



7.15D 3D Pythagoras and Trigonometry: Fluency and Exam Drill

EDEXCEL Edexcel 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** Work out the length of the diagonal of a rectangle with sides 6 cm and 8 cm.

(Total for Question 1 is 1 mark)

- 2** A cuboid measures 3 m by 4 m by 12 m. Work out the length of the space diagonal from one corner to the opposite corner.

(Total for Question 2 is 2 marks)

- 3** A rectangular prism has length 5 m, width 12 m and height 4 m. Find the distance from a top front corner to the opposite bottom back corner. Give your answer to 2 decimal places.

(Total for Question 3 is 2 marks)

- 4** A telegraph pole is 15 m high. A guy wire is attached to the top of the pole and fixed to the ground 20 m from the base of the pole. Work out the angle between the guy wire and the ground. Give your answer to 1 decimal place.

(Total for Question 4 is 2 marks)

- 5 A cuboid has base sides 6 m and 8 m and height 3 m. Find the angle between the space diagonal and the base plane. Give your answer to 1 decimal place.

(Total for Question 5 is 3 marks)

- 6 A rectangular pool is 9 m by 12 m. The depth at one shallow corner is 1.2 m and at the diagonally opposite deep corner is 2.4 m. A straight line runs from the shallow surface corner to the deep bottom corner. Find the length of this line. Give your answer to 2 decimal places.

(Total for Question 6 is 3 marks)

- 7 A warehouse floor is a rectangle 20 m by 15 m. Point A is at one corner on the floor. Point B is on the opposite wall, directly above the midpoint of the far side of the floor, at a height of 6 m above the floor. Find the straight-line distance AB. Give your answer to 2 decimal places.

(Total for Question 7 is 4 marks)

- 8 Using the situation in question 7 (warehouse, A at a corner on the floor, B at the point described), find the angle between AB and the floor. Give your answer to 1 decimal place.

(Total for Question 8 is 4 marks)

- 9** A rectangular block measures 12 cm by 5 cm by 4 cm (length by width by height). Point A is the top corner at (0,0,4). Point B is the midpoint of the opposite bottom edge, which has endpoints (12,0,0) and (12,5,0).

(a) Find the straight-line distance AB, giving your answer to 2 decimal places.

(b) Find the angle between AB and the base plane, to 1 decimal place.

(a) (a) Find AB to 2 decimal places.

(2)

(b) (b) Find the angle between AB and the base plane to 1 decimal place.

(2)

(Total for Question 9 is 4 marks)

- 10** A cuboid has corners with coordinates A(0,0,0), B(8,0,0), D(0,6,0) and E(0,0,7). Find the angle between the line EB and the base plane ABCD. Give your answer to 1 decimal place.

(Total for Question 10 is 5 marks)

11 A rectangular tank inside dimensions are length 10 m, width 6 m and depth 4 m. A pipe runs from the top front-left corner of the tank to the centre of the opposite end face at the bottom. (Take the top front-left corner as point P at coordinates (0,0,4). The centre of the opposite end face is at (10,3,0).)

(a) Find the length of the pipe, giving your answer to 2 decimal places.

(b) Find the angle the pipe makes with the base of the tank, to 1 decimal place.

(a) (a) Find the length of the pipe to 2 decimal places. **(3)**

(b) (b) Find the angle between the pipe and the base to 1 decimal place. **(4)**

(Total for Question 11 is 7 marks)

12 A cuboid measures 9 m by 12 m by 5 m (length by width by height). Consider the space diagonal from the origin O(0,0,0) to the opposite corner P(9,12,5), and the diagonal of the end face from Q(9,0,0) to P(9,12,5).

Find the angle between the space diagonal OP and the face diagonal QP. Give your answer to 1 decimal place.

