

Vectors in three dimensions

A-level Pure Mathematics (Year 2) | Edexcel 9MA0 | 12 questions, 64 marks

A-level Maths topic practice



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Name: _____ Date: _____ Score: _____ / 64

1 The vector $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$

- Find $|\mathbf{a}|$
- Find a unit vector in the direction of $\mathbf{a}$
- Find the angle that $\mathbf{a}$ makes with the positive x -axis, giving your answer in degrees to 1 decimal place.

(4 marks)

Answer _____

2 Relative to a fixed origin O , the point A has coordinates $(3, -1, 4)$ and the point B has coordinates $(-1, 2, 16)$.

- Find $\vec{AB}$ in the form $p\mathbf{i} + q\mathbf{j} + r\mathbf{k}$
- Find the distance AB .
- Find the coordinates of the midpoint of AB .

(3 marks)

Answer _____

3 The vectors $\mathbf{p} = 3\mathbf{i} + a\mathbf{j} - 6\mathbf{k}$ and $\mathbf{q} = b\mathbf{i} - 4\mathbf{j} + 8\mathbf{k}$, where a and b are constants, are parallel. Find the value of a and the value of b .

(3 marks)

Answer _____

- 4 Relative to a fixed origin O , the point A has position vector $4\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ and the point B has position vector $p\mathbf{i} + 3\mathbf{j} - \mathbf{k}$, where p is a positive constant.

Given that $|\vec{AB}| = 7$, find the exact value of p .

(4 marks)

Answer _____

- 5 Relative to a fixed origin O , the points A , B and C have coordinates $(1, 2, -3)$, $(4, 0, 1)$ and $(10, -4, 9)$ respectively.

- Show that A , B and C are collinear.
- Find the ratio $AB : BC$

(4 marks)

Answer _____

- 6 The triangle ABC has

$$\vec{AB} = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k} \quad \text{and} \quad \vec{BC} = 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$$

- Find $\vec{AC}$
- Show that angle ABC is a right angle.
- Find the area of triangle ABC .

(5 marks)

Answer _____

7

Relative to a fixed origin O , the points P , Q and R have position vectors

$$\mathbf{p} = \mathbf{i} + 2\mathbf{k}, \quad \mathbf{q} = 3\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}, \quad \mathbf{r} = 5\mathbf{j} + \mathbf{k}$$

- Find the size of angle QPR , giving your answer in degrees to 1 decimal place.
- Find the area of triangle PQR , giving your answer to 3 significant figures.

(6 marks)

Answer _____

8

Relative to a fixed origin O , the point A has position vector $2\mathbf{i} - \mathbf{j} + 5\mathbf{k}$ and the point B has position vector $8\mathbf{i} + 5\mathbf{j} - 4\mathbf{k}$

The straight line l passes through A and B .

- Find $\vec{AB}$
- Given that the point P lies on l such that $|\vec{AP}| = 2|\vec{BP}|$, find the two possible position vectors of P .

(5 marks)

Answer _____

9

Relative to a fixed origin O ,

- the point A has position vector $2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$
- the point B has position vector $7\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}$
- the point C has position vector $3\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$

a. Find $\vec{AB}$ and $\vec{CB}$

b. Show that the quadrilateral $OABC$ is a trapezium, giving reasons for your answer.

c. Find the ratio $OA : CB$

(5 marks)

Answer _____

10

Relative to a fixed origin O , the points A , B and C have coordinates $(2, 4, -1)$, $(5, 3, 4)$ and $(3, -1, 5)$ respectively.

a. Show that $OABC$ is a parallelogram.

b. Find the size of angle AOC , giving your answer in degrees to 1 decimal place.

c. Find the area of the parallelogram $OABC$, giving your answer to 3 significant figures.

(8 marks)

Answer _____

11

An adventure park builds a zip wire. Relative to a fixed origin O at the base of the starting tower, the unit vectors $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ point east, north and vertically upwards, and distances are in metres.

The wire is modelled as a straight line from the top of the tower, T , with position vector $12\mathbf{k}$, to the landing point L , with position vector $40\mathbf{i} + 30\mathbf{j} + 2\mathbf{k}$

- Find the length of the wire.
- Find the angle the wire makes with the horizontal, giving your answer in degrees to 1 decimal place.
- A rider is three quarters of the way along the wire from T to L . Find the height of the rider above the ground, which is horizontal.
- Give one reason why the model of the wire as a straight line may not be realistic.

(8 marks)

Answer

12

Relative to a fixed origin O , the points A , B and C have coordinates $(2, 0, 1)$, $(4, 3, -1)$ and $(a, 5, a)$ respectively, where a is a constant.

Given that $|\vec{AB}| = |\vec{BC}|$,

- show that $a^2 - 3a + 2 = 0$ and hence find the two possible values of a .
- For the smaller value of a , find the coordinates of the point D such that $ABCD$ is a parallelogram, and explain why $ABCD$ is a rhombus.
- For the smaller value of a , find the size of angle ABC , giving your answer in degrees to 1 decimal place.

(9 marks)

Answer

End of questions | Total 64 marks