MATHEMATICS
QUESTION BANK
CLASS IX

UNIT 1: NUMBER SYSTEM

Chapter 1 – Number System

Rational and Irrational Numbers

1. Classify the following numbers as rational or irrational: $\sqrt{2}$, 3/7, 0.1010010001..., $\sqrt{9}$, π.
2. Prove that $\sqrt{3}$ is irrational.
3. Find three rational numbers between 2/5 and 3/5.
4. Insert five irrational numbers between $\sqrt{2}$ and $\sqrt{3}$.
5. Is the sum of two irrational numbers always irrational? Justify with examples.
6. Determine which of the following are irrational: $(\sqrt{2} + \sqrt{3})$, $(\sqrt{2} + \sqrt{2})$, $(\sqrt{2} \times \sqrt{3})$, $(\sqrt{4} \times \sqrt{3})$.

Laws of Exponents for Real Numbers

1. Simplify: $(243)^{3/5} \times (32)^{-2/5}$.
2. If $2^x = 3^y = 6^z$, prove that $1/x + 1/y = 1/z$.
3. Simplify: $(x^a / x^b)^{a+b} \times (x^b / x^c)^{b+c} \times (x^c / x^a)^{c+a}$.
4. Evaluate: $[5^{n+1} \times 25^{n-1}] / [5^{n-1} \times 125^n]$.
5. Simplify: $(\sqrt{6} + \sqrt{5})(\sqrt{6} - \sqrt{5})$ and state the type of number obtained.
6. Rationalise the denominator: $4/(\sqrt{7} - \sqrt{3})$.
7. If $a = 2 + \sqrt{3}$, find the value of $a - 1/a$.
8. If $x = 3 - 2\sqrt{2}$, find the value of $x^2 + 1/x^2$.

UNIT 2: ALGEBRA

Chapter 2 – Introduction to Polynomials

Polynomials – Basics and Classification

1. State whether the following are polynomials. Give reasons: $x^2 + 2x + 1/x$, $3x^{1/2} + 2$, $\sqrt{2}\,x + 1$, $x^2 - 3x + 2$.
2. Find the degree, leading coefficient and constant term of: $p(x) = 5x^3 - 4x^2 + 2x - 7$.
3. Find the zeroes of the polynomial $p(x) = x^2 - 5x + 6$.
4. Verify that $x = 2$ and $x = 3$ are zeroes of $p(x) = x^2 - 5x + 6$.
5. Using the Remainder Theorem, find the remainder when $p(x) = x^3 - 3x^2 + x + 1$ is divided by $(x - 1)$.
6. If $p(x) = x^3 + ax^2 + bx + 6$ and $(x - 2)$ is a factor of $p(x)$ and $p(3) = 0$, find a and b.
7. Find the value of k if $(x - 1)$ is a factor of $p(x) = kx^2 - 3x + k$.
8. Factorise using Factor Theorem: $x^3 - 6x^2 + 11x - 6$.
9. Find the remainder when $x^{100} - 1$ is divided by $(x + 1)$.
10. If α and β are zeroes of $p(x) = x^2 - 5x + 6$, find the value of $\alpha^2 + \beta^2$ and $\alpha^3 + \beta^3$.
11. Factorise: $2x^3 - 7x^2 - 3x + 18$.

Algebraic Identities

1. Expand using algebraic identities: $(3x + 4y)^2$, $(2a - 3b)^3$, $(x + 1/x)^2$.
2. Evaluate 105^2 using the identity $(a + b)^2 = a^2 + 2ab + b^2$.
3. If $x + y + z = 0$, prove that $x^3 + y^3 + z^3 = 3xyz$.
4. Factorise: $a^3 + b^3 + c^3 - 3abc$.
5. Using identity, evaluate: $(999)^3$.
6. If $x + y = 10$ and $xy = 21$, find the value of $x^3 + y^3$.

Sequences and Progressions

1. Define an Arithmetic Progression (AP). Find the nth term of the AP: 5, 8, 11, 14, ...
2. Find the 20th term and the sum of first 20 terms of: 3, 7, 11, 15, ...
3. Which term of the AP 3, 15, 27, 39, ... will be 132 more than its 54th term?
4. Find the sum of all two-digit natural numbers divisible by 3.
5. How many terms of the AP 9, 17, 25, ... must be taken so that their sum is 636?
6. Find three numbers in AP whose sum is 27 and product is 504.
7. The sum of first n terms of an AP is $3n^2 + 5n$. Find the AP and the common difference.

Additional Questions

1. The 7th term of an AP is 32 and its 13th term is 62. Find the AP.
2. If the sum of first 14 terms of an AP is 1050 and its first term is 10, find the 20th term.
3. Find the AP whose 3rd term is 16 and 7th term exceeds the 5th term by 12.

