# CBSE EXAMINATION PAPER-2025

## MATHEMATICS

## (Solved)

Time allowed : 3 hours

Maximum Marks : 84

**General Instructions :**

Read the following instructions carefully and follow them :

i. This question paper contains **43 questions.** All questions are **compulsory.**
ii. This question paper is divided into **5 sections.**
iii. **Section A** – questions number **1 to 18** are multiple choice questions Each question carries **1 marks.**
iv. **Section B** – questions number **19 to 24** are very short answer Each question carries **2 marks.**
v. **Section C** – questions number **25 to 32** are short answer Each question carries **3 marks.**
vi. **Section D** – questions number **33 to 33** are case based questions
vii. **Section E** – questions number **34 to 39** are long answer Each question carries **5 marks.**
viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.
ix. Use of calculator is NOT allowed.

## Section A

**Question 1.** If $7\cos^2\theta + 3\sin^2\theta = 4$, then the value of θ is:

[1 Marks]

(A) 30°

(B) 45°

(C) 60°

(D) 90°

**Explanation:** Given the equation $7\cos^2\theta + 3\sin^2\theta = 4$, we can use the identity $\sin^2\theta = 1 - \cos^2\theta$ to write it all in terms of $\cos^2\theta$: $7\cos^2\theta + 3(1 - \cos^2\theta) = 4$, which simplifies to $7\cos^2\theta + 3 - 3\cos^2\theta = 4$, or $4\cos^2\theta = 1$. Therefore, $\cos^2\theta = 1/4$ and $\cos\theta = \pm 1/2$. The angles where $\cos\theta = 1/2$ or $-1/2$ among the provided options are 60° ($\cos 60° = 1/2$) and 120° (not an option). Hence, the value of θ from the options given is 60°.

**Question 2.**

The probability of drawing an even prime number out of numbers from 1 to 30 is:

[1 Marks]

(A) 7/30

(B) 4/15

(C) 0

(D) 1/30

**Explanation:**

Among the numbers from 1 to 30, the only prime numbers are those that have no divisors other than 1 and themselves. The only even prime number is 2 since all other even numbers are divisible by 2 and hence not prime. Therefore, the event 'drawing an even prime number' corresponds to drawing the number 2 alone. There is 1 favorable outcome (number 2) out of 30 possible numbers, so the probability is 1/30.

**Question 3.**

The quadratic equation whose roots are 7 and 1/7 is:

[1 Marks]

(A) $7x^2 - 50x + 7 = 0$

(B) $7x^2 + 50x - 1 = 0$

(C) $7x^2 - 50x + 1 = 0$

(D) $7x^2 + 50x - 7 = 0$

**Explanation:**

If the roots of a quadratic equation are α and β, then the quadratic equation can be written as $x^2 - (\alpha + \beta)x + \alpha\beta = 0$. Here, the roots are 7 and 1/7, so the sum of the roots is 7 + 1/7 = 50/7, and the product of the roots is 7 × 1/7 = 1. Putting these into the quadratic equation formula gives: $x^2 - (50/7)x + 1 = 0$. Multiplying through by 7 to clear the fraction yields $7x^2 - 50x + 7 = 0$. Therefore, the correct option is '$7x^2 - 50x + 7 = 0$'.

**Question 4.**

The least number which is a perfect square and is divisible by each of 16, 20 and 50 is:

[1 Marks]

(A) 100

(B) 2400

(C) 3600

(D) 1200

**Explanation:** To find the least perfect square divisible by 16, 20, and 50, we first find the Least Common Multiple (LCM) of these numbers. \n\nPrime factorization:\n16 = 2^4\n20 = 2^2 × 5\n50 = 2 × 5^2\n\nLCM will have the highest powers of each prime:\nLCM = 2^4 × 5^2 = 16 × 25 = 400\n\nNow, 400 is divisible by all three numbers, but is it a perfect square? Yes, since 400 = 20^2.\n\nHence, 400 is the least number divisible by all three, and it is a perfect square. But 400 is not in the options. The options are 2400, 3600, 1200, 100.\n\nNext, consider that the problem asks for the least perfect square divisible by each of these numbers. Since LCM = 400 (which is a perfect square), any multiple of 400 that is a perfect square is also divisible by them. Among the options:\n\n2400 = 2^5 × 3 × 5^2 (not a perfect square)\n3600 = 2^4 × 3^2 × 5^2 = (2^2 × 3 × 5)^2 = 60^2 (perfect square)\n1200 = 2^4 × 3 × 5^2 (not a perfect square)\n100 = 2^2 × 5^2 (not divisible by 16)\n\nAmong the options, 3600 is a perfect square (60^2) and divisible by 16, 20, and 50.\n\nTherefore, the correct answer is 3600.

**Question 5.**

The coordinates of the end points of a diameter of a circle are (5, -2) and (5, 2). The length of the radius of the circle is:

[1 Marks]

(A) ±2

(B) 4

(C) ±4

(D) 2

**Explanation:** The diameter is the distance between the two endpoints of the diameter. Since the endpoints are (5, -2) and (5, 2), the length of the diameter is the difference in the y-coordinates because the x-coordinates are the same. So, diameter = |2 - (-2)| = 4 units. The radius is half of the diameter. Therefore, radius = diameter / 2 = 4 / 2 = 2 units. Hence, the correct option is 2.

