Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Thursday 08 October 2020

Afternoon	Paper Reference **8FM0/25**

Further Mathematics

Advanced Subsidiary
Further Mathematics options
25: Further Mechanics 1
(Part of options C, E, H and J)

Shadow Set 1

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 $g = 9.8\,\text{m s}^{-2}$ 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 40. There are 4 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

1 Two particles P_1 and P_2 have masses $2m$ and $5m$ respectively. The particles are at rest on a smooth horizontal plane. Particle P_1 is given a horizontal impulse, of magnitude I, in the direction P_1P_2. Particle P_1 then collides directly with P_2. Immediately after this collision, P_1 is at rest and P_2 has speed v. The coefficient of restitution between the particles is e.

(a) Find I in terms of m and v.

(2)

(b) Show that $e = 0.4$

(1)

(c) Find, in terms of m and v, the total kinetic energy lost in the collision between P_1 and P_2

(2)

(Total for Question 1 is 5 marks)

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2 A cyclist and his bicycle have a combined mass of 75kg.

The cyclist is moving along a straight horizontal road.

In all circumstances, when the speed of the cyclist is v m s^{-1}, the combined resistance to the motion of the cyclist and his bicycle is modelled as a force of magnitude $k\left(v^2 + 2v\right)$ N, where k is a constant.

The maximum power that can be developed by the cyclist is 240 W.

At the instant when the speed of the cyclist is 4 m s^{-1} and he is working at his maximum power, his acceleration is $\frac{2}{3}$ m s^{-2}

(a) Find the acceleration of the cyclist at the instant when his speed is 6 m s^{-1} and he is working at his maximum power.

(7)

The maximum speed of the cyclist when he is working at his maximum power is V m s^{-1}

(b) Find, to 3 significant figures, the value of V

(4)

(Total for Question 2 is 11 marks)

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3 Two particles A and B are at rest on a smooth horizontal plane.

Particle A has mass km and particle B has mass $2m$, where k is a positive constant.
Particle A is projected with speed u along the plane towards B and they collide directly.

The coefficient of restitution between A and B is $\frac{1}{3}$

(a) Find the range of values of k for which the direction of travel of A is reversed after the collision.

(8)

The magnitude of the impulse on A in the collision between A and B is $\frac{10kmu}{9}$

(b) Find the value of k.

(4)

(Total for Question 3 is 12 marks)

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4 A small ball bearing, of mass m, is thrown vertically upwards with speed $u = 4\sqrt{gx}$ from a point O on a smooth horizontal floor, towards a smooth horizontal ceiling that is a vertical distance x above O.

The coefficient of restitution between the ball and the ceiling is $\frac{1}{4}$

In a model of the motion of the ball bearing, it is assumed that the ball bearing, as it moves up or down, is subject to air resistance of constant magnitude $\frac{1}{4}mg$.

Using this model,

(a) use the work-energy principle to find, in terms of g and x, the speed of the ball bearing immediately before it strikes the ceiling,

(5)

(b) show that the speed of the ball bearing, immediately before it strikes the floor at O for the first time, is $\frac{5\sqrt{6gx}}{8}$

(5)

The ball bearing rebounds vertically upwards from the floor.

(c) Show that the ball bearing does not reach the ceiling again.

(2)

(Total for Question 4 is 12 marks)

TOTAL FOR FURTHER MECHANICS 1 IS 40 MARKS