Model Question Paper 2

Half-Yearly Examination 2026-27

MATHEMATICS

Time Allowed: 3 Hours **Maximum Marks: 80**

General Instructions:

1. This question paper has 5 sections: A, B, C, D and E.
2. Section A has 20 objective type questions (Multiple Choice Questions and Assertion-Reason questions) carrying 1 mark each.
3. Section B has 5 questions carrying 2 marks each. Answers to these should not exceed 40-50 words each.
4. Section C has 6 questions carrying 3 marks each. Answers to these should not exceed 60-80 words each.
5. Section D has 4 questions carrying 5 marks each. Answers to these should not exceed 120 words each.
6. Section E has 3 source/case-based questions carrying 4 marks each, with four sub-parts of 1 mark each.
7. There is no overall choice. However, internal choices have been provided in all four questions of Section D and in one sub-part of each case-based question of Section E. A student has to attempt only one of the choices in such questions.
8. Use of calculators is not permitted.
9. Wherever necessary, neat and labelled figures should be drawn.

SECTION A

Question numbers 1 to 20 carry 1 mark each. Choose the most appropriate answer.

1. Which of the following numbers is a perfect square? *[1]*

(a) 45
(b) 81
(c) 99
(d) 120
Answer: (b) — $81 = 9^2$, a perfect square; the others are not.

2. The cube root of 2744 is: *[1]*

(a) 12
(b) 13
(c) 14
(d) 15
Answer: (c) — $14^3 = 14\times14\times14 = 2744$, so the cube root is 14.

3. Using the pattern $1^3=1^2=(1)^2$, $1^3+2^3=(1+2)^2$, $1^3+2^3+3^3=(1+2+3)^2$, the value of $1^3+2^3+3^3+4^3$ is: *[1]*

(a) 64
(b) 90
(c) 100
(d) 144
Answer: (c) — $1^3+2^3+3^3+4^3 = (1+2+3+4)^2 = 10^2 = 100$.

4. Simplify: $4^2 \times 4^{-5}$. *[1]*

(a) $4^{-3} = 1/64$
(b) 4^7
(c) $4^3 = 64$
(d) 4^{-7}
Answer: (a) — $4^2 \times 4^{-5} = 4^{(2-5)} = 4^{-3} = 1/64$.

5. The standard form of 0.000029 is: *[1]*

(a) 2.9×10^{-5}

(b) 29×10^{-6}
(c) 2.9×10^{-4}
(d) 0.29×10^{-4}
Answer: (a) — $0.000029 = 2.9 \times 10^{-5}$.

6. Simplify: $(3^2)^3 \div 3^5$. *[1]*
(a) 1
(b) 3
(c) 9
(d) 27
Answer: (b) — $(3^2)^3 = 3^6$; $3^6 \div 3^5 = 3^1 = 3$.

7. The multiplicative inverse (reciprocal) of -4/7 is: *[1]*
(a) -4/7
(b) 4/7
(c) -7/4
(d) 7/4
Answer: (c) — The reciprocal of -4/7 is -7/4, since (-4/7) × (-7/4) = 1.

8. Which of the following rational numbers lies between -2 and -1? *[1]*
(a) -3/2
(b) -5/2
(c) 0
(d) 1
Answer: (a) — -3/2 = -1.5, which lies between -2 and -1.

9. *This question consists of two statements — Assertion (A) and Reason (R). Choose the correct option: [1]*
Assertion (A): The rational numbers are closed under subtraction.
Reason (R): For any two rational numbers a and b, a - b is always a rational number.
(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
Answer: (a) — Both true; R states exactly the closure property asserted in A.

10. The sum of the interior angles of a quadrilateral is: *[1]*
(a) 180°
(b) 270°
(c) 360°
(d) 400°
Answer: (c) — By the angle sum property of a quadrilateral, the interior angles add up to 360°.

11. In a parallelogram, two adjacent angles are in the ratio 5:4. The measure of the smaller angle is: *[1]*
(a) 70°
(b) 80°
(c) 100°
(d) 90°
Answer: (b) — Adjacent angles are supplementary (sum 180°); parts = 5+4 = 9, one part = 20°, smaller angle = 4×20° = 80°.

12. Which of the following statements about a trapezium is correct? *[1]*
(a) Both pairs of opposite sides are parallel
(b) Only one pair of opposite sides is parallel

(c) All four sides are equal

(d) Diagonals always bisect each other

Answer: (b) — A trapezium has exactly one pair of parallel opposite sides.

