Pure Year 1 Chapter 11: Vectors – Exam Questions (Total Marks 56)

1. A particle P is moving with constant velocity $(-3\mathbf{i} + 2\mathbf{j})\text{ms}^{-1}$. At time $t = 6$ s P is at the point with position vector $(-4\mathbf{i} - 7\mathbf{j})$m. Find the distance of P from the origin at time $t = 2$ s.

(Total 5 marks)

2. A particle P moves with constant acceleration $(2\mathbf{i} - 5\mathbf{j})$ m s^{-2}. At time $t = 0$, P has speed u m s^{-1}. At time $t = 3$ s, P has velocity $(-6\mathbf{i} + \mathbf{j})$ m s^{-1}.

Using $v = u + at$ find the value of u.

(Total 5 marks)

3. A particle P of mass 0.4 kg moves under the action of a single constant force **F** newtons. The acceleration of P is $(6\mathbf{i} + 8\mathbf{j})$ m s^{-2}. Find

(a) the angle between the acceleration vector and **i**,

(2)

(b) the magnitude of **F**.

(3)

Given that when $t = 0$ the velocity of P is $9\mathbf{i} - 10\mathbf{j}$,

(c) find the velocity of P when $t = 5$.

(3)

(Total 8 marks)

4. A particle is acted upon by two forces $\mathbf{F}_1$ and $\mathbf{F}_2$, given by

$\mathbf{F}_1 = (1\mathbf{i} - 3\mathbf{j})$ N,

$\mathbf{F}_2 = (p\mathbf{i} + 2p\mathbf{j})$ N, where p is a positive constant.

(a) Find the angle between $\mathbf{F}_2$ and $\mathbf{j}$.

(2)

The resultant force $\mathbf{R}$ acting on the particle is given by $\mathbf{R} = \mathbf{F}_1 + \mathbf{F}_2$. Given that $\mathbf{R}$ is parallel to $\mathbf{i}$,

(b) find the value of p.

(4)

(Total 6 marks)

5. Two forces, $\mathbf{F}_2$ $(4\mathbf{i} - 5\mathbf{j})$ N and $\mathbf{F}_2$ $(p\mathbf{i} + q\mathbf{j})$ N, act on a particle P of mass m kg. The resultant of the two forces is $\mathbf{R} = \mathbf{F}_1 + \mathbf{F}_2$. Given that $\mathbf{R}$ is parallel to the vector $(1\mathbf{i} - 2\mathbf{j})$,

(a) find the angle between $\mathbf{R}$ and the vector $\mathbf{j}$,

(3)

(b) show that $2p + q + 3 = 0$.

(4)

Given also that $q = 1$ and that P moves with an acceleration of magnitude $8\sqrt{5}$ m s^{-2},

(c) find the value of m.

(7)

(Total 14 marks)

6. *[In this question,* **i** *and* **j** *are horizontal unit vectors due east and due north respectively and position vectors are given with respect to a fixed origin.]*

A ship S is moving along a straight line with constant velocity.
When $t = 0$ the position vector of s = $9\mathbf{i} - 6\mathbf{j}$.
When $t = 4$, the position vector of s = $21\mathbf{i} + 10\mathbf{j}$.

Find

(a) the speed of S,

(4)

(b) the direction in which S is moving, giving your answer as a bearing.

(2)

(c) Show that s = $(3t + 9)\,\mathbf{i} + (4t - 6)\,\mathbf{j}$.

(2)

A lighthouse L is located at the point with position vector $(18\mathbf{i} + 6\mathbf{j})$ km.

(d) When $t = 4$, find the distance the ship S is from L.

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(4)
(Total 12 marks)

7. [*In this question the unit vectors* **i** *and* **j** *are due east and north respectively.*]

A ship S is moving with constant velocity $(-2.5\mathbf{i} + 6\mathbf{j})$ km h^{-1}.
At time 1200, the position vector of S is $(16\mathbf{i} + 5\mathbf{j})$ km. Find

(a) the speed of S,

(2)

(b) the bearing on which S is moving.

(2)

The ship is heading directly towards a submerged rock R. A radar tracking station calculates that, if S continues on the same course with the same speed, it will hit R at the time 1500.

(c) Find the position vector of R.

(2)

(Total 6 marks)