Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 3 June 2026

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WME02/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M2

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 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 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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P 8 1 3 2 8 A 0 1 3 2

Pearson

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

At time t seconds, $t \geqslant 0$, a particle P is at the point with position vector $\mathbf{r}$ metres relative to a fixed origin, where

$$\mathbf{r} = 4e^{2t}\mathbf{i} + (12t - e^{2t})\mathbf{j}$$

(a) Find, in terms of e, the exact velocity of P when $t = 3$

(3)

At time T seconds, $T \geqslant 0$, P is moving in the direction of the vector $\mathbf{i} + \mathbf{j}$

(b) Find the exact acceleration of P when $t = T$

(4)

Question 1 continued

Question 1 continued

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Question 1 continued

(Total for Question 1 is 7 marks)

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

A particle Q of mass 5 kg is moving on a smooth horizontal surface.

Particle Q is moving with velocity $(2\mathbf{i} + 3\mathbf{j})\,\text{m s}^{-1}$ when it receives a horizontal impulse of magnitude $10\sqrt{2}\,\text{N s}$.

Immediately after receiving the impulse, the velocity of Q is $(a\mathbf{i} + \mathbf{j})\,\text{m s}^{-1}$, where a is a positive constant.

(a) Find the value of a.

(4)

The angle between the direction of motion of Q before receiving the impulse and the direction of motion of Q after receiving the impulse is $\theta°$.

(b) Find the value of θ.

(2)

Question 2 continued

(Total for Question 2 is 6 marks)

3.

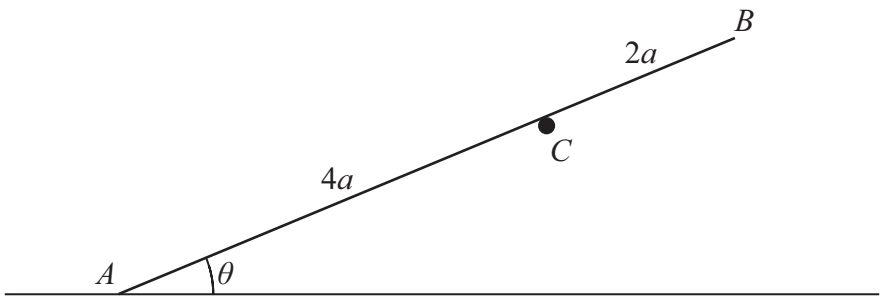

Figure 1

A beam AB, of weight W and length $6a$, rests in equilibrium with its end A on rough horizontal ground.
The beam rests on a rough horizontal peg at C, where $AC = 4a$, as shown in Figure 1.
Friction is limiting at both A and C.

- the coefficient of friction between the beam and the peg at C is $\frac{1}{6}$
- the beam is inclined at an angle θ to the ground, where $\tan\theta = \frac{3}{4}$
- the beam is modelled as a uniform rod that lies in a vertical plane perpendicular to the peg
- the normal reaction between the beam and the peg at C has magnitude kW

Using the model,

(a) find the exact value of k,

(3)

(b) find the exact value of the coefficient of friction between the beam and the ground.

(6)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 9 marks)

4.

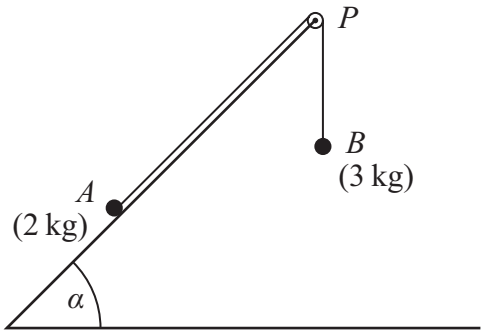

Figure 2

Two particles, A and B, of mass 2 kg and 3 kg respectively, are connected by a light inextensible string.

Particle A is held at rest on a fixed rough ramp that is inclined at an angle α to the horizontal ground, where $\tan\alpha = \frac{4}{3}$

The string passes over a small smooth pulley P that is fixed at the top of the ramp. Particle B hangs vertically below P, as shown in Figure 2.

