

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

Candidate Number

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Sample Assessment Materials for first teaching September 2018

(Time: 1 hour 30 minutes)

Paper Reference **WME01/01****Mathematics****International Advanced Subsidiary/Advanced Level
Mechanics M1****You must have:**

Mathematical Formulae and Statistical Tables, 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

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.

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Answer ALL questions. Write your answers in the spaces provided.

Unless otherwise indicated, whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

1. A car is moving along a straight horizontal road with constant acceleration $a \text{ m s}^{-2}$ ($a > 0$). At time $t = 0$ the car passes the point P moving with speed $u \text{ m s}^{-1}$. In the next 4 s, the car travels 76 m and then in the following 6 s it travels a further 219 m.

Find

(i) the value of u ,

(ii) the value of a .

(7)

$$\textcircled{1}, s = 76.$$

$$v = u$$

v

$$g = 9.$$

$$t = 4$$

\textcircled{1}

$$38 = 2u + 4g$$

$$\underline{-59 = 2u + 10g}$$

$$-21 = -6g$$

$$g = 7/2$$

$$76 = u(4) + \frac{1}{2}g(4)^2$$

$$u = \frac{59 - 10(3.5)}{2}$$

$$38 = 2u + 4g. - \textcircled{1}$$

$$= \underline{\underline{12 \text{ ms}^{-1}}}$$

$$s = 295$$

$$v = v$$

v

$$g = 9.$$

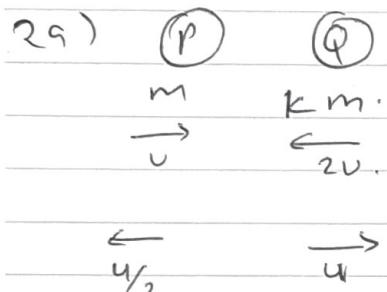
$$t = 10$$

$$295 = u(10) + \frac{1}{2}g(10)^2$$

$$59 = 2u + 10g.$$

Simultaneous eqns.

2. Two particles P and Q are moving in opposite directions along the same horizontal straight line. Particle P has mass m and particle Q has mass km . The particles collide directly. Immediately before the collision, the speed of P is u and the speed of Q is $2u$. As a result of the collision, the direction of motion of each particle is reversed and the speed of each particle is halved.
- (a) Find the value of k . (4)
- (b) Find, in terms of m and u only, the magnitude of the impulse exerted on Q by P in the collision. (2)



$R(-\rightarrow)$.

$$m(u) + km(-2u) = m(-\frac{u}{2}) + km(u)$$

$$u - 2ku = -\frac{u}{2} + ku$$

$$3ku = \frac{3}{2}u$$

$$k = \frac{1}{2}$$

(b) I (\leftarrow) on Q by P

$$m(u_2 - -u)$$

$$= \frac{3mu}{2} \text{ NS}$$

3. A block A of mass 9 kg is released from rest from a point P which is a height h metres above horizontal soft ground. The block falls and strikes another block B of mass 1.5 kg which is on the ground vertically below P . The speed of A immediately before it strikes B is 7 m s^{-1} . The blocks are modelled as particles.

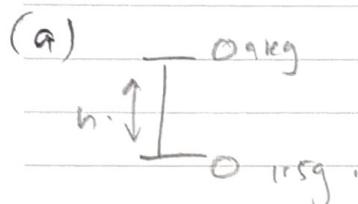
(a) Find the value of h .

(2)

Immediately after the impact the blocks move downwards together with the same speed and both come to rest after sinking a vertical distance of 12 cm into the ground. Assuming that the resistance offered by the ground has constant magnitude R newtons,

(b) find the value of R .

(8)



$$0^2 = 6^2 + 2(9 \times 0.12)$$

$$9 = 150$$

$$s = h.$$

$$u = 0$$

$$v = 7$$

$$g = 9.8$$

t

$$7^2 = 2(9.8)(h)$$

$$F = mg$$

(\downarrow)

$$10.5g - R = 10.5 \times -150$$

$$R = 1680$$

$$\underline{\underline{h = 2.5}}$$

(b) LCM

$$9(7) = (9+1.5)x$$

$$\underline{\underline{x = 6 \text{ ms}^{-1}}}$$

$$s = 0.12$$

$$u = 6$$

$$v = 0$$

$$g = ?$$

t

4.

