GradeMax

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 11 June 2026

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WME03/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M3

You must have:
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 two significant figures or three 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.

Turn over ▶

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

A particle P is moving along the positive x-axis.
At time t seconds, $t \geqslant 0$, P is x metres from the origin O and is moving away from O with velocity $v\,\text{m s}^{-1}$, where

$$v = \frac{6}{x^2 + 4}$$

(a) Find the deceleration of P when $x = 3$

(4)

When $t = 0$, $x = 3$

When $t = T$, $x = 6$

(b) Find the value of T.

(5)

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Question 1 continued

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Question 1 continued

(Total for Question 1 is 9 marks)

2.

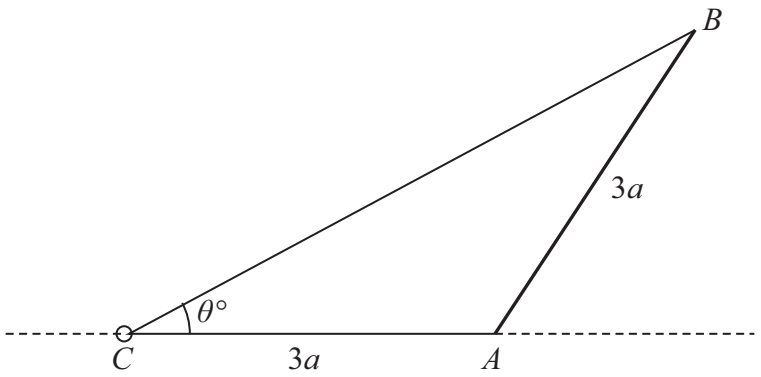


Figure 1

Figure 1 shows a uniform rod AB of mass M and length $3a$.
The rod is smoothly hinged at A to a fixed point so that the rod can rotate in a vertical plane.

A small smooth ring is fixed at point C, a distance $3a$ from A, on the same horizontal level as A and in the same vertical plane as AB.

One end of a light elastic string is attached to A. The string passes through the ring at C and the other end of the string is attached to B.

The rod rests in equilibrium with angle $BCA = \theta°$, where $0 < \theta < 45$

(a) Show that the tension in the string is $\dfrac{Mg\cos(2\theta°)}{2\sin\theta°}$

(3)

Given that the string has natural length $3a$ and modulus of elasticity $\dfrac{2}{5}Mg$,

(b) show that $\tan(2\theta°) = \dfrac{5}{4}$

(4)

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Question 2 continued

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Question 2 continued

(Total for Question 2 is 7 marks)

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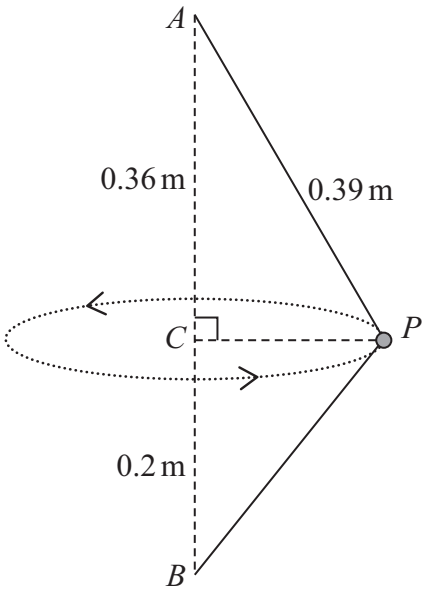


Figure 2

Two fixed points, A and B, are such that $AB = 0.56\,\text{m}$ and A is vertically above B.
The point C on AB is such that $AC = 0.36\,\text{m}$ and $CB = 0.2\,\text{m}$.
A light inextensible string of length 0.64 m has one end attached to A and the other end attached to B.

A particle of mass $0.1\,\text{kg}$ is attached to the string at the point P, where $AP = 0.39\,\text{m}$.
The particle moves with constant angular speed in a horizontal circle with centre C, as shown in Figure 2.
The angular speed of the particle is $\omega\ \text{rad}\,\text{s}^{-1}$

Given that both parts of the string are taut,

(a) find the tension in PB when $\omega = 3\sqrt{5}$

(7)

(b) Find the greatest value of ω for which PB is slack, making your method clear.

(4)

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Question 3 continued

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Question 3 continued

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4.

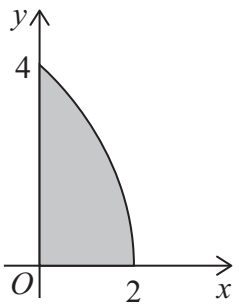


Figure 3

The shaded region shown in Figure 3 is bounded by the positive x-axis, the positive y-axis and the curve with equation $(x + 3)^2 + y^2 = 25$

The unit of length on both of the axes is 1 m.

The shaded region is rotated through 2π radians about the x-axis to form a solid of revolution which is used to model a uniform solid S.