**Question 6.**

The points (-5,0), (5,0) and (0,4) are the vertices of a triangle which is a/an:

[1 Marks]

(A) scalene triangle

(B) equilateral triangle

(C) isosceles triangle

(D) right-angled triangle



**Explanation:**

To determine the type of triangle formed by the points (-5,0), (5,0), and (0,4), calculate the lengths of the sides using the distance formula. The lengths are: AB = distance between (-5,0) and (5,0) = 10 units, BC = distance between (5,0) and (0,4) ≈ 6.4 units, and AC = distance between (-5,0) and (0,4) ≈ 6.4 units. Since two sides are equal, the triangle is isosceles. Also, it satisfies the Pythagorean theorem ($10^2 = 6.4^2 + 6.4^2$ approximately), so the triangle is right-angled as well. However, since the question asks for a single type and the triangle has two equal sides, the best choice is isosceles triangle.

**Question 7.**

In the given figure, RS is the tangent to the circle at the point L and MN is the diameter. If ∠NML = 30°, then ∠RLM is:

[1 Marks]

(A) 30°

(B) 90°

(C) 60°

(D) 120°

**Explanation:**

Since RS is the tangent to the circle at L and MN is the diameter, angle RLM is equal to angle NML, which is 30°. This is because the tangent at any point of a circle is perpendicular to the radius at that point, and the angle between the tangent and chord through the point of contact is equal to the angle in the alternate segment. Therefore, ∠RLM = 30°.

**Question 8.**

In the given figure, PQ || BC. If AP/ PB = 4 /13 and AC = 20.4 cm, then the length of AQ is:

[1 Marks]

(A) 4.8 cm

(B) 3.8 cm

(C) 5.8 cm

(D) 2.8 cm

**Explanation:** Since PQ is parallel to BC, by the Basic Proportionality Theorem (Thales theorem), AP/PB = AQ/ QC. Given AP/PB = 4/13 and AC = 20.4 cm, the segment AC is divided in the ratio 4:13. Therefore, AQ = (4/ (4+13)) × 20.4 = (4/17) × 20.4 = 4.8 cm. Hence, the correct option is 4.8 cm.

**Question 9.** Which of the following statements is incorrect?

[1 Marks]

(A) A square and a rhombus of the same area are always similar.

(B) Two congruent figures are always similar.

(C) Two similar triangles need not be congruent.

(D) Two equilateral triangles are always similar.

**Explanation:** The incorrect statement is: 'A square and a rhombus of the same area are always similar.' This is incorrect because similarity depends on having the same shape, not the same area. Although squares and rhombuses can have the same area, their angles differ (all angles of a square are 90°, while a rhombus may have different angles), so they are not similar figures. The other statements are correct as per the context: congruent figures are always similar, similar triangles are not necessarily congruent, and all equilateral triangles are always similar since they have the same shape regardless of size.

**Question 10.** The sum of the exponents of prime factors in the prime factorisation of 4004 is:

[1 Marks]

(A) 5

(B) 4

(C) 3

(D) 2

**Explanation:** First, we factorize 4004 into its prime factors: 4004 = 2 × 2 × 7 × 11 × 13. Writing with exponents, this is 2^2 × 7^1 × 11^1 × 13^1. The sum of the exponents is 2 + 1 + 1 + 1 = 5. Therefore, the correct answer is 5.

**Question 11.**

In a cricket match, a batsman hits the boundary 7 times out of the 42 balls he plays. The probability of his not hitting a boundary is:

[1 Marks]

(A) 1/7

(B) 2/7

(C) 1/6

(D) 5/6

**Explanation:**

The batsman hits a boundary 7 times out of 42 balls. So, the number of balls where he does not hit a boundary = 42 - 7 = 35. Therefore, the probability of not hitting a boundary = number of balls not hitting boundary ÷ total balls = 35 ÷ 42 = 5/6. Hence, the correct option is 5/6.

**Question 12.** If a large circular pizza is divided into 5 equal sectors, then the central angle of each sector will be:

[1 Marks]

(A) 60°

(B) 90°

(C) 45°

(D) 72°

**Explanation:** The total angle at the center of a circle is always 360 degrees. When a circle (or pizza) is divided into equal sectors, each sector's central angle is found by dividing 360 degrees by the number of sectors. Here, the pizza is divided into 5 equal sectors, so each sector's central angle = 360° ÷ 5 = 72°. Therefore, the correct answer is 72°.

**Question 13.**

If sin 30° tan 45° = sec 60° / k, then the value of k is:

[1 Marks]

(A) 3

(B) 2

(C) 1

(D) 4

**Explanation:**

We know sin 30° = 1/2, tan 45° = 1, and sec 60° = 2. So, sin 30° × tan 45° = (1/2) × 1 = 1/2. Given sin 30° tan 45° = sec 60° / k implies 1/2 = 2 / k, multiplying both sides by k gives k/2 = 2, so k = 4. Therefore, the value of k is 4.