The particles are released from rest with the string taut so that A moves up the ramp. The section of the string from A to P is parallel to a line of greatest slope of the ramp.

The coefficient of friction between A and the ramp is $\frac{1}{4}$

Air resistance is ignored.

(a) Find the magnitude of the frictional force acting on A as A moves up the ramp.

(2)

When the particles are released from rest, A is more than 2.5 m from the pulley and B is more than 2.5 m above the ground.

(b) Use the work-energy principle to find the speed of A at the instant when it has moved 2.5 m up the ramp.

(6)

Question 4 continued

Question 4 continued

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Question 4 continued

(Total for Question 4 is 8 marks)

5. [*In this question you may assume, without proof, that the centre of mass of a circular sector of radius r and angle 2α is* $\frac{2r\sin\alpha}{3\alpha}$ *from the centre.*]

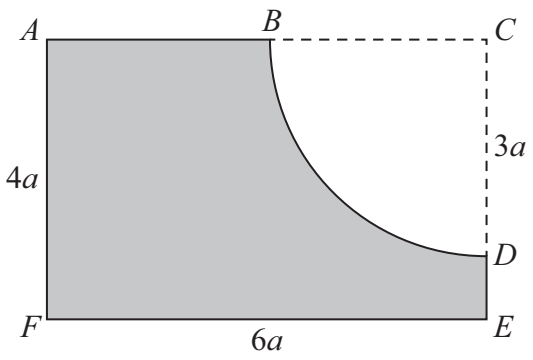

Figure 3

The uniform **lamina** $ACEF$ is a rectangle with $AF = 4a$ and $FE = 6a$.

The point B on AC and the point D on CE are such that the arc BD is a quarter circle with radius $3a$ and centre C.
The sector BCD is removed from the lamina to form the template shown shaded in Figure 3.

(a) Show that the centre of mass of the **sector** BCD is $\frac{4a}{\pi}$ from CD.

(2)

The distance of the centre of mass of the **template** from AF is d.

(b) Show that $d = \frac{108 - 18\pi}{32 - 3\pi}a$

(5)

The template is suspended from A and hangs freely in equilibrium.

(c) Find the size of the angle between AF and the downward vertical.

(4)

Question 5 continued

Question 5 continued

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Question 5 continued

(Total for Question 5 is 11 marks)

6. A particle P has mass $2m$ and a particle Q has mass $4m$.
The particles are moving in the **same** direction along the same straight line on a smooth horizontal surface, with P behind Q.

Particle P collides directly with particle Q and both particles continue to move in the **same** direction.

Immediately **before** the collision, the speed of P is $4u$ and the speed of Q is u.
Immediately **after** the collision, the speed of P is w and the speed of Q is v.

The coefficient of restitution between P and Q is e, where $e > 0$

(a) Show that $v = 2u + eu$

(5)

(b) Hence find, in terms of u, the full range of possible values of w.

(2)

After the collision with P, particle Q collides directly with a third particle R.
Before the collision with Q, particle R was at rest on the same straight line as P and Q.
The coefficient of restitution between Q and R is also e.

Given that the mass of R is $5m$,

(c) show that there will be a second collision between P and Q.
(*Solutions relying entirely on calculator technology are not acceptable.*)

(6)

Question 6 continued

Question 6 continued

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Question 6 continued

(Total for Question 6 is 13 marks)

7.

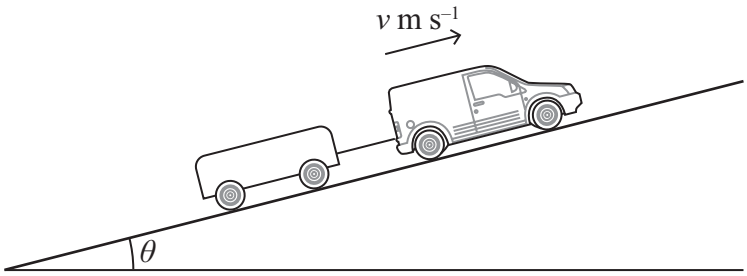

Figure 4

A van of mass 800 kg is moving up a straight road that is inclined at an angle θ to the horizontal, where $\sin\theta = \frac{1}{12}$

The van is towing a trailer of mass 300 kg. The trailer is attached to the van by a rigid towbar that is parallel to the direction of motion of the van and the trailer, as shown in Figure 4.

