Pearson Edexcel International Advanced Level

Thursday 7 May 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WME01/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M1
Question paper

You must have:
Answer book (sent separately).
Do not return this question paper with the answer book.

Turn over ▶

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P 8 1 3 5 4 A

Pearson

1. A particle A has mass m and a particle B has mass km, where k is a constant. The particles are moving towards each other in opposite directions along the same straight line when they collide directly.

Immediately before the collision, the speed of A is $3u$ and the speed of B is $2u$.

As a result of the collision, the speed of each particle is halved and the direction of motion of each particle is reversed.

(a) Find the value of k.

(3)

(b) Find, in terms of m and u, the magnitude of the impulse exerted on B by A in the collision.

(3)

(Total for Question 1 is 6 marks)

2.

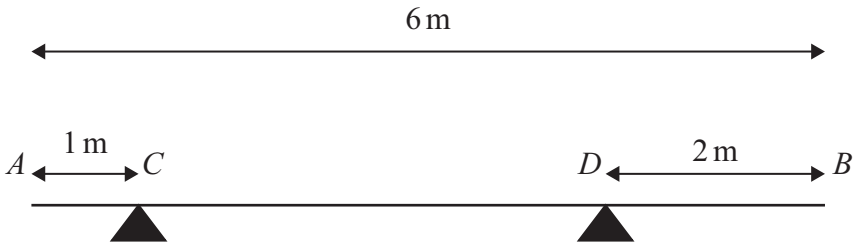

Figure 1

A uniform rod AB has mass 30 kg and length 6 m. The rod rests in equilibrium in a horizontal position on two supports, one at C, where $AC = 1$ m, and the other at D, where $DB = 2$ m, as shown in Figure 1.

A particle of mass 60 kg is placed on the rod at a point which is 2 m from A.

Another particle, whose mass is 75 kg, is placed on the rod at a point that is x metres from B.

The rod remains at rest in equilibrium in a horizontal position.

The magnitude of the force acting on the rod at C is two thirds of the magnitude of the force acting on the rod at D.

(a) Find the magnitude of the force acting on the rod at D.

(3)

(b) Find the exact value of x.

(3)

The particle of mass 75 kg is now removed.

A particle of unknown mass is placed on the rod at B and the rod is now on the point of tilting.

(c) Find the magnitude of the force that is now acting on the rod at D.

(3)

(Total for Question 2 is 9 marks)

3. A train travels between two points, A and B, on a straight horizontal track.

The train usually travels at a constant speed of $50\,\text{m s}^{-1}$ for 15 minutes between the two points.

On one occasion, the train was delayed, because of signals. Figure 2 shows a sketch of the speed-time graph for the motion of the train on this occasion.

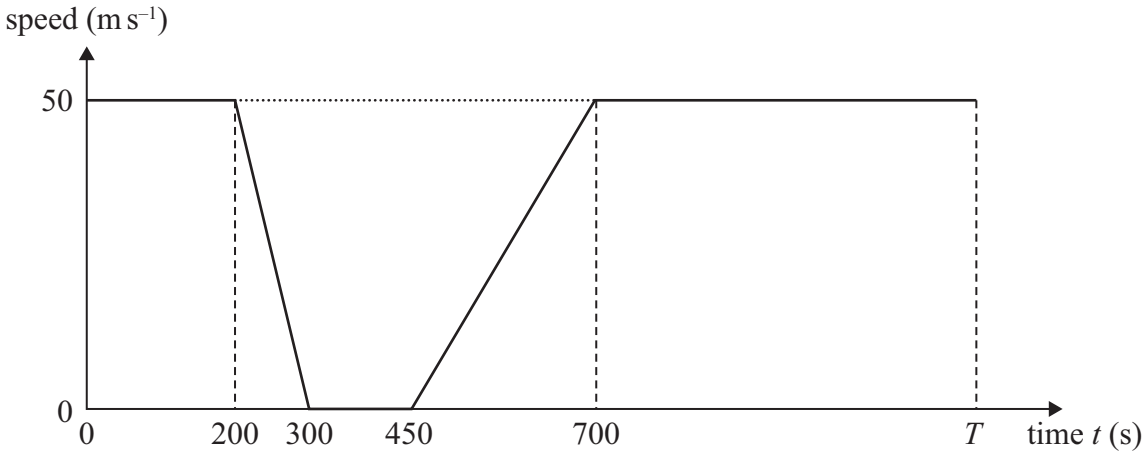

Figure 2

On this occasion, the train passes A at time $t = 0$ and passes B at time $t = T$ seconds.

(a) Find the deceleration of the train while it was slowing down.

(2)

(b) Sketch an acceleration-time graph for the motion of the train, from $t = 0$ to $t = T$ seconds, on this occasion.

(2)

(c) Find the value of T.

(4)

(d) Find the total length of time, between $t = 0$ and $t = T$ seconds, for which the speed of the train was less than $30\,\text{m s}^{-1}$ on this occasion.

(4)

(Total for Question 3 is 12 marks)

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

A particle P of mass m kg lies on a smooth horizontal plane. The particle is acted upon by two forces, $\mathbf{F}_1$ N and $\mathbf{F}_2$ N, where $\mathbf{F}_1 = (3\mathbf{i} + \mathbf{j})$ and $\mathbf{F}_2 = (5\mathbf{i} - 16\mathbf{j})$.

