CBSE 2024 Maths Standard — Set 3 — Answer Key

English Medium

Time Allowed: 3 Hours | Maximum Marks: 80

General Instructions:

1. This question paper contains 38 questions. All questions are compulsory.
2. Section A has 20 MCQs carrying 1 mark each.
3. Section B has 6 questions carrying 2 marks each.
4. Section C has 6 questions carrying 3 marks each.
5. Section D has 4 questions carrying 5 marks each.
6. Section E has 3 case-study based questions carrying 4 marks each.
7. Draw neat figures wherever required.

Section A

Multiple Choice Questions (1 mark each)

Q.1 [1 mark]

The pair of linear equations x + 2y + 5 = 0 and -3x = 6y - 1 has

(a) unique solution

(b) exactly two solutions

(c) infinitely many solutions

(d) no solution <<

Explanation:

Write both equations in standard form: x + 2y + 5 = 0 →

x + 2y = -5, and -3x - 6y + 1 = 0 →

-3x - 6y = -1 →

3x + 6y = 1.

Compare ratios: a1/a2 = 1/3, b1/b2 = 2/6 = 1/3, c1/c2 = -5/1 = -5.

Since a1/a2 = b1/b2 ≠ c1/c2 (1/3 ≠ -5), the lines are parallel.

Therefore there is no solution.

Q.2 [1 mark]

The common difference of the A.P. 1/(2x), (1-4x)/(2x), (1-8x)/(2x), ... is

(a) -2x

(b) -2 <<

(c) 2

(d) 2x

Explanation:

Find the difference between consecutive terms: a2 - a1 = (1-4x)/(2x) - 1/(2x) = (-4x)/(2x) = -2.

Common difference = -2.

Answer is (B) -2.

Q.3 [1 mark]

Two dice are thrown together. The probability that they show different

numbers is

(a) 1/6

(b) 5/6 <<

(c) 1/3

(d) 2/3

Explanation:

Total outcomes when two dice are thrown = 6 × 6 = 36.

Outcomes where both dice show same number = 6 (i.e., (1,1),(2,2),(3,3),(4,4),(5,5),(6,6)).

Outcomes where they show different numbers = 36 - 6 = 30.

Probability = 30/36 = 5/6.

Q.4 [1 mark]

The probability of guessing the correct answer to a certain test question is x/6. If the probability of not guessing the correct answer to this question is 2/3, then the value of x is

(a) 2 <<

(b) 3

(c) 4

(d) 6

Explanation:

P(correct) + P(not correct) = 1.

So x/6 + 2/3 = 1.

x/6 = 1 - 2/3 = 1/3.

x = 6 × (1/3) = 2.

Q.5 [1 mark]

If a = 2² × 3^x, b = 2² × 3 × 5, c = 2² × 3 × 7 and LCM(a, b, c) = 3780, then x is equal to

(a) 1

(b) 2

(c) 3 <<

(d) 0

Explanation:

LCM(a, b, c) = 2² × 3^x × 5 × 7.

3780 = 2² × 3³ × 5 × 7 = 140 × 27.

So 3^x = 3³, meaning x = 3.

Answer is (C) 3.

Q.6 [1 mark]

The zeroes of the quadratic polynomial 2x² - 3x - 9 are

(a) 3, -3/2 <<

(b) -3, -3/2

(c) -3, 3/2

(d) 3, 3/2

Explanation:

Factor 2x² - 3x - 9 = 0.

Using factorisation: 2x² - 6x + 3x - 9 = 2x(x-3) + 3(x-3) = (2x+3)(x-3) = 0.

So x = 3 or x = -3/2.

The zeroes are 3 and -3/2.

Q.7 [1 mark]

From a point on the ground, which is 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 60°. The height (in metres) of the tower is

(a) 10√3

(b) 30√3 <<

(c) 60

(d) 30

Explanation:

Let height of tower = h.

Distance from foot = 30 m.

tan 60° = h/30.

√3 = h/30.

h = 30√3 m.

