Pearson Edexcel International Advanced Level

Tuesday 13 October 2026

Afternoon (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.

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1.

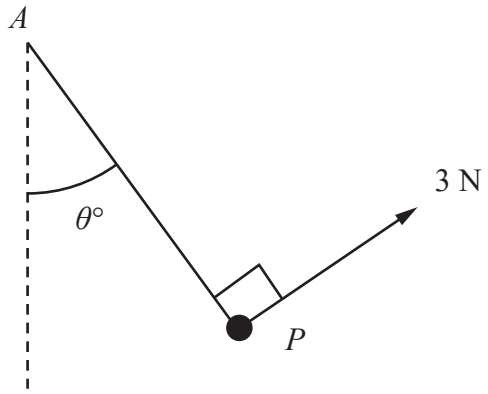


Figure 1

A particle P of mass 0.5 kg is attached to one end of a light inextensible string. The other end of the string is attached to a point A. The particle P is held in equilibrium by a force of magnitude 3 N which acts in a direction that is perpendicular to the string. The string makes an angle of $\theta°$ with the downward vertical, as shown in Figure 1.

(a) By resolving perpendicular to the string or otherwise, find the value of θ

(3)

(b) Find the tension in the string.

(3)

(Total for Question 1 is 6 marks)

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2. A particle P has mass $2m$ and a particle Q has mass km. The particles are moving towards each other in opposite directions along the same straight line when they collide directly.

Immediately **before** the collision, P has speed $2u$ and Q has speed $\frac{7u}{3}$

The magnitude of the impulse exerted on P in the collision is $5mu$

(a) Find, in terms of u only, the speed of P immediately after the collision.

(3)

Immediately **after** the collision, Q continues to move in its **original direction** with speed $\frac{u}{3}$

(b) Find the value of k.

(3)

(Total for Question 2 is 6 marks)

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3. An athlete is running in a straight line along a horizontal road at a constant speed of $4\,\text{m}\,\text{s}^{-1}$

At time $t = 0$, he passes a cyclist who is standing at the side of the road. The cyclist sets off 20 s later in a straight line along the road in pursuit of the athlete. The cyclist accelerates from rest at a constant rate of $3\,\text{m}\,\text{s}^{-2}$ until she reaches a speed of $12\,\text{m}\,\text{s}^{-1}$ She then maintains a constant speed of $12\,\text{m}\,\text{s}^{-1}$ until she catches up with the athlete at time $t = T$ seconds.

(a) Sketch, **on the same axes**, a speed-time graph for the motion of the athlete and for the motion of the cyclist from $t = 0$ to $t = T$ seconds.
(No further calculations are needed in order to draw this sketch.)

(3)

(b) Find the **exact** distance that has been moved by the cyclist when the athlete and the cyclist are both moving at the same speed.

(3)

(c) Find the value of T.

(4)

(Total for Question 3 is 10 marks)

4.

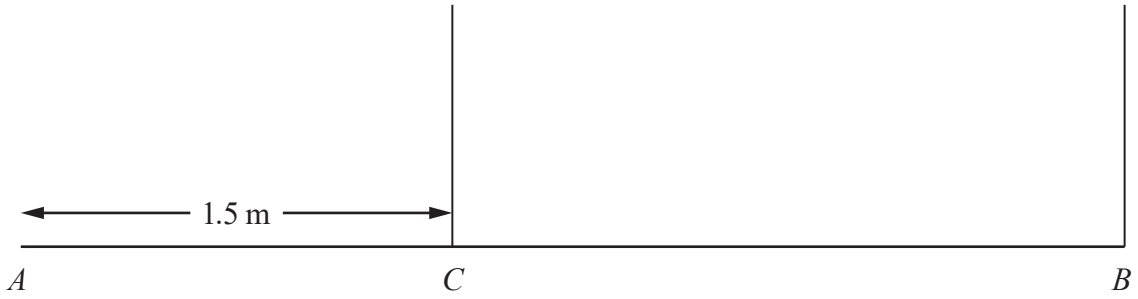


Figure 2

A beam AB has mass 15 kg and length 4 m. The beam is supported in a horizontal position by two vertical ropes, one attached to the beam at B and the other attached to the beam at C, where $AC = 1.5$ m, as shown in Figure 2.

When a box of mass M kg is placed on the beam at D, where $AD = 0.3$ m, the beam remains in a horizontal position but is on the point of tilting.

- the box is modelled as a particle
- the beam is modelled as a uniform rod
- the ropes are modelled as being light

Using the model,

(a) find the **exact** value of M.

