FREE SAMPLE: THE FIRST QUESTION

Question One (12 marks)

(a) The diagram shows a cuboid with side lengths 3x + 3 cm, 2x + 5 cm and 5x + 4 cm.

Find the total surface area of the cuboid, given that x = 6.

[2 marks]

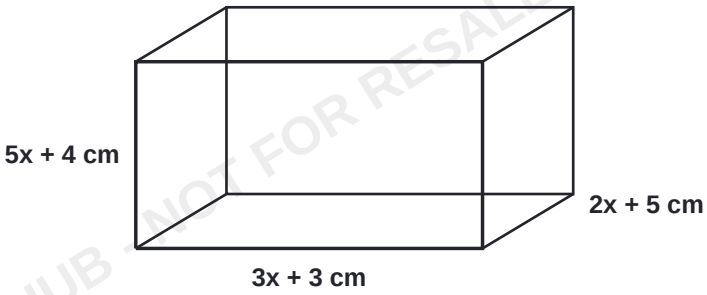


Diagram is NOT to scale

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(b) The graph below shows two straight lines with equations

$x - 2y = -11$ and $2x + y = 13$

The lines intersect at the point Q.

Find the coordinates of Q, using an algebraic method. Clearly show all steps of your working.

[3 marks]

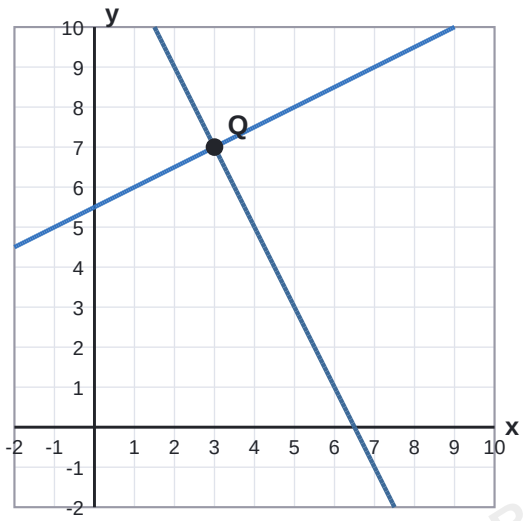


Diagram is NOT to scale

(c) The diagram shows a rectangle ABCE. The point D lies on AB.

Length AE = 70 cm, length AB = 1.3 m, and angle AED = 28°.

Find the perimeter of triangle CDE. Give your answer in centimetres, correct to one decimal place.

[3 marks]

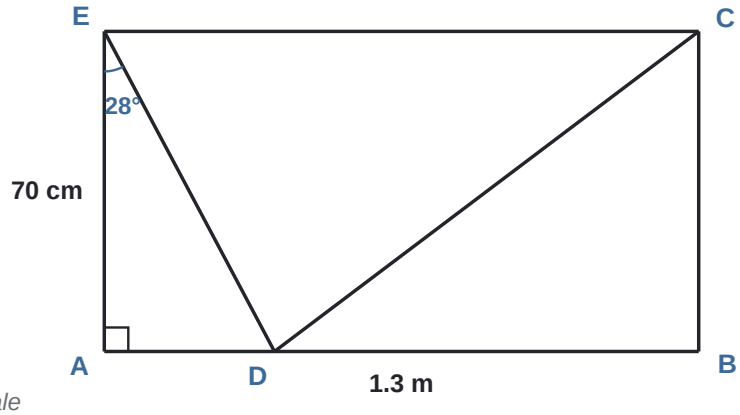


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(d) The relationship between the x and y values in a pattern is shown in the table below.

Find an equation that gives y for any value of x. Show working to support your answer.

x	1	2	3	4	5
y	4	6	10	18	34

[2 marks]

(e) The graph of y = 2^x + 2 could be drawn for all values of x.

Identify THREE different features of the graph, using the equation.