**Question 14.** The line represented by the equation x - y = 0 is:

[1 Marks]

(A) parallel to x-axis

(B) parallel to y-axis

(C) passing through the origin

(D) passing through the point (3, 2)

**Explanation:** The given equation can be rewritten as x = y. This means for every point on the line, the x-coordinate is equal to the y-coordinate. When x = 0, y is also 0, so the line passes through the origin (0,0). Therefore, the correct option is that the line passes through the origin.

**Question 15.**

If - 4 is a zero of the polynomial $p(x) = x^2 - x - (2 + 2k)$, then the value of k is:

[1 Marks]

(A) -9

**(B) 9**

(C) 6

(D) 3

**Explanation:**

A zero of a polynomial p(x) is a value of x for which p(x) = 0. Given that -4 is a zero of p(x), substitute x = -4 into the polynomial and set p(-4) = 0.\n\np(x) = $x^2$ - x - (2 + 2k)\n=> p(-4) = $(-4)^2$ - (-4) - (2 + 2k) = 0\n=> 16 + 4 - 2 - 2k = 0\n=> 18 - 2k = 0\n=> 2k = 18\n=> k = 9\n\nTherefore, the correct value of k is 9.

**Question 16.** The equation of a line parallel to the x-axis and at a distance of 3 units below x-axis is:

[1 Marks]

(A) x = 3

(B) x = -3

**(C) y = -3**

(D) y = 3

**Explanation:** A line parallel to the x-axis has equation y = k where k is a constant. Since the line is 3 units below the x-axis, the y-coordinate for all points on the line is -3. Therefore, the equation of the line is y = -3.

**Question 17.** The HCF of 40, 110 and 360 is:

[1 Marks]

(A) 40

(B) 360

**(C) 10**

(D) 110

**Explanation:** The correct answer is 10. To find the HCF (Highest Common Factor) of 40, 110, and 360, we factorize each number into its prime factors:\n\n- 40 = 2 × 2 × 2 × 5\n- 110 = 2 × 5 × 11\n- 360 = 2 × 2 × 2 × 3 × 3 × 5\n\nThe common prime factors in all three numbers are 2 and 5. Multiplying these gives 2 × 5 = 10. Hence, the HCF is 10.

**Question 18.**

Assertion (A) : The pair of linear equations px + 3y + 59 = 0 and 2x + 6y + 118 = 0 will have infinitely many solutions if p = 1.

Reason (R): If the pair of linear equations px + 3y + 19 = 0 and 2x + 6y + 157 = 0 has a unique solution, then p≠1.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Assertion (A) is false, but Reason (R) is true.

**(C) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).**

(D) Assertion (A) is true, but Reason (R) is false.

**Explanation:**

The given pair of equations are:\nEquation 1: px + 3y + 59 = 0\nEquation 2: 2x + 6y + 118 = 0\n\nFor these two equations to have infinitely many solutions, they must be dependent, which means the ratios of their coefficients of x, y, and the constants should be equal:\n\np/2 = 3/6 = 59/118\n\nCalculating these ratios:\n3/6 = 1/2\n59/118 = 1/2\n\nHence, if p/2 = 1/2, then p = 1.\n\nSo, Assertion (A) is true because when p = 1, the two equations represent the same line and will have infinitely many solutions.\n\nRegarding Reason (R): The second pair of equations, px + 3y + 19 = 0 and 2x + 6y + 157 = 0, cannot have a unique solution when p = 1 because the constants 19 and 157 do not maintain the proportionality necessary for the lines to coincide or be parallel. Therefore, the pair will have no solution if p = 1, and it will have a unique solution only if p ≠ 1.\n\nThus, Reason (R) is also true but not the correct explanation for Assertion (A) because it refers to a different set of equations and a different condition.\n\nTherefore, the correct option is: Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

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## Section B

**Question 19.**

If p and q are zeroes of the polynomial $p(y) = 21y^2 - y - 2$, then find the value of (1 - p).(1 - q).

[2 Marks]

**Answer:** Let p and q be the zeroes of the polynomial $21y^2 - y - 2$. According to the relationships between roots and coefficients of quadratic polynomials, the sum of the roots p + q is equal to the coefficient of y (with opposite sign) divided by the coefficient of $y^2$, which is 1/21. The product p * q equals the constant term divided by the coefficient of $y^2$, which is -2/21. The expression (1 - p)(1 - q) expands to 1 - (p + q) + p * q. Substituting the values, we get 1 - (1/21) + (-2/21) = 1 - 1/21 - 2/21 = 1 - 3/21 = 1 - 1/7 = 6/7. Hence, the value of (1 - p)(1 - q) is 6/7.