Q.8 [1 mark]

If cos θ = √3/2 and sin φ = 1/2, then tan(θ + φ) is

(a) √3 <<

(b) 1/√3

(c) 1

(d) not defined

Explanation:

cos θ = √3/2 → θ = 30°.

sin φ = 1/2 → φ = 30°.

θ + φ = 60°.

tan 60° = √3.

Answer is (A) √3.

Q.9 [1 mark]

Maximum number of common tangents that can be drawn to two circles intersecting at two distinct points is

(a) 4

(b) 3

(c) 2 <<

(d) 1

Explanation:

When two circles intersect at two distinct points, they have exactly 2 common tangents — both are external common tangents.

Internal common tangents do not exist when circles intersect.

Maximum = 2.

Q.10 [1 mark]

In the given figure, if PT is a tangent to a circle with centre O and ∠TPO =

35°, then the measure of ∠x is

(a) 110°

(b) 115°

(c) 120°

(d) 125° <<

Explanation:

OT is radius and PT is tangent, so ∠OTP = 90°.

In triangle OTP: ∠TOP = 180° - 90° - 35° = 55°.

The angle x is the supplementary angle at O on the other side: x = 180° - 55° = 125°.

Answer is (D) 125°.

Q.11 [1 mark]

If the diagonals of a quadrilateral divide each other proportionally, then it is a

(a) parallelogram

(b) rectangle

(c) square

(d) trapezium <<

Explanation:

If the diagonals of a quadrilateral divide each other proportionally (but not necessarily equally), then the quadrilateral is a trapezium.

By the converse of BPT (Basic Proportionality Theorem), if AO/OC = BO/OD, then AB || CD, making it a trapezium.

Q.12 [1 mark]

In △ABC, DE || BC (as shown in the figure). If AD = 2 cm, BD = 3 cm, BC = 7.5 cm, then the length of DE (in cm) is

(a) 2.5

(b) 3 <<

(c) 5

(d) 6

Explanation:

By BPT, since DE || BC, △ADE ~ △ABC.

AD/AB = DE/BC.

AB = AD + DB = 2 + 3 = 5 cm.

DE/BC = AD/AB = 2/5.

DE = (2/5) × 7.5 = 3 cm.

Q.13 [1 mark]

Given HCF(2520, 6600) = 40, LCM(2520, 6600) = 252 × k, then the value of k is

(a) 1650 <<

(b) 1600

(c) 165

(d) 1625

Explanation:

Using the relation: HCF × LCM = product of the two numbers.

40 × LCM = 2520 × 6600.

LCM = (2520 × 6600)/40 = 2520 × 165 = 415800.

Also LCM = 252 × k.

So 252 × k = 415800.

k = 415800/252 = 1650.

Q.14 [1 mark]

A pair of irrational numbers whose product is a rational number is

(a) (√16, √4)

(b) (√5, √2)

(c) (√3, √27) <<

(d) (√36, √2)

Explanation:

Check each pair: (A) √16 = 4 and √4 = 2 — both rational, not irrational.

(B) √5 × √2 = √10 — irrational.

(C) √3 × √27 = √81 = 9 — rational! And both √3 and √27 are irrational.

(D) √36 = 6 — rational, not irrational.

Answer: (C) (√3, √27).

Q.15 [1 mark]

If a digit is chosen at random from the digits 1, 2, 3, 4, 5, 6, 7, 8, 9; then the probability that this digit is an odd prime number is

(a) 1/3 <<

(b) 2/3

(c) 4/9

(d) 5/9

Explanation:

Total digits = 9.

Odd prime numbers from 1 to 9: 3, 5, 7 (Note: 1 is not prime).

Count = 3.

Probability = 3/9 = 1/3.

Q.16 [1 mark]

The mean of five observations is 15. If the mean of first three observations is 14 and that of the last three observations is 17, then the third observation is

(a) 20

(b) 19

(c) 18 <<

(d) 17

Explanation:

Sum of all 5 = 5 × 15 = 75.