- the resistance to the motion of the **van** from non-gravitational forces is modelled as a constant force of magnitude 400 N
- the resistance to the motion of the **trailer** from non-gravitational forces is modelled as a constant force of magnitude 200 N
- the towbar is modelled as a light rod

The engine of the van is working at a constant rate of 12 kW.

The van is moving up the straight road at a constant speed of v m s^{-1}

(a) Find the value of v.

(4)

Question 7 continues on page 26

Question 7 continued

Question 7 continued from page 24

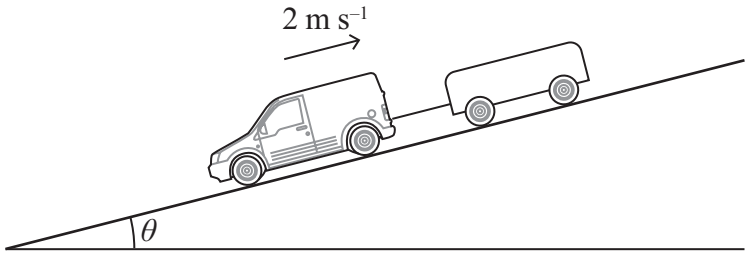

Figure 5

On another occasion, the van and the trailer are **reversing up** the same straight road. The towbar is again parallel to the direction of motion of the van and the trailer, as shown in Figure 5.

- the resistance to the motion of the **van** from non-gravitational forces is again modelled as a constant force of magnitude 400 N
- the resistance to the motion of the **trailer** from non-gravitational forces is again modelled as a constant force of magnitude 200 N
- the towbar is modelled as a light rod

The engine of the van is working at a constant rate of 4 kW.

(b) Find the thrust in the towbar at the instant when the speed of the van **up the road** is 2 m s^{-1}

(6)

Question 7 continued

(Total for Question 7 is 10 marks)

8.

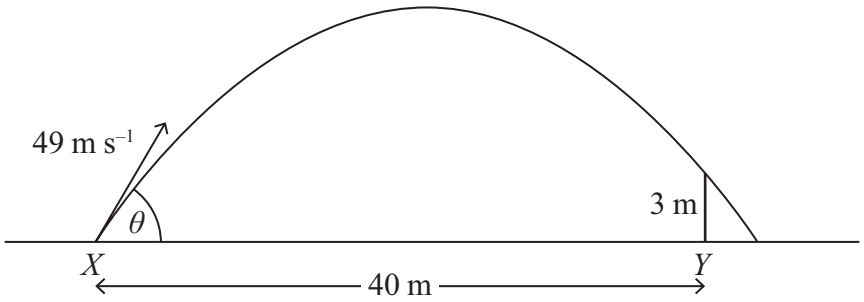

Figure 6

Two points X and Y, on horizontal ground, are 40 m apart.

A vertical pole, fixed to the ground at Y, has length 3 m.

At time $t = 0$, a particle P is projected from X with speed 49 m s^{-1} at an angle θ to the ground.

Particle P **just** passes over the top of the pole, as shown in Figure 6.

(a) Show that $\tan\theta$ satisfies the equation $a\tan^2\theta + b\tan\theta + c = 0$, where a, b and c are integers to be given to 3 significant figures.

(6)

A particle Q is now projected from X with speed 49 m s^{-1} at 30° to the ground.
The particle passes over the top of the pole and reaches the ground at the point Z.

(b) Find the minimum speed of Q on its journey from X to Z.

(1)

(c) Find the speed of Q at the instant when it is vertically above the top of the pole.

(4)

Question 8 continued

Question 8 continued

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Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS

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