13. A number is divisible by 15 if it is divisible by both: *[1]*

(a) 3 and 5

(b) 2 and 5

(c) 3 and 4

(d) 2 and 3

Answer: (a) — 3 and 5 are co-prime factors of 15 (3×5=15, HCF=1), so divisibility by both guarantees divisibility by 15.

14. The LCM of 15 and 20 is: *[1]*

(a) 30

(b) 45

(c) 60

(d) 75

Answer: (c) — 15 = 3×5; 20 = 2^2×5; LCM = 2^2×3×5 = 60.

15. Using the distributive law, 9 × (15 + 5) is equal to: *[1]*

(a) 9×15 + 9×5

(b) 9×15 + 5

(c) 9 + 15×5

(d) 15 + 9×5

Answer: (a) — By the distributive law, a×(b+c) = a×b + a×c, so 9×(15+5) = 9×15 + 9×5.

16. The product of $(-2x^2)$ and $(5x^3)$ is: *[1]*

(a) $-10x^5$

(b) $10x^5$

(c) $-10x^6$

(d) $-7x^5$

Answer: (a) — $(-2x^2)(5x^3) = -2\times5\times x^2\times x^3 = -10x^5$.

17. Using the distributive law, a(b+c) - a(c) simplifies to: *[1]*

(a) ab

(b) ac

(c) ab+ac

(d) a(b-c)

Answer: (a) — a(b+c) - a(c) = ab+ac-ac = ab.

18. ₹1500 is divided among P, Q and R in the ratio 3:4:5. Q's share is: *[1]*

(a) ₹375

(b) ₹450

(c) ₹500

(d) ₹625

Answer: (c) — Total parts = 3+4+5 = 12; each part = 1500/12 = ₹125; Q's share = 4×125 = ₹500.

19. If the cost of 12 notebooks is ₹180, find the cost of 15 notebooks (at the same rate). *[1]*

(a) ₹200

(b) ₹210

(c) ₹225

(d) ₹240

Answer: (c) — Cost of 1 notebook = 180/12 = ₹15; cost of 15 notebooks = 15×15 = ₹225.

20. *This question consists of two statements — Assertion (A) and Reason (R). Choose the correct option: [1]*

Assertion (A): A marked price of ₹1200 with a discount of 25% gives a selling price of ₹900.

Reason (R): Discount = 25% of ₹1200 = ₹300, and Selling Price = Marked Price − Discount = 1200 − 300 = ₹900.

(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

Answer: (a) — Both true; R correctly computes the discount and derives the selling price stated in A.

SECTION B

Question numbers 21 to 25 carry 2 marks each.

21. Find the square root of 441 by the prime factorisation method. *[2]*

Marking Scheme / Value Points:

- 441 = 3 × 3 × 7 × 7 (prime factorisation) — 1 mark
- Pairing equal factors: √441 = 3 × 7 = 21 — 1 mark

22. Find the LCM of 12 and 30 using prime factorisation. *[2]*

Marking Scheme / Value Points:

- $12 = 2^2 \times 3$; $30 = 2 \times 3 \times 5$ — 1 mark
- LCM = $2^2 \times 3 \times 5 = 4 \times 15 = 60$ — 1 mark

23. Verify that multiplication of rational numbers is commutative for -3/4 and 5/6, by checking that (-3/4) × (5/6) = (5/6) × (-3/4). *[2]*

Marking Scheme / Value Points:

- LHS: (-3/4) × (5/6) = -15/24 = -5/8 — 1 mark
- RHS: (5/6) × (-3/4) = -15/24 = -5/8. Since LHS = RHS = -5/8, commutativity is verified — 1 mark

24. Using the distributive law, find the product 4y(3y - 2x + 7). *[2]*

Marking Scheme / Value Points:

- $4y \times 3y = 12y^2$; $4y \times (-2x) = -8xy$ — 1 mark
- $4y \times 7 = 28y$; so $4y(3y-2x+7) = 12y^2 - 8xy + 28y$ — 1 mark

25. The angles of a quadrilateral are in the ratio 2:4:5:7. Find the measure of each angle. *[2]*

Marking Scheme / Value Points:

- Sum of ratio parts = 2+4+5+7 = 18; each part = 360°/18 = 20° — 1 mark
- Angles = 2×20°, 4×20°, 5×20°, 7×20° = 40°, 80°, 100°, 140° (sum = 360°, verified) — 1 mark

SECTION C

Question numbers 26 to 31 carry 3 marks each.