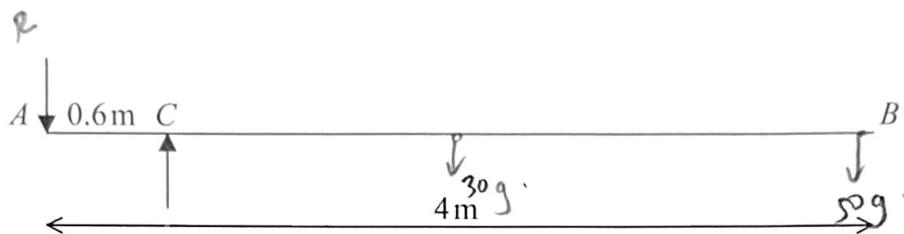


Figure 1

A diving board AB consists of a wooden plank of length 4m and mass 30kg. The plank is held at rest in a horizontal position by two supports at the points A and C , where $AC = 0.6$ m, as shown in Figure 1. The force on the plank at A acts vertically downwards and the force on the plank at C acts vertically upwards.

A diver of mass 50 kg is standing on the board at the end B . The diver is modelled as a particle and the plank is modelled as a uniform rod. The plank is in equilibrium.

(a) Find

- (i) the magnitude of the force acting on the plank at A ,
- (ii) the magnitude of the force acting on the plank at C .

(6)

The support at A will break if subjected to a force whose magnitude is greater than 5000 N.

(b) Find, in kg, the greatest integer mass of a diver who can stand on the board at B without breaking the support at A .

(3)

(c) Explain how you have used the fact that the diver is modelled as a particle.

(1)

$$\text{ai) } M(A).$$

$$A = \frac{1060}{3} \text{ g}$$

$$0.6(C) = 30g(2) + 50g(4)$$

$$\text{bi) } M(C).$$

$$C = \frac{60g + 200g}{0.6}$$

$$(30g \times 1.4) + (Mg \times 3.4) = 0.6 \times 5000$$

$$C = \frac{1300}{3} \text{ g}$$

$$M = 77 \text{ kg (nearest integer)}$$

\uparrow Balancing Forces.

(c) Weight of the diver acts at a point.

$$A + 30g + 50g = C$$

$$A + 80g = \frac{1300}{3}$$

5. Two forces, \mathbf{F}_1 and \mathbf{F}_2 , act on a particle A .

$$\mathbf{F}_1 = (2\mathbf{i} - 3\mathbf{j}) \text{ N and } \mathbf{F}_2 = (p\mathbf{i} + q\mathbf{j}) \text{ N, where } p \text{ and } q \text{ are constants.}$$

Given that the resultant of \mathbf{F}_1 and \mathbf{F}_2 is parallel to $(\mathbf{i} + 2\mathbf{j})$,

(a) show that $2p - q + 7 = 0$

(5)

Given that $q = 11$ and that the mass of A is 2 kg, and that \mathbf{F}_1 and \mathbf{F}_2 are the only forces acting on A ,

(b) find the magnitude of the acceleration of A .

(5)

$$\mathbf{F}_1 = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$$

$$\mathbf{F}_2 = \begin{pmatrix} p \\ q \end{pmatrix},$$

$$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} p \\ q \end{pmatrix} = k \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

$$F = ma$$

$$\begin{pmatrix} 4 \\ 8 \end{pmatrix} = 2a$$

$$a = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$$

$$2+p = k$$

$$\sqrt{2^2 + 4^2}$$

$$-3+q = 2k$$

$$= \underline{\underline{\sqrt{80}}}$$

$$2(2+p) = -3+q$$

$$-3+q = 4+2p$$

$$2p - q + 7 = 0 \text{ as req.}$$

(b) if $q = 11$ then $p = ?$

$$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} 2 \\ 11 \end{pmatrix}$$

$$= \begin{pmatrix} 4 \\ 8 \end{pmatrix}$$

6.

