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Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

8409557496

MATHEMATICS **9709/43**

Paper 4 Mechanics 1 **(M1)** **May/June 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use $10\,\text{m}\,\text{s}^{-2}$.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 50.

This document consists of **12** printed pages.

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1 A bus moves in a straight line between two bus stops. The bus starts from rest and accelerates at $2.1\ \text{m s}^{-2}$ for 5 s. The bus then travels for 24 s at constant speed and finally slows down, with a constant deceleration, stopping in a further 6 s. Sketch a velocity-time graph for the motion and hence find the distance between the two bus stops. [5]

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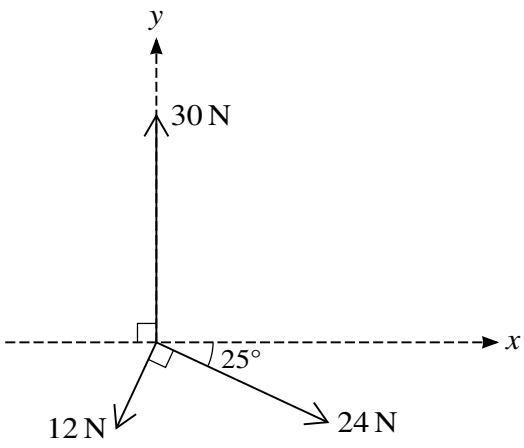
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2



Coplanar forces of magnitudes 12 N, 24 N and 30 N act at a point in the directions shown in the diagram.

(i) Find the components of the resultant of the three forces in the x-direction and in the y-direction. [4]

Component in x-direction.....

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Component in y-direction.....

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(ii) Hence find the direction of the resultant. [2]

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3 A car of mass 1400 kg is travelling up a hill inclined at an angle of 4° to the horizontal. There is a constant resistance to motion of magnitude 1550 N acting on the car.

(i) Given that the engine of the car is working at 30 kW, find the speed of the car at an instant when its acceleration is $0.4\ \text{m s}^{-2}$. [4]

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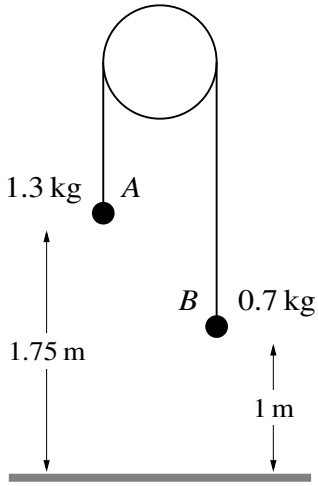
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(ii) The greatest possible constant speed at which the car can travel up the hill is $40\,\text{m}\,\text{s}^{-1}$. Find the maximum possible power of the engine. [3]

4



Two particles A and B, of masses 1.3 kg and 0.7 kg respectively, are connected by a light inextensible string which passes over a smooth fixed pulley. Particle A is 1.75 m above the floor and particle B is 1 m above the floor (see diagram). The system is released from rest with the string taut, and the particles move vertically. When the particles are at the same height the string breaks.

(i) Show that, before the string breaks, the magnitude of the acceleration of each particle is $3\,\text{m}\,\text{s}^{-2}$ and find the tension in the string. [4]

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(ii) Find the difference in the times that it takes the particles to hit the ground. [6]

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5 A particle of mass 18 kg is on a plane inclined at an angle of 30° to the horizontal. The particle is projected up a line of greatest slope of the plane with a speed of $20\,\text{m}\,\text{s}^{-1}$.

(i) Given that the plane is smooth, use an energy method to find the distance the particle moves up the plane before coming to instantaneous rest. [4]

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(ii) Given instead that the plane is rough and the coefficient of friction between the particle and the plane is 0.25, find the speed of the particle as it returns to its starting point. [8]

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6 A particle P moves in a straight line. The acceleration $a\,\text{m s}^{-2}$ of P at time t s is given by $a = 6t - 12$. The displacement of P from a fixed point O on the line is s m. It is given that $s = 5$ when $t = 1$ and $s = 1$ when $t = 3$.

(i) Show that $s = t^3 - 6t^2 + pt + q$, where p and q are constants to be found. [4]

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(ii) Find the values of t when P is at instantaneous rest. [2]

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(iii) Find the total distance travelled by P in the interval $0 \leqslant t \leqslant 4$. [4]

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Additional Page

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