UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

**MATHEMATICS** **9709/42**

Paper 4 Mechanics 1 **(M1)** **October/November 2012**

**1 hour 15 minutes**

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

*1855091403*

**READ THESE INSTRUCTIONS FIRST**

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

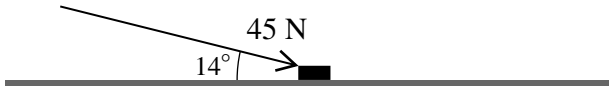
Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use $10\,\text{m}\,\text{s}^{-2}$.
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.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

This document consists of **3** printed pages and **1** blank page.


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**1**




A block is pushed along a horizontal floor by a force of magnitude 45 N acting at an angle of 14° to the horizontal (see diagram). Find the work done by the force in moving the block a distance of 25 m. [3]

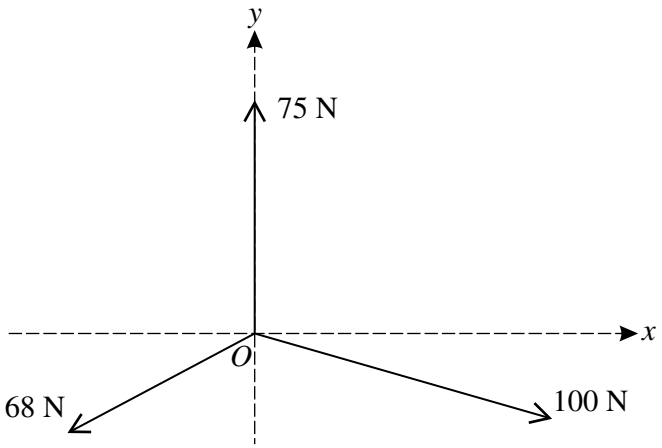
**2** Particles $A$ and $B$ of masses $m$ kg and $(1 - m)$ kg respectively are attached to the ends of a light inextensible string which passes over a fixed smooth pulley. The system is released from rest with the straight parts of the string vertical. $A$ moves vertically downwards and 0.3 seconds later it has speed $0.6\,\text{m s}^{-1}$. Find

**(i)** the acceleration of $A$, [2]

**(ii)** the value of $m$ and the tension in the string. [4]

**3** A car travels along a straight road with constant acceleration $a\,\text{m s}^{-2}$. It passes through points $A$, $B$ and $C$; the time taken from $A$ to $B$ and from $B$ to $C$ is 5 s in each case. The speed of the car at $A$ is $u\,\text{m s}^{-1}$ and the distances $AB$ and $BC$ are 55 m and 65 m respectively. Find the values of $a$ and $u$. [6]

**4**




Three coplanar forces of magnitudes 68 N, 75 N and 100 N act at an origin $O$, as shown in the diagram. The components of the three forces in the positive $x$-direction are −60 N, 0 N and 96 N, respectively. Find

**(i)** the components of the three forces in the positive $y$-direction, [3]

**(ii)** the magnitude and direction of the resultant of the three forces. [4]

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**5** $A$, $B$ and $C$ are three points on a line of greatest slope of a plane which is inclined at $\theta^\circ$ to the horizontal, with $A$ higher than $B$ and $B$ higher than $C$. Between $A$ and $B$ the plane is smooth, and between $B$ and $C$ the plane is rough. A particle $P$ is released from rest on the plane at $A$ and slides down the line $ABC$. At time 0.8 s after leaving $A$, the particle passes through $B$ with speed $4\,\text{m s}^{-1}$.

**(i)** Find the value of $\theta$. [3]

At time 4.8 s after leaving $A$, the particle comes to rest at $C$.

**(ii)** Find the coefficient of friction between $P$ and the rough part of the plane. [5]

**6** A car of mass 1250 kg moves from the bottom to the top of a straight hill of length 500 m. The top of the hill is 30 m above the level of the bottom. The power of the car's engine is constant and equal to 30 000 W. The car's acceleration is $4\,\text{m s}^{-2}$ at the bottom of the hill and is $0.2\,\text{m s}^{-2}$ at the top. The resistance to the car's motion is 1000 N. Find

**(i)** the car's gain in kinetic energy, [5]

**(ii)** the work done by the car's engine. [3]

**7** A particle $P$ starts to move from a point $O$ and travels in a straight line. The velocity of $P$ is $k(60t^2 - t^3)\,\text{m s}^{-1}$ at time $t$ s after leaving $O$, where $k$ is a constant. The maximum velocity of $P$ is $6.4\,\text{m s}^{-1}$.

**(i)** Show that $k = 0.0002$. [3]

$P$ comes to instantaneous rest at a point $A$ on the line. Find

**(ii)** the distance $OA$, [5]

**(iii)** the magnitude of the acceleration of $P$ at $A$, [2]

**(iv)** the speed of $P$ when it subsequently passes through $O$. [2]

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