Given that P moves with acceleration $68\,\text{m s}^{-2}$

(a) find the value of m.

(4)

Given that the force $(\mathbf{F}_1 + k\mathbf{F}_2)$ N, where k is a constant, acts in a direction which is perpendicular to the vector $(2\mathbf{i} + \mathbf{j})$

(b) find the exact value of k.

(4)

(Total for Question 4 is 8 marks)

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5. A motor race between two cars, A and B, takes place on a straight horizontal track.

At time $t = 0$, A has speed $35\,\text{m s}^{-1}$ and is 1 km from the finishing line. It then moves with constant acceleration $0.4\,\text{m s}^{-2}$ until it reaches the finishing line at time $t = T$ seconds.

(a) Find the value of T.

(3)

At time $t = 0$, B has speed $44\,\text{m s}^{-1}$ and is 200 m behind A.

Car B then moves with constant acceleration $0.5\,\text{m s}^{-2}$ until it reaches the finishing line.

(b) Find the length of time, from the instant when the speed of B is $9.5\,\text{m s}^{-1}$ **greater than** the speed of A, to the instant when B catches up with A.

(7)

(Total for Question 5 is 10 marks)

6.

Figure 3

A washing line $ABCD$ holds two heavy garments, one at B and one at C.

The section AB makes an angle of 20° with the horizontal, the section BC is horizontal and the section CD makes an angle of $\alpha°$ with the horizontal, as shown in Figure 3.

The points A, B, C and D all lie in the same vertical plane.

The washing line and the two garments are in equilibrium, with all three sections of the washing line taut.

- the garment at B is modelled as a particle of mass 2 kg
- the garment at C is modelled as a particle of mass 3 kg
- the washing line is modelled as being light

(a) Find the tension in AB.

(2)

(b) Find the value of α

(6)

(c) If the washing line was **not** modelled as being light, state why it would **not** be possible to answer part (a).

(1)

(Total for Question 6 is 9 marks)

7. [*In this question* **i** *and* **j** *are horizontal unit vectors directed due east and due north respectively and position vectors are given relative to a fixed origin O.*]

A small boat is modelled as a particle moving with constant velocity.

At time t hours after 2 pm, the position vector of the boat is

$$[(4 - 3t)\mathbf{i} + (2 + t)\mathbf{j}]\,\text{km}$$

(a) Find the speed of the boat.

(3)

The point A has position vector $(2\mathbf{i} - \mathbf{j})\,\text{km}$

(b) Find the time of day when the bearing of the boat from A is 315°

(5)

(Total for Question 7 is 8 marks)

8.

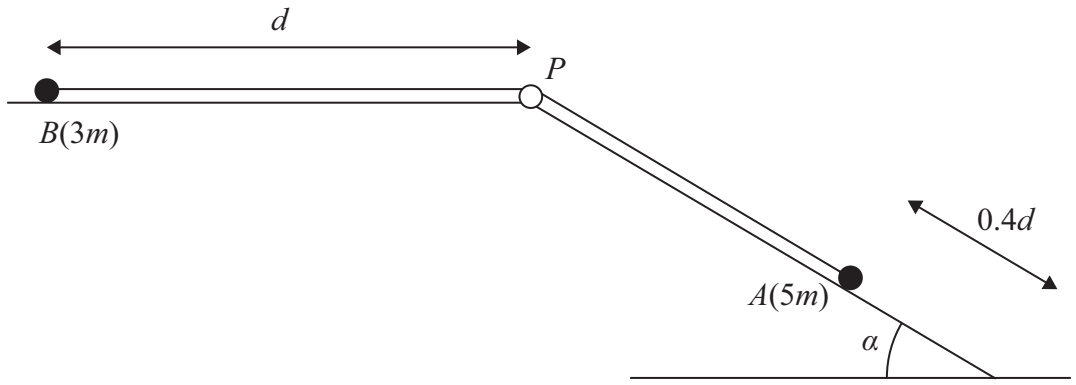

Figure 4

One end of a light inextensible string is attached to a particle A of mass $5m$. The other end of the string is attached to a particle B of mass $3m$. Particle A lies on a **smooth** plane that is inclined to horizontal ground at an angle α, where $\tan\alpha = \frac{3}{4}$. Particle B lies on a **rough** horizontal plane. The string passes over a small smooth pulley P that is fixed at the top of the inclined plane.

The two particles, the string and the pulley all lie in the same vertical plane.
The portion of the string between A and P lies along a line of greatest slope of the inclined plane. The portion of the string between B and P is horizontal.

The system is held at rest with $BP = d$ and particle A at a distance $0.4d$ from the bottom of the inclined plane, as shown in Figure 4.

The coefficient of friction between B and the horizontal plane is 0.2

The system is released from rest with the string taut and A begins to move down the inclined plane.

(a) Find, in terms of m and g, the magnitude of the frictional force acting on B.

(2)

By writing down an equation of motion for each particle,

(b) show that the acceleration of A down the inclined plane is $0.3g$

(5)

(c) State how you have used the fact that the string is inextensible in your working for part (b).

(1)

When A hits the ground at the bottom of the inclined plane it stops.

(d) Show that B comes to rest just as it reaches the pulley.

(5)

(Total for Question 8 is 13 marks)

TOTAL FOR PAPER IS 75 MARKS