.33 mm^3

Total steel required to be melted = 14373.3 + 3593.33 = 17966 mm^3(Approx)

Thus steel left over = 20,000 - 17966 = 2034 mm^3

(iii)Radius of one ball= 7 cm

Thus volume of 10 balls of radius 7 mm

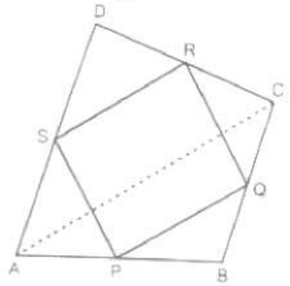
$= 10 \times \frac{4}{3}\pi r^3$

$= 10 \times \frac{4}{3} \times \frac{22}{7} \times 7^3$

$= 14373.3 \text{ mm}^3$

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

Modern curricula include several problem-solving strategies. Teachers model the process, and students work independently to copy it. Sheela Maths teacher of class 9^{th} wants to explain the properties of parallelograms in a creative way, so she gave students colored paper in the shape of a quadrilateral and then ask the students to make a parallelogram from it by using paper folding.



(i) By joining mid points of sides of a quadrilateral one can make parallelogram.
S and R are mid points of sides AD and CD of ΔADC, P and Q are mid points of sides AB and BC of ΔABC, then by mid-point theorem SR || AC and SR = $\frac{1}{2}$AC similarly PQ || AC and PQ = $\frac{1}{2}$AC.
Therefore SR || PQ and SR = PQ
A quadrilateral is a parallelogram if a pair of opposite sides is equal and parallel.
Hence PQRS is parallelogram.

(ii) $\angle RQP = 30^o$, Opposite angles of a parallelogram are equal.

OR

RQ = 3 cm
Opposite side of a parallelogram are equal.

(iii) Adjacent angles of a parallelogram are supplementary.

Thus, $\angle RSP + \angle SPQ = 180^o$

$50^o + \angle SPQ = 180^o$

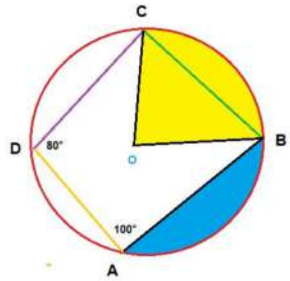
$\angle SPQ = 180^o - 50^o$

$= 130^o$

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

There was a circular park in Defence colony at Delhi. For fencing purpose poles A, B, C and D were installed at the circumference of the park.
Ram tied wires From A to B, B to C and C to D, and he managed to measure the $\angle A = 100°$ and $\angle D = 80°$

Point O in the middle of the park is the center of the circle.



(i) ABCD is cyclic quadrilateral.
A quadrilateral ABCD is called cyclic if all the four vertices of it lie on a circle.
Here all four vertices A, B, C and D lie on a circle.

(ii) We know that the sum of both pair of opposite angles of a cyclic quadrilateral is 180º.
$\angle C + \angle A = 1800$
$\angle C = 1800 - 1000 = 800$

(iii)We know that
The sum of both pair of opposite angles of a cyclic quadrilateral is 180º.
$\angle B + \angle D = 1800$
$\angle B = 1800 - 800 = 1000$

OR

i. In a cyclic quadrilateral, all the four vertices of the quadrilateral lie on the circumference of the circle.
ii. The four sides of the inscribed quadrilateral are the four chords of the circle.
iii. The sum of a pair of opposite angles is 180° (supplementary). Let $\angle A$, $\angle B$, $\angle C$, and $\angle D$ be the four angles of an inscribed quadrilateral. Then, $\angle A + \angle C = 180°$ and $\angle B + \angle D = 180°$.