[2 marks]

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THE WORKED ANSWER TO THAT QUESTION

Question 1 (12 marks) [Algebra, graphs and measurement]

(a) The diagram shows a cuboid with side lengths 3x + 3 cm, 2x + 5 cm and 5x + 4 cm. Find the total surface area of the cuboid, given that x = 6.

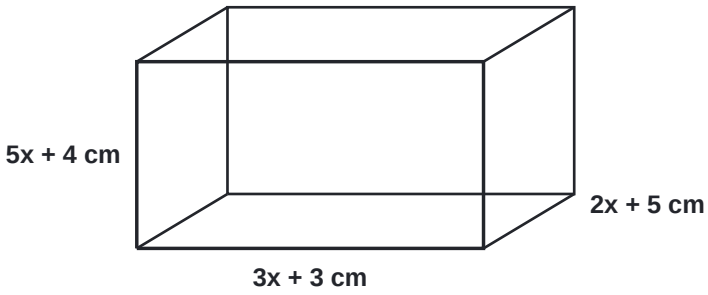


Diagram is NOT to scale

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(a) Answer: 3298 cm²

- Evidence level: Achieved (substitute into an algebraic expression, then use the surface area of a cuboid).
- Substitute x = 6 into each side: 21 cm, 17 cm and 34 cm.
- A cuboid has three pairs of identical faces, so surface area = 2(lw + lh + wh).
- = 2(21 × 17 + 21 × 34 + 17 × 34) = 2(357 + 714 + 578) = 2 × 1649
- Total surface area = 3298 cm².

> **KEY TAKEAWAY**
> Substitute the value first, then count every face: a cuboid has 6 faces in 3 matching pairs.

(b) The graph below shows two straight lines with equations x − 2y = −11 and 2x + y = 13 The lines intersect at the point Q. Find the coordinates of Q, using an algebraic method. Clearly show all steps of your working.

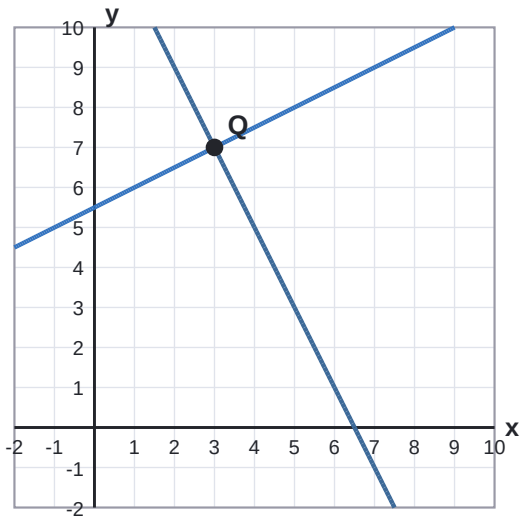


Diagram is NOT to scale

(b) Answer: Q = (3, 7)

- Evidence level: Achieved (solve a pair of simultaneous equations by an algebraic method; do not read Q from the graph).
- Label the equations: (1) $x - 2y = -11$ and (2) $2x + y = 13$.
- To eliminate y, multiply (1) by 1 and (2) by −2: $x - 2y = -11$ and $-4x - 2y = -26$.
- Subtract the second from the first: $(5)x = 15$, so $x = 3$.
- Substitute $x = 3$ into (1): $3 - 2y = -11$, so $y = 7$.
- Check in (2): $2 \times 3 + 1 \times 7 = 13$ ✓.
- Q = (3, 7).

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KEY TAKEAWAY

Simultaneous equations: make the coefficients of one letter match, subtract or add to remove it, then substitute back and check in the other equation.

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(c) The diagram shows a rectangle ABCE. The point D lies on AB. Length AE = 70 cm, length AB = 1.3 m, and angle AED = 28°. Find the perimeter of triangle CDE. Give your answer in centimetres, correct to one decimal place.