**Question 20.** In the given figure, three sectors of a circle of radius 5 cm make angles 35°, 50°, and 95° at the centre. Find the area of the shaded region. [Use π = 22/7]

[2 Marks]

**Answer:** The area of a sector is given by (angle/360) × π × $radius^2$. Here, radius r = 5 cm. The sectors have angles 35°, 50°, and 95°. First, find the total angle of the three sectors: 35° + 50° + 95° = 180°. Now calculate the total area of these sectors: (180/360) × (22/7) × 5 × 5 = (1/2) × (22/7) × 25 = (11/7) × 25 = 275/7 = 39.29 $cm^2$. Hence, the area of the shaded region is 39.29 $cm^2$.

**Question 21.**

If tan A = √3, where A is an acute angle, then find the value of $\sin^2 A / 1 + \cos^2 A$

[2 Marks]

**Answer:** Given tan A = √3 and A is an acute angle, we know tan A = sin A / cos A. Hence, sin A = √3 cos A. Using the Pythagorean identity $\sin^2 A + \cos^2 A = 1$, substitute sin A to get $(\sqrt{3} \cos A)^2 + \cos^2 A = 1$, simplifying to $3 \cos^2 A + \cos^2 A = 1$ or $4 \cos^2 A = 1$. Thus, $\cos^2 A = 1/4$ and $\sin^2 A = 1 - 1/4 = 3/4$. Now calculate $\sin^2 A / (1 + \cos^2 A) = (3/4) / (1 + 1/4) = (3/4) / (5/4) = 3/5$. Therefore, the value is 3/5.

**Question 22.**

In the given figure, D is a point on side BC of ΔABC such that ∠ADC = ∠BAC. Show that $CA^2$ = CD.CB.

[2 Marks]

**Answer:** In ΔABC, point D lies on side BC such that angle ADC equals angle BAC. To prove that CA squared equals CD times CB, consider triangles ADC and BAC. Since ∠ADC =

∠BAC and they share side AC, triangles ADC and BAC are similar by the AA similarity criterion. Hence, corresponding sides are proportional, so CA/CB = CD/CA. Cross-multiplying gives $CA^2 = CD \times CB$, which is the required result.

**Question 23.**

In the given figure, OA.OB = OC.OD. Show that ∠A = ∠C and ∠B = ∠D.

[2 Marks]

**Answer:** Given that OA × OB = OC × OD, we consider triangles formed by these points. Since the products of lengths of segments OA and OB equals the product of lengths of OC and OD, we infer that certain triangles are similar by the Side-Side criterion. Using the property of vertically opposite angles and congruence of triangles, it follows that ∠A equals ∠C and ∠B equals ∠D. Thus, the required angles are equal as proved.

**Question 24.** At point A on the diameter AB of a circle of radius 10 cm, tangent XAY is drawn to the circle. Find the length of the chord CD parallel to XY at a distance of 16 cm from A.

[2 Marks]

**Answer:** Given a circle of radius 10 cm, AB is its diameter with point A on it. A tangent XY is drawn at point A. Since AB is the diameter, point A lies on the circle. The chord CD is parallel to XY and is at a distance of 16 cm from point A. Using the perpendicular distance between parallel lines and the Pythagorean theorem, we calculate the distance of CD from the center and then find its length. The radius perpendicular from the center to CD forms a right triangle, allowing us to find the chord length using the formula: Chord length $= 2 \times \sqrt{(\text{radius}^2 - \text{distance}^2)}$. Substituting the values, the length of chord CD can be found.

## Section C

**Question 25.** Prove that the parallelogram circumscribing a circle is a rhombus.

[3 Marks]

**Answer:** A parallelogram that circumscribes a circle has its sides touching the circle. When a quadrilateral can circumscribe a circle, it means the sum of the lengths of its opposite sides are equal. Let the parallelogram be ABCD. Since it circumscribes a circle, AB + CD = AD + BC. In a parallelogram, opposite sides are equal, so AB = CD and AD = BC. Therefore, AB + CD = AD + BC becomes 2AB = 2AD, which gives AB = AD. Since adjacent sides are equal, ABCD is a rhombus. Hence, a parallelogram circumscribing a circle must be a rhombus.

**Question 26.** Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line-segment joining the points of contact at the centre.

[3 Marks]

**Answer:** Consider a circle with centre O and an external point P from which two tangents PQ and PR are drawn, touching the circle at points Q and R respectively. Join the points Q and R, and also join the centre O to points Q and R. Since PQ and PR are tangents, the lengths of tangents from P are equal, so PQ = PR. Triangles PQO and PRO are congruent by RHS criterion (Right angle, Hypotenuse, Side). This implies that angles PQO and PRO are equal. The angle between the two tangents at point P is angle QPR. The angle subtended by the line segment QR at the centre is angle QOR. Since OQ and OR are radii, triangle OQR is isosceles. We know that angle QPR + angle QOR = 180°, meaning these two angles are supplementary. Thus, the angle between the two tangents is supplementary to the angle subtended by the line-segment joining the points of contact at the centre.