Sum of first 3 = 3 × 14 = 42.

Sum of last 3 = 3 × 17 = 51.

First 3 + Last 3 = 93 = 75 + 3rd observation.

3rd observation = 93 - 75 = 18.

Answer is (C) 18.

Q.17 [1 mark]

Perimeter of a sector of a circle whose central angle is 90° and radius 7 cm is

(a) 35 cm
(b) 11 cm
(c) 22 cm
(d) 25 cm <<

Explanation:

Perimeter of sector = $2r + (\theta/360°) \times 2\pi r = 2(7) + (90/360) \times 2 \times (22/7) \times 7 = 14 + (1/4) \times 44 = 14 + 11 = 25$ cm.

Q.18 [1 mark]

In the given figure, O is the centre of the circle. MN is the chord and the tangent ML at point M makes an angle of 70° with MN. The measure of ∠MON is

(a) 120°
(b) 140° <<
(c) 70°
(d) 90°

Explanation:

By the tangent-chord angle theorem, the angle between a tangent and a chord equals the inscribed angle in the alternate segment.

∠NML = 70° (angle between tangent ML and chord MN).

The angle subtended by chord MN at centre = 2 × angle subtended at circumference by same arc.

The inscribed angle in alternate segment = 70°.

So ∠MON = 2 × 70° = 140°.

Q.19 [1 mark]

Assertion (A): The point which divides the line segment joining the points A(1, 2) and B(-1, 1) internally in the ratio 1:2 is (-1/3, 5/3).

Reason (R): The coordinates of the point which divides the line segment joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m_1:m_2$ are $((m_1x_2 + m_2x_1)/(m_1 + m_2), (m_1y_2 + m_2y_1)/(m_1 + m_2))$.

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

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

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

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

Explanation:

Using section formula with $m_1:m_2 = 1:2$, A(1,2), B(-1,1): $x = (1\times(-1) + 2\times1)/(1+2) = 1/3$.

$y = (1\times1 + 2\times2)/(1+2) = 5/3$.

The point is (1/3, 5/3), not (-1/3, 5/3).

Assertion (A) is FALSE.

Reason (R) is the correct section formula, so R is TRUE.

Answer is (D).

Q.20 [1 mark]

Assertion (A): In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball, he does not hit the boundary is 4/5.

Reason (R): P(E) + P(not E) = 1.

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

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

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

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

Explanation:

P(hits boundary) = 9/45 = 1/5.

P(does not hit boundary) = 1 - 1/5 = 4/5.

Assertion A is TRUE.

Reason R states P(E) + P(not E) = 1, which is the fundamental probability law and is TRUE.

R correctly explains why A is true (we used complementary probability).

Answer: (A) Both A and R are true and R is the correct explanation of A.

Section B

Very Short Answer Questions (2 marks each)

Q.21 [2 marks]

One card is drawn at random from a well shuffled deck of 52 cards. Find the probability that the card drawn (i) is queen of hearts; (ii) is not a jack.

Answer: (i) 1/52; (ii) 12/13

Explanation:

(i) There is only 1 queen of hearts in a deck of 52 cards.

P(queen of hearts) = 1/52.

(ii) There are 4 jacks in a deck of 52 cards.

P(not a jack) = (52-4)/52 = 48/52 = 12/13.

Q.22(a) [2 marks]

If 2x + y = 13 and 4x - y = 17, find the value of (x - y).

Answer: 2

Explanation:

Adding the two equations: (2x + y) + (4x – y) = 13 + 17 ⇒ 6x = 30 ⇒ x = 5.

From 2x + y = 13: 10 + y = 13 ⇒ y = 3.

Therefore x – y = 5 – 3 = 2.

OR

Q.22(a) [2 marks]

Sum of two numbers is 105 and their difference is 45. Find the numbers.

Answer: 75 and 30

Explanation:

Let the two numbers be a and b.

a + b = 105 and a - b = 45.

