

Cambridge International AS & A Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

1076280977

FURTHER MATHEMATICS

9231/32

Paper 3 Further Mechanics

October/November 2022

1 hour 30 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer all questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- Do not write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- Where a numerical value for the acceleration due to gravity (g) is needed, use $10 \,\mathrm{m\,s^{-2}}$.

INFORMATION

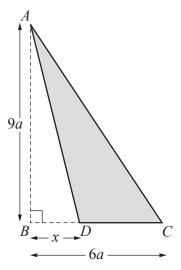
- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has 16 pages. Any blank pages are indicated.

1

A particle P of mass m is attached to one end of a light inextensible string of length a. The other end

Find the cosin slack.	ne of the angl	e between	the string	and the u	ipward ver	tical when	the string	first beco
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A uniform lamina is in the form of a triangle ABC in which angle B is a right angle, AB = 9a and BC = 6a. The point D is on BC such that BD = x (see diagram). The region ABD is removed from the lamina. The resulting shape ADC is placed with the edge DC on a horizontal surface and the plane ADC is vertical.

Find the set of values of x , in terms of a , for which the shape is in equilibrium.	[6]

One end of a light elastic string, of natural length a and modulus of elasticity $\frac{16}{3}Mg$, is attached to a fixed point O . A particle P of mass $4M$ is attached to the other end of the string and hangs vertically in equilibrium. Another particle of mass $2M$ is attached to P and the combined particle is then released from rest. The speed of the combined particle when it has descended a distance $\frac{1}{4}a$ is v .						
Find an expression for v in terms of g and a .	[6					

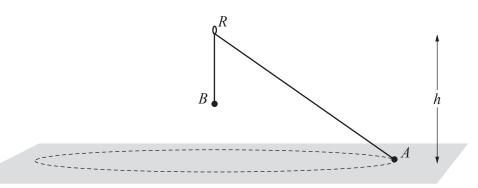
mag	gnitude $\frac{500}{v}$ N in the direction <i>OP</i> and a resistive force of magnitude $\frac{1}{2}v^2$ N	When $t = 0$, $x = 0$
v =	5.	
(a)	Find an expression for v in terms of x .	

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A particle P is projected with speed u m s⁻¹ at an angle of θ above the horizontal from a point O on a horizontal plane and moves freely under gravity. The horizontal and vertical displacements of P from Oat a subsequent time ts are denoted by x m and y m respectively. (a) Show that the equation of the trajectory is given by $y = x \tan \theta - \frac{gx^2}{2u^2} (1 + \tan^2 \theta).$ [4]

Given that one possible value of $\tan \theta$ is $\frac{4}{3}$, find the other possible value of $\tan \theta$.	
Orven that one possible value of tail of is 3, find the other possible value of tail of	
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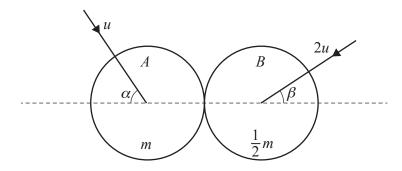
A light inextensible string is threaded through a fixed smooth ring R which is at a height h above a smooth horizontal surface. One end of the string is attached to a particle A of mass m. The other end of the string is attached to a particle B of mass $\frac{6}{7}m$. The particle B moves in a horizontal circle on the surface. The particle B hangs in equilibrium below the ring and above the surface (see diagram).

When A has constant angular speed ω , the angle between AR and BR is θ and the normal reaction between A and the surface is N.

When A has constant angular speed $\frac{3}{2}\omega$, the angle between AR and BR is α and the normal reaction between A and the surface is $\frac{1}{2}N$.

(a)	Show that $\cos \theta = \frac{4}{9} \cos \alpha$.	[5]
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Find <i>I</i>	V in terms o	of m and g	and find t	he value	of $\cos \alpha$.			
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Two uniform smooth spheres A and B of equal radii have masses m and $\frac{1}{2}m$ respectively. The two spheres are moving on a horizontal surface when they collide. Immediately before the collision, sphere A is travelling with speed u and its direction of motion makes an angle α with the line of centres. Sphere B is travelling with speed 2u and its direction of motion makes an angle β with the line of centres (see diagram). The coefficient of restitution between the spheres is $\frac{5}{8}$ and $\alpha + \beta = 90^{\circ}$.

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The direction of motion of B after the collision is parallel to the direction of motion of A before the collision.

	If the value of $\tan \alpha$.	
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Additional page

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