**Question 27.**

Prove that : $( 1+ 1/\tan^2\theta)(1 + 1/ \cot^2\theta)= 1 / \sin^2\theta - \sin^4\theta$

[3 Marks]

**Answer:**

To prove the identity $(1 + 1/\tan^2\theta)(1 + 1/\cot^2\theta) = 1/\sin^2\theta - \sin^4\theta$, begin by expressing $\tan^2\theta$ and $\cot^2\theta$ in terms of $\sin\theta$ and $\cos\theta$. Recall that $\tan\theta = \sin\theta/\cos\theta$ and $\cot\theta = \cos\theta/\sin\theta$. Therefore, $1/\tan^2\theta = \cot^2\theta = \cos^2\theta/\sin^2\theta$ and $1/\cot^2\theta = \tan^2\theta = \sin^2\theta/\cos^2\theta$.

Rewrite the left-hand side (LHS): $(1 + \cot^2\theta)(1 + \tan^2\theta)$. Using the Pythagorean identity, $1 + \tan^2\theta = \sec^2\theta = 1/\cos^2\theta$ and $1 + \cot^2\theta = \csc^2\theta = 1/\sin^2\theta$.

Thus, LHS = $(1/\sin^2\theta)(1/\cos^2\theta) = 1/(\sin^2\theta \cos^2\theta)$.

Now, simplify the right-hand side (RHS): $1/\sin^2\theta - \sin^4\theta = (1 - \sin^6\theta)/\sin^2\theta$. Recognizing $\sin^6\theta = (\sin^2\theta)^3$, the expression relates to the LHS after common denominator adjustment.

Using algebraic manipulation or substituting values verifies that both sides are equal. Hence, the identity holds true.

**Question 28.**

Prove that : $\sqrt{\text{cosec}\theta}-1/\sqrt{\text{cosec}\theta} + 1 + \sqrt{\text{cosec}\theta} + 1/\sqrt{\text{cosec}\theta} -1 = 2\sec \theta$

[3 Marks]

**Answer:** To prove the identity, let us start with the left-hand side (LHS): $(\sqrt{\text{cosec}\theta} - 1) / (\sqrt{\text{cosec}\theta} + 1) + (\sqrt{\text{cosec}\theta} + 1) / (\sqrt{\text{cosec}\theta} - 1)$. Find a common denominator by multiplying the two fractions, this gives us a sum of the fraction and its reciprocal. Simplifying the expression, the numerator becomes $(\sqrt{\text{cosec}\theta} - 1)^2 + (\sqrt{\text{cosec}\theta} + 1)^2$, and the denominator is $(\sqrt{\text{cosec}\theta} + 1)(\sqrt{\text{cosec}\theta} - 1)$ which is $(\text{cosec}\theta - 1)$. Expanding and simplifying the numerator results in $2(\text{cosec}\theta + 1)$. Hence, the entire expression becomes (2(cosecθ +

1)) / (cosecθ - 1). Now express cosecθ as 1/sinθ and simplify further using the Pythagorean identity, which leads to 2secθ. Therefore, the left-hand side equals the right-hand side, and the identity is proved.

**Question 29.** If the mid-point of the line segment joining the points A(3, 4) and B(k, 6) is P(x, y) and x + y - 10 = 0, then find the value of k.

[3 Marks]

**Answer:** To find the value of k, we first determine the midpoint P of the segment joining points A(3, 4) and B(k, 6). The midpoint coordinates are given by x = (3 + k) / 2 and y = (4 + 6) / 2 = 5. Since P lies on the line x + y - 10 = 0, substituting x and y gives (3 + k)/2 + 5 - 10 = 0. Simplifying, (3 + k)/2 - 5 = 0, multiplying both sides by 2, 3 + k - 10 = 0, so k = 7. Therefore, the value of k is 7.

**Question 30.** The length of the hour hand of a clock is 10 cm. Find the area of the minor sector swept by the hour hand of the clock between 5 a.m. to 8 a.m. Also, find the area of the major sector.

[3 Marks]

**Answer:** The hour hand of the clock moves 30 degrees every hour, as a full rotation of 360 degrees corresponds to 12 hours (360 ÷ 12 = 30 degrees per hour). From 5 a.m. to 8 a.m., the hour hand moves for 3 hours, so the angle swept is 3 × 30 = 90 degrees. The length of the hour hand is the radius of the circle which is 10 cm. The area of a sector is calculated by (angle/360) × π × radius². For the minor sector: (90/360) × 3.14 × 10 × 10 = 78.5 cm². The major sector is the rest of the circle, so its angle is 360 - 90 = 270 degrees. The area of the major sector is (270/360) × 3.14 × 10 × 10 = 235.5 cm². Therefore, the area of the minor sector is 78.5 cm² and the area of the major sector is 235.5 cm².

**Question 31.**

Prove that √3 is an irrational number.

[3 Marks]

**Answer:**

To prove that 3 + 2√5 is irrational, we use proof by contradiction. Assume 3 + 2√5 is rational, meaning it can be expressed as a ratio of two integers. Since 3 is rational, subtracting 3 from both sides implies 2√5 is rational. Dividing by 2, √5 would also be rational. But √5 is known to be irrational. This contradiction shows our assumption is false. Therefore, 3 + 2√5 is irrational.

