Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
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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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Pearson

**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**

**Question 1 continued**

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**Question 1 continued**

**(Total for Question 1 is 9 marks)**

**2.**

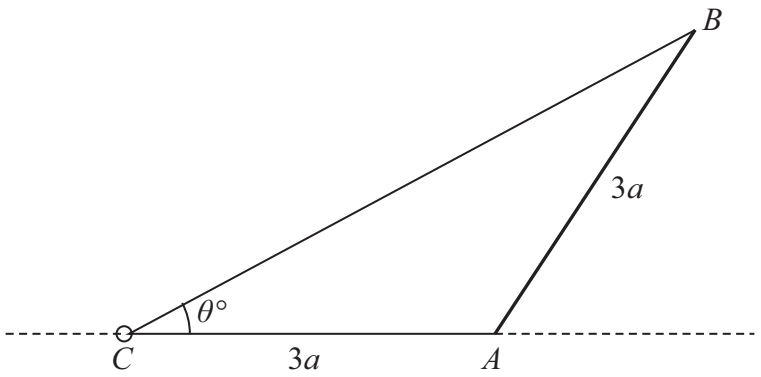


**Figure 1**

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)**

**Question 2 continued**

**Question 2 continued**

**Question 2 continued**

**(Total for Question 2 is 7 marks)**

**3.**

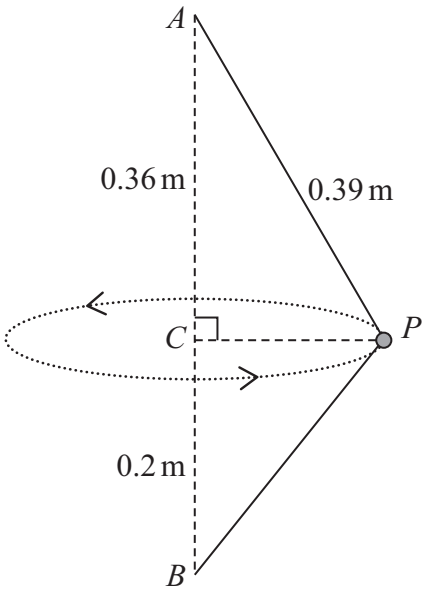


**Figure 2**

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 $\omega$ for which $PB$ is slack, making your method clear.

**(4)**

**Question 3 continued**

**Question 3 continued**

**Question 3 continued**

**(Total for Question 3 is 11 marks)**

**4.**

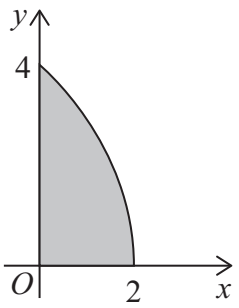


**Figure 3**

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 $2\pi$ 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)**

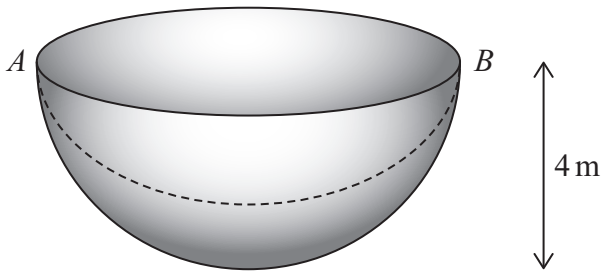


**Figure 4**

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 $\theta$

**(2)**

**Question 4 continued**

**Question 4 continued**

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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 $\lambda$
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)**

**Question 5 continued**

**Question 5 continued**

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**Question 5 continued**

**(Total for Question 5 is 14 marks)**

**6.**

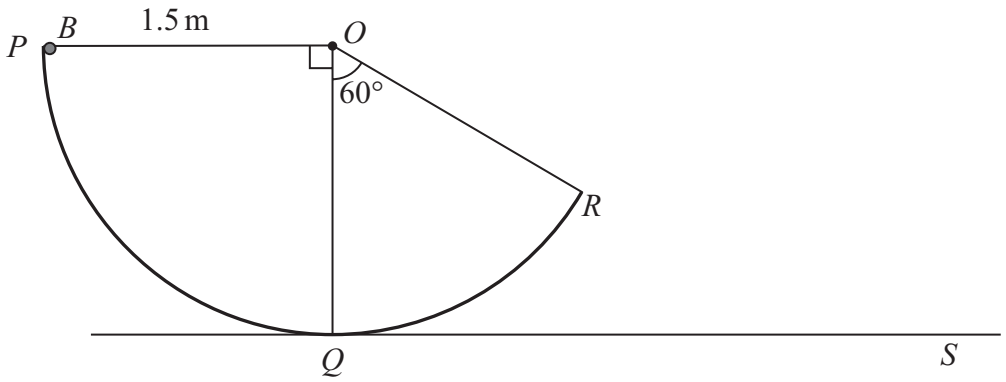


**Figure 5**

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)**

**Question 6 continued**

**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)**

**Question 7 continued**

**Question 7 continued**

**(Total for Question 7 is 9 marks)**

**TOTAL FOR PAPER IS 75 MARKS**

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