3.6 3D Pythagoras and Trigonometry: 30-minute Pack

AQA 8365 · Calculator allowed · about 30 minutes

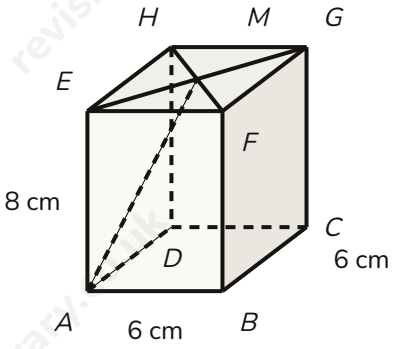
Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A cuboid has a square base ABCD with side length 6 cm and height 8 cm. Points E, F, G, H lie directly above A, B, C, D respectively. M is the centre of the top face EFGH (the point where the diagonals EG and FH cross). AM is the line from base vertex A to M.

Diagram NOT accurately drawn



(a) Find the horizontal distance from A to the point directly below M (the centre of the base ABCD), giving your answer in exact surd form. **(2)**

.....

(b) Hence calculate the length AM, giving your answer correct to 3 significant figures. **(2)**

.....

(c) Calculate the angle that AM makes with the base, giving your answer correct to 1 decimal place. **(2)**

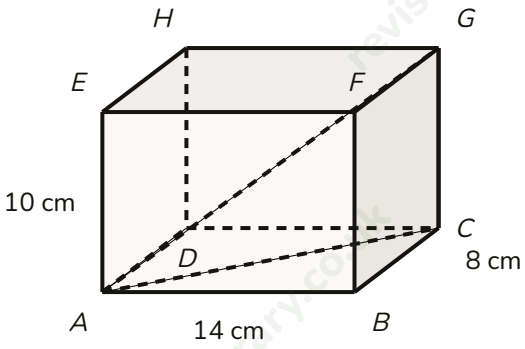
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(Total for Question 1 is 6 marks)

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2 A cuboid ABCDEFGH has AB = 14 cm, BC = 8 cm and AE = 10 cm. Calculate the angle between the diagonal AG and the base ABCD. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

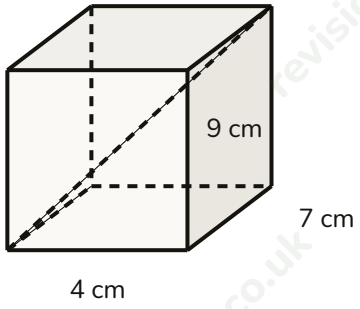


(Total for Question 2 is 3 marks)

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3 A cuboid has length 4 cm and width 7 cm. The length of its space diagonal is 9 cm. Work out the height of the cuboid.

Diagram NOT accurately drawn

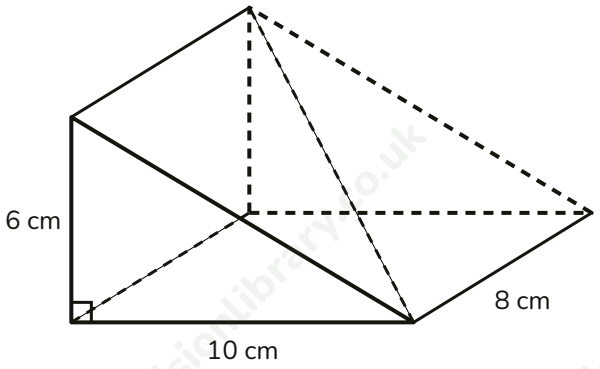


(Total for Question 3 is 3 marks)

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4 A triangular prism has a right-angled triangle as its cross-section, with perpendicular sides 10 cm and 6 cm. The length of the prism is 8 cm. Calculate the length of the longest straight line that can be drawn on or inside the prism, from one corner to the opposite corner. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

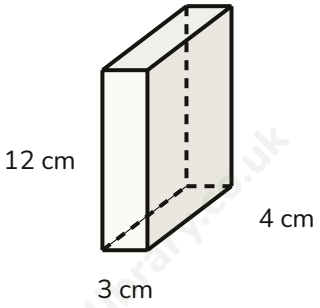


(Total for Question 4 is 3 marks)

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5 A cuboid has length 3 cm, width 4 cm and height 12 cm. Calculate the length of the space diagonal connecting two opposite vertices of the cuboid.

Diagram NOT accurately drawn

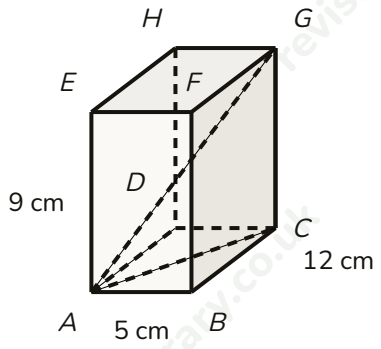


(Total for Question 5 is 3 marks)

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6 A cuboid ABCDEFGH has a rectangular base ABCD with AB = 5 cm and BC = 12 cm. The height of the cuboid, AE, is 9 cm.