Adding: 2a = 150 → a = 75.

Substituting: 75 + b = 105 → b = 30.

The two numbers are 75 and 30.

Q.23(a) [2 marks]

Find a relation between x and y such that the point P(x, y) is equidistant from the points A(7, 1) and B(3, 5).

Answer: x - y - 2 = 0

Explanation:

PA = PB means $PA^2 = PB^2$.

$(x-7)^2 + (y-1)^2 = (x-3)^2 + (y-5)^2$.

Expanding: $x^2-14x+49 + y^2-2y+1 = x^2-6x+9 + y^2-10y+25$.

$-14x+49-2y+1 = -6x+9-10y+25$.

$-14x-2y+50 = -6x-10y+34$.

$-14x+6x-2y+10y = 34-50$.

$-8x+8y = -16$.

$-x+y = -2$.

$x-y = 2$ or $x-y-2 = 0$.

OR

Q.23(b) [2 marks]

Points A(-1, y) and B(5, 7) lie on a circle with centre O(2, -3y) such that AB is a diameter of the circle. Find the value of y. Also, find the radius of the circle.

Answer: y = –1, radius = 5

Explanation:

Since AB is a diameter, the centre O is the midpoint of AB.

Midpoint of AB = $((-1 + 5)/2, (y + 7)/2) = (2, (y + 7)/2) = (2, -3y)$.

So $(y + 7)/2 = -3y \Rightarrow y + 7 = -6y \Rightarrow y = -1$.

Then A = (–1, –1), AB = $\sqrt{((5 + 1)^2 + (7 + 1)^2)} = \sqrt{(36 + 64)} = 10$.

Radius = AB/2 = 5.

Q.24 [2 marks]

In the given figure, EA/EC = EB/ED. Prove that ΔEAB ~ ΔECD.

Answer: ΔEAB ~ ΔECD (by SAS similarity criterion)

Explanation:

Given: EA/EC = EB/ED.

In ΔEAB and ΔECD: ∠AEB = ∠CED (vertically opposite angles).

EA/EC = EB/ED (given).

By SAS similarity criterion (sides about the equal angle are proportional), ΔEAB ~ ΔECD.

Hence proved.

Q.25 [2 marks]

Evaluate: (cos 45° + sin 60°) / (sec 30° + cosec 30°)

Answer: √3(√2+√3) / (2(1+√3)) which simplifies to (3+√6)/8 ... recalculate properly

Explanation:

cos 45° = 1/√2, sin 60° = √3/2, sec 30° = 2/√3, cosec 30° = 2.

Numerator = 1/√2 + √3/2 = (2 + √6)/(2√2).

Denominator = 2/√3 + 2 = (2 + 2√3)/√3.

Value = [(2+√6)/(2√2)] / [(2+2√3)/√3] = [(2+√6)√3] / [2√2 × 2(1+√3)] = [√3(2+√6)] / [4√2(1+√3)].

Simplify: = [2√3 + √18] / [4√2 + 4√6] = [2√3 + 3√2] / [4√2(1+√3)] = (2√3+3√2)/(4√2+4√6).

This equals (√6+3)/(4+4√3) × ...

The simplified result = (√6+3)/(2(2+2√3))...

Final answer: (3+√6)/(4(1+√3)) × rationalize = (3+√6)(1-√3)/(4(1-3)) = (3-3√3+√6-√18)/(-8) = (3-3√3+√6-3√2)/(-8) = (3√3-3-√6+3√2)/8.

Q.26(a) [2 marks]

If the sum of first 7 terms of an A.P. is 49 and that of first 17 terms is 289, find the sum of first 20 terms.

Answer: 400

Explanation:

S7 = 49: (7/2)(2a + 6d) = 49 → 7(a + 3d) = 49 → a + 3d = 7.

S17 = 289: (17/2)(2a + 16d) = 289 → 17(a + 8d) = 289 → a + 8d = 17.

Subtracting: 5d = 10 → d = 2.

a = 7 - 6 = 1.

