Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Mock Paper Set 3

Paper Reference **9MA0/32**

Mathematics

Advanced

Paper 32: Mechanics

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed 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 value of g is required, take $g = 9.8\,\text{m}\,\text{s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 50. There are 5 questions.
- 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.

Turn over ▶

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Pearson

1. Two cyclists, A and B, are cycling along the same straight horizontal track.

The cyclists are modelled as particles and the motion of the cyclists is modelled as follows:

- At time $t = 0$, cyclist A passes through the point O with speed $2\,\text{m s}^{-1}$
- Cyclist A is moving in a straight line with constant acceleration $2\,\text{m s}^{-2}$
- At time $t = 2$ seconds, cyclist B starts from rest at O
- Cyclist B moves with constant acceleration $6\,\text{m s}^{-2}$ along the same straight line and in the same direction as cyclist A
- At time $t = T$ seconds, B overtakes A at the point X

Using the model,

(a) sketch, on the **same** axes, for the interval from $t = 0$ to $t = T$ seconds,

- a velocity-time graph for the motion of A
- a velocity-time graph for the motion of B

(2)

(b) explain why the two graphs must cross before time $t = T$ seconds,

(1)

(c) find the time when A and B are moving at the same speed,

(2)

(d) find the distance OX

(5)

Question 1 continued

Question 1 continued

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Question 1 continued

(Total for Question 1 is 10 marks)

2. [*In this question* **i** *and* **j** *are horizontal unit vectors*.]

A particle P of mass 0.5 kg is moving on a smooth horizontal plane.

The origin O is on the plane.

At time $t = 0$, P passes through O moving with velocity $(\mathbf{i} - \mathbf{j})\,\text{m s}^{-1}$

At time t seconds, the resultant horizontal force acting on P is

$$[(3t - 1)\mathbf{i} + 2\mathbf{j}]\,\text{N}$$

(a) Find the velocity of P at $t = 2$

(5)

(b) Find the distance of P from O at $t = 2$

(4)

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Question 2 continued

(Total for Question 2 is 9 marks)

3.

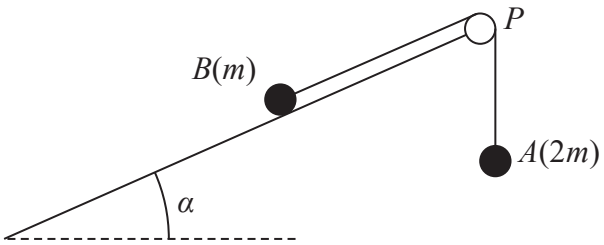

Figure 1

A fixed rough plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{4}{3}$

A small smooth light pulley P is fixed at the top of the plane.

A particle A of mass $2m$ and a particle B of mass m are connected by a rope.

The rope passes over the pulley P

The part of the rope from B to P is parallel to a line of greatest slope of the plane.

Particle B is held at rest on the rough plane and A hangs freely with the rope taut, as shown in Figure 1.

Particle B is released from rest and begins to move up the plane.

(a) Find, in terms of mg, the magnitude of the normal reaction that the plane exerts on B.

(2)

The rope is modelled as being light and inextensible.

As B moves up the plane, the tension in the rope has magnitude $\frac{7mg}{5}$

The coefficient of friction between B and the plane is μ.

Using the model,

(b) (i) write down an equation of motion for A,

(ii) hence, find in terms of g, the magnitude of the acceleration of A,

(3)

(c) find the value of μ.

(5)

In reality, the rope would not be light.

(d) State how this would affect the tension in the rope.

