3D Trigonometry: exam practice

10 questions · 33 marks · worked solutions and markschemes

Name _____ Date _____ Score / 33

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/3d-trigonometry-exam-practice

1. **2 marks · Paper 1 style · calculator allowed**

Calculate the exact distance between the 3D coordinates $A(1, 2, 4)$ and $B(4, -2, 4)$.

2. **3 marks · Paper 1 style · calculator allowed**

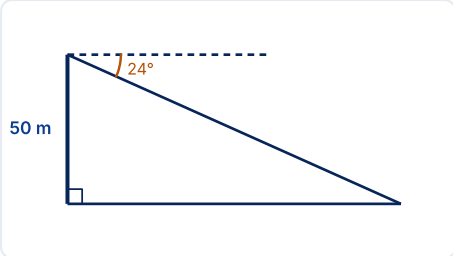
The point $M(5, -2, 7)$ is the midpoint of the line segment joining $A(1, y, 4)$ and $B(x, -6, z)$. Find the values of x, y, and z.

3. **3 marks · Paper 1 style · calculator allowed**

A storage container is in the shape of a rectangular cuboid with floor dimensions 5 m by 12 m and height 4 m. A cable is stretched tightly from one corner of the floor to the opposite corner of the ceiling. Calculate the angle the cable makes with the floor.

4. **3 marks · Paper 1 style · calculator allowed**

From the top of a vertical cliff 50 m high, the angle of depression to a boat at sea is $24°$. Calculate the horizontal distance from the base of the cliff to the boat.



Cliff 50 m; depression 24°

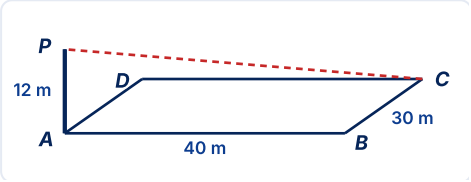
5. **3 marks · Paper 1 style · calculator allowed**

A square-based pyramid has a base of side length 6 cm and a vertical height of 8 cm. Calculate the angle between a sloping triangular face and the square base.

6. **3 marks · Paper 2 style · calculator allowed**

A vertical pole of height 12 m stands at one corner of a horizontal rectangular field that measures 30 m by 40 m.

Find the angle of elevation of the top of the pole from the opposite corner of the field. **[3]**



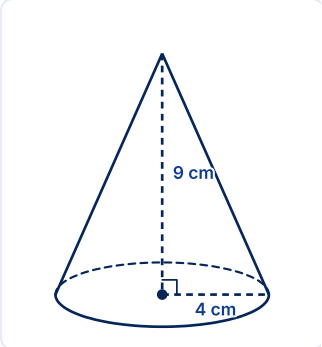
Field 40 m × 30 m, pole 12 m

7. **4 marks · Paper 1 style · calculator allowed**

A right cone has base radius 4 cm and height 9 cm.

(a) Find the slant height. **[2]**

(b) Find the angle between the slant height and the base. **[2]**



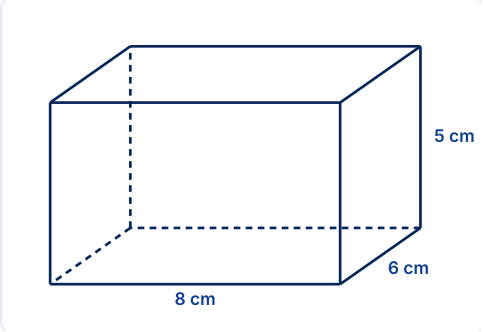
Cone: radius 4 cm, height 9 cm

8. **3 marks · Paper 1 style · calculator allowed**

A cuboid measures 8 cm by 6 cm by 5 cm.

