CBSE 2022 Maths Standard (Term 2) — Set 2 — 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]

Solve the quadratic equation x^2 + 2*sqrt(2)*x - 6 = 0 for x.

Answer: x = sqrt(2) or x = -3*sqrt(2)

Explanation:

x^2 + 2*sqrt(2)*x - 6 = 0. Using the quadratic formula: x = (-2*sqrt(2) +/- sqrt(8 + 24))/2 = (-2*sqrt(2) +/- sqrt(32))/2 = (-2*sqrt(2) +/- 4*sqrt(2))/2. So x = (-2*sqrt(2) + 4*sqrt(2))/2 = 2*sqrt(2)/2 = sqrt(2), or x = (-2*sqrt(2) - 4*sqrt(2))/2 = -6*sqrt(2)/2 = -3*sqrt(2).

Q.2 [1 mark]

Which term of the A.P. -11/2, -3, -1/2, ... is 49/2?

Answer: 13th term

Explanation:

First term a = -11/2. Common difference d = -3 - (-11/2) = -3 + 11/2 = (-6 + 11)/2 = 5/2.
We need a_n = 49/2. Using a_n = a + (n-1)d: 49/2 = -11/2 + (n-1)(5/2).
(49 + 11)/2 = (n-1)(5/2).
60/2 = (n-1)(5/2).
30 = 5(n-1)/2. 60 = 5(n-1).
n - 1 = 12. n = 13. So 49/2 is the 13th term.

OR

Q.2 [1 mark]

Find a and b so that the numbers a, 7, b, 23 are in A.P.

Answer: a = -1, b = 15

Explanation:

In an A.P., the common difference is constant.
Let common difference = d.
Second term - First term: 7 - a = d.

Third term - Second term: b - 7 = d.
Fourth term - Third term: 23 - b = d.
From equations 2 and 3: b - 7 = 23 - b.
2b = 30. b = 15. So d = 15 - 7 = 8. Therefore a = 7 - d = 7 - 8 = -1.

Q.3 [1 mark]

A solid piece of metal in the form of a cuboid of dimensions 11 cm x 7 cm x 7 cm is melted to form 'n' number of solid spheres of radii 7/2 cm each. Find the value of n.

Answer: n = 3

Explanation:

Volume of cuboid = 11 * 7 * 7 = 539 cm^3. Volume of one sphere = (4/3)*pi*r^3 = (4/3)*(22/7)*(7/2)^3 = (4/3)*(22/7)*(343/8) = (4 * 22 * 343)/(3 * 7 * 8) = (4 * 22 * 49)/24 = 4312/24 = 539/3 cm^3. n = Volume of cuboid / Volume of one sphere = 539 / (539/3) = 3. So n = 3.

Q.4 [1 mark]

AB is the diameter of a circle centered at O. BC is tangent to the circle at B. If OP bisects the chord AD and angle AOP = 60 degrees, find the measure of angle C.

Answer: 30 degrees

Explanation:

Since OP bisects chord AD, OP is perpendicular to AD (perpendicular from center bisects the chord).
angle AOP = 60 degrees.
Since OP bisects AD, angle AOD = 2 * angle AOP = 120 degrees (OP is the perpendicular bisector, so it splits angle AOD symmetrically).
Since AB is a diameter, angle AOB = 180 degrees.
Therefore angle DOB = 180 - 120 = 60 degrees.
Since D lies on line BC (extended), angle BOC = angle DOB = 60 degrees.
In triangle OBC: angle OBC = 90 degrees (tangent at B is perpendicular to radius OB).
angle C = 180 - 90 - 60 = 30 degrees.

OR

Q.4 [1 mark]

XAY is a tangent to the circle centered at O. If angle ABO = 40 degrees, find the measure of angle BAY and angle AOB.

Answer: angle BAY = 50 degrees, angle AOB = 100 degrees

Explanation:

Since XAY is a tangent at A and OA is the radius, angle OAY = 90 degrees (tangent perpendicular to radius).