CASE STUDY BASED QUESTIONS

Case Study 4: Ramesh saves money every month. In January he saves ₹500, in February ₹700, in March ₹900, and so on — an increase of ₹200 each month. This forms an Arithmetic Progression.

4. Write the AP and identify the first term (a) and common difference (d).
5. How much does Ramesh save in the month of December (12th month)?
6. In which month does Ramesh's monthly saving first exceed ₹2000?

Linear Equations in Two Variables

1. Express the equation $3x - 5y = 15$ in the form $ax + by + c = 0$ and find two solutions.
2. Write four solutions of the equation $2x + y = 7$ and plot them on a graph.
3. For what value of k does the equation $2x + ky = 6$ have (2, 2) as a solution?
4. The cost of a notebook is twice the cost of a pen. Write this situation as a linear equation in two variables.
5. Find the equation of a line passing through (2, 3) and (4, 5). Express in standard form.
6. Draw the graph of $x + 2y = 6$ and find the point where it meets the x-axis and y-axis.
7. Show that the points (0, 3), (1, 2), (3, 0) are collinear by checking if they satisfy $x + y = 3$.
8. If $x = 2$, $y = 1$ is a solution of $x + ay = 5$, find the value of a.
9. Graph the equations $y = 3x$ and $y = -x + 4$. Find their point of intersection.
10. Ramesh is 3 times older than his daughter. Write a linear equation representing this, find two solutions, and interpret them.
11. Write the linear equation that has infinite solutions for any value of y: express x as a constant equation.
12. Verify whether (1, −2) is a solution of $x - 3y + 7 = 0$.

UNIT 3: COORDINATE GEOMETRY

Chapter 3 – Coordinate Geometry

The Cartesian Plane and Plotting Points

1. Plot the following points on a Cartesian plane: A(3,4), B(−2,3), C(−3,−5), D(4,−2).
2. State the quadrant in which each point lies: (−3, 4), (5, −7), (−2, −6), (6, 8).
3. Find the mirror image of (3, −5) about (i) the x-axis, (ii) the y-axis, (iii) the origin.
4. The point (a, b) lies in the 3rd quadrant. What are the signs of a and b?
5. Plot triangle ABC with A(1,2), B(4,2), C(2,5). Find the type of triangle it forms.
6. Write the coordinates of a point that lies on the x-axis at a distance of 5 units from the origin.
7. If the x-coordinate of a point is 0, where does the point lie? Give an example.
8. Find the distance of the point (3, 4) from the origin.

UNIT 4: GEOMETRY

Chapter 4 – Introduction to Euclid's Geometry

Euclid's Definitions, Axioms and Postulates

1. State any two of Euclid's axioms. Give a real-life example of each.
2. Prove that two distinct lines cannot have more than one point in common.
3. If a point C lies between A and B such that AC = BC, prove that AC = AB/2.
4. Explain the difference between a theorem, a postulate, and an axiom.

Lines and Angles

1. Prove that vertically opposite angles are equal.
2. If two lines intersect and one of the angles formed is 70°, find all four angles.
3. In the figure, lines AB and CD intersect at O. If ∠AOC + ∠BOE = 70° and ∠BOD = 40°, find ∠BOE and reflex ∠COE.
4. Prove that if a transversal intersects two parallel lines, alternate interior angles are equal.
5. Two lines are perpendicular to the same line. Prove they are parallel to each other.
6. The angles of a triangle are in the ratio 2:3:4. Find the three angles.
7. An exterior angle of a triangle is 110° and one of the interior opposite angles is 45°. Find the other interior opposite angle.
8. Prove that the sum of all interior angles of a triangle is 180°.
9. Two parallel lines are cut by a transversal. If co-interior (same-side interior) angles are (3x+10)° and (x+30)°, find x.

Additional Questions

If two lines intersect at a point, and one of the four angles is 55°, find all four angles. Name the pair of vertically opposite angles.

1. In the given figure, PQ is a line. Ray OR is perpendicular to line PQ. OS is another ray lying between rays OP and OR. Prove that ∠ROS = ½(∠QOS − ∠POS).
2. If a transversal intersects two parallel lines, prove that the bisectors of a pair of alternate interior angles are parallel to each other.
3. In △ABC, if ∠A = 50° and ∠B = 70°, find ∠C. If the bisector of ∠A meets BC at D, find ∠ADB and ∠ADC.

CASE STUDY BASED QUESTIONS

Case Study 1: A surveyor is marking roads in a new township. Road AB and Road CD are straight roads that cross each other at point O. A third road PQ passes through the intersection such that ∠AOP = 40° and ∠AOC = 90°. Using properties of lines and angles, answer the following questions.