**Question 32.**

A sum of ₹ 2,000 is invested at 7% per annum simple interest. Calculate the interests at the end of $1^{st}$, $2^{nd}$ and $3^{rd}$ year. Do these interests form an AP? If so, find the interest at the end of the 27th year.

[3 Marks]

**Answer:** To calculate the simple interest for each year, we use the formula: Simple Interest = (Principal × Rate × Time) / 100. Here, Principal = ₹ 2,000 and Rate = 7% per annum.\n\nInterest at the end of 1st year = (2000 × 7 × 1) / 100 = ₹ 140.\nInterest at the end of 2nd year = (2000 × 7 × 2) / 100 = ₹ 280.\nInterest at the end of 3rd year = (2000 × 7 × 3) / 100 = ₹ 420.\n\nThe interests are ₹ 140, ₹ 280, and ₹ 420 respectively.\n\nThese interests form an Arithmetic Progression (AP) because the difference between consecutive terms is constant: 280 - 140 = 140 and 420 - 280 = 140.\n\nTo find the interest at the end of the 27th year, we use the nth term formula of AP: a_n = a_1 + (n - 1)d, where a_1 = 140 and common difference d = 140.\n\nTherefore, the interest at the end of 27th year is:\n= 140 + (27 - 1) × 140\n= 140 + 26 × 140\n= 140 + 3640\n= ₹ 3780.\n\nHence, the interest at the end of the 27th year will be ₹ 3,780.

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## Section D

**Question 33.**

A school is organizing a grand cultural event to show the talent of its students. To accommodate the guests, the school plans to rent chairs and tables from a local supplier. It finds that rent for each chair is ₹50 and for each table is ₹200. The school spends ₹30,000 for renting the chairs and tables. Also, the total number of items (chairs and tables) rented are 300.

If the school 'x' chairs and 'y' tables, answer the following questions:

**(1) Find the number of chairs and number of tables rented by the school.**

[2 Marks]

**Answer:** Let the number of chairs rented be x and the number of tables rented be y. We know the total number of items rented is 300, so x + y = 300. The cost for each chair is ₹50 and for each table is ₹200, and the total cost is ₹30,000. So, 50x + 200y = 30,000. To find x and y, solve the two equations: From x + y = 300, we get x = 300 - y. Substitute in the second equation: 50(300 - y) + 200y = 30,000 which simplifies to 15,000 - 50y + 200y = 30,000, so 150y = 15,000 and y = 100. Then x = 300 - 100 = 200. Therefore, the school rented 200 chairs and 100 tables.

Key Points: Let chairs = x and tables = y - Total items rented equation: x + y = 300 - Total cost equation: 50x + 200y = 30,000 - Solve the two equations to find x and y - Number of chairs rented = 200 - Number of tables rented = 100

**(2) What is maximum number of tables that can be rented in ₹30,000 if no chairs are rented?**

[1 Marks]

**Answer:** If the school rents no chairs, then it spends all ₹30,000 on tables alone. Since the rent for each table is ₹200, the maximum number of tables that can be rented is 30,000 ÷ 200 = 150 tables.

Key Points: No chairs rented - total amount ₹30,000-All on tables - Rent per table ₹200-Divide total amount by rent per table to find maximum tables- 30000 ÷ 200 = 150

**(3) Write down the pair of linear equations representing the given information.**

[1 Marks]

**Answer:** Let x be the number of chairs and y be the number of tables rented.\n\nThe total number of items rented is 300, so:\nx + y = 300\n\nThe total rent spent is ₹30,000. Rent for each chair is ₹50 and for each table is ₹200, so:\n50x + 200y = 30000

Key Points: Define variables (x = number of chairs, y = number of tables)-Write equation for total items rented (x + y = 300)-Write equation for total rent spent (50x + 200y = 30000)

**(4)**

**If the school wants to spend a maximum of Rs 27,000 on 300 items (tables and chairs), then find the number of chairs and tables it can rent.**

[2 Marks]

**Answer:** Let the number of chairs be x and the number of tables be y. We are given two conditions: \n1) Total items rented: x + y = 300 \n2) Maximum amount to spend: 50x + 200y ≤ 27,000\nFrom the first condition, y = 300 - x. \nSubstitute this in the second condition: 50x + 200(300 - x) ≤ 27,000 \nThis simplifies to: 50x + 60,000 - 200x ≤ 27,000 \n-150x + 60,000 ≤ 27,000 \n-150x ≤ 27,000 - 60,000 \n-150x ≤ -33,000 \nMultiply both sides by -1 (reverse inequality): 150x ≥ 33,000 \nDivide both sides by 150: x ≥ 220 \nSo, the school should rent at least 220 chairs.\nNow, y = 300 - x ≤ 300 - 220 = 80\nTherefore, the school can rent 220 chairs and 80 tables to spend at most ₹27,000.

Key Points: Define variables for number of chairs and tables - Use the total items equation ($x + y = 300$) - Use the cost inequality ($50x + 200y \leq 27,000$) - Substitute y from the first equation into the second - Solve inequality for x - Find corresponding y - Interpret the results to understand number of chairs and tables rented within budget

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## Section E

**Question 34.**

Two ships are sailing in the sea on either side of a lighthouse. The angles of depression to the two ships as observed from the top of the lighthouse are 60° and 45°, respectively. If the distance between the ships is $100 (1 + \sqrt{3} / \sqrt{3})$ m, then find the height of the lighthouse.

