Pearson Edexcel International Advanced Level

Wednesday 21 January 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WME03/01A**

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Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M3
Question Paper

You must have:
Answer Book (sent separately).
Mathematical Formulae and Statistical Tables (Yellow), calculator.

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1. A particle P of mass 0.5 kg moves along the positive x-axis under the action of a single force of magnitude F newtons.

The force acts along the x-axis in the direction of x increasing.

When P is x metres from the origin O, it is moving away from O with

speed $\sqrt{\left(8x^{\frac{3}{2}} - 4\right)}$ m s^{-1}

Find F when P is 4 m from O.

(5)

(Total for Question 1 is 5 marks)

2. A spacecraft S of mass m moves in a straight line towards the centre of the Earth.

The Earth is modelled as a sphere of radius R and S is modelled as a particle.

When S is at a distance x, $x \geqslant R$, from the centre of the Earth, the force exerted by the Earth on S is directed towards the centre of the Earth.

The force has magnitude $\frac{K}{x^2}$, where K is a constant.

(a) Show that $K = mgR^2$

(2)

When S is at a distance $3R$ from the centre of the Earth, the speed of S is V.

Assuming that air resistance can be ignored,

(b) find, in terms of g, R and V, the speed of S as it hits the surface of the Earth.

(7)

(Total for Question 2 is 9 marks)

3. A particle P is moving in a straight line with simple harmonic motion about the fixed point O as centre.

When P is a distance 0.02 m from O, the speed of P is $0.3\,\text{m s}^{-1}$ and the magnitude of the acceleration of P is $0.5\,\text{m s}^{-2}$

(a) Find the period of the motion.

(4)

The amplitude of the motion is a metres.

Find

(b) the value of a,

(3)

(c) the total length of time during each complete oscillation for which P is within $\frac{1}{2}a$ metres of O.

(4)

(Total for Question 3 is 11 marks)

4. A light elastic string has natural length 5 m and modulus of elasticity 20 N.

The ends of the string are attached to two fixed points A and B, which are 6 m apart on a horizontal ceiling.

A particle P is attached to the midpoint of the string and hangs in equilibrium at a point which is 4 m below AB.

(a) Calculate the weight of P.

(6)

The particle is now raised to the midpoint of AB and released from rest.

(b) Calculate the speed of P when it has fallen 4 m.

(5)

(Total for Question 4 is 11 marks)

5. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

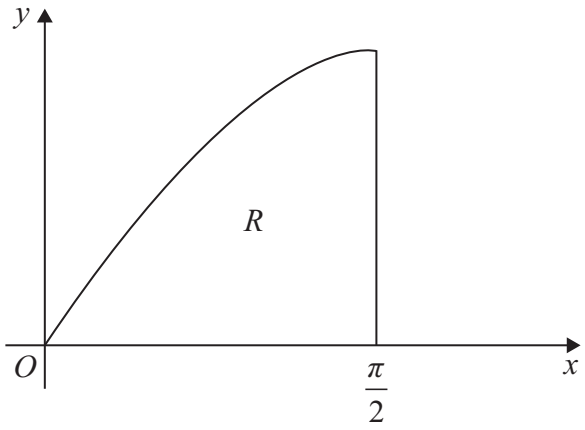

Figure 1

Figure 1 shows the finite region R which is bounded by part of the curve with equation $y = \sin x$, the x-axis and the line with equation $x = \frac{\pi}{2}$

A uniform solid S is formed by rotating R through 2π radians about the x-axis.

Using algebraic integration,

(a) show that the volume of S is $\frac{\pi^2}{4}$

(4)

(b) find, in terms of π, the x coordinate of the centre of mass of S.

(7)

(Total for Question 5 is 11 marks)

6 The path followed by a motorcycle round a circular racetrack is modelled as a horizontal circle of radius 50 m. The track is banked at an angle θ to the horizontal, where $\sin\theta = \frac{3}{5}$. The motorcycle travels round the track at constant speed.

The motorcycle is modelled as a particle and air resistance can be ignored.

In an initial model it is assumed that there is no sideways friction between the motorcycle tyres and the track.

Using this model,

(a) find the speed, in m s^{-1}, of the motorcycle.