(Total for Question 12 is 4 marks)

Mark scheme · 7.15D 3D Pythagoras and Trigonometry: Fluency and Exam Drill

Question 1

- **B1** 10 cm cao
- **Answer: 10 cm (cao)**

Question 2

- **M1** use 3D Pythagoras: $\sqrt{3^2 + 4^2 + 12^2}$ or equivalent method
- **A1** 13 m cao
- **Answer: 13 m**

Question 3

- **M1** use 3D Pythagoras: $\sqrt{5^2 + 12^2 + 4^2}$ oe
- **A1** 13.60 m awrt
- **Answer: 13.60 m (awrt)**

Question 4

- **M1** use $\tan(\theta) = \text{opposite/adjacent} = 15/20$ oe
- **A1** 36.9 degrees awrt
- **Answer: 36.9 degrees (awrt)**

Question 5

- **M1** calculate base diagonal = $\sqrt{6^2 + 8^2} = 10$ m
- **M1** use $\tan(\theta) = \text{height} / \text{base diagonal} = 3/10$ oe
- **A1** 16.7 degrees awrt
- **Answer: 16.7 degrees (awrt)**

Question 6

- **M1** horizontal diagonal = $\sqrt{9^2 + 12^2} = 15$ m
- **M1** use 3D Pythagoras: $\sqrt{15^2 + (2.4 - 1.2)^2}$ oe
- **A1** 15.05 m awrt
- **Answer: 15.05 m (awrt)**

Question 7

- **M1** find horizontal distance from A to projection of B: $\sqrt{20^2 + 7.5^2} = \sqrt{456.25}$ oe
- **M1** use Pythagoras with vertical: $\sqrt{456.25 + 6^2}$ oe
- **A1** 22.19 m awrt
- **B1** units stated (m) or clear final value with units
- **Answer: 22.19 m (awrt)**

Question 8

- **M1** use horizontal projection length = $\sqrt{20^2 + 7.5^2}$ (as in Q7) oe
- **M1** use $\tan(\theta) = \text{vertical} / \text{horizontal} = 6 / \sqrt{456.25}$ oe
- **M1** calculate $\theta = \arctan(6 / 21.352...)$ oe
- **A1** 15.7 degrees awrt
- **Answer: 15.7 degrees (awrt)**

Question 9

- (a) **M1** find horizontal projection length = $\sqrt{12^2 + 2.5^2} = \sqrt{150.25}$ oe
- (a) **A1** 12.89 cm awrt
- (a) **Answer: 12.89 cm**
- (b) **M1** use $\tan(\theta) = \text{vertical} / \text{horizontal projection} = 4 / \sqrt{150.25}$ oe
- (b) **A1** 18.1 degrees awrt
- (b) **Answer: 18.1 degrees**

Question 10

- **M1** identify projection of EB on base has length equal to horizontal distance between B and projection of E = distance between (8,0,0) and (0,0,0) = 8
- **M1** use $\tan(\theta) = \text{vertical} / \text{horizontal} = 7 / 8$ oe
- **M1** calculate $\theta = \arctan(7/8)$ oe
- **A1** 41.2 degrees awrt
- **B1** units stated (degrees) or clear final answer with units
- **Answer: 41.2 degrees (awrt)**

Question 11

- (a) **M1** find horizontal projection length = $\sqrt{10^2 + 3^2} = \sqrt{109}$ oe
- (a) **M1** use 3D Pythagoras: length = $\sqrt{109 + 4^2} = \sqrt{125}$ oe
- (a) **A1** 11.18 m awrt
- (a) **Answer: 11.18 m**
- (b) **M1** use $\tan(\theta) = \text{vertical} / \text{horizontal} = 4 / \sqrt{109}$ oe
- (b) **M1** substitute horizontal = $\sqrt{109}$ and calculate $\tan(\theta)$ value oe
- (b) **M1** calculate $\theta = \arctan(4 / 10.4403\dots)$ oe
- (b) **A1** 21.0 degrees awrt
- (b) **Answer: 21.0 degrees**

Question 12

- **M1** form vectors $OP = (9,12,5)$ and $QP = (0,12,5)$ and compute dot product = $9*0 + 12*12 + 5*5 = 169$
- **M1** find magnitudes $|OP| = \sqrt{9^2+12^2+5^2} = \sqrt{250}$, $|QP| = 13$
- **M1** use $\cos(\theta) = \text{dot} / (|OP||QP|)$ and calculate $\theta = \arccos(169 / (\sqrt{250} * 13))$
- **A1** 34.7 degrees awrt
- **Answer: 34.7 degrees (awrt)**