4. Find the measure of ∠POC.
5. Find the measure of ∠BOD. Name the property used.
6. Are roads AB and CD perpendicular? Give reason.

Triangles – Congruence Theorems

1. State all four congruence criteria (SSS, SAS, ASA, RHS). Give examples of each.
2. Prove: If two sides and the included angle of one triangle are equal to two sides and the included angle of another triangle, the triangles are congruent (SAS).
3. In △ABC, AB = AC. Prove that ∠B = ∠C (angles opposite equal sides are equal).
4. △ABC ≅ △PQR by SAS. If AB = 5 cm, BC = 7 cm, ∠B = 60°, PQ = 5 cm, ∠P = 60°, find QR.
5. In △ABC and △DEF, ∠A = ∠D, ∠B = ∠E, BC = EF. Prove △ABC ≅ △DEF (AAS).
6. Two sides of a triangle are 6 cm and 8 cm. Between what values must the third side lie?
7. Prove that in any triangle, the side opposite the greater angle is longer.
8. In a △ABC, if D is the mid-point of BC, prove that AB + AC > 2AD (median inequality).
9. Prove that the sum of any two sides of a triangle is greater than the third side.
10. In right-angled △ABC, ∠C = 90°. D is a point on BC. Prove that $AB^2 > AD^2$.
11. Prove that the hypotenuse is the longest side in a right-angled triangle.

Additional Questions

1. In △ABC, AB = BC and ∠B = 80°. Find ∠A and ∠C. If D is the midpoint of AC, show that BD ⊥ AC.
2. △ABC and △DBC are two isosceles triangles on the same base BC. Show that ∠ABD = ∠ACD.
3. Prove that angles opposite to equal sides of an isosceles triangle are equal. Use this to show that an equilateral triangle is equiangular.

CASE STUDY BASED QUESTIONS

Case Study 2: A triangular plot of land ABC is owned by a farmer. The local municipality measures the plot: AB = AC = 10 m, BC = 12 m. A water pipe has to be laid from vertex A to the midpoint M of BC.

4. Show that AM ⊥ BC using the property of isosceles triangles.
5. Find the length AM using the Pythagorean theorem. [Hint: $AM^2 + BM^2 = AB^2$, where BM = BC/2 = 6 m and AB = 10 m]
6. If ∠B = ∠C, what does this tell you about the triangle? Which congruence theorem confirms △ABM ≅ △ACM?

Quadrilaterals (4-gons)

1. Prove that the diagonals of a parallelogram bisect each other.
2. Prove that a quadrilateral is a parallelogram if its diagonals bisect each other.
3. ABCD is a rhombus. Prove that its diagonals bisect each other at right angles.
4. The angles of a quadrilateral are in the ratio 1:2:3:4. Find the angles.
5. Prove the Midpoint Theorem: The line segment joining the midpoints of two sides of a triangle is parallel to the third side and half its length.
6. In a parallelogram ABCD, if ∠A = 80°, find all four angles.
7. Show that each diagonal of a rhombus bisects the vertex angles.
8. ABCD is a rectangle. Prove that its diagonals are equal in length.
9. Prove that if the diagonals of a parallelogram are equal, it is a rectangle.
10. P, Q, R, S are midpoints of sides AB, BC, CD, DA of quadrilateral ABCD. Prove PQRS is a parallelogram.
11. In trapezium ABCD, AB || CD. If ∠A = 65° and ∠B = 70°, find ∠C and ∠D.

Additional Questions

12. The diagonals of a rhombus measure 16 cm and 12 cm. Find the side using: $side^2 = (d_1/2)^2 + (d_2/2)^2$ and hence find the perimeter.
13. In a parallelogram PQRS, the diagonal PR bisects ∠P. Show that PQRS is a rhombus.
14. ABCD is a square. BD is a diagonal. Prove that △ABD ≅ △CBD by SSS and find ∠ABD.
15. D, E, F are midpoints of sides AB, BC, CA of △ABC respectively. Prove that BDEF is a parallelogram.

CASE STUDY BASED QUESTIONS

Case Study 3: A school garden is shaped as a quadrilateral ABCD where AB ∥ CD and AD = BC. The groundskeeper says it is an isosceles trapezium. AB = 20 m, CD = 12 m, AD = BC = 8 m. Diagonals AC and BD are also equal.

16. What are the properties that confirm ABCD is an isosceles trapezium?
17. If ∠DAB = 70°, find ∠ABC, ∠BCD, and ∠CDA.
18. Find the area of trapezium ABCD using the formula: Area = ½ × (sum of parallel sides) × height, given height = 6 m.