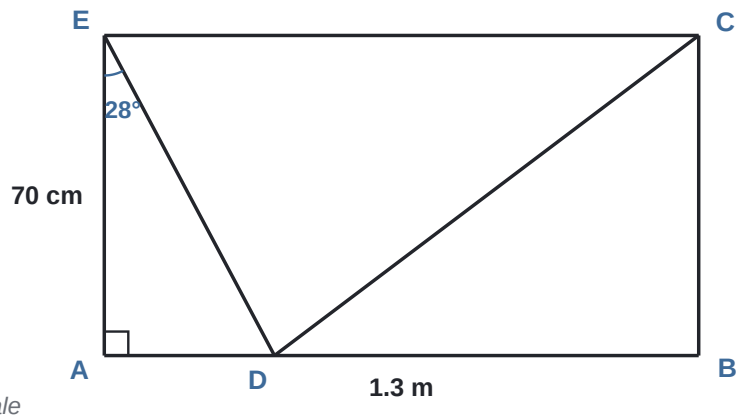


Diagram is NOT to scale

(c) Answer: 325.5 cm

• Evidence level: Merit (relate the triangles in the diagram; work in one unit; choose the correct trigonometric ratio).

• Change to one unit: AB = 1.3 m = 130 cm.

• Triangle AED is right-angled at A. cos 28° = AE/ED, so ED = 70 ÷ cos 28° = 79.28 cm.

• tan 28° = AD/AE, so AD = 70 × tan 28° = 37.22 cm. Then DB = AB − AD = 130 − 37.22 = 92.78 cm.

• Triangle DBC is right-angled at B with BC = AE = 70 cm: $DC^2 = 92.78^2 + 70^2$, so DC = 116.22 cm (Pythagoras).

• EC is the top side of the rectangle, so EC = AB = 130 cm.

• Perimeter = ED + DC + EC = 79.28 + 116.22 + 130.00 = 325.5 cm (1 d.p.).

KEY TAKEAWAY

Trigonometry in a composite diagram: put every length in the same unit, find the missing sides one right-angled triangle at a time, then add.

(d) The relationship between the x and y values in a pattern is shown in the table below. Find an equation that gives y for any value of x. Show working to support your answer.

(d) Answer: y = 2^x + 2

• Evidence level: Merit (spot the multiplying pattern in the differences and build the equation).

• The differences between consecutive y values are 2, 4, 8, 16.

• Each difference is 2 times the one before, so the pattern is exponential with base b = 2: y = a × 2^x + c.

• The first difference is a(2^2 − 2^1) = 2, so a = 1.

• Use the first point: 4 = 1 × 2^1 + c, so c = 2.

• Check on the last point: 1 × 2^5 + 2 = 34 ✓.

• Equation: y = 2^x + 2.

KEY TAKEAWAY

Exponential pattern: if the differences between y values are themselves multiplied by the same number, that number is the base; then solve for the other constants using the table.

(e) The graph of y = 2^x + 2 could be drawn for all values of x. Identify THREE different features of the graph, using the equation.

(e) Answer: y-intercept (0, 3); asymptote y = 2; increasing and curving upwards

• Evidence level: Excellence (link the structure of the equation to features of its graph).

• Feature 1: y-intercept. When x = 0, y = 1 × 1 + 2 = 3, so the graph crosses the y-axis at (0, 3).

• Feature 2: horizontal asymptote. As x becomes very negative, 2^x gets close to 0, so y gets close to 2 and never reaches it: the line y = 2 is an asymptote.

• Feature 3: shape. The base 2 is greater than 1 and a = 1 is positive, so the graph is always increasing and curves upwards (it grows faster as x increases); every y value is greater than 2.

• Other acceptable features: it never crosses the x-axis, because y is always greater than 2.

KEY TAKEAWAY

Read an equation like a graph: the constant added is the asymptote, the value at x = 0 gives the y-intercept, and a base above 1 means growth.

LOS: Algebra, graphs and measurement (91947)

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