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I declare this is my own work.

INTERNATIONAL A-LEVEL FURTHER MATHEMATICS

(9665/FM05) Unit FM2 Mechanics

Friday 19 January 2024 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the OxfordAQA 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
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



Answer **all** questions in the spaces provided.

1 Two particles A and B are moving on a smooth horizontal surface.

The two particles collide.

Particle A has mass 2 kg and has velocity $\begin{bmatrix} 4 \\ 7 \end{bmatrix} \text{ m s}^{-1}$ before the collision.

Particle B has mass 6 kg and has velocity $\begin{bmatrix} 6 \\ -4 \end{bmatrix} \text{ m s}^{-1}$ before the collision.

After the collision particle A has velocity $\begin{bmatrix} 7 \\ 1 \end{bmatrix} \text{ m s}^{-1}$

1 (a) Find the velocity of B after the collision.

[4 marks]

Answer _____



2 A particle moves with simple harmonic motion between two points A and B which are 1.5 metres apart on a straight line.

The period of the motion is 4 seconds.

2 (a) Calculate the maximum speed of the particle.

Give your answer in terms of π

[2 marks]

Answer _____

2 (b) The point C is between A and B and the distance between A and C is 0.3 metres.

Find the speed of the particle at C

Give your answer in terms of π

[2 marks]

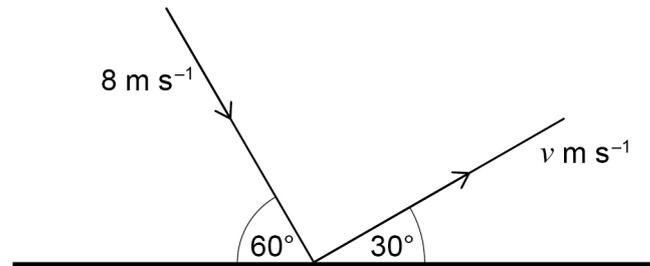
Answer _____



- 3** A disc of mass 0.2 kg is moving on a smooth horizontal surface, when it hits a smooth vertical wall which is fixed to the surface.

When it hits the wall, the disc is moving at 8 m s^{-1} and its velocity makes an angle of 60° to the wall.

When the disc leaves the wall it has a velocity of $v \text{ m s}^{-1}$ at an angle 30° to the wall, as shown in the diagram.



- 3 (a)** Find the value of v

Give your answer in an exact form.

[3 marks]

Answer _____



3 (b) Find the coefficient of restitution between the wall and the disc.

[3 marks]

Answer _____

3 (c) Find the magnitude of the impulse exerted on the disc.

Give your answer in an exact form.

[3 marks]

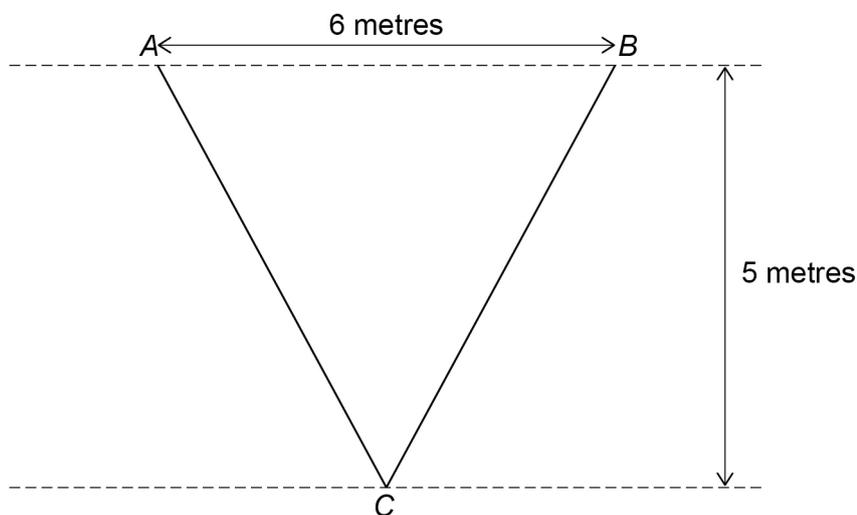
Answer _____

9

Turn over ►



- 7** Two identical light elastic strings have modulus of elasticity 800 newtons and natural length 5 metres.
- One end of each string is attached to a particle of mass 7 kg
- The other end of one string is attached to the point A and the other end of the second string is attached to the point B
- The points A and B are 6 metres apart and at the same level.
- The particle is released from rest at the point C which is 5 metres vertically below the level of the points A and B
- When the particle is released, the magnitude of the tension is the same in each string.
- The elastic strings are shown in the diagram below.



- 7 (a)** Find the total elastic potential energy of the system when the particle is released.
- Give your answer to three significant figures.

[4 marks]

Answer _____



9 Two smooth spheres A and B have the same diameter and are on a smooth horizontal surface.

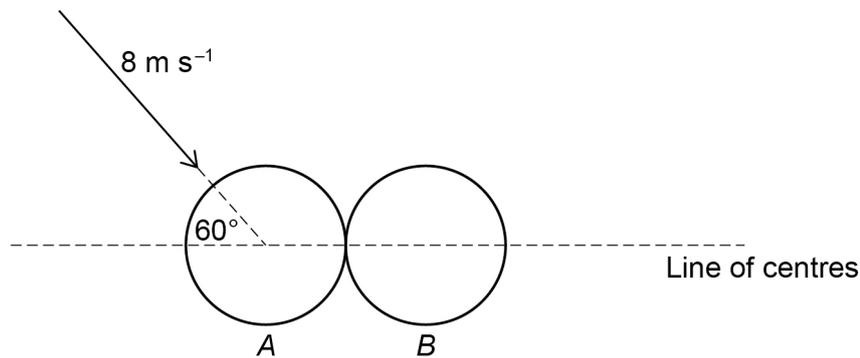
The mass of A is 12 kg and the mass of B is 3 kg

Sphere A is set into motion and hits sphere B which is at rest.

Before the collision the velocity of A is 8 m s^{-1} at an angle of 60° to the line of centres.

The coefficient of restitution between the spheres is e

The diagram shows the velocity of sphere A before the collision.



9 (a) Find, in terms of e , the speed of A after the collision.

[6 marks]



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