

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
A level Mathematics Practice Paper Mechanics – Vectors in mechanics	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 6 questions in this question paper. The total mark for this paper is 66.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. [In this question $\mathbf{i}$ and $\mathbf{j}$ are horizontal unit vectors due east and due north respectively and position vectors are given relative to a fixed origin O .]

Two cars P and Q are moving on straight horizontal roads with constant velocities. The velocity of P is $(15\mathbf{i} + 20\mathbf{j}) \text{ m s}^{-1}$ and the velocity of Q is $(20\mathbf{i} - 5\mathbf{j}) \text{ m s}^{-1}$

- (a) Find the direction of motion of Q , giving your answer as a bearing to the nearest degree. (3)

At time $t = 0$, the position vector of P is $400\mathbf{i}$ metres and the position vector of Q is $800\mathbf{j}$ metres. At time t seconds, the position vectors of P and Q are $\mathbf{p}$ metres and $\mathbf{q}$ metres respectively.

- (b) Find an expression for

(i) $\mathbf{p}$ in terms of t ,

(ii) $\mathbf{q}$ in terms of t . (3)

- (c) Find the position vector of Q when Q is due west of P . (4)

(Total 10 marks)

2. Two forces $(4\mathbf{i} - 2\mathbf{j}) \text{ N}$ and $(2\mathbf{i} + q\mathbf{j}) \text{ N}$ act on a particle P of mass 1.5 kg . The resultant of these two forces is parallel to the vector $(2\mathbf{i} + \mathbf{j})$.

- (a) Find the value of q . (4)

At time $t = 0$, P is moving with velocity $(-2\mathbf{i} + 4\mathbf{j}) \text{ m s}^{-1}$.

- (b) Find the speed of P at time $t = 2$ seconds. (6)

(Total 10 marks)

3. A particle P of mass 0.5 kg is moving under the action of a single force $(3\mathbf{i} - 2\mathbf{j}) \text{ N}$.

(a) Show that the magnitude of the acceleration of P is $2\sqrt{13} \text{ m s}^{-2}$. (4)

At time $t = 0$, the velocity of P is $(\mathbf{i} + 3\mathbf{j}) \text{ m s}^{-1}$.

(b) Find the velocity of P at time $t = 2$ seconds. (3)

Another particle Q moves with constant velocity $\mathbf{v} = (2\mathbf{i} - \mathbf{j}) \text{ m s}^{-1}$.

(c) Find the distance moved by Q in 2 seconds. (2)

(d) Show that at time $t = 3.5$ seconds both particles are moving in the same direction. (3)

(Total 12 marks)

4.

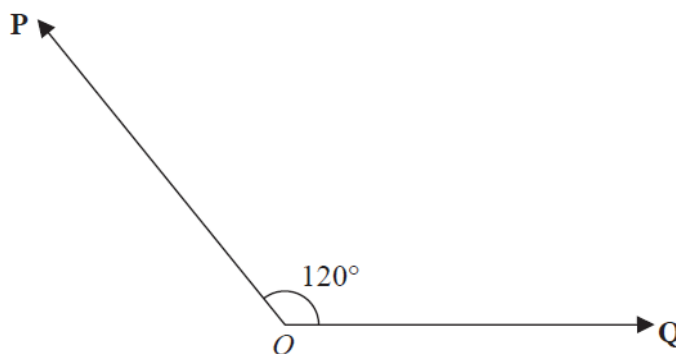


Figure 4

Two forces $\mathbf{P}$ and $\mathbf{Q}$ act on a particle at O . The angle between the lines of action of $\mathbf{P}$ and $\mathbf{Q}$ is 120° as shown in Figure 4. The force $\mathbf{P}$ has magnitude 20 N and the force $\mathbf{Q}$ has magnitude X newtons. The resultant of $\mathbf{P}$ and $\mathbf{Q}$ is the force $\mathbf{R}$.

Given that the magnitude of $\mathbf{R}$ is $3X$ newtons, find, giving your answers to 3 significant figures,

(a) the value of X , (5)

(b) the magnitude of $(\mathbf{P} - \mathbf{Q})$. (4)

(Total 9 marks)

5. Two forces $\mathbf{F}_1$ and $\mathbf{F}_2$ act on a particle P .

The force $\mathbf{F}_1$ is given by $\mathbf{F}_1 = (-\mathbf{i} + 2\mathbf{j})$ N and $\mathbf{F}_2$ acts in the direction of the vector $(\mathbf{i} + \mathbf{j})$.

Given that the resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$ acts in the direction of the vector $(\mathbf{i} + 3\mathbf{j})$,

- (a) find $\mathbf{F}_2$.

(7)

The acceleration of P is $(3\mathbf{i} + 9\mathbf{j}) \text{ m s}^{-2}$. At time $t = 0$, the velocity of P is $(3\mathbf{i} - 22\mathbf{j}) \text{ m s}^{-1}$.

- (b) Find the speed of P when $t = 3$ seconds.

(4)

(Total 11 marks)

6. [In this question $\mathbf{i}$ and $\mathbf{j}$ are horizontal unit vectors due east and due north respectively and position vectors are given relative to a fixed origin O .]

Two ships, P and Q , are moving with constant velocities.

The velocity of P is $(9\mathbf{i} - 2\mathbf{j}) \text{ km h}^{-1}$ and the velocity of Q is $(4\mathbf{i} + 8\mathbf{j}) \text{ km h}^{-1}$

- (a) Find the direction of motion of P , giving your answer as a bearing to the nearest degree.

(3)

When $t = 0$, the position vector of P is $(9\mathbf{i} + 10\mathbf{j}) \text{ km}$ and the position vector of Q is $(\mathbf{i} + 4\mathbf{j}) \text{ km}$. At time t hours, the position vectors of P and Q are $\mathbf{p}$ km and $\mathbf{q}$ km respectively.

- (b) Find an expression for

(i) $\mathbf{p}$ in terms of t ,

(ii) $\mathbf{q}$ in terms of t .

(3)

- (c) Hence show that, at time t hours,

$$\vec{QP} = (8 + 5t)\mathbf{i} + (6 - 10t)\mathbf{j}$$

(2)

- (d) Find the values of t when the ships are 10 km apart.

(6)

(Total 14 marks)

TOTAL FOR PAPER: 66 MARKS