Diagram NOT accurately drawn



(a) Find the length of the diagonal AC of the base. **(2)**

.....

(b) Hence find the length of the space diagonal AG, giving your answer correct to 3 significant figures. **(2)**

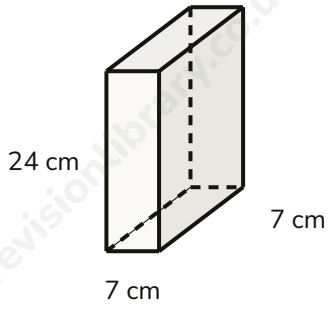
.....

(Total for Question 6 is 4 marks)

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7 A cuboid has a square base of side 7 cm and height 24 cm. State the length of the diagonal of the square base, in exact surd form.

Diagram NOT accurately drawn



(Total for Question 7 is 1 mark)

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8 To find the angle between the space diagonal of a cuboid and its base, which trigonometric ratio directly relates the vertical height, the base diagonal and the angle?

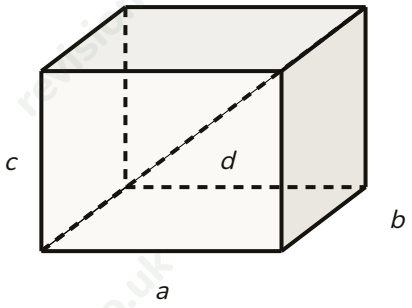
- ☐ A) Sine
- ☐ B) Cosine
- ☐ C) Tangent
- ☐ D) Pythagoras' theorem

(Total for Question 8 is 1 mark)

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9 A cuboid has length a, width b and height c. Show that the length, d, of the space diagonal connecting two opposite vertices is given by $d = \sqrt{a^2 + b^2 + c^2}$.

Diagram NOT accurately drawn



(Total for Question 9 is 3 marks)

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Mark scheme · 3.6 3D Pythagoras and Trigonometry: 30-minute Pack

Question 1

(a) finds the base diagonal AC = $\sqrt{6^2 + 6^2} = 6\sqrt{2}$, then halves it **M1**

(a) $3\sqrt{2}$ cm (exact) cao **A1**

(a) Answer: $3\sqrt{2}$ cm

(b) AM = $\sqrt{(\text{their } 3\sqrt{2})^2 + 8^2}$ **M1**

(b) AM = 9.06 cm (3sf) cao **A1**

(b) Answer: 9.06 cm (3sf)

(c) sets up tan(angle) = 8 / their $3\sqrt{2}$ **M1**

(c) angle = 62.1 degrees (1dp) cao **A1**

(c) Answer: 62.1 degrees (1dp)

Question 2

AC = $\sqrt{14^2 + 8^2} = 16.125$ **M1**

tan (angle GAC) = 10 / AC **M1**

31.8 degrees cao **A1**

Answer: 31.8 degrees

Question 3

$4^2 + 7^2 + h^2 = 9^2$ **M1**

$h^2 = 16$ **M1**

4 cm cao **A1**

Answer: 4 cm

Question 4

hypotenuse of the cross-section = $\sqrt{10^2 + 6^2}$ **M1**

$d^2 = (10^2 + 6^2) + 8^2 = 200$ **M1**

14.1 cm cao **A1**

Answer: 14.1 cm

Question 5

uses d = $\sqrt{\text{length}^2 + \text{width}^2 + \text{height}^2}$ **M1**

substitutes correctly, $\sqrt{3^2 + 4^2 + 12^2} = \sqrt{9 + 16 + 144}$ **M1**

d = 13 cm cao **A1**

Answer: 13 cm

Question 6

(a) AC = $\sqrt{5^2 + 12^2}$ **M1**

(a) AC = 13 cm cao **A1**

(a) Answer: 13 cm

(b) AG = $\sqrt{\text{their AC}^2 + 9^2}$ **M1**

(b) AG = 15.8 cm (3sf) cao **A1**

(b) Answer: 15.8 cm (3sf)

Question 7

$7\sqrt{2}$ cm (exact) cao **B1**

Answer: $7\sqrt{2}$ cm

Question 8

C cao **B1**

Answer: C) Tangent

Question 9

uses Pythagoras' theorem in the rectangular base to find the base diagonal, p = $\sqrt{a^2 + b^2}$ **M1**

uses Pythagoras' theorem in the vertical right-angled triangle formed by the base diagonal p and the height c: d = $\sqrt{p^2 + c^2}$ **M1**

substitutes to obtain d = $\sqrt{a^2 + b^2 + c^2}$, as required **A1**

Answer: d = $\sqrt{a^2 + b^2 + c^2}$ (shown)

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