Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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5616219722

MATHEMATICS **9709/43**

Paper 4 Mechanics 1 **(M1)** **October/November 2017**

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.
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 $10\ \text{m s}^{-2}$.
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 **11** printed pages and **1** blank page.

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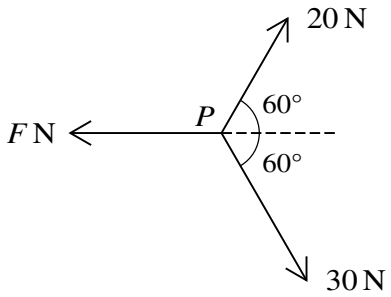

Three coplanar forces of magnitudes F N, 20 N and 30 N act at a point P, as shown in the diagram. The resultant of the three forces acts in a direction perpendicular to the force of magnitude F N. Find the value of F. [3]

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2 A lorry of mass 7850 kg travels on a straight hill which is inclined at an angle of 3° to the horizontal. There is a constant resistance to motion of 1480 N.

(i) Find the power of the lorry's engine when the lorry is going up the hill at a constant speed of $10\,\text{m}\,\text{s}^{-1}$. [3]

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(ii) Find the power of the lorry's engine at an instant when the lorry is going down the hill at a speed of $15\,\text{m}\,\text{s}^{-1}$ with an acceleration of $0.8\,\text{m}\,\text{s}^{-2}$. [3]

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3 A particle is released from rest and slides down a line of greatest slope of a rough plane which is inclined at 25° to the horizontal. The coefficient of friction between the particle and the plane is 0.4.

(i) Find the acceleration of the particle. [4]

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(ii) Find the distance travelled by the particle in the first 3 s after it is released. [2]

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4 Two particles A and B have masses 0.35 kg and 0.45 kg respectively. The particles are attached to the ends of a light inextensible string which passes over a small fixed smooth pulley which is 1 m above horizontal ground. Initially particle A is held at rest on the ground vertically below the pulley, with the string taut. Particle B hangs vertically below the pulley at a height of 0.64 m above the ground. Particle A is released.

(i) Find the speed of A at the instant that B reaches the ground. [5]

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(ii) Assuming that B does not bounce after it reaches the ground, find the total distance travelled by A between the instant that B reaches the ground and the instant when the string becomes taut again. [2]

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5 A particle starts from a fixed origin with velocity $0.4\,\text{m s}^{-1}$ and moves in a straight line. The acceleration $a\,\text{m s}^{-2}$ of the particle t s after it leaves the origin is given by $a = k(3t^2 - 12t + 2)$, where k is a constant. When $t = 1$, the velocity of P is $0.1\,\text{m s}^{-1}$.

(i) Show that the value of k is 0.1. [5]

(ii) Find an expression for the displacement of the particle from the origin in terms of t. [2]

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(iii) Hence verify that the particle is again at the origin at $t = 2$. [1]

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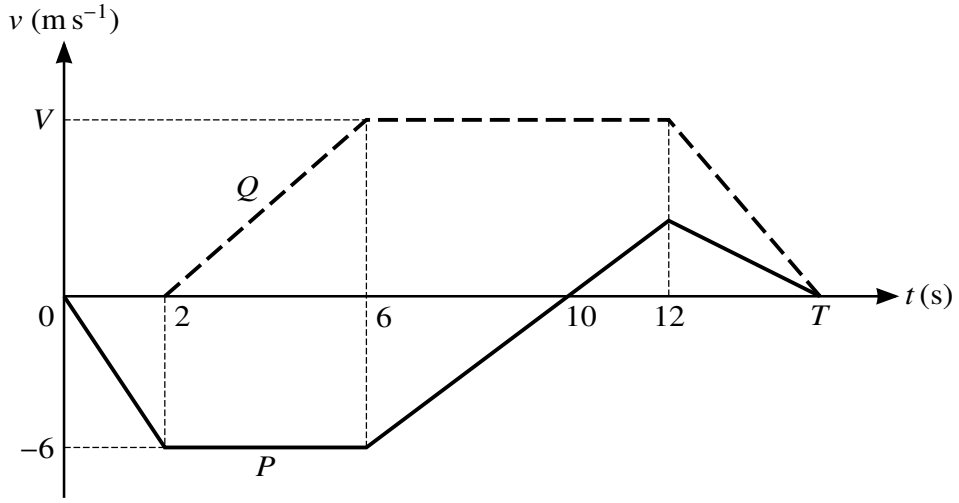

The diagram shows the velocity-time graphs for two particles, P and Q, which are moving in the same straight line. The graph for P consists of four straight line segments. The graph for Q consists of three straight line segments. Both particles start from the same initial position O on the line. Q starts 2 seconds after P and both particles come to rest at time $t = T$. The greatest velocity of Q is V m s^{-1}.

(i) Find the displacement of P from O at $t = 10$. [1]

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(ii) Find the velocity of P at $t = 12$. [2]

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(iii) Given that the total distance covered by P during the T seconds of its motion is 49.5 m, find the value of T. [3]

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(iv) Given also that the acceleration of Q from $t = 2$ to $t = 6$ is $1.75\,\text{m s}^{-2}$, find the value of V and hence find the distance between the two particles when they both come to rest at $t = T$. [3]

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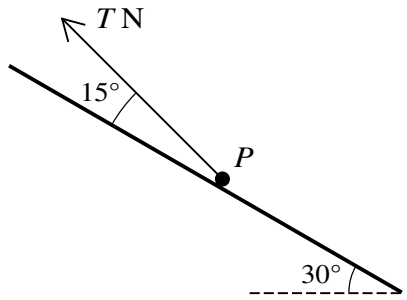

A particle P of mass 0.2 kg rests on a rough plane inclined at 30° to the horizontal. The coefficient of friction between the particle and the plane is 0.3. A force of magnitude T N acts upwards on P at 15° above a line of greatest slope of the plane (see diagram).

(i) Find the least value of T for which the particle remains at rest. [6]

The force of magnitude T N is now removed. A new force of magnitude 0.25 N acts on P up the plane, parallel to a line of greatest slope of the plane. Starting from rest, P slides down the plane. After moving a distance of 3 m, P passes through the point A.

(ii) Use an energy method to find the speed of P at A. [5]

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