



Cambridge International AS & A Level

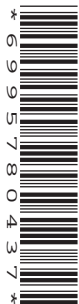
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FURTHER MATHEMATICS

9231/31

Paper 3 Further Mechanics

May/June 2020

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 ms^{-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. Blank pages are indicated.

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- 1 A particle P is projected with speed u at an angle of 30° above the horizontal from a point O on a horizontal plane and moves freely under gravity. The particle reaches its greatest height at time T after projection.

Find, in terms of u , the speed of P at time $\frac{2}{3}T$ after projection. [5]

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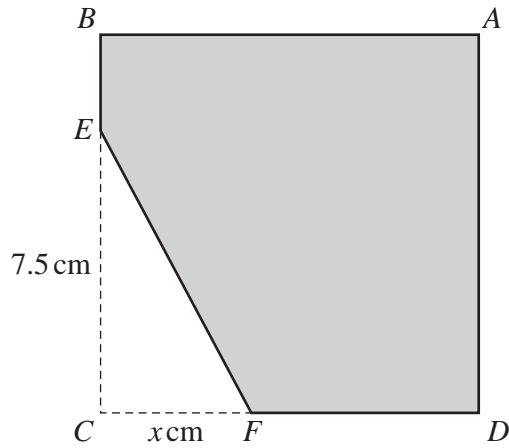
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(b) Find the speed of P when the spring first returns to its natural length. [4]

A series of horizontal dotted lines for writing the answer.

4



A uniform square lamina $ABCD$ has sides of length 10 cm. The point E is on BC with $EC = 7.5$ cm, and the point F is on DC with $CF = x$ cm. The triangle EFC is removed from $ABCD$ (see diagram). The centre of mass of the resulting shape $ABEFD$ is a distance \bar{x} cm from CB and a distance \bar{y} cm from CD .

- (a) Show that $\bar{x} = \frac{400 - x^2}{80 - 3x}$ and find a corresponding expression for \bar{y} . [4]

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The shape $ABEFD$ is in equilibrium in a vertical plane with the edge DF resting on a smooth horizontal surface.

- (b) Find the greatest possible value of x , giving your answer in the form $a + b\sqrt{2}$, where a and b are constants to be determined. [3]

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(b) Find an expression for the displacement of P from its initial position when its velocity is $2u$. [5]

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(b) Show that in its subsequent motion P strikes the cylinder at the point A. [5]

A series of horizontal dotted lines provided for the student to write their answer.