(a) Find the length of the diagonal of the 8 cm by 6 cm base. **[1]**

(b) Find the angle between a space diagonal and the base. **[2]**



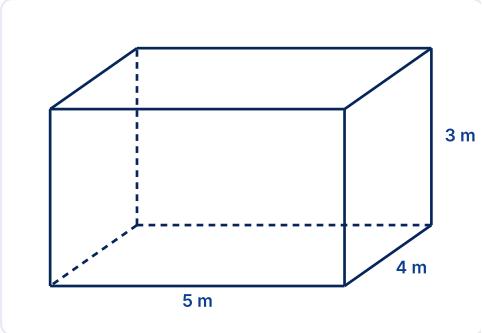
Cuboid 8 cm × 6 cm × 5 cm

9. **4 marks · Paper 1 style · calculator allowed**

A room is a cuboid 5 m long, 4 m wide and 3 m high. A wire runs from a corner on the floor to the opposite corner on the ceiling.

(a) Find the length of the wire. **[2]**

(b) Find the angle between the wire and the floor. **[2]**



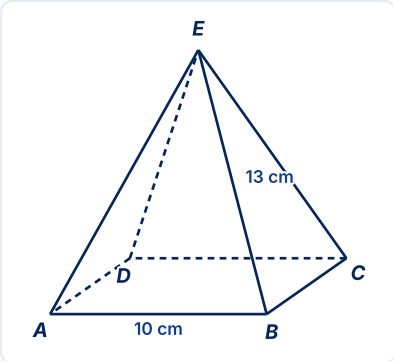
Room 5 m × 4 m × 3 m

10. **5 marks · Paper 2 style · calculator allowed**

A right pyramid has a square base of side 10 cm. Each sloping edge is 13 cm long.

(a) Find the height of the pyramid. **[3]**

(b) Find the angle between a sloping edge and the base. **[2]**



Square base 10 cm, sloping edges 13 cm

Answers and worked solutions

Question 1

2 marks

Answer: 5

Use the 3D distance formula:

$d = \sqrt{(4-1)^2 + (-2-2)^2 + (4-4)^2}$ **M1**

$d = \sqrt{9 + 16 + 0} = \sqrt{25} = 5$ **A1**

Question 2

3 marks

Answer: $(9, 2, 10)$

Set each midpoint coordinate equal to M: $\frac{1+x}{2} = 5$, $\frac{y-6}{2} = -2$, $\frac{4+z}{2} = 7$ **M1**

$x = 10 - 1 = 9$ **A1**

$y = -4 + 6 = 2$ and $z = 14 - 4 = 10$ **A1**

Question 3

3 marks

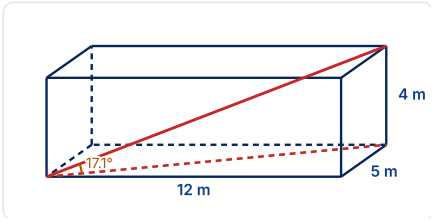
Answer: $17.1°$

Use Pythagoras for the floor diagonal:

$d^2 = 5^2 + 12^2 = 169 \implies d = 13$ m **M1**

The cable, floor diagonal and vertical edge form a right-angled triangle: $\tan\theta = \frac{4}{13}$ **M1**

$\theta = \tan^{-1}\left(\frac{4}{13}\right) = 17.1°$ (3 s.f.) **A1**



Angle with the floor: $17.1°$

Question 4

3 marks

Answer: 112

The angle of elevation from the boat to the cliff top equals the angle of depression (alternate angles): $24°$ **(M1)**

Set up the tangent ratio with horizontal distance d:

$\tan 24° = \frac{50}{d}$ **M1**

$d = \frac{50}{\tan 24°} = 112\ m$ (3 s.f.) **A1**

Question 5

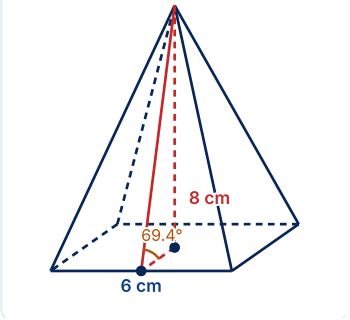
3 marks

Answer: $69.4°$

Use the right-angled triangle from the centre of the base to the midpoint of a base edge: horizontal side $= \frac{6}{2} = 3$ cm, vertical side $= 8$ cm **M1**

