

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel 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 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 ►

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Question 1 continued

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Q1

(Total 8 marks)



- (5)

(4)

Question 2 continued

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Question 2 continued

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Q2

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- (6)



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Question 3 continued

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Q3

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Question 4 continued

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Question 4 continued

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Question 4 continued

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(Total 10 marks)

Q4



5.

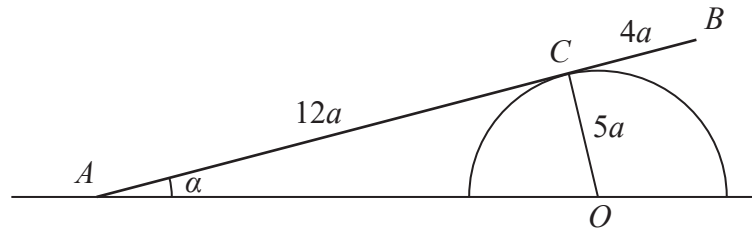


Figure 1

A smooth solid hemisphere is fixed with its flat surface in contact with rough horizontal ground. The hemisphere has centre  $O$  and radius  $5a$ .

A uniform rod  $AB$ , of length  $16a$  and weight  $W$ , rests in equilibrium on the hemisphere with end  $A$  on the ground. The rod rests on the hemisphere at the point  $C$ , where  $AC = 12a$  and angle  $CAO = \alpha$ , as shown in Figure 1.

Points  $A$ ,  $C$ ,  $B$  and  $O$  all lie in the same vertical plane.

- (a) Explain why  $AO = 13a$  (1)

The normal reaction on the rod at  $C$  has magnitude  $kW$

- (b) Show that  $k = \frac{8}{13}$  (3)

The resultant force acting on the rod at  $A$  has magnitude  $R$  and acts upwards at  $\theta^\circ$  to the horizontal.

- (c) Find
- (i) an expression for  $R$  in terms of  $W$
- (ii) the value of  $\theta$  (8)





Question 5 continued

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Question 5 continued

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Question 5 continued

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Q5

(Total 12 marks)



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6. [The centre of mass of a semicircular arc of radius  $r$  is  $\frac{2r}{\pi}$  from the centre.]

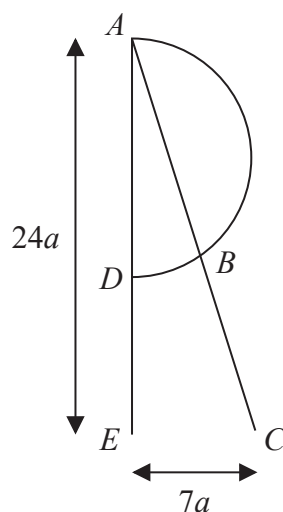


Figure 2

Uniform wire is used to form the framework shown in Figure 2.

In the framework,

- $ABC$  is straight and has length  $25a$
- $ADE$  is straight and has length  $24a$
- $ABD$  is a semicircular arc of radius  $7a$
- $EC = 7a$
- angle  $AEC = 90^\circ$
- the points  $A, B, C, D$  and  $E$  all lie in the same plane

The distance of the centre of mass of the framework from  $AE$  is  $d$ .

- (a) Show that  $d = \frac{53}{2(7 + \pi)}a$  (4)

The framework is freely suspended from  $A$  and hangs in equilibrium with  $AC$  at angle  $\alpha^\circ$  to the downward vertical.

- (b) Find the value of  $\alpha$ . (7)



Question 6 continued

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Question 6 continued

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Question 6 continued

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(Total 11 marks)

Q6



7. A particle  $P$  is projected from a fixed point  $O$  on horizontal ground. The particle is projected with speed  $u$  at an angle  $\alpha$  above the horizontal. At the instant when the horizontal distance of  $P$  from  $O$  is  $x$ , the vertical distance of  $P$  above the ground is  $y$ . The motion of  $P$  is modelled as that of a particle moving freely under gravity.

(a) Show that  $y = x \tan \alpha - \frac{gx^2}{2u^2} (1 + \tan^2 \alpha)$  (6)

A small ball is projected from the fixed point  $O$  on horizontal ground. The ball is projected with speed  $20 \text{ m s}^{-1}$  at angle  $\theta^\circ$  above the horizontal. A vertical pole  $AB$ , of height  $2 \text{ m}$ , stands on the ground with  $OA = 10 \text{ m}$ , as shown in Figure 3.

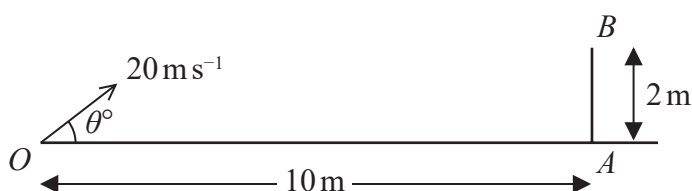


Figure 3

The ball is modelled as a particle moving freely under gravity and the pole is modelled as a rod.

The path of the ball lies in the vertical plane containing  $O$ ,  $A$  and  $B$ .

Using the model,

- (b) find the range of values of  $\theta$  for which the ball will pass over the pole. (3)

Given that  $\theta = 40^\circ$  and that the ball first hits the ground at the point  $C$

- (c) find the speed of the ball at the instant it passes over the pole, (5)

- (d) find the distance  $OC$ . (2)





Question 7 continued

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Question 7 continued

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Question 7 continued

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