26. Find the smallest number by which 50 must be multiplied so that the product is a perfect square. Also find the square root of the resulting number. *[3]*

Marking Scheme / Value Points:

- $50 = 2 \times 5 \times 5 = 2^1 \times 5^2$; the factor 2 has an odd power (1), so 50 must be multiplied by 2 — 1 mark
- Resulting number = $50 \times 2 = 100 = 2^2 \times 5^2$ — 1 mark
- $\sqrt{100} = 2 \times 5 = 10$ — 1 mark

27. The ratio of red balls to blue balls in a bag is 3:7. If there are 21 red balls, find the number of blue balls and the total number of balls in the bag. *[3]*

Marking Scheme / Value Points:

- Red:Blue = 3:7; one part = 21/3 = 7 — 1 mark
- Number of blue balls = 7×7 = 49 — 1 mark
- Total balls = 21+49 = 70 — 1 mark

28. Simplify: 3/4 - (-2/3) × 3/8. *[3]*

Marking Scheme / Value Points:

- By the order of operations, multiplication is done first: (-2/3)×(3/8) = -6/24 = -1/4 — 1.5 marks
- 3/4 - (-1/4) = 3/4 + 1/4 = 1 — 1.5 marks

29. Multiply (3x-4)(x+6) and simplify your answer. *[3]*

Marking Scheme / Value Points:

- (3x-4)(x+6) = 3x×x + 3x×6 + (-4)×x + (-4)×6 — 1 mark
- = $3x^2$ + 18x - 4x - 24 — 1 mark
- = $3x^2$ + 14x - 24 (combining like terms) — 1 mark

30. In a parallelogram PQRS, angle P = 125°. Diagonal PR bisects angle P into two equal parts. Find angle Q, angle R, angle S, and each half of the bisected angle P. *[3]*

Marking Scheme / Value Points:

- Angle Q = 180° - 125° = 55° (adjacent angles P and Q are co-interior/supplementary) — 1 mark
- Angle R = angle P = 125°; angle S = angle Q = 55° (opposite angles of a parallelogram are equal) — 1 mark
- Each half of the bisected angle P = 125°/2 = 62.5° — 1 mark

31. Using divisibility tests, check whether the number 68,340 is divisible by (a) 4, and (b) 11. Show your working. *[3]*

Marking Scheme / Value Points:

- (a) Test for 4: check the last 2 digits, 40. 40 ÷ 4 = 10 exactly, so 68,340 is divisible by 4 — 1.5 marks
- (b) Test for 11: sum of digits at odd places (from the right) = 0+3+6 = 9; sum at even places = 4+8 = 12; difference = 9-12 = -3, which is not a multiple of 11 (including 0), so 68,340 is NOT divisible by 11 — 1.5 marks

SECTION D

Question numbers 32 to 35 carry 5 marks each.

32. (a) Simplify using laws of exponents: $2^3 \times 2^{-1} \div 2^{-4}$. (b) Express 7,20,00,000 in standard form. (c) Simplify: $(3/4)^{-2}$. *[5]*

OR

(a) Simplify using laws of exponents: $4^2 \times 4^{-4} \div 4^{-3}$. (b) Express 0.0000091 in standard form. (c) Simplify: $(2/5)^{-2}$.

Marking Scheme / Value Points:

- (a) $2^3 \times 2^{-1} \div 2^{-4}$ = 2^(3-1-(-4)) = 2^(3-1+4) = 2^6 = 64 — 2 marks
- (b) 7,20,00,000 = 7.2×10^7 — 1.5 marks
- (c) $(3/4)^{-2} = (4/3)^2$ = 16/9 — 1.5 marks

OR (value points):

- (a) $4^2 \times 4^{-4} \div 4^{-3}$ = 4^(2-4+3) = 4^1 = 4 — 2 marks
- (b) 0.0000091 = 9.1×10^{-6} — 1.5 marks
- (c) $(2/5)^{-2} = (5/2)^2$ = 25/4 — 1.5 marks

33. By using suitable properties, find: 3/8 × (-4/9) + 3/8 × (-5/9) + 3/8 × 1. *[5]*

OR

By using suitable properties, find: (-5/6) × 2/7 + (-5/6) × 5/7 + (-5/6) × (-1).

