Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

A Level Clouds 出品

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 (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 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 ▶

Pearson

1. Two particles, P and Q, with masses m and $2m$ respectively, are moving in the same direction along the same straight line when they collide directly. Immediately before they collide, P is moving with speed $4u$ and Q is moving with speed u. Immediately after they collide, both particles are moving in the same direction and the speed of Q is four times the speed of P.

(a) Find the speed of Q immediately after the collision.

(3)

(b) Find the magnitude of the impulse exerted by Q on P in the collision.

(3)

(c) State clearly the direction of this impulse.

(1)

Question 1 continued

(Total for Question 1 is 7 marks)

2.

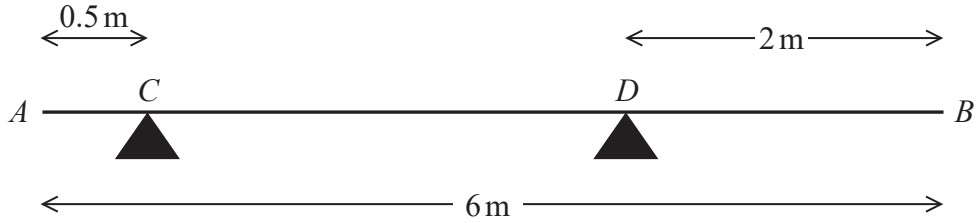

Figure 1

A metal girder AB, of weight 1080 N and length 6 m, rests in equilibrium in a horizontal position on two supports, one at C and one at D, where $AC = 0.5$ m and $BD = 2$ m, as shown in Figure 1. A boy of weight 400 N stands on the girder at B and the girder remains horizontal and in equilibrium. The boy is modelled as a particle and the girder is modelled as a uniform rod.

(a) Find

(i) the magnitude of the reaction on the girder at C,

(ii) the magnitude of the reaction on the girder at D.

(6)

The boy now stands at a point E on the girder, where $AE = x$ metres, and the girder remains horizontal and in equilibrium. Given that the magnitude of the reaction on the girder at D is now 520 N greater than the magnitude of the reaction on the girder at C,

(b) find the value of x.

(5)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 11 marks)

3. A particle, P, is projected vertically upwards with speed U from a fixed point O. At the instant when P reaches its greatest height H above O, a second particle, Q, is projected with speed $\frac{1}{2}U$ vertically upwards from O.

(a) Find H in terms of U and g.

(2)

(b) Find, in terms of U and g, the time between the instant when Q is projected and the instant when the two particles collide.

(6)

(c) Find where the two particles collide.

(3)

Question 3 continued

Question 3 continued

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Question 3 continued

(Total for Question 3 is 11 marks)

4. Two forces $\mathbf{F}_1$ and $\mathbf{F}_2$ act on a particle. The force $\mathbf{F}_1$ has magnitude 8 N and acts due east. The resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$ is a force of magnitude 14 N acting in a direction whose bearing is 120°.

Find

(i) the magnitude of $\mathbf{F}_2$,

(4)

(ii) the direction of $\mathbf{F}_2$, giving your answer as a bearing to the nearest degree.

(5)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 9 marks)

5.

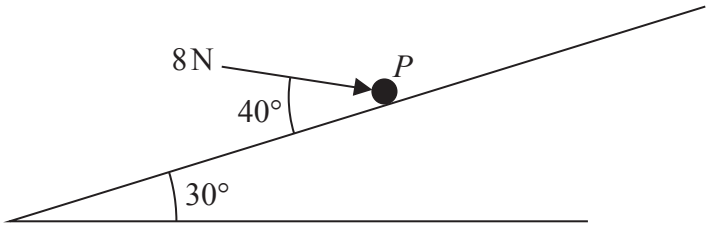

Figure 2

A particle P of mass 0.5 kg is at rest on a rough plane which is inclined to the horizontal at 30°. The particle is held in equilibrium by a force of magnitude 8 N, acting at an angle of 40° to the plane, as shown in Figure 2. The line of action of the force lies in the vertical plane containing P and a line of greatest slope of the plane. The coefficient of friction between P and the plane is μ. Given that P is on the point of sliding up the plane, find the value of μ.

(9)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 9 marks)

6. Two girls, Agatha and Brionie, are roller skating inside a large empty building. The girls are modelled as particles.

At time $t = 0$, Agatha is at the point with position vector $(11\mathbf{i} + 11\mathbf{j})$ m and Brionie is at the point with position vector $(7\mathbf{i} + 16\mathbf{j})$ m. The position vectors are given relative to the door, O, and $\mathbf{i}$ and $\mathbf{j}$ are horizontal perpendicular unit vectors.

Agatha skates with constant velocity $(3\mathbf{i} - \mathbf{j})\,\text{m s}^{-1}$

Brionie skates with constant velocity $(4\mathbf{i} - 2\mathbf{j})\,\text{m s}^{-1}$

(a) Find the position vector of Agatha at time t seconds.

(2)

At time $t = 6$ seconds, Agatha passes through the point P.

(b) Show that Brionie also passes through P and find the value of t when this occurs.

(4)

At time t seconds, Agatha is at the point A and Brionie is at the point B.

(c) Show that $\overrightarrow{AB} = [(t - 4)\mathbf{i} + (5 - t)\mathbf{j}]$ m

(2)

(d) Find the distance between the two girls when they are closest together.

(4)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 12 marks)

7.

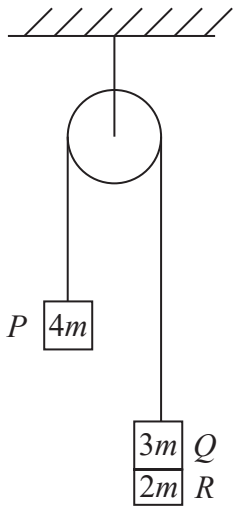

Figure 3

Three particles, P, Q and R, have masses $4m$, $3m$ and $2m$ respectively. Particles P and Q are connected by a light inextensible string that passes over a smooth light fixed pulley. Particle R is attached to particle Q. The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 3. The system is released from rest.

(a) Find

(i) the acceleration of particle P,

(ii) the tension in the string.

(7)

(b) State how you have used the fact that the string is inextensible.

(1)

At the instant when particle P has moved a distance d upwards from its initial position, particle R separates from particle Q and falls away. In the subsequent motion, particles P and Q continue to move and particle P does not reach the pulley.

At the instant when particles R and Q separate, particle Q is at the point A, and it continues to move downwards. Particle Q then comes to instantaneous rest at the point B.

(c) Find, in terms of d, the distance AB.

(8)

Question 7 continued

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 16 marks)

TOTAL FOR PAPER IS 75 MARKS