S20 = (20/2)(2×1 + 19×2) = 10(2 + 38) = 10 × 40 = 400.

OR

Q.26(b) [2 marks]

The ratio of the 10th term to the 30th term of an A.P. is 1:3, and the sum of first six terms is 42. Find the first term and the common difference of the A.P.

Answer: a = 2, d = 2

Explanation:

a10/a30 = 1/3: (a+9d)/(a+29d) = 1/3 → 3(a+9d) = a+29d → 3a+27d = a+29d → 2a = 2d → a = d.

S6 = 42: (6/2)(2a+5d) = 42 → 3(2a+5d) = 42 → 2a+5d = 14.

Since a = d: 2d+5d = 14 → 7d = 14 → d = 2.

a = 2.

Section C

Short Answer Questions (3 marks each)

Q.27 [3 marks]

Find the zeroes of the quadratic polynomial $x^2 - 15$ and verify the relationship between the zeroes and the coefficients of the polynomial.

Answer: Zeroes are $\sqrt{15}$ and $-\sqrt{15}$

Explanation:

Set $x^2 - 15 = 0 \Rightarrow x^2 = 15 \Rightarrow x = \pm\sqrt{15}$.

The two zeroes are $\alpha = \sqrt{15}$ and $\beta = -\sqrt{15}$.

Verification for polynomial $x^2 + 0 \cdot x - 15$ ($a = 1, b = 0, c = -15$): Sum of zeroes: $\alpha + \beta =$

√15 + (−√15) = 0 = −b/a = −0/1 = 0.

✓ Product of zeroes: α × β = √15 × (−√15) = −15 = c/a = −15/1 = −15.

✓

Q.28 [3 marks]

Solve the following system of linear equations graphically: x - y + 1 = 0 and x + y = 5.

Answer: x = 2, y = 3

Explanation:

From x - y + 1 = 0: y = x + 1.

Points: (0,1), (2,3), (4,5).

From x + y = 5: y = 5 - x.

Points: (0,5), (2,3), (5,0).

The two lines intersect at (2, 3).

Solution: x = 2, y = 3.

Q.29(a) [3 marks]

Find the ratio in which the line segment joining the points (5, 3) and (-1, 6) is divided by the Y-axis.

Answer: 5:1

Explanation:

Let Y-axis divide the segment joining (5,3) and (-1,6) in ratio k:1.

The x-coordinate of the point on Y-axis = 0.

Using section formula: x = (k×(-1) + 1×5)/(k+1) = 0.

-k + 5 = 0.

k = 5.

The ratio is 5:1.

OR

Q.29(b) [3 marks]

P(-2, 5) and Q(3, 2) are two points. Find the coordinates of the point R on line segment PQ such that PR = 2QR.

Answer: R = (4/3, 3)

Explanation:

PR = 2QR means PR:QR = 2:1.

R divides PQ in ratio PR:RQ = 2:1.

Using section formula: R = ((2×3 + 1×(-2))/(2+1), (2×2 + 1×5)/(2+1)) = ((6-2)/3, (4+5)/3) = (4/3, 3).

Q.30 [3 marks]

Prove that $(\sin\theta - 2\sin^3\theta) / (2\cos^3\theta - \cos\theta) = \tan\theta$.

Answer: LHS = tan θ = RHS (proved)

Explanation:

LHS = $(\sin\theta - 2\sin^3\theta) / (2\cos^3\theta - \cos\theta)$.

Factor sin θ from numerator and cos θ from denominator: = $\sin\theta(1 - 2\sin^2\theta) / [\cos\theta(2\cos^2\theta - 1)]$.

Now, $1 - 2\sin^2\theta = 1 - 2(1 - \cos^2\theta) = 2\cos^2\theta - 1$.

So: = $\sin\theta(2\cos^2\theta - 1) / [\cos\theta(2\cos^2\theta - 1)] = \sin\theta / \cos\theta = \tan\theta$ = RHS.

Hence proved.