UNIT 5: MENSURATION

Chapter 5 – Area, Perimeter, Surface Area & Volume

Area and Perimeter

1. Find the area of a triangle with sides 13 cm, 14 cm, and 15 cm using Heron's formula.
2. A triangular park has sides 120 m, 80 m, and 50 m. Find its area. If the cost of levelling is Rs.2 per m^2, find the total cost.
3. Find the area of a quadrilateral ABCD in which AB = 3 cm, BC = 4 cm, CD = 4 cm, DA = 5 cm, and diagonal AC = 5 cm.
4. The area of a rhombus is 480 cm^2 and one of its diagonals is 48 cm. Find the other diagonal and the perimeter.
5. A field is in the shape of a trapezium with parallel sides 25 m and 10 m, and non-parallel sides 14 m and 13 m. Find its area.
6. The perimeter of a right-angled triangle is 60 cm and its hypotenuse is 26 cm. Find its area.
7. A floral design on a floor is made up of 16 triangular tiles, each with sides 9 cm, 28 cm, and 35 cm. Find the cost of polishing at Rs. 0.50 per cm^2.
8. An isosceles triangle has perimeter 30 cm and each equal side is 12 cm. Find its area.
9. Find the area of a regular hexagon with side 6 cm. (Divide into 6 equilateral triangles.)
10. A rhombus-shaped sheet has diagonals 32 cm and 24 cm. Find the cost of polishing it at Rs.5 per m^2.
11. Find the area of the quadrilateral with vertices (1,2), (6,2), (5,6), (1,5) on the Cartesian plane.
12. The area of a parallelogram is 392 m^2 and its base is 28 m. Find its height.

Surface Area and Volume

1. Find the total surface area and volume of a cuboid with dimensions 12 cm × 8 cm × 5 cm.
2. A spherical ball has a surface area of 154 cm^2. Find its radius and volume. (Use $\pi = 22/7$)
3. A cylindrical tank has radius 7 m and height 3 m. Find the lateral surface area and total surface area.
4. The volume of a right circular cone is 1232 cm^3 and its height is 24 cm. Find the slant height and total surface area.
5. A hemispherical bowl has inner radius 5 cm. Find the volume of water it can hold.
6. How many spherical lead shots of diameter 4 mm can be made from a cuboid of lead measuring 11 cm × 4 cm × 3 cm?
7. A cone has the same base and height as a cylinder. Find the ratio of their volumes.
8. The diameter of a sphere is decreased by 25%. By what percent does its surface area decrease?
9. A cylindrical pipe has inner diameter 3.5 cm and water flows at 2 m/s. Find the volume of water flowing per minute.
10. Find the volume of a right pyramid with a square base of side 6 cm and height 8 cm.
11. The surface areas of two spheres are in the ratio 4:9. Find the ratio of their volumes.

UNIT 6: STATISTICS & PROBABILITY

Chapter 6 – Statistics

Statistics

1. The marks of 30 students in a test are: 35,40,55,60,65,70,35,40,45,50,55,60,65,70,75,40,45,50,55,60,65,70,35,50,55,60,65,70,75,80. Prepare a frequency distribution table with class intervals of width 10.
2. Draw a histogram for the following data on heights of students (in cm): 150–155: 5, 155–160: 10, 160–165: 15, 165–170: 12, 170–175: 8.
3. Find the mean of the following data: 12, 15, 14, 10, 17, 13, 15, 14, 16, 14.
4. Calculate the mean of the following frequency distribution: x: 10, 20, 30, 40, 50; f: 7, 10, 15, 8, 10.
5. Find the median of: 11, 13, 15, 17, 19, 21 and explain the concept of median for even n.
6. Find the mode of: 14, 25, 28, 25, 32, 17, 25, 28, 25, 40.
7. The following are the wages of 8 workers: 25, 20, 15, 18, 30, 35, 10, 24. Find mean, median, and mode.
8. Draw a frequency polygon for the data: 0–10: 4, 10–20: 8, 20–30: 16, 30–40: 12, 40–50: 6.

Introduction to Probability

1. A coin is tossed 400 times and heads appear 220 times. Find the empirical probability of (i) getting a head, (ii) getting a tail.
2. A bag contains 3 red, 5 blue, and 2 green balls. If one ball is drawn at random, find the probability of: (i) red, (ii) blue, (iii) not green.
3. Two coins are tossed simultaneously 200 times. Outcomes: 2H→56, 1H→100, 0H→44. Find P(at least one head).
4. Cards numbered 1 to 20 are placed in a box. Find P(card with a prime number), P(card with a multiple of 3), P(card with a number between 5 and 15 exclusive).
5. In a survey of 200 students, 120 play cricket, 50 play football, and 30 play both. Find P(student plays only cricket), P(student plays neither).
6. A die is thrown once. Find the probability of: (i) a multiple of 2, (ii) a factor of 6, (iii) a number greater than 4.