(1)

Question 3 continued

Question 3 continued

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Question 3 continued

(Total for Question 3 is 11 marks)

4. [*In this question the unit vectors* **i** *and* **j** *are directed horizontally and vertically upwards respectively.*]

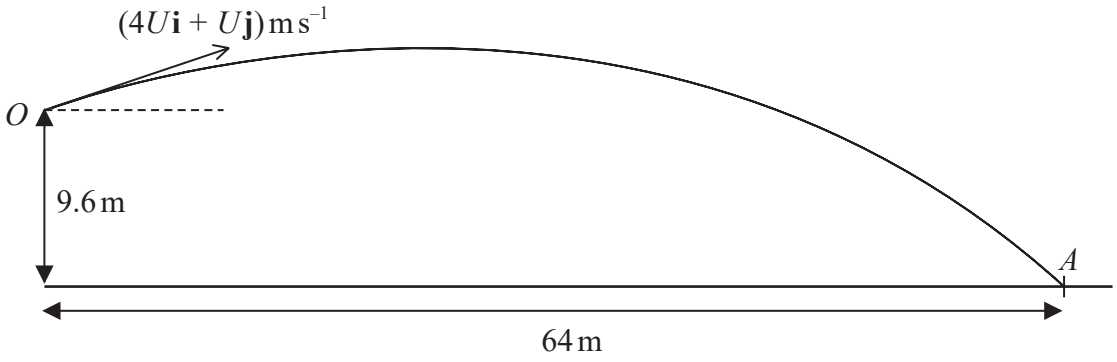

Figure 2

The point O is 9.6 m above horizontal ground.

A small ball is projected with velocity $(4U\mathbf{i} + U\mathbf{j})\,\mathrm{m\,s^{-1}}$, where U is a positive constant, from the point O

The ball first hits the ground T seconds later, at the point A

The point A is at a horizontal distance of 64 m from O, as shown in Figure 2.

In an initial model

- the ball is modelled as a particle moving under gravity
- air resistance is ignored
- the ball has an initial speed of $V\,\mathrm{m\,s^{-1}}$

Using this model,

(a) show that $UT = 16$

(2)

(b) find the value of V

(6)

(c) State two improvements to the model, other than including air resistance, that would make the model more realistic.

(2)

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Question 4 continued

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Question 4 continued

(Total for Question 4 is 10 marks)

5.

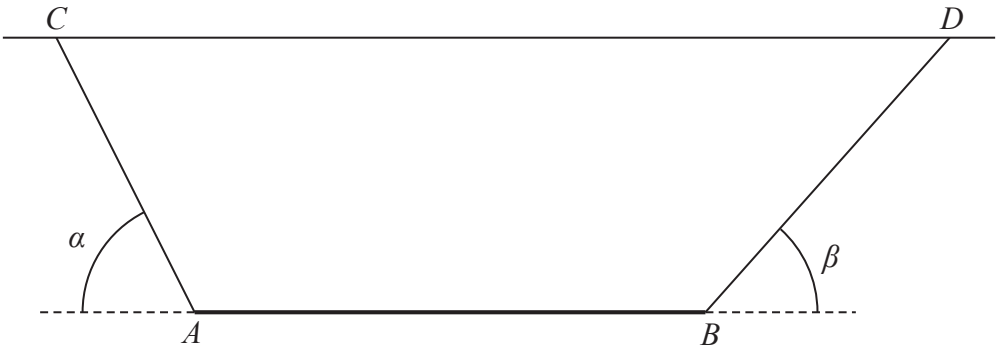

Figure 3

A non-uniform rod AB is held in equilibrium in a horizontal position by two light inextensible strings.

The first string has one end attached to the end A of the rod and the other end attached to a point C on a horizontal ceiling.

The second string has one end attached to the end B of the rod and the other end attached to a point D on the horizontal ceiling, as shown in Figure 3.

The points A, B, C and D all lie in the same vertical plane.

Given that

- the rod AB has weight W and length a
- the centre of mass of the rod is a distance $\frac{1}{3}a$ from A
- the string AC makes an angle α with the horizontal, where $\tan\alpha = \frac{4}{3}$
- the string BD makes an angle β with the horizontal

(a) show that the tension in the string AC is $\frac{5}{6}W$

(3)

The tension in the string BD is S

(b) Show that $S\sin\beta = \frac{1}{3}W$

(2)

(c) Find S in terms of W

(5)

Question 5 continued

Question 5 continued

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Question 5 continued

Question 5 continued

(Total for Question 5 is 10 marks)

TOTAL FOR MECHANICS IS 50 MARKS

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