Q.31 [3 marks]

Prove that the tangents drawn at the end points of a chord of a circle make equal angles with the chord.

Answer: ∠PAB = ∠PBA (proved using congruent triangles)

Explanation:

Let AB be a chord of a circle with centre O, and let PA and PB be tangents at A and B respectively, meeting at external point P.

Since tangents from an external point are equal: PA = PB.

In ΔPAB: PA = PB, so ΔPAB is isosceles.

The base angles of an isosceles triangle are equal, therefore ∠PAB = ∠PBA.

That is, the tangents at A and B make equal angles with the chord AB.

Hence proved.

Q.32(a) [3 marks]

In a flight of 2800 km, an aircraft was slowed down due to bad weather. Its average speed is reduced by 100 km/h and the time of flight is increased by 30 minutes. Find the original duration of the flight.

Answer: 3.5 hours

Explanation:

Let original speed = v km/h.
Original time = 2800/v hours.
New speed = (v-100) km/h.
New time = 2800/(v-100) hours.
Time increased by 30 min = 1/2 hr: 2800/(v-100) - 2800/v = 1/2.
2800[1/(v-100) - 1/v] = 1/2.
2800[v - (v-100)] / [v(v-100)] = 1/2.
2800 × 100 / [v(v-100)] = 1/2.
v(v-100) = 2800 × 200 = 560000.
v^2 - 100v - 560000 = 0.
Using quadratic formula: v = (100 ± √(10000 + 2240000))/2 = (100 ± √2250000)/2 = (100 ± 1500)/2.
Taking positive root: v = 1600/2 = 800 km/h.
Original time = 2800/800 = 3.5 hours.

OR

Q.32(b) [3 marks]

The denominator of a fraction is one more than twice the numerator. If the sum of the fraction and its reciprocal is 2 and 16/21, find the fraction.

Answer: 3/7

Explanation:

Let numerator = x, denominator = 2x+1.
Fraction = x/(2x+1).
Sum of fraction and reciprocal = x/(2x+1) + (2x+1)/x = 2 + 16/21 = 58/21.
Let f = x/(2x+1).

f + 1/f = 58/21.

f^2 - (58/21)f + 1 = 0.

$21f^2$ - 58f + 21 = 0.

f = (58 ± √(3364 - 1764))/42 = (58 ± √1600)/42 = (58 ± 40)/42.

f = 98/42 = 7/3 or f = 18/42 = 3/7.

Since denominator = 2x+1 > numerator (denominator is more than numerator), f < 1, so f = 3/7.

Fraction = 3/7.

Section D

Long Answer Questions (5 marks each)

Q.33 [5 marks]

State and prove the Basic Proportionality Theorem (Thales' Theorem).

Answer: BPT: If a line is drawn parallel to one side of a triangle, it divides the other two sides proportionally. AD/DB = AE/EC (proved).

Explanation:

Statement: If a line is drawn parallel to one side of a triangle, then it divides the other two sides in the same ratio.

Given: ΔABC with DE ∥ BC, D on AB and E on AC.

To prove: AD/DB = AE/EC.

Construction: Join BE and CD.

Draw EN ⊥ AB and DM ⊥ AC.

Proof: area(ΔADE) = (1/2) × AD × EN and area(ΔBDE) = (1/2) × DB × EN.

⇒ area(ΔADE)/area(ΔBDE) = AD/DB …(1).

Also area(ΔADE) = (1/2) × AE × DM and area(ΔCDE) = (1/2) × EC × DM.

⇒ area(ΔADE)/area(ΔCDE) = AE/EC …(2).

Since ΔBDE and ΔCDE share the same base DE and lie between the same parallels DE ∥ BC: area(ΔBDE) = area(ΔCDE) …(3).

From (1), (2) and (3): AD/DB = AE/EC.

Hence proved.

Q.34 [5 marks]

From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

Answer: $20(\sqrt{3} - 1)$ m

Explanation:

Let the point on ground be P, building height = 20 m (bottom of tower at A, top at B), tower height = h (top at C).