(3)

The box remains at D and is now filled with sand so that its **total** mass is now 20 kg.

A second box with a **different** mass is placed on the beam at E, where $AE = 2.25$ m, and the beam remains in a horizontal position and is again on the point of tilting.

- both boxes are modelled as particles
- the beam is modelled as a uniform rod
- the ropes are modelled as being light

Using the model,

(b) find the tension in the rope attached to the beam at C.

(3)

(c) State how you have used the modelling assumption that the boxes are particles in your calculations.

(1)

(Total for Question 4 is 7 marks)

5.

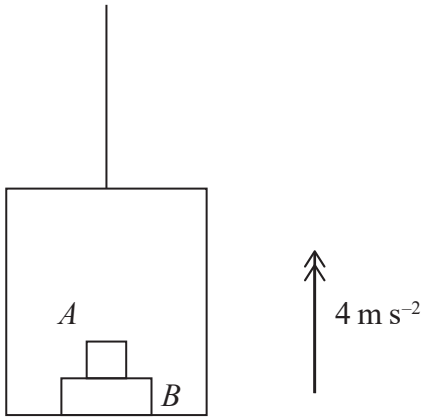


Figure 3

A lift has mass Mkg when **empty**.
A block B in the shape of a cuboid, of mass 20 kg, is placed on the horizontal floor of the lift.
A block A in the shape of a cuboid, of mass 5 kg, is placed on top of block B.
The lift with the two blocks inside is being accelerated vertically **upwards** at 4 m s^{-2} by a light vertical cable which is attached to the top of the lift, as shown in Figure 3.

The tension in the cable is 1725 N.

(a) Find the value of M.

(3)

(b) Find the magnitude of the force exerted on block B by the floor of the lift.

(3)

(c) Find the magnitude of the force exerted on block B by block A.

(3)

(Total for Question 5 is 9 marks)

6. At time $t = 0$, a parachutist drops vertically from rest from a helicopter. She drops from a point that is 500 m above the ground.

In the subsequent motion

- she falls vertically at all times
- she falls freely under gravity for 3 seconds
- the parachute then opens and causes an instant and constant deceleration of $12\,\text{m s}^{-2}$ for 2 seconds, reaching a speed of $V\,\text{m s}^{-1}$
- she maintains this speed until she reaches the ground at time T seconds
- the time for the parachute to open is assumed to be negligible

(a) Find the value of V.

(3)

(b) Find the value of T.

(6)

(Total for Question 6 is 9 marks)

7.

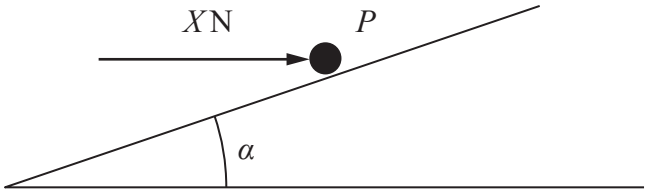


Figure 4

A particle P of mass 10 kg is held in equilibrium on a fixed rough inclined plane under the action of a horizontal force of magnitude X newtons, as shown in Figure 4.

The force acts in a vertical plane containing a line of greatest slope of the inclined plane.

The plane is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$

The coefficient of friction between P and the plane is 0.2

Given that P is on the point of sliding **up** the plane,

(a) find the value of X.

(6)

The horizontal force is now removed.

(b) Find, in terms of g, the acceleration of P down the plane.

(6)

(Total for Question 7 is 12 marks)

8. [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.]

A ship P moves with constant velocity $(3\mathbf{i} + \mathbf{j})$ km h^{-1}

At 12 noon, P is at the point with position vector $(2\mathbf{i} + \mathbf{j})$ km.

At time t hours after noon, the position vector of P is $\mathbf{p}$ km.

(a) Find $\mathbf{p}$ in terms of t.

(2)

At time t hours after noon, the position vector of another ship Q is $\mathbf{q}$ km, where

$$\mathbf{q} = (11t - 1)\mathbf{i} + (3t - 4)\mathbf{j}$$

(b) Find the direction of motion of Q, giving your answer as a bearing.

(3)

(c) Show that, at time t hours after noon,

$$\overrightarrow{PQ} = [(8t - 3)\mathbf{i} + (2t - 5)\mathbf{j}] \text{ km}$$

(2)

(d) Find the time of day when the two ships are closest together.

(4)

(e) Find the position vector of Q when the bearing of Q from P is 135°

(5)

(Total for Question 8 is 16 marks)

TOTAL FOR PAPER IS 75 MARKS