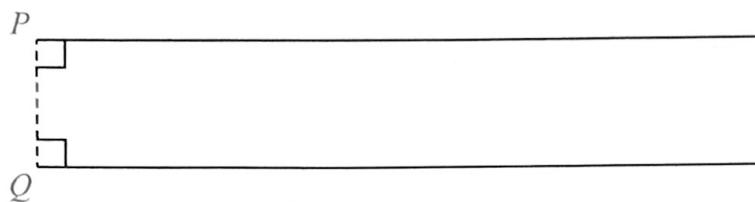


Figure 2

Two cars, A and B , move on parallel straight horizontal tracks. Initially A and B are both at rest with A at the point P and B at the point Q , as shown in Figure 2. At time $t = 0$ seconds, A starts to move with constant acceleration $a \text{ m s}^{-2}$ for 3.5 s, reaching a speed of 14 m s^{-1} . Car A then moves with constant speed 14 m s^{-1} .

- (a) Find the value of a . (2)

Car B also starts to move at time $t = 0$ seconds, in the same direction as car A . Car B moves with a constant acceleration of 3 m s^{-2} . At time $t = T$ seconds, B overtakes A . At this instant A is moving with constant speed.

- (b) On a diagram, sketch, on the same axes, a speed-time graph for the motion of A for the interval $0 \leq t \leq T$ and a speed-time graph for the motion of B for the interval $0 \leq t \leq T$. (3)

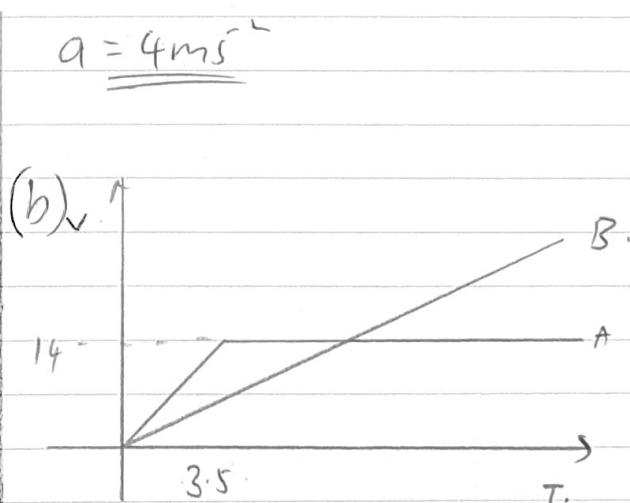
- (c) Find the value of T . (8)

- (d) Find the distance of car B from the point Q when B overtakes A . (1)

- (e) On a new diagram, sketch, on the same axes, an acceleration-time graph for the motion of A for the interval $0 \leq t \leq T$ and an acceleration-time graph for the motion of B for the interval $0 \leq t \leq T$. (3)

$$\begin{aligned}(a) \quad & s \\& v = 0 \\& v = 14 \\& a = 9 \\& t = 3.5\end{aligned}$$

$$\begin{aligned}\frac{v - u}{t} &= a \\ \frac{14 - 0}{3.5} &= 9 \\ 14 &= 3.5 \times 9\end{aligned}$$



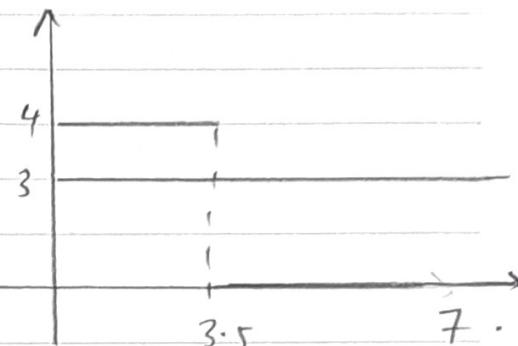
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Question 6 continued

(c) Area under A

$$\frac{1}{2} \times 3.5 \times 14 + (7 - 3.5)14$$

$$= 14\bar{T} - 24.5$$

(e)



Under B.

S

$$U = 0$$

$$V = 3T$$

$$g = 3$$

$$\frac{V}{3} = T$$

$$v = 3T$$

$$k = T$$

$$\frac{1}{2} \times T \times 3T = \frac{3T^2}{2}$$

$$\frac{3T^2}{2} = 14\bar{T} - 24.5$$

$$3T^2 = 28T - 49$$

$$\frac{-28 \pm \sqrt{28^2 - 4(-3)(-49)}}{2 \times -3}$$

$$T = 7 \text{ or } 7/3$$

Since $T > 3.5$

$$\bar{T} = 7$$

d) area under B = $\frac{1}{2}(T)(3T)$
 $= \frac{1}{2}(7)(3)(7) = 73.5$

7.