Distance from P to base of building = d.

Angle of elevation of A (bottom of tower / top of building) = 45°: $\tan 45° = 20/d \rightarrow$

$1 = 20/d \rightarrow$

$d = 20$ m.

Angle of elevation of C (top of tower) = 60°: $\tan 60° = (20+h)/d \rightarrow$

$\sqrt{3} = (20+h)/20 \rightarrow$

$20+h = 20\sqrt{3} \rightarrow$

$h = 20\sqrt{3} - 20 = 20(\sqrt{3}-1)$ m.

Q.35(a) [5 marks]

A solid iron pole consists of a solid cylinder of height 200 cm and base diameter 28 cm, which is surmounted by another cylinder of height 50 cm and radius 7 cm. Find the mass of the pole, given that 1 cm^3 of iron has approximately 8 g mass.

Answer: Approximately 1047.2 kg

Explanation:

Lower cylinder: r = 28/2 = 14 cm, h = 200 cm $\Rightarrow V_1 = \pi \times 14^2 \times 200 = 39200\pi$ cm^3.

Upper cylinder: r = 7 cm, h = 50 cm $\Rightarrow V_2 = \pi \times 7^2 \times 50 = 2450\pi$ cm^3.

Total volume = $41650\pi = 41650 \times 22/7 = 130900$ cm^3.

Mass = 130900 × 8 g = 1047200 g = 1047.2 kg.

OR

Q.35(b) [5 marks]

A medicine capsule is in the shape of a cylinder with two hemispheres stuck to each of its ends. The length of the entire capsule is 14 mm and the diameter of the capsule is 4 mm. Find its surface area. Also find its volume.

Answer: Surface area = 56π = 176 mm²; Volume = 152π/3 ≈ 159.24 mm³

Explanation:

r = 4/2 = 2 mm.

Each hemisphere adds r = 2 mm to the length, so cylinder length h = 14 – 2 – 2 = 10 mm.

Surface area = 2πrh + 2 × 2πr² = 2π(2)(10) + 4π(4) = 40π + 16π = 56π = 56 × 22/7 = 176 mm².

Volume = πr²h + 2 × (2/3)πr³ = π(4)(10) + (4/3)π(8) = 40π + 32π/3 = 152π/3 = 3344/21 ≈ 159.24 mm³.

Q.36(i) [5 marks]

A stable owner has four horses. He ties each horse with a 7 m long rope to pegs at each corner of a square shaped grass field of 20 m length. Find the area of the square shaped grass field.

Answer: 400 m²

Explanation:

The grass field is square with side 20 m. Area = side² = 20² = 400 m².

Q.0

A stable owner has four horses tied with 7 m long ropes at each corner of a square shaped grass field of 20 m length. Find the area of the total field in which these horses can graze.

Answer: 154 m²

Explanation:

Each horse is tied at a corner of the square with rope length 7 m.

At each corner, the interior angle of the square is 90°.

Each horse can graze a sector of radius 7 m and angle 90°.

Area grazed by one horse = (90/360) × π × 7² = (1/4) × π × 49.

Total area grazed by 4 horses = 4 × (1/4) × π × 49 = π × 49 = 49π = 49 × 22/7 = 154 m².

Q.0

If the length of the rope of each horse is increased from 7 m to 10 m, find the area grazed by one horse. (Use π = 3.14)

Answer: 78.5 m²

Explanation:

With rope length 10 m, each horse grazes a sector of radius 10 m and angle 90° (corner angle of square).

Area grazed by one horse = (90/360) × π × 10² = (1/4) × 3.14 × 100 = 78.5 m².

Q.0

In the stable owner scenario with four horses tied with 7 m ropes at corners of a 20 m square field, what is the area of the field that is left ungrazed?

Answer: 246 m²

Explanation:

Total area of square field = 400 m².

Total area grazed = 154 m² (four quarter-circles of radius 7 m).

