



2018 Year 11 math topic test: Vectors in two dimensions © itute 2018

Q1 Particle P starts from point A. It moves 12 m east and then 5 m north to point B. Particle Q also starts from point A. It moves 5 m in the direction S 30° W to point C.

- a. Find the distance travelled by Particle P from A to B. 1 mark

- b. Find the displacement of Particle P travelling from A to B. 3 marks

- c. How far to the south is C from A? 1 mark

- d. How far to the west is C from A? 1 mark

- e. Find the position of Particle Q from Particle P at the end of their journeys. 3 marks

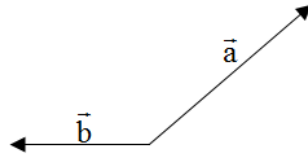
Q2 A particle is projected to the east at an angle of 60° to the horizontal ground. The initial speed of projection is 12 m s⁻¹. Let \vec{i} and \vec{j} be unit vectors in the easterly and vertically upward directions respectively.

- a. Find the initial **horizontal** speed of the particle. 1 mark

- b. Find the initial **velocity** of projection of the particle in terms of \vec{i} and \vec{j} . 2 marks



Q3 Vectors \vec{a} and \vec{b} are shown on the diagram below. On the same diagram draw vector $(\vec{a} - 2\vec{b})$.
2 marks



Q4 Consider $\vec{c} = 2p\vec{i} - 6\vec{j}$ and $\vec{d} = 2\vec{i} + (1 - q)\vec{j}$ where $p, q \in R$.

a. If $\vec{c} = 2\vec{d}$, find the values of p and q .
2 marks

b. Use the values found in part a to find vector $(\vec{c} + 2\vec{d})$.
2 marks

c. If \vec{c} is perpendicular to \vec{d} , find the value of $2p + 3q$.
2 marks

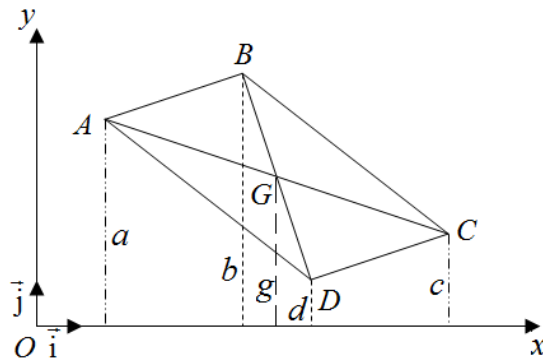
Q5 \vec{i} and \vec{j} be two perpendicular unit vectors. Let $\vec{u} = 2\vec{i}$ and $\vec{v} = 3\vec{j}$.

a. If they are joined tail to tail, find a **unit** vector which bisects the angle between them.
3 marks

b. Find the exact angle (in degrees) that vector $\frac{\vec{u}}{2} + \frac{\vec{v}}{\sqrt{3}}$ makes with \vec{v} .
3 marks



Q6 $ABCD$ is a parallelogram. The two diagonals AC and BD intersect at G .
 a, b, c, d and g are respectively the heights of points A, B, C, D and G above the x -axis.
 \vec{i} and \vec{j} are unit vectors as shown.



Use vectors to show the following ideas in geometry.

a. AC and BD bisect each other at G .

Hint: Let M and N be the midpoints of AC and BD respectively. Show that M and N are the same point.

5 marks

b. $c - d = b - a$.

5 marks

Q7 a, b and c are the side lengths of a triangle.

The measure of the angle opposite to the side of length a is α .

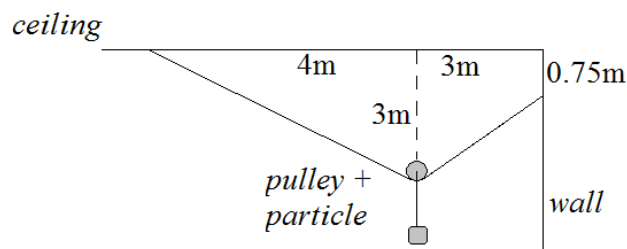
Use vectors to show that $\cos \alpha = \frac{b^2 + c^2 - a^2}{2bc}$.

4 marks

Q8 The angle between vectors $a\vec{i} + b\vec{j}$ and $c\vec{i} + d\vec{j}$ is 45° , where a , b , c and d are real numbers. Show that $(ac + bd)^2 = (bc - ad)^2$.

5 marks

Q9 A pulley with a particle attached exerts a downward force of 10 N on a cord. One end of the cord is fastened to the ceiling and the other end to a wall. The pulley comes to rest on the cord as shown in the diagram below.



a. Draw accurately a triangle of forces showing the addition of the 10 N force and the two forces exerted by the cord on the pulley.

2 marks

b. Use similarity to determine the tension in the cord.

3 marks