(5)

In a refined model it is assumed that there is sideways friction.

The coefficient of friction between the motorcycle tyres and the track is $\frac{1}{4}$

It is still assumed that air resistance can be ignored and that the motorcycle is modelled as a particle.

The motorcycle's path is unchanged.

Using this model,

(b) find the maximum speed, in m s^{-1}, at which the motorcycle can travel without slipping sideways.

(8)

(Total for Question 6 is 13 marks)

7.

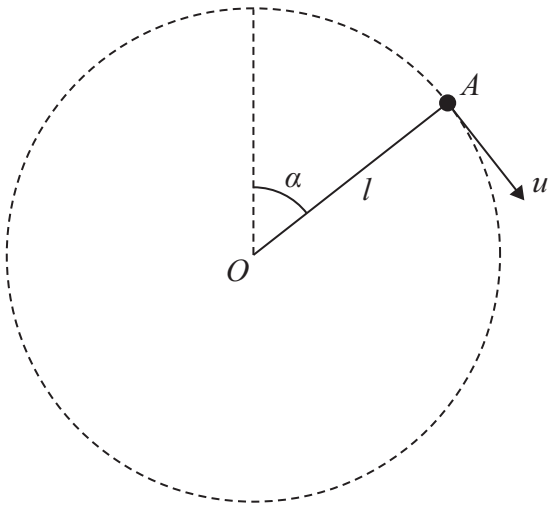

Figure 2

A particle of mass m is attached to one end of a light rod of length l. The other end of the rod is attached to a fixed point O. The rod can turn freely in a vertical plane about a horizontal axis through O.

The particle is projected with speed u from a point A, where OA makes an angle α with the upward vertical through O, as shown in Figure 2.

The particle moves in complete vertical circles.

Given that $\cos\alpha = \frac{4}{5}$

(a) show that $u > \sqrt{\frac{2gl}{5}}$

(4)

As the rod rotates, the least tension in the rod is T and the greatest tension is $4T$.

(b) Show that $u = \sqrt{\frac{17}{5}gl}$

(11)

(Total for Question 7 is 15 marks)

TOTAL FOR PAPER IS 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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Mathematics

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Answer Book

You must have:
Question paper (sent separately),
Mathematical Formulae and Statistical Tables (Yellow), 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.
- Whenever a numerical 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.
- 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

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Question 1

Write the answer to Question 1 on these 2 pages

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 1 continued

This is the end of Question 1 answer space. Please turn the page for Question 2 answer space.

(Total for Question 1 is 5 marks)

Question 2

Write the answer to Question 2 on these 4 pages

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2 continued

Question 2 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2 continued

This is the end of Question 2 answer space. Please turn the page for Question 3 answer space.

(Total for Question 2 is 9 marks)

Question 3

Write the answer to Question 3 on these 4 pages

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 3 continued

Question 3 continued

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 3 continued

This is the end of Question 3 answer space. Please turn the page for Question 4 answer space.

(Total for Question 3 is 11 marks)

Question 4

Write the answer to Question 4 on these 4 pages

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 4 continued

Question 4 continued

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DO NOT WRITE IN THIS AREA

Question 4 continued

This is the end of Question 4 answer space. Please turn the page for Question 5 answer space.

(Total for Question 4 is 11 marks)

Question 5

Write the answer to Question 5 on these 4 pages

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Question 5 continued

Question 5 continued

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DO NOT WRITE IN THIS AREA

Question 5 continued

This is the end of Question 5 answer space. Please turn the page for Question 6 answer space.

(Total for Question 5 is 11 marks)

Question 6

Write the answer to Question 6 on these 4 pages

DO NOT WRITE IN THIS AREA

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Question 6 continued

Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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Question 6 continued

This is the end of Question 6 answer space. Please turn the page for Question 7 answer space.

(Total for Question 6 is 13 marks)

Question 7

Write the answer to Question 7 on these 5 pages

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 7 continued

Question 7 continued

DO NOT WRITE IN THIS AREA

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DO NOT WRITE IN THIS AREA

Question 7 continued

Question 7 continued

(Total for Question 7 is 15 marks)

TOTAL FOR PAPER IS 75 MARKS

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