In triangle OAB, OA = OB (radii).

So triangle OAB is isosceles with angle OAB = angle OBA = 40 degrees.

angle BAY = angle OAY - angle OAB = 90 - 40 = 50 degrees.

In triangle OAB: angle AOB = 180 - 40 - 40 = 100 degrees.

Q.5 [1 mark]

If the mode of the following frequency distribution is 55, find the value of x.

Class: 0-15, 15-30, 30-45, 45-60, 60-75, 75-90

Frequency: 10, 7, x, 15, 10, 12

Answer: x = 5

Explanation:

The modal class is 45-60 (since mode = 55 lies in this class).

For modal class: l = 45, h = 15, f1 = 15 (modal class frequency), f0 = x (preceding class frequency), f2 = 10 (succeeding class frequency).

Mode = l + ((f1 - f0)/(2*f1 - f0 - f2)) * h.

55 = 45 + ((15 - x)/(30 - x - 10)) * 15. 10 = ((15 - x)/(20 - x)) * 15. 10(20 - x) = 15(15 - x).

200 - 10x = 225 - 15x.

5x = 25. x = 5. Verification: frequencies are 10, 7, 5, 15, 10, 12. Mode = 45 + ((15-5)/(30-5-10))*15 = 45 + (10/15)*15 = 45 + 10 = 55. Correct.

Q.6 [1 mark]

Find the sum of the first 20 terms of an A.P. whose nth term is given as a_n = 5 - 2n.

Answer: -320

Explanation:

a_n = 5 - 2n.

First term: a_1 = 5 - 2(1) = 3. Last term (20th): a_20 = 5 - 2(20) = 5 - 40 = -35. Sum of first 20 terms: S_20 = (20/2)(a_1 + a_20) = 10(3 + (-35)) = 10(-32) = -320.

Q.8 [1 mark]

AB is a tower of height 50 m. A man standing on its top observes two cars on the opposite sides of the tower with angles of depression 30 degrees and 45 degrees respectively. Find the distance between the two cars.

Answer: 50(sqrt(3) + 1) m or 136.5 m

Explanation:

Let the tower AB = 50 m.

Let car C be on one side at distance BC from the base, and car D on the other side at distance BD.

Angle of depression to C = 30 degrees, so angle ACB = 30 degrees.

tan(30) = AB/BC = 50/BC.

BC = 50/tan(30) = 50*sqrt(3).

Angle of depression to D = 45 degrees, so angle ADB = 45 degrees.

tan(45) = AB/BD = 50/BD.

BD = 50/tan(45) = 50. Distance between cars = BC + BD = 50*sqrt(3) + 50 = 50(sqrt(3) + 1).

Using sqrt(3) = 1.73: Distance = 50(1.73 + 1) = 50(2.73) = 136.5 m.

Q.9 [1 mark]

The mean of the following frequency distribution is 25. Find the value of f.

Class: 0-10, 10-20, 20-30, 30-40, 40-50

Frequency: 5, 18, 15, f, 6

Answer: f = 16

Explanation:

Class marks (x_i): 5, 15, 25, 35, 45. Sum of f_i = 5 + 18 + 15 + f + 6 = 44 + f.

Sum of f_i*x_i = 5*5 + 18*15 + 15*25 + f*35 + 6*45 = 25 + 270 + 375 + 35f + 270 = 940 + 35f.

Mean = Sum(f_i*x_i)/Sum(f_i).

25 = (940 + 35f)/(44 + f).

25(44 + f) = 940 + 35f.

1100 + 25f = 940 + 35f.

160 = 10f.

f = 16.

OR

Q.9 [1 mark]

Find the mean of the following data using assumed mean method.

Class: 0-5, 5-10, 10-15, 15-20, 20-25

Frequency: 8, 7, 10, 13, 12

Answer: 13.9

Explanation:

Let assumed mean A = 12.5 (mid-value of class 10-15).

