

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Pearson Edexcel		Centre Number	Candidate Number
International			
Advanced Level			
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 $g = 9.8 \text{ m s}^{-2}$, 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.
- Good luck with your examination.

Turn over ►

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1. A motorcyclist and his motorcycle have a combined mass of 480 kg.

The motorcyclist drives down a straight road that is inclined at an angle θ to the horizontal, where $\sin \theta = \frac{1}{12}$, with the engine of the motorcycle working at 3.5 kW. The motorcycle is moving at a constant speed of $V \text{ ms}^{-1}$. The resistance to the motion of the motorcycle is modelled as a constant force with magnitude $20V$ newtons.

Find the value of V .

(5)

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Question 1 continued

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Q1

(Total 5 marks)



- At time t seconds, $t \geq 0$, P has velocity $v \text{ m s}^{-1}$, where

$$\mathbf{v} = (5t^2 - t^3)\mathbf{i} + (2t^3 - 8t)\mathbf{j}$$

- (a) Find $\mathbf{F}$ when $t = 2$

(4)

At time $t = 0$, P is at the origin O .

- (b) Find the position vector of P relative to O at the instant when P is moving in the direction of the vector $\mathbf{j}$

(4)

Question 2 continued

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Q2

(Total 8 marks)



3.

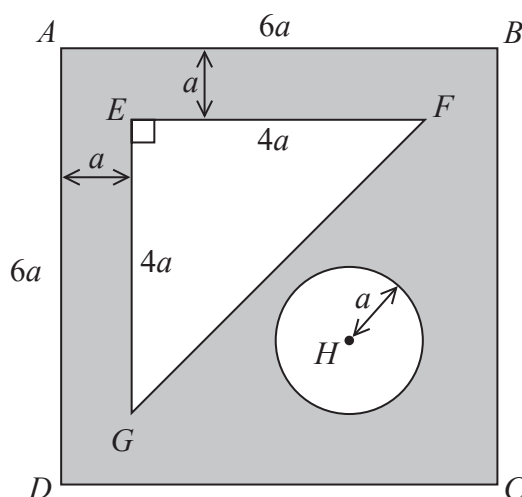


Figure 1

The uniform lamina $ABCD$ is a square of side $6a$. The template T , shown shaded in Figure 1, is formed by removing the right-angled triangle EFG and the circle, centre H and radius a , from the square lamina.

Triangle EFG has $EF = EG = 4a$, with EF parallel to AB and EG parallel to AD . The distance between AB and EF is a and the distance between AD and EG is a .

The point H lies on AC and the distance of H from BC is $2a$.

- (a) Show that the centre of mass of T is a distance $\frac{4(67 - 3\pi)}{3(28 - \pi)}a$ from AD . (5)

The template T is suspended from the ceiling by two light inextensible vertical strings. One string is attached to T at A and the other string is attached to T at B so that T hangs in equilibrium with AB horizontal.

The weight of T is W . The tension in the string attached to T at B is kW , where k is a constant.

- (b) Find the value of k , giving your answer to 2 decimal places. (3)

Question 3 continued

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Question 3 continued

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Q3

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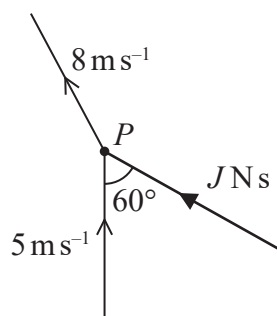


Figure 2

A particle P of mass 0.3 kg is moving with speed 5 m s^{-1} along a straight line on a smooth horizontal plane. The particle receives a horizontal impulse of magnitude $J \text{ N s}$. The speed of P immediately after receiving the impulse is 8 m s^{-1} . The angle between the direction of motion of P before it receives the impulse and the direction of the impulse is 60° , as shown in Figure 2.

Find the value of J .

(6)

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Question 4 continued

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Q4

(Total 6 marks)



Question 5 continued

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Question 5 continued

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Q5

(Total 9 marks)



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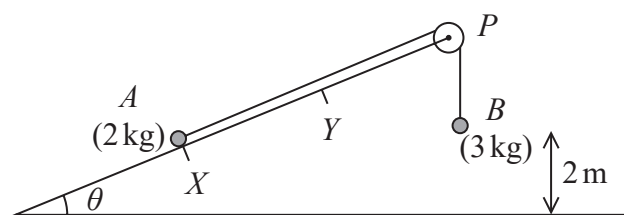


Figure 4

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 at the point X on a fixed rough ramp that is inclined at an angle θ to the horizontal, where $\tan \theta = \frac{5}{12}$. The string passes over a small smooth pulley P that is fixed at the top of the ramp. Particle B hangs vertically below P , 2 m above the ground, as shown in Figure 4.

The particles are released from rest with the string taut so that A moves up the ramp and 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 $\frac{3}{8}$.

Air resistance is ignored.

- (a) Find the potential energy lost by the system as A moves 2 m up the ramp. (3)

- (b) Find the work done against friction as A moves 2 m up the ramp. (4)

When B hits the ground, B is brought to rest by the impact and does not rebound and A continues to move up the ramp.

- (c) Use the work-energy principle to find the speed of B at the instant before it hits the ground. (4)

Particle A comes to instantaneous rest at the point Y on the ramp, where $XY = (2 + d)\text{ m}$.

- (d) Use the work-energy principle to find the value of d . (4)



Question 6 continued

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Question 6 continued

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Handwriting practice area with 30 horizontal lines.

(Total 15 marks)

Q6

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- A diagram showing a parabolic path of a particle starting at point A and ending at point B . The path is a semi-circle above a horizontal line. At point A , an arrow indicates the initial velocity vector, labeled $(6\mathbf{i} + 12\mathbf{j}) \text{ m s}^{-1}$.

(c) Find, in terms of $\mathbf{i}$ and $\mathbf{j}$, the velocity of the ball when it is at C . (3)

Question 7 continued

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Question 7 continued

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Q7

(Total 11 marks)



Question 8 continued

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Question 8 continued

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Question 8 continued

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Q8

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

END

