

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL A-LEVEL FURTHER MATHEMATICS

(9665/FM05) Unit FM2 Mechanics

Wednesday 18 January 2023 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- The **final** answer to questions requiring the use of calculators should be given to two significant figures, unless stated otherwise.
- Unless stated otherwise, the acceleration due to gravity, g , should be taken as 9.8 m s^{-2}

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
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TOTAL	



J A N 2 3 F M 0 5 0 1

4

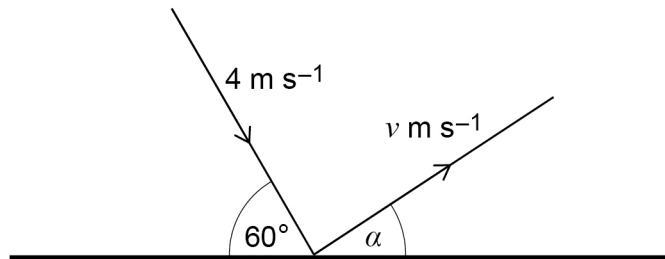


[illegible]

4

When the disc hits the wall, it has a speed of 4 m s^{-1} and is moving at an angle of 60° to the wall.

The motion of the disc is shown in the diagram below.



[4 marks]

[illegible]

3 (b) Determine the range of possible values of v

[2 marks]

Answer

6

Turn over for the next question

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[5 marks]

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Answer _____

4 (b) Calculate the value of V giving your answer to **two** significant figures.

[2 marks]

$V =$ _____

<hr/> 7

Turn over ►



[6 marks]

[illegible]

[4 marks]

[illegible]

Answer _____

10

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One end of the string is attached to a fixed point O and the other end is attached to a small sphere of mass 0.2 kg

6 (a) Find the maximum length of the string in the subsequent motion.

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Answer

[3 marks]



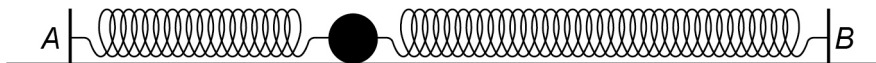
[5 marks]

[illegible]

12

- 7** A particle of mass m kg is on a smooth horizontal surface.

Two springs are attached to the particle, with the other ends of the springs attached to fixed points A and B , as shown in the diagram.



The spring attached to A has stiffness $4k \text{ N m}^{-1}$ and natural length $2d$ metres.

The spring attached to B has stiffness $3k \text{ N m}^{-1}$ and natural length $3d$ metres.

The distance between A and B is $7d$ metres.

- 7 (a)** Find in terms of d the distance of the particle from A when it is in equilibrium.

[3 marks]

Answer _____



- In the subsequent motion the displacement of the particle to the right of its equilibrium position is x metres at time t seconds.

- [2 marks]**

Answer

- [5 marks]**

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Question 7 continues on the next page

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7 (b) (iii) Find in terms of k , m and π the period of the motion.

[2 marks]

Answer _____

7 (b) (iv) Determine the maximum speed of the particle in terms of d , k and m

[2 marks]

Answer _____



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8

A block of mass 1.5 kg is placed on a rough horizontal surface.

The coefficient of friction between the block and the surface is 0.3

A light inextensible string is attached to the block and passes over a smooth peg.

The smooth peg is positioned on the edge of the horizontal surface.

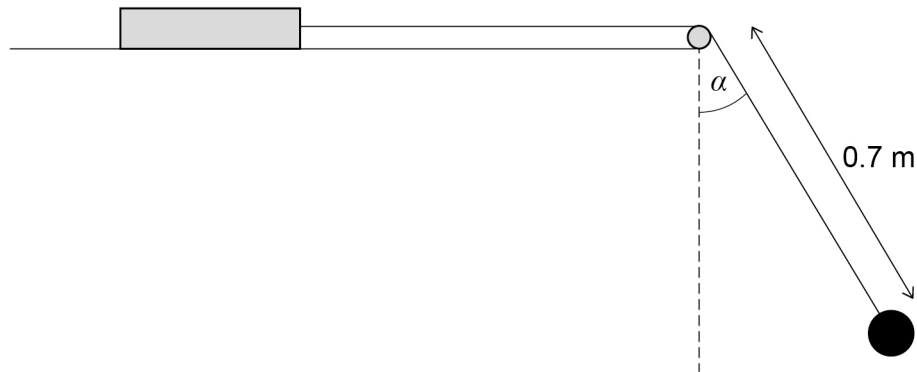
The string between the block and the peg is horizontal.

The other end of the string is attached to a particle of mass 0.4 kg

The particle is released from rest with the string at an angle α degrees to the downward vertical.

The initial path of the particle is part of a vertical circle of radius 0.7 metres.

The diagram below shows the initial situation.



8 (a) In a first case $\alpha = 30$

Find the angle between the string and the vertical when the block is on the point of sliding for the first time, giving your answer to the nearest degree.

[7 marks]



Answer _____

- Find the maximum possible value of α giving your answer to the nearest degree.

[5 marks]

Answer _____

12

Turn over ►



11

END OF QUESTIONS



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Question number	Additional page, if required. Write the question numbers in the left-hand margin.



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