Test - Vectors in three dimensions

Year: Year 13 · Duration: 40 minutes · /20

Name:	Date:	**Mark: /20**

Question	1	2	3	4	5	Total
marks	4	4	4	4	4	**20**
Mark						

Show your working.

Question 1 (4 marks)

Question 1 – Working with vectors

$\mathbf{a} = 3\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$ and $\mathbf{b} = -\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$.

a. Find $\mathbf{a} + \mathbf{b}$. [1 mark]
b. Find $3\mathbf{a} - 2\mathbf{b}$. [2 marks]
c. Find $|\mathbf{a}|$. [1 mark]

Question 2 (4 marks)

Question 2 – A triangle in three dimensions

The points $A(2, 1, 3)$, $B(5, 5, 15)$ and $C(2, 1, 8)$ are given.

a. Find $\overrightarrow{AB}$ and show that $AB = 13$. [2 marks]

b. Show that $AC = 5$ and find BC. [1 mark]
c. Find angle BAC. [1 mark]

Question 3 (4 marks)

Question 3 – Collinear points

$A(1, 2, 3)$, $B(3, p, 7)$ and $C(7, 11, 15)$ are three points that lie on a straight line.

a. Find $\overrightarrow{AB}$ and use it to find the value of p. [2 marks]

b. Find the ratio $AB : BC$. [2 marks]

Question 4 (4 marks)

Question 4 – A particle in motion

A particle moves so that its position vector at time t seconds is $\mathbf{r} = (1 + 3t)\mathbf{i} + (2 - 2t)\mathbf{j} + (4 + 6t)\mathbf{k}$ metres.

a. Find the velocity and the speed of the particle. [2 marks]
b. Find the position and the distance from the origin when $t = 5$. [2 marks]

Question 5 (4 marks)

Question 5 – Forces in equilibrium

Three forces $\mathbf{F}_1 = (2\mathbf{i} - 3\mathbf{j} + 5\mathbf{k})$ N, $\mathbf{F}_2 = (-6\mathbf{i} + \mathbf{j} + \mathbf{k})$ N and $\mathbf{F}_3$ act on a particle of mass 2 kg and the particle is in equilibrium.

a. Find $\mathbf{F}_3$ and its magnitude. [2 marks]
b. $\mathbf{F}_3$ is removed. Find the acceleration vector and its magnitude. [2 marks]