Class marks: 2.5, 7.5, 12.5, 17.5, 22.5. Deviations d_i = x_i - A: -10, -5, 0, 5, 10. f_i*d_i: 8*(-10) = -80, 7*(-5) = -35, 10*0 = 0, 13*5 = 65, 12*10 = 120. Sum(f_i) = 50. Sum(f_i*d_i) = -80 - 35 + 0 + 65 + 120 = 70. Mean = A + Sum(f_i*d_i)/Sum(f_i) = 12.5 + 70/50 = 12.5 + 1.4 = 13.9.

Q.10 [1 mark]

Heights of 50 students of class X of a school are recorded and the following data is obtained.

Height (in cm): 130-135, 135-140, 140-145, 145-150, 150-155, 155-160

Number of students: 4, 11, 12, 7, 10, 6

Find the median height of the students.

Answer: 144.17 cm

Explanation:

N = 50, N/2 = 25. Cumulative frequencies: 4, 15, 27, 34, 44, 50. The median class is 140-145 (cumulative frequency first exceeds 25).

l = 140, n/2 = 25, cf = 15 (cumulative frequency of class before median class), f = 12 (frequency of median class), h = 5. Median = l + ((n/2 - cf)/f) * h = 140 + ((25 - 15)/12) * 5 = 140 + (10/12) * 5 = 140 + 50/12 = 140 + 4.17 = 144.17 cm.

Q.11 [1 mark]

PQ is a chord of length 8 cm of a circle of radius 5 cm. The tangents at P and Q meet at a point T. Find the length of TP.

Answer: 20/3 cm

Explanation:

Let O be the center.

PQ = 8 cm, radius = 5 cm.

Let R be the midpoint of PQ.

Then PR = RQ = 4 cm.

OR is perpendicular to PQ.

OR = sqrt(OP^2 - PR^2) = sqrt(25 - 16) = sqrt(9) = 3 cm.

Let TP = TQ = x (tangent lengths from external point are equal).

T, R, O are collinear (by symmetry).

TR = TP^2 can be found using: In right triangle TPR: TP^2 = TR^2 + PR^2. In right triangle OPT: OT^2 = OP^2 + TP^2 (angle OPT = 90 degrees since TP is tangent).

OT = OR + RT = 3 + RT.

So (3 + RT)^2 = 25 + x^2. Also x^2 = RT^2 + 16. Substituting: (3 + RT)^2 = 25 + RT^2 + 16. 9 + 6RT + RT^2 = 41 + RT^2. 6RT = 32. RT = 16/3. TP = sqrt(RT^2 + 16) = sqrt(256/9 + 16) = sqrt(256/9 + 144/9) = sqrt(400/9) = 20/3 cm.

Q.12 [1 mark]

A 2-digit number is such that the product of its digits is 24. If 18 is subtracted from the number, the digits interchange their places. Find the number.

Answer: 64

Explanation:

Let the tens digit = x and units digit = y.

Product of digits: x*y = 24. The number = 10x + y.

When 18 is subtracted, digits interchange: 10x + y - 18 = 10y + x.

9x - 9y = 18. x - y = 2. So x = y + 2. Substituting in x*y = 24: (y + 2)*y = 24. y^2 + 2y - 24 = 0. (y + 6)(y - 4) = 0. y = 4 (rejecting y = -6).

x = 4 + 2 = 6. The number = 10(6) + 4 = 64. Verification: 6 * 4 = 24 and 64 - 18 = 46 (digits interchanged).

The number is 64.

OR

Q.12 [1 mark]

The difference of the squares of two numbers is 180. The square of the smaller number is 8 times the greater number. Find the two numbers.

Answer: 18 and 12 (or -18 and -12)

Explanation:

Let the greater number = x and smaller number = y.

x^2 - y^2 = 180. y^2 = 8x.