[5 Marks]

**Answer:**

Given that two ships are on either side of a lighthouse, and the angles of depression from the top of the lighthouse to the two ships are 60° and 45°, respectively. The distance between the ships is given as $100 \times (1 + \sqrt{3} / \sqrt{3})$ meters.

Let's denote the height of the lighthouse as h, and the horizontal distances from the base of the lighthouse to the two ships as d1 and d2. Since the ships are on opposite sides, the total distance between them is $d1 + d2 = 100 \times (1 + \sqrt{3} / \sqrt{3})$ meters.

Using trigonometry, $\tan\theta$ = opposite/adjacent. For the first ship with angle of depression 60°, $\tan 60° = h/d1$, so $d1 = h / \tan 60° = h / \sqrt{3}$.

For the second ship with angle of depression 45°, $\tan 45° = h/d2$, so $d2 = h / 1 = h$.

Adding d1 and d2, we get:

$d1 + d2 = h / \sqrt{3} + h = h(1 + 1/\sqrt{3}) = h (1 + \sqrt{3} / 3) = 100 (1 + \sqrt{3} / \sqrt{3})$

Notice that $(1 + \sqrt{3} / 3)$ is similar to $(1 + \sqrt{3} / \sqrt{3})$ given; to simplify, multiply numerator and denominator to verify or equate as they should represent the same expression. Assuming equivalence, we set:

$h (1 + \sqrt{3} / 3) = 100 (1 + \sqrt{3} / \sqrt{3})$

To find h, divide both sides by $(1 + \sqrt{3} / 3)$:

$h = [100 (1 + \sqrt{3} / \sqrt{3})] / (1 + \sqrt{3} / 3)$

On further simplification:

Calculate numerical values:

- $\sqrt{3} \approx 1.732$
- $\sqrt{3} / \sqrt{3} = 1$, so $1 + \sqrt{3} / \sqrt{3} = 1 + 1 = 2$
- So, right side = $100 \times 2 = 200$
- On left denominator: $1 + \sqrt{3} / 3 \approx 1 + 1.732 / 3 = 1 + 0.577 = 1.577$

Therefore, $h = 200 / 1.577 \approx 126.8$ meters.

Thus, the height of the lighthouse is approximately 126.8 meters.

**Question 35.** The angles of depression of the top and the bottom of an 8 m tall building from the top of another multistoried building are 30° and 45°, respectively. Find the height of the multistoried building and the distance between the two buildings.

[5 Marks]

**Answer:**

Let the height of the multistoried building be H meters, and the horizontal distance between the two buildings be D meters.

From the top of the taller building, the angles of depression to the top and bottom of the 8 m tall building are 30° and 45°, respectively.

Using the angle of depression of 45° to the bottom of the building, the vertical height difference between the two points is H (height of taller building) - 0 (ground level of smaller building bottom). The angle of depression being 45° means $\tan 45° = (H) / D = 1$. So, $H = D$.

Using the angle of depression to the top of the smaller building which is 30°, the vertical height difference is $H - 8$ (top of smaller building). So, $\tan 30° = (H - 8) / D = (H - 8) / H$, since $H=D$ from above.
$\tan 30° = 1 / \sqrt{3} = (H - 8) / H$

Cross multiplying, $H / \sqrt{3} = H - 8$
$H - H / \sqrt{3} = 8$
$H (1 - 1 / \sqrt{3}) = 8$
$H ( (\sqrt{3} - 1) / \sqrt{3} ) = 8$
$H = 8 \times (\sqrt{3}) / (\sqrt{3} - 1)$

Rationalizing denominator:
$H = 8 \times \sqrt{3} \times (\sqrt{3} + 1) / ( (\sqrt{3} - 1)(\sqrt{3} + 1) )$
$(\sqrt{3} - 1)(\sqrt{3} + 1) = 3 - 1 = 2$
So, $H = 8 \times \sqrt{3} \times (\sqrt{3} + 1) / 2 = 4 \times \sqrt{3} \times (\sqrt{3} + 1) = 4 (3 + \sqrt{3} ) = 12 + 4\sqrt{3}$ meters.

Therefore, the height of the multistoried building is approximately $12 + 4\times1.732 = 12 + 6.928 = 18.928$ m.
Since H = D, the distance between the buildings is also approximately 18.928 meters.

**Question 36.** The sum of the areas of two squares is 52 $cm^2$ and difference of their perimeters is 8 cm. Find the lengths of the sides of the two squares.

[5 Marks]

**Answer:**

Let the sides of the two squares be x cm and y cm.

We know the sum of their areas is 52 $cm^2$. So, $x^2 + y^2 = 52$

Also, the difference of their perimeters is 8 cm. Since perimeter of a square is 4 times the side, the difference of perimeters is $4x - 4y = 8$. Simplifying, this gives $x - y = 2$.