The volume of S is $\frac{52}{3}\pi \text{m}^3$

(a) Show, using **algebraic integration**, that the centre of mass of S is $\frac{9}{13}$ m from O.

(6)

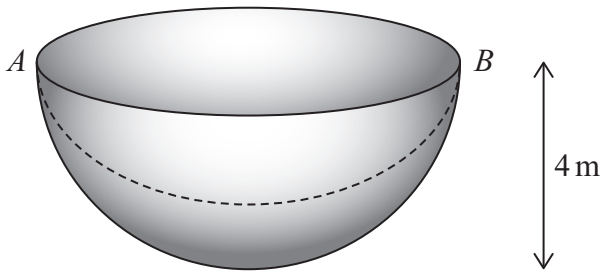


Figure 4

A solid T, which is the same size and shape as S, is **removed** from a uniform solid hemisphere of radius 4 m. The plane face of T is the plane face of the hemisphere.

The solid remaining is in the shape of a bowl, shown in Figure 4, where A and B are points on the circular rim of the bowl and AB is a diameter of the rim.

The centre of mass of the bowl is d metres from the midpoint of AB.

(b) Show that $d = \frac{39}{19}$

(4)

The bowl is now suspended from A and hangs freely in equilibrium with AB at $\theta°$ to the downward vertical.

(c) Find the value of θ

(2)

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Question 4 continued

(Total for Question 4 is 12 marks)

5. A particle P of mass m is attached to one end of a light elastic **spring** of natural length a and modulus of elasticity λ
The other end of the spring is attached to a fixed point A on a ceiling.

The points B, C and D are such that

- B lies vertically below A and $AB = \frac{1}{2}a$
- C lies vertically below A and $AC = a$
- D lies vertically below A and $AD = 3a$

The particle P is pulled vertically downwards until it is at D and released from rest.

Given that P comes to instantaneous rest at B,

(a) show that $\lambda = \frac{4}{3}mg$

(4)

(b) Find, in terms of a and g, the speed of P at the instant it reaches C.

(4)

The maximum speed of P occurs when P is at the point E.

(c) Show that $AE = \frac{7}{4}a$

(3)

(d) Show that P moves with simple harmonic motion about E.

(3)

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 14 marks)

6.

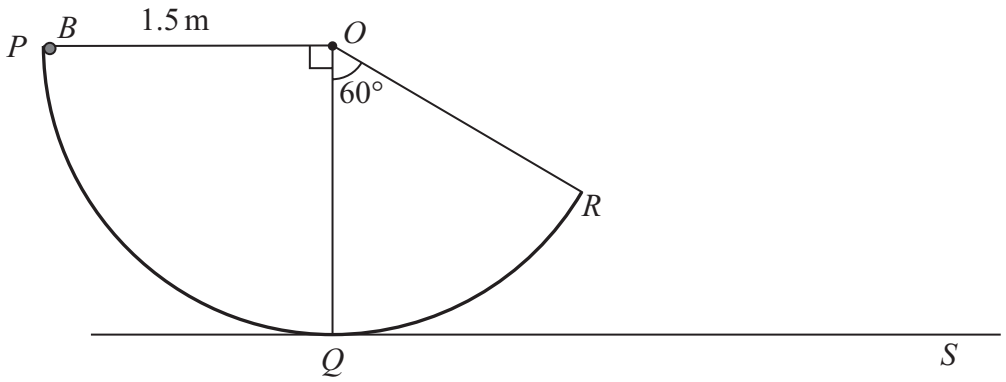


Figure 5

Figure 5 shows a smooth track PQR which is part of a circle.
The track is fixed in a **vertical** plane.

The circle has centre O and radius $OP = 1.5\,\text{m}$.

The highest point of the track is P and PO is horizontal.

The lowest point of the track Q is on horizontal ground.

A small ball B, of mass $0.2\,\text{kg}$, is released from rest at P and moves on the track until it leaves the track at R, where angle $QOR = 60°$

The ball is modelled as a particle.

(a) Find the magnitude of the normal reaction between the ball and the track when the ball is at Q.

(5)

After leaving the track, the ball moves freely under gravity and first lands on the ground at the point S.

(b) Find the distance QS.

(8)

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 13 marks)

7. A particle Q moves in a straight line with simple harmonic motion about centre O.

The maximum speed of Q is $12\,\text{m s}^{-1}$

When Q is 2 m from O, the speed of Q is $4\sqrt{5}\,\text{m s}^{-1}$

(a) Find the amplitude of the motion.

(4)

The maximum magnitude of the acceleration of Q is $A\,\text{m s}^{-2}$

(b) Find the value of A.

(1)

(c) Find the length of time, in any one complete oscillation, for which the magnitude of the acceleration of Q is less than $\frac{1}{2}A$.

(4)

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Question 7 continued

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TOTAL FOR PAPER IS 75 MARKS

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