Substituting y^2 = 8x in the first equation: x^2 - 8x = 180. x^2 - 8x - 180 = 0. (x - 18)(x + 10) = 0. x = 18 or x = -10. If x = 18: y^2 = 8*18 = 144, y = 12 or y = -12. Check: 18^2 - 12^2 = 324 - 144 = 180. Correct.

If x = -10: y^2 = 8*(-10) = -80, which is not possible.

So the two numbers are 18 and 12.

Q.13(a) [1 mark]

Case Study - Kite Festival: A man at point C is flying two kites A and B. The angles of elevation of kites A and B from C are 30 degrees and 60 degrees

respectively. If AD = 50 m and BE = 60 m (where D and E are the feet of perpendiculars from A and B to the ground), find the lengths of strings used for kites A and B (assume strings are taut/straight).

Answer: String CA = 100 m, String CB = 40*sqrt(3) m (approximately 69.28 m)

Explanation:

For kite A: angle of elevation from C = 30 degrees.

AD = 50 m (height).

In right triangle ACD: sin(30) = AD/CA.

1/2 = 50/CA.

CA = 100 m.

For kite B: angle of elevation from C = 60 degrees.

BE = 60 m (height).

In right triangle BCE: sin(60) = BE/CB.

sqrt(3)/2 = 60/CB.

CB = 120/sqrt(3) = 120*sqrt(3)/3 = 40*sqrt(3) m = approximately 69.28 m.

Q.13(b) [1 mark]

Case Study - Kite Festival: A man at point C is flying two kites A and B. The angles of elevation of kites A and B from C are 30 degrees and 60 degrees respectively. AD = 50 m and BE = 60 m (heights of kites from ground). D and E are points on the ground on opposite sides of C. Find the distance 'd' between the two kites A and B.

Answer: d = 20*sqrt(37) m (approximately 121.66 m)

Explanation:

From the previous part: CD = AD/tan(30) = 50*sqrt(3) m and CE = BE/tan(60) = 60/sqrt(3) = 20*sqrt(3) m.

Kite A is at position (50*sqrt(3) horizontal from C, 50 m height) and kite B is at position (20*sqrt(3) horizontal from C on opposite side, 60 m height).

Total horizontal separation between A and B = CD + CE = 50*sqrt(3) + 20*sqrt(3) = 70*sqrt(3) m.

Vertical difference = 60 - 50 = 10 m.

Distance d = sqrt((70*sqrt(3))^2 + 10^2) = sqrt(14700 + 100) = sqrt(14800) = 20*sqrt(37) m, approximately 121.66 m.

Q.14(a) [1 mark]

Case Study - Circus Tent: A tent is in the shape of a cylinder surmounted by a conical top. The height and diameter of the cylindrical part are 9 m and 30 m respectively, and the height of the conical part is 8 m with the same diameter as the cylindrical part. Find the area of the canvas used in making the tent.

Answer: 1650 sq m

Explanation:

Cylindrical part: height = 9 m, diameter = 30 m, radius = 15 m.

Curved surface area of cylinder = 2*pi*r*h = 2*(22/7)*15*9 = 270*pi sq m.

Conical part: height = 8 m, radius = 15 m.

Slant height l = sqrt(r^2 + h^2) = sqrt(225 + 64) = sqrt(289) = 17 m.

Curved surface area of cone = pi*r*l = (22/7)*15*17 = 255*pi sq m.

Total canvas area = 270*pi + 255*pi = 525*pi = 525 * 22/7 = 75 * 22 = 1650 sq m.

Q.14(b) [1 mark]

Case Study - Circus Tent: A tent is in the shape of a cylinder surmounted by a conical top. The canvas area of the tent is 1650 sq m. Find the cost of the canvas bought at the rate of Rs 200 per sq m, if 30 sq m of canvas was wasted during stitching.

Answer: Rs 3,36,000

Explanation:

Total canvas area of tent = 1650 sq m.

Canvas wasted during stitching = 30 sq m.

Total canvas bought = 1650 + 30 = 1680 sq m.

Cost = 1680 * 200 = Rs 3,36,000.