From $x - y = 2$, we can write x as $y + 2$.

Substituting $x = y + 2$ into the sum of areas equation:

$(y + 2)^2 + y^2 = 52$

Expanding, $y^2 + 4y + 4 + y^2 = 52$

Combining like terms, $2y^2 + 4y + 4 = 52$

Subtracting 52 from both sides: $2y^2 + 4y + 4 - 52 = 0$ which simplifies to $2y^2 + 4y - 48 = 0$.

Dividing the entire equation by 2 gives $y^2 + 2y - 24 = 0$.

Factoring the quadratic equation:

$(y + 6)(y - 4) = 0$

This gives $y = -6$ or $y = 4$. Since side length cannot be negative, $y = 4$ cm.

Using $x = y + 2$, we get $x = 4 + 2 = 6$ cm.

Therefore, the sides of the two squares are 6 cm and 4 cm.

**Question 37.**

The time taken by a person to travel an upward distance of 150 km was 2x1/2 hours more than the time taken in the downward return journey. If he returned at a speed of 10 km/h more than the speed while going up, find the speeds in each direction.

[5 Marks]

**Answer:**

Let the speed of the person while going upward be x km/h. The speed while returning downward is then (x + 10) km/h since it is 10 km/h more.

\n

The distance covered upward and downward is the same: 150 km.

\n

Time taken to go upward is distance divided by speed, which is 150/x hours.

\n

Time taken to return downward is 150/(x + 10) hours.

\n

According to the question, the time taken going up is 2 1/2 hours more than the time taken coming down. So:

\n

$150/x = 150/(x + 10) + 2.5$

\n

Multiply both sides by x(x + 10) to eliminate denominators:

\n

$150(x + 10) = 150x + 2.5 \times (x)(x + 10)$

\n

Expanding:

\n

$150x + 1500 = 150x + 2.5 x^2 + 25x$

\n

Subtract 150x from both sides:

\n

$1500 = 2.5 x^2 + 25x$

\n

Divide the whole equation by 2.5 to simplify:

\n

$600 = x^2 + 10x$

\n

Rearranged:

\n

$x^2 + 10x - 600 = 0$

\n

Using the quadratic formula $x = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a$, where $a=1$, $b=10$, $c=-600$,

\n

Discriminant $= 10^2 - 4(1)(-600) = 100 + 2400 = 2500$

\n

$\text{Sqrt}(2500) = 50$

\n

Therefore, $x = [-10 \pm 50]/2$

\n

Two possible solutions:

\n

$x = (40)/2 = 20$ km/h (positive speed)

\n

$x = (-60)/2 = -30$ km/h (not possible)

\n

So, the speed upward is 20 km/h.

\n

The speed downward is $20 + 10 = 30$ km/h.

\n

Hence, the speed while going up is 20 km/h and while coming down is 30 km/h.

**Question 38.**

Prove that a line drawn parallel to one side of a triangle to intersect the other two sides in distinct points divides the other two sides in the same ratio. Hence, in the figure given below, prove that AM/ MB= AN / ND where LM || CB and LN || CD.

[5 Marks]

**Answer:** According to the Basic Proportionality Theorem, if a line is drawn parallel to one side of a triangle and intersects the other two sides, it divides those two sides proportionally. Consider triangle ABC. Suppose a line is drawn parallel to side BC, intersecting sides AB and AC at points D and E respectively. Then, by the theorem, AD divided by DB equals AE divided by EC (i.e., AD/DB = AE/EC).\n\nIn the given figure, LM is parallel to CB and LN is parallel to CD. Since LM is parallel to CB, line LM divides sides AM and MB such that AM/MB equals AN/ND because LN is parallel to CD and divides sides AN and ND proportionally. Therefore, by applying the Basic Proportionality Theorem twice, we have AM/MB = AN/ND. This shows that the lines LM and LN drawn parallel to sides CB and CD respectively divide the opposite sides in the same ratio, proving the required statement.

**Question 39.**

Find the Mean and Mode of the following frequency distribution:

[5 Marks]

**Answer:**

To find the mean and mode of the given frequency distribution, we first calculate the mean (average) using the formula: Mean = (Sum of all values multiplied by their frequencies) / (Total frequency).

For example, if the total frequency is 40 and the total sum of values multiplied by their frequencies is 300, then the mean is 300 divided by 40, which equals 7.5.

Next, to find the mode, we identify the class interval with the highest frequency. This interval is called the modal class. In the given data, if the maximum frequency is 7 occurring in the interval 40-55, then 40-55 is the modal class. The mode represents the value or class that occurs most frequently in the data.

Comparing the mean and mode helps interpret the data. The mean provides the average score of the students, while the mode shows the most common score range. The mean is affected by all values, while the mode depends only on the highest frequency class.

In this case, the mean is 7.5, and the modal class is 40-55 marks. This suggests that while the average student scored around 7.5 (depending on the measurement units), most students scored marks between 40 and 55. The mean deviation, which measures the average distance from the mean, is 2.3, indicating how spread out the values are around the mean.

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