

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

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Candidate Number

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Time 1 hour 30 minutes

Paper
reference

9FM0/3C

Further Mathematics

Advanced

PAPER 3C: Further Mechanics 1

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

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** 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.
- Unless otherwise indicated, whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

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.
- Good luck with your examination.

Turn over ►

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1. A van of mass 900 kg is moving along a straight horizontal road.

At the instant when the speed of the van is $v \text{ m s}^{-1}$, the resistance to the motion of the van is modelled as a force of magnitude $(500 + 7v) \text{ N}$.

When the engine of the van is working at a constant rate of 18 kW, the van is moving along the road at a constant speed $V \text{ m s}^{-1}$

- (a) Find the value of V .

(5)

Later on, the van is moving up a straight road that is inclined to the horizontal at an angle θ , where $\sin \theta = \frac{1}{21}$

At the instant when the speed of the van is $v \text{ m s}^{-1}$, the resistance to the motion of the van from non-gravitational forces is modelled as a force of magnitude $(500 + 7v) \text{ N}$.

The engine of the van is again working at a constant rate of 18 kW.

- (b) Find the acceleration of the van at the instant when $v = 15$

(4)



4. A particle P has mass 0.5 kg . It is moving in the xy plane with velocity $8\mathbf{i} \text{ m s}^{-1}$ when it receives an impulse $\lambda(-\mathbf{i} + \mathbf{j}) \text{ N s}$, where λ is a positive constant.

The angle between the direction of motion of P immediately before receiving the impulse and the direction of motion of P immediately after receiving the impulse is θ°

Immediately after receiving the impulse, P is moving with speed $4\sqrt{10} \text{ m s}^{-1}$

Find (i) the value of λ

(ii) the value of θ

(8)



5.

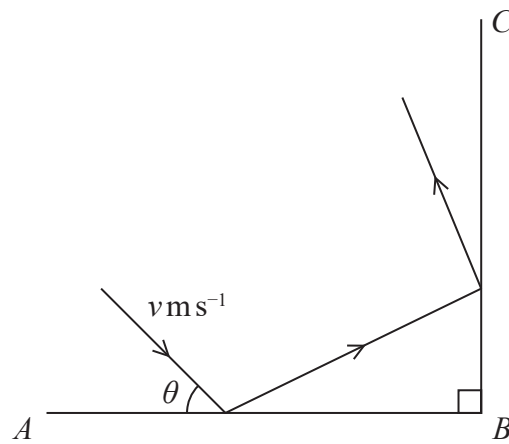


Figure 1

Figure 1 represents the plan view of part of a horizontal floor, where AB and BC represent fixed vertical walls, with AB perpendicular to BC .

A small ball is projected along the floor towards the wall AB . Immediately before hitting the wall AB the ball is moving with speed $v \text{ m s}^{-1}$ at an angle θ to AB .

The ball hits the wall AB and then hits the wall BC .

The coefficient of restitution between the ball and the wall AB is $\frac{1}{3}$

The coefficient of restitution between the ball and the wall BC is e .

The floor and the walls are modelled as being smooth.

The ball is modelled as a particle.

The ball loses half of its kinetic energy in the impact with the wall AB .

(a) Find the exact value of $\cos \theta$. (5)

The ball loses half of its remaining kinetic energy in the impact with the wall BC .

(b) Find the exact value of e . (5)

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7. [In this question, \mathbf{i} and \mathbf{j} are perpendicular unit vectors in a horizontal plane.]

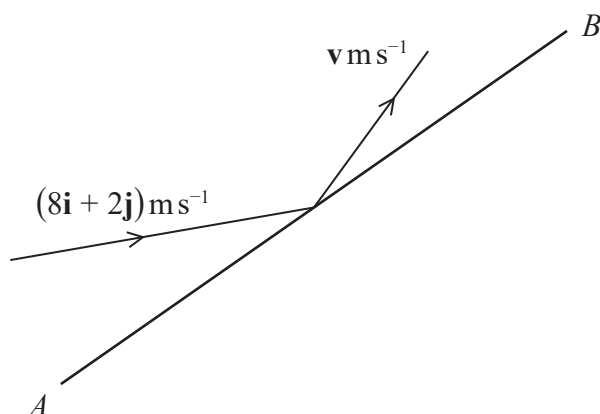


Figure 3

Figure 3 represents the plan view of part of a smooth horizontal floor, where AB is a fixed smooth vertical wall.

The direction of \overrightarrow{AB} is in the direction of the vector $(\mathbf{i} + \mathbf{j})$

A small ball of mass 0.25 kg is moving on the floor when it strikes the wall AB .

Immediately before its impact with the wall AB , the velocity of the ball is $(8\mathbf{i} + 2\mathbf{j}) \text{ ms}^{-1}$

Immediately after its impact with the wall AB , the velocity of the ball is $\mathbf{v} \text{ ms}^{-1}$

The coefficient of restitution between the ball and the wall is $\frac{1}{3}$

By modelling the ball as a particle,

(a) show that $\mathbf{v} = 4\mathbf{i} + 6\mathbf{j}$ (6)

(b) Find the magnitude of the impulse received by the ball in the impact. (3)