Marking Scheme / Value Points:

- By the distributive law, factor out 3/8: $3/8 \times (-4/9 - 5/9 + 1)$ — 2 marks
- Simplify inside the bracket: $-4/9-5/9+1 = -9/9+1 = -1+1 = 0$ — 1.5 marks
- Result = $3/8 \times 0 = 0$ — 1.5 marks

OR (value points):

- By the distributive law, factor out -5/6: $-5/6 \times (2/7 + 5/7 - 1)$ — 2 marks
- Simplify inside the bracket: $2/7+5/7-1 = 7/7-1 = 1-1 = 0$ — 1.5 marks
- Result = $-5/6 \times 0 = 0$ — 1.5 marks

34. A shopkeeper buys x chairs on rent at ₹15 each and y tables at ₹25 each for a school event, and adds a fixed delivery charge of ₹40, giving the total cost expression $15x + 25y + 40$. (a) If x=20 and y=10, find the total bill using the expression. (b) Using the distributive law, expand and simplify: $5(3x+4y) - 2(x-y)$. *[5]*

OR

A caterer buys x chairs on rent at ₹12 each and y tables at ₹80 each for an event, plus a fixed transport charge of ₹150, given by the expression $12x + 80y + 150$. (a) If x=30 and y=8, find the total cost. (b) Using the distributive law, expand and simplify: $6(2x+5y) - 3(x-2y)$.

Marking Scheme / Value Points:

- (a) $15\times20 = 300$; $25\times10 = 250$; total = 300+250+40 = ₹590 — 2 marks
- (b) $5(3x+4y) = 15x+20y$; $2(x-y) = 2x-2y$ — 1.5 marks
- (b) $15x+20y - (2x-2y) = 15x+20y-2x+2y = 13x+22y$ — 1.5 marks

OR (value points):

- (a) $12\times30 = 360$; $80\times8 = 640$; total = 360+640+150 = ₹1,150 — 2 marks
- (b) $6(2x+5y) = 12x+30y$; $3(x-2y) = 3x-6y$ — 1.5 marks
- (b) $12x+30y - (3x-6y) = 12x+30y-3x+6y = 9x+36y$ — 1.5 marks

35. The angles of a quadrilateral are in the ratio 3:5:7:9. (a) Find the measure of each angle. (b) Show that one pair of these (consecutive) angles is supplementary, and explain what this suggests about the quadrilateral possibly being a trapezium. (c) Find the largest angle. *[5]*

OR

The angles of a quadrilateral are in the ratio 5:6:7:12. (a) Find the measure of each angle. (b) Verify that the sum of the angles equals 360°. (c) Find the difference between the largest and smallest angles.

Marking Scheme / Value Points:

- (a) Sum of ratio parts = 3+5+7+9 = 24; each part = 360°/24 = 15°; angles = 45°, 75°, 105°, 135° — 2 marks
- (b) First and fourth angles: 45°+135° = 180°; second and third angles: 75°+105° = 180°. Since both pairs of consecutive angles are supplementary, the sides between them could be parallel, so the quadrilateral could be a trapezium — 2 marks
- (c) The largest angle is 135° — 1 mark

OR (value points):

- (a) Sum of ratio parts = 5+6+7+12 = 30; each part = 360°/30 = 12°; angles = 60°, 72°, 84°, 144° — 2 marks
- (b) Sum = 60°+72°+84°+144° = 360°, which verifies the angle sum property — 1.5 marks
- (c) Largest - smallest = 144° - 60° = 84° — 1.5 marks

SECTION E

Question numbers 36 to 38 are source/case-based questions carrying 4 marks each, with four sub-parts of 1 mark each.

Case Study 1 — Question 36 [4 Marks]

A shopkeeper packs small cube-shaped soap boxes, each of side 5 cm, into a larger cube-shaped carton. The carton is designed to hold exactly 512 small cube boxes, arranged in a perfect $n \times n \times n$ pattern.

(i) Is 512 a perfect cube? Find its cube root by prime factorisation, and hence find n. *[1]*

Answer: $512 = 2\times2\times2\times2\times2\times2\times2\times2\times2 = 2^9 = (2^3)\times(2^3)\times(2^3)$. Grouping in triples, the cube root = $2\times2\times2 = 8$. So 512 is a perfect cube and n = 8.