Ungrazed area = 400 - 154 = 246 m².

Q.37(i) [4 marks]

A teacher made a frequency distribution table of students/adults undergoing vocational training from a training institute with the following data:

Age (in years): 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54

Number of participants: 62, 132, 96, 37, 13, 11, 10, 4

What is the lower limit of the modal class of the above data?

Answer: 20

Explanation:

The modal class is the class with the highest frequency.

Looking at the frequencies: 62, 132, 96, 37, 13, 11, 10, 4.

The highest frequency is 132, which corresponds to the age group 20-24.

The lower limit of the modal class = 20.

Q.0

Using the vocational training frequency distribution (Age groups 15-19:62, 20-24:132, 25-29:96, 30-34:37, 35-39:13, 40-44:11, 45-49:10, 50-54:4), find the median class of the above data.

Answer: Median = 24.2 years (median class is 20-24)

Explanation:

Total participants N = 62+132+96+37+13+11+10+4 = 365.

N/2 = 182.5.

Cumulative frequencies: up to 19: 62; up to 24: 194; up to 29: 290...

The cumulative frequency first exceeds 182.5 in the class 20-24 (CF goes from 62 to 194).

So median class = 20-24.

l=20, cf=62, f=132, h=5.

Median = 20 + ((182.5-62)/132) × 5 = 20 + (120.5/132) × 5 = 20 + 4.56 ≈ 24.56.

Median class is 20-24.

Q.0

Using the vocational training frequency distribution (Age groups 15-19:62, 20-24:132, 25-29:96, 30-34:37, 35-39:13, 40-44:11, 45-49:10, 50-54:4), find the number of participants of age less than 50 years who undergo vocational training.

Answer: 361

Explanation:

Count participants aged less than 50 years, i.e., in age groups 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49.

Sum = 62+132+96+37+13+11+10 = 361.

Q.0

For the vocational training frequency distribution, give the empirical relationship between mean, median and mode.

Answer: Mode = 3 × Median - 2 × Mean

Explanation:

The empirical relationship between mean, median and mode (given by Karl Pearson) is: Mode = 3 × Median - 2 × Mean.

Q.38(i) [4 marks]

Ms. Mukta planned a prime number game for class 5 students. She announces the number 2 in her class and asked the first student to multiply it by a prime number and then pass it to the second student. Second student also multiplied it by a prime number and passed it to third student. In this way by multiplying to a prime number, the last student got 173250. What is the least prime number used by students?

Answer: 3

Explanation:

173250 = 2 × 86625 and 86625 = $3^2 \times 5^3 \times 7 \times 11$, so 173250 = $2 \times 3^2 \times 5^3 \times 7 \times 11$.

The 2 is the number announced by the teacher;

the students multiplied by the primes of 86625 = 3 × 3 × 5 × 5 × 5 × 7 × 11.

The least prime used by the students = 3.

Q.0

In Ms. Mukta's prime number game (teacher announces 2, each student multiplies by a prime, the last student gets 173250), how many students are in the class?

Answer: 7

Explanation:

173250 = 2 × 3² × 5³ × 7 × 11.

The 2 was announced by the teacher, and each student multiplied by exactly one prime: 173250/2 = 86625 = 3 × 3 × 5 × 5 × 5 × 7 × 11.

That is 2 + 3 + 1 + 1 = 7 prime factors, so there are 7 students.

Q.0

In Ms. Mukta's prime number game where starting number is 2 and each student multiplies by a prime to get 173250, what is the highest prime number used by students?

Answer: 11

Explanation:

173250 = 2 × 3² × 5³ × 7 × 11.

The prime factors are 2, 3, 5, 7, 11.

The highest prime number among these is 11.

Q.0

In Ms. Mukta's prime number game where 173250 is the final product, which prime number has been used maximum times?

Answer: 5

Explanation:

173250 = 2¹ × 3² × 5³ × 7¹ × 11¹.

The prime 5 appears 3 times, which is the maximum.

The prime number used maximum times is 5.