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FURTHER MATHEMATICS

9231/34

Paper 3 Further Mechanics

May/June 2026

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. Do **not** use correction fluid or tape.
- 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 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.



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- [4]

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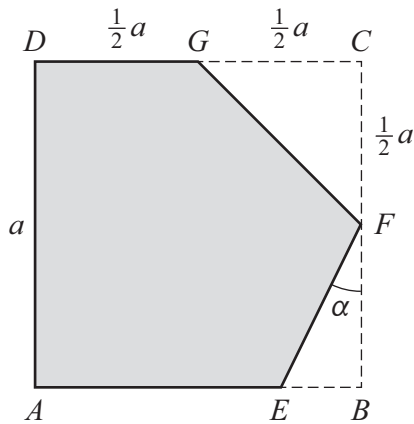
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2



A uniform lamina $AEFGD$ is formed by removing two triangles from a square $ABCD$ of side length a . Triangle FCG is isosceles and the two equal sides each have length $\frac{1}{2}a$. The angle between EF and BF is α , where $\tan \alpha = \frac{1}{2}$ (see diagram).

The centre of mass of the lamina is at a distance $\bar{x}$ from AD and at a distance $\bar{y}$ from AE .

- (a) Show that $\bar{x} = \frac{5}{12}a$ and find a corresponding expression for $\bar{y}$ in terms of a . [5]

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- (b) The lamina is freely suspended from the point G and hangs in equilibrium. The angle between DA and the downward vertical through G is θ .

Find the value of θ .

[2]





- 3 A particle of mass m is attached to a fixed point O by a light inextensible string of length a . The particle moves in complete vertical circles about O . Points A and B are on the path of the particle. OA makes an angle of 60° with the upward vertical through O . The speed of the particle at A is u and the tension in the string at A is T_A . The point B is vertically below O . The speed of the particle at B is $2u$ and the tension in the string at B is T_B .

(a) Show that $T_B = kT_A$, where k is a constant to be determined. [6]

[illegible]



- (b) Find the loss in kinetic energy of the particle between its lowest and highest points. Give your answer in terms of m , g and a . [1]





- 4 Two particles A and B have masses km and m respectively. Particle A is at rest on a smooth horizontal surface and is exactly halfway between two fixed parallel smooth vertical walls. Particle B is moving on the surface with speed u in a direction perpendicular to the walls, and collides directly with A . The coefficient of restitution between the two particles is 0.2 . As a result of the collision, the direction of motion of B is reversed.

(a) Show that $k > 5$.

[3]

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- (b) Particle B then collides with one of the vertical walls and rebounds. The coefficient of restitution between B and the wall is 0.8. It then collides again with particle A at the instant when A collides with the other vertical wall.

Find the value of k .

[3]

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- 5 A particle P of mass m is moving in a straight horizontal line under a variable force $m(v^2 - ku^2)$, where v is the velocity of P at time t , u is the initial velocity of P , and k is a positive constant. It is given that $u > 0$ and $k > 1$.

(a) Explain why, initially, the acceleration and velocity of P have opposite directions. [1]

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(b) Find, in terms of k , the distance travelled by P until it first comes to instantaneous rest. [4]

[illegible]

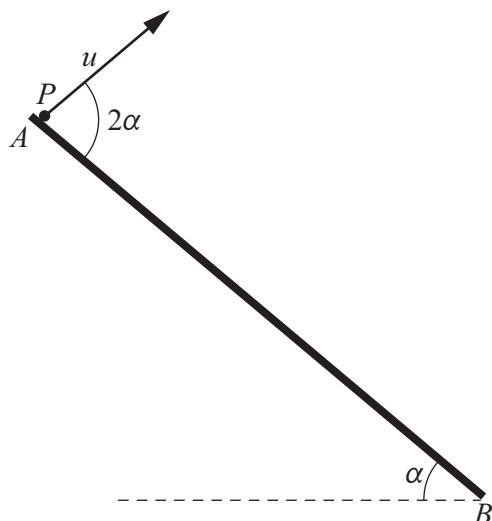


(c) Find, in terms of k and u , the time taken for P to first come to instantaneous rest.

[4]

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6



The points A and B lie on the line of greatest slope of a smooth inclined plane, with A above B . The plane is inclined to the horizontal at an acute angle α .

At time $t = 0$, a particle P is projected from A with speed u at an angle 2α to the plane and moves freely under gravity (see diagram). At the same time, a second particle Q is released from rest at A . Particle Q moves down the plane along the line of greatest slope. The two particles move in the same vertical plane. At time $t = T$, the two particles collide at point B . The length of AB is d .

- (a) By considering the motion of particle Q , show that $T = \sqrt{\frac{2d}{g \sin \alpha}}$. [2]

[illegible]



[5]

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- 7 One end of a light elastic string of natural length $8a$ and modulus of elasticity $6mg$ is attached to a fixed point O on a rough plane. The plane is inclined at an angle θ to the horizontal where $\sin \theta = \frac{5}{13}$. A particle P of mass m is attached to the other end of the string. The string lies along a line of greatest slope of the plane, with P below the level of O . The particle is held at a point such that the extension of the string is $3a$.

When P is released from rest, its acceleration is $\frac{5}{4}g$ in the direction PO .

- (a) Find the coefficient of friction between the particle and the plane. [4]

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- Find, in terms of a , the distance OC .

[6]

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Additional page

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