(ii) Find the length of one edge of the large cube-shaped carton, given the n×n×n arrangement (n=8) of small cubes of side 5 cm each. *[1]*

Answer: Edge of carton = n × 5 cm = 8 × 5 = 40 cm.

(iii) Find the volume of the large cube-shaped carton, and verify that it equals 512 times the volume of one small cube box. *[1]*

Answer: Volume of carton = 40^3 = 64,000 cm^3. Volume of one small box = 5^3 = 125 cm^3; 512 × 125 = 64,000 cm^3, which matches — verified.

(iv) If the shopkeeper instead wants to pack 1000 such small cube boxes in a similar perfect cube arrangement (n×n×n), find n and state whether this is possible without any leftover boxes. *[1]*

OR If each small cube box costs ₹8, find the total cost of the 512 boxes needed to fill one large carton.

Answer: 1000 = 10^3, so n = 10; since 10×10×10 = 1000 exactly, all 1000 boxes fit perfectly in a 10×10×10 arrangement with no leftover.

OR Answer: Total cost = 512 × ₹8 = ₹4,096.

Case Study 2 — Question 37 [4 Marks]

Rohan wants to buy a bicycle worth ₹6000. The shop offers an interest-free instalment plan splitting the price into 3 monthly instalments in the ratio 2:3:5, or a 10% discount if the full amount is paid in cash upfront.

(i) Using the ratio 2:3:5, find the amount payable in each of the three instalments (total ₹6000). *[1]*

Answer: Total parts = 2+3+5 = 10; one part = 6000/10 = ₹600. Instalments = 2×600=₹1200, 3×600=₹1800, 5×600=₹3000.

(ii) Find the ratio of the second instalment (₹1800) to the total price (₹6000), in simplest form. *[1]*

Answer: 1800:6000 = 3:10 (dividing both terms by their HCF, 600).

(iii) If Rohan instead pays cash upfront and gets a 10% discount, find the discounted price he pays. *[1]*

Answer: Discount = 10% of ₹6000 = ₹600. Discounted price = 6000 - 600 = ₹5,400.

(iv) Find how much Rohan saves by paying cash upfront compared to paying the full ₹6000 through instalments, and express this saving as a percentage of the original price. *[1]*

OR If Rohan's friend buys a similar bicycle worth ₹7500 under the same instalment ratio (2:3:5), find the amount of the friend's largest instalment.

Answer: Saving = 6000 - 5400 = ₹600. As a percentage: (600/6000) × 100 = 10%.

OR Answer: One part = 7500/10 = ₹750; largest instalment = 5×750 = ₹3,750.

Case Study 3 — Question 38 [4 Marks]

A kite-shaped flower bed PQRS has PQ = PS = 13 m and QR = RS = 15 m, with diagonal PR as the axis of symmetry. The diagonals PR and QS intersect at right angles at point O, and it is known that in a kite, the diagonal joining the vertices between the equal sides bisects the angles at those vertices, and the two angles between the unequal sides are equal.

(i) State two properties of the diagonals of the kite-shaped flower bed PQRS. *[1]*

Answer: The diagonals PR and QS intersect at right angles (are perpendicular); diagonal PR bisects diagonal QS (so OQ = OS) and also bisects the angles at P and R.

(ii) Diagonal PR bisects angle P into two equal parts of 35° each. Find the full measure of angle P. *[1]*

Answer: Angle P = 35° + 35° = 70°.

(iii) In this kite, angle Q = angle S = 115° (the angles between the unequal sides are equal). Using the angle sum property of a quadrilateral, find angle R. *[1]*

Answer: Sum of angles = 360°: 70° + 115° + 115° + angle R = 360° ⇒ 300° + angle R = 360° ⇒ angle R = 60°.

(iv) Given that the diagonals intersect at O with OQ = 12 m and PQ = 13 m, find the length OP using the right triangle POQ. *[1]*

OR Given that OQ = 12 m and QR = 15 m, and the diagonals intersect at right angles at O, find the length OR using the right triangle QOR.

Answer: $OP^2 = PQ^2 - OQ^2 = 13^2 - 12^2 = 169 - 144 = 25 \Rightarrow OP = 5$ m.

OR Answer: $OR^2 = QR^2 - OQ^2 = 15^2 - 12^2 = 225 - 144 = 81 \Rightarrow OR = 9$ m.