Use the tangent ratio: $\tan\theta = \frac{8}{3}$ **M1**

$\theta = \tan^{-1}\left(\frac{8}{3}\right) = 69.4°$ (3 s.f.) **A1**



Use the triangle EOM: tan $= \frac{8}{3}$

Question 6

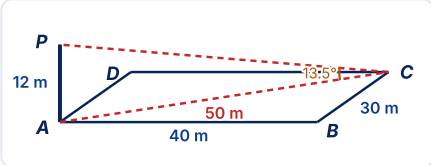
3 marks

Answer: $13.5°$

diagonal $\sqrt{30^2 + 40^2} = 50$ **(A1)**

$\tan\theta = \frac{12}{50}$ **(M1)**

$13.5°$ **A1**



Diagonal 50 m; elevation $13.5°$

Question 7

4 marks

Answer: (a) 9.85 cm; (b) $66.0°$

(a)

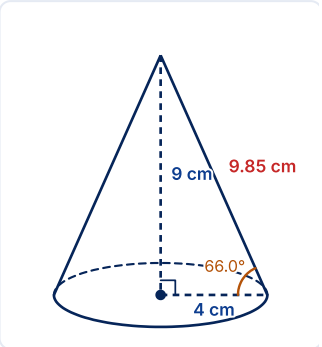
$\sqrt{4^2 + 9^2}$ **(M1)**

9.85 cm **A1**

(b)

$\tan\theta = \frac{9}{4}$ **(M1)**

$66.0°$ **A1**



Slant 9.85 cm at $66.0°$ to the base

Question 8

3 marks

Answer: (a) 10 cm; (b) $26.6°$

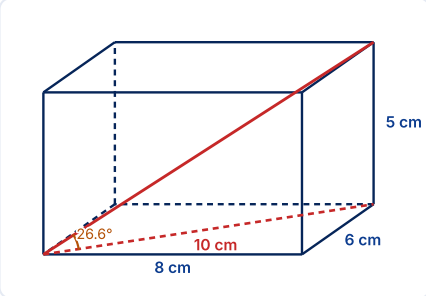
(a)

10 cm **A1**

(b)

$\tan\theta = \frac{5}{10}$ **(M1)**

$26.6°$ **A1**



Base diagonal 10 cm; angle $26.6°$

Question 9

4 marks

Answer: (a) $7.07\ m$; (b) $25.1°$

(a)

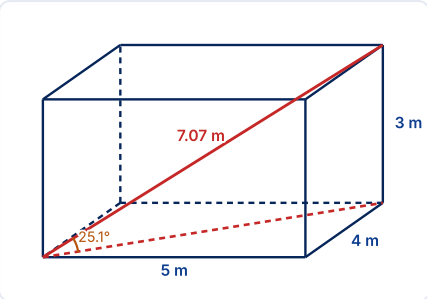
$\sqrt{25+16+9}$ **(M1)**

$7.07\ m$ **A1**

(b)

$\sin\theta = \dfrac{3}{\sqrt{50}}$ **(M1)**

$25.1°$ **A1**



Wire 7.07 m at $25.1°$ to the floor

Question 10

5 marks

Answer: (a) 10.9 cm; (b) $57.0°$

(a)

half-diagonal of base $5\sqrt{2}$ **(A1)**

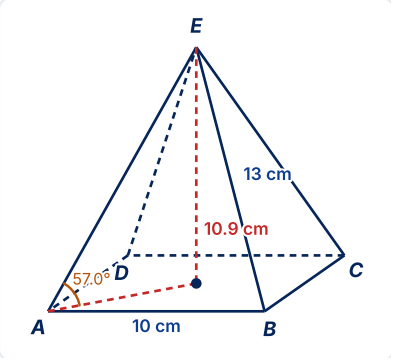
$h^2 = 13^2 - 50$ **(M1)**

$h = 10.9$ cm **A1**

(b)

$\cos\theta = \dfrac{5\sqrt{2}}{13}$ **(M1)**

$57.0°$ **A1**



Height 10.9 cm; edge at $57.0°$ to the base

Every solution is also on ibmathrevision.com/slai/3d-trigonometry-exam-practice
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