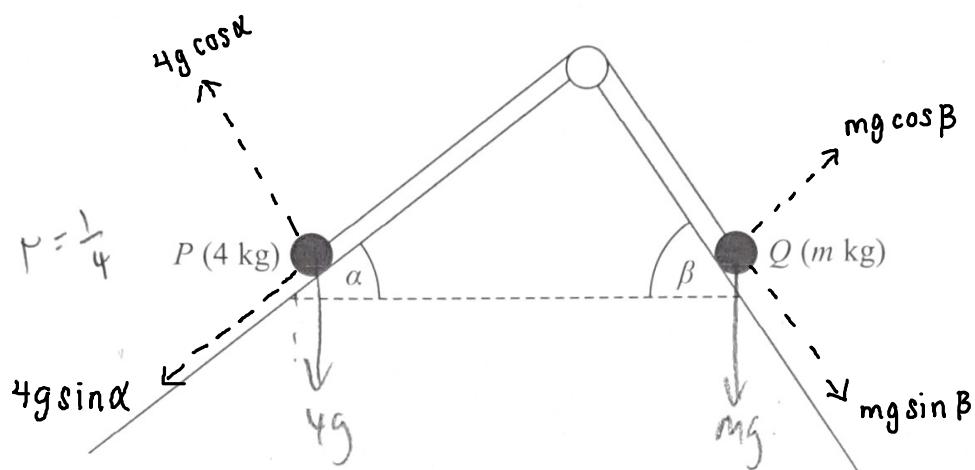


Figure 3

A particle P of mass 4 kg is attached to one end of a light inextensible string. A particle Q of mass m kg is attached to the other end of the string. The string passes over a small smooth pulley which is fixed at a point on the intersection of two fixed inclined planes. The string lies in a vertical plane that contains a line of greatest slope of each of the two inclined planes. The first plane is inclined to the horizontal at an angle α , where

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

$\tan \beta = \frac{4}{3}$. Particle P is on the first plane and particle Q is on the second plane with the string taut, as shown in Figure 3.

The first plane is rough and the coefficient of friction between P and the plane is $\frac{1}{4}$. The second plane is smooth. The system is in limiting equilibrium.

Given that P is on the point of slipping down the first plane,

(a) find the value of m ,

(10)

(b) find the magnitude of the force exerted on the pulley by the string,

(4)

(c) find the direction of the force exerted on the pulley by the string.

$$\sin \alpha = \frac{3}{5}, \cos \alpha = \frac{4}{5} \quad \sin \beta = \frac{4}{5}, \cos \beta = \frac{3}{5} \quad (\text{L}) \quad 4g \sin \alpha - F - T = 0 \quad (1)$$

$$(a) \quad 4g \cos \alpha = R.$$

$$4g \left(\frac{3}{5}\right) - \frac{4}{5}g - T = 0$$

$$R = \frac{16}{5}g$$

$$F = MR = 0.25 \left(\frac{16}{5}g\right) = \frac{4}{5}g$$

$$\frac{12g}{5} - \frac{4g}{5} - T = 0. \quad \dots \quad (1)$$

$$T - mg \sin \beta = 0.$$

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blank**Question 7 continued**

$$\frac{T - 4mg}{5} = 0 \quad \text{--- (1)}$$

$$(1) + (2) \quad .$$

$$\frac{8g}{5} - \frac{4mg}{5} = 0.$$

$$\frac{4mg}{5} = \frac{8g}{5}$$

$$\underline{\underline{m = 2}}$$

$$(b) F = \sqrt{T^2 + T^2} \quad T = \frac{8g}{5}$$

$$= \sqrt{\left(\frac{8g}{5}\right)^2 + \left(\frac{8g}{5}\right)^2}$$

$$\underline{\underline{= 22.2 \text{ N}}}$$

(c) Along the perpendicular angle bisector at the pulley.