| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
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| Candidate No. | | | | | | 6 | 6 | 7 | 7 | / | 0 | 1 | Signature | |

Paper Reference(s)

**6677/01**

# Edexcel GCE

## Mechanics M1

## Advanced/Advanced Subsidiary

Tuesday 13 January 2009 – Morning

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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**Materials required for examination**
Mathematical Formulae (Green)

**Items included with question papers**
Nil

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
If you need more space to complete your answers to any question, use additional sheets.
Whenever a numerical value of $g$ is required, take $g = 9.8$ m s$^{-2}$.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 7 questions in this question paper. The total mark for this paper is 75.
There are 24 pages in this question paper. Any blank pages are indicated.

### Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.



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***Turn over***

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**1.** A particle $P$ moves with constant acceleration $(2\mathbf{i} - 5\mathbf{j})$ m s$^{-2}$. At time $t = 0$, $P$ has speed $u$ m s$^{-1}$. At time $t = 3$ s, $P$ has velocity $(-6\mathbf{i} + \mathbf{j})$ m s$^{-1}$.

Find the value of $u$.

**(5)**

Leave blank

**Question 1 continued**

**Q1**

**(Total 5 marks)**



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**2.** A small ball is projected vertically upwards from ground level with speed $u$ m s$^{-1}$. The ball takes 4 s to return to ground level.

(a) Draw, in the space below, a velocity-time graph to represent the motion of the ball during the first 4 s.

**(2)**

(b) The maximum height of the ball above the ground during the first 4 s is 19.6 m. Find the value of $u$.

**(3)**

Leave blank

**Question 2 continued**

**Q2**

**(Total 5 marks)**

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**3.** Two particles $A$ and $B$ are moving on a smooth horizontal plane. The mass of $A$ is $km$, where $2 < k < 3$, and the mass of $B$ is $m$. The particles are moving along the same straight line, but in opposite directions, and they collide directly. Immediately before they collide the speed of $A$ is $2u$ and the speed of $B$ is $4u$. As a result of the collision the speed of $A$ is halved and its direction of motion is reversed.

(a) Find, in terms of $k$ and $u$, the speed of $B$ immediately after the collision.

**(3)**

(b) State whether the direction of motion of $B$ changes as a result of the collision, explaining your answer.

**(3)**

Given that $k = \frac{7}{3}$,

(c) find, in terms of $m$ and $u$, the magnitude of the impulse that $A$ exerts on $B$ in the collision.

**(3)**

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**Question 3 continued**

**Q3**

**(Total 9 marks)**

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**4.**

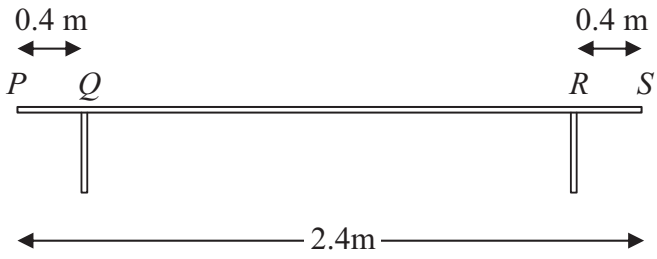


**Figure 1**

A bench consists of a plank which is resting in a horizontal position on two thin vertical legs. The plank is modelled as a uniform rod $PS$ of length 2.4 m and mass 20 kg. The legs at $Q$ and $R$ are 0.4 m from each end of the plank, as shown in Figure 1.

Two pupils, Arthur and Beatrice, sit on the plank. Arthur has mass 60 kg and sits at the middle of the plank and Beatrice has mass 40 kg and sits at the end $P$. The plank remains horizontal and in equilibrium. By modelling the pupils as particles, find

(a) the magnitude of the normal reaction between the plank and the leg at $Q$ and the magnitude of the normal reaction between the plank and the leg at $R$.

**(7)**

Beatrice stays sitting at $P$ but Arthur now moves and sits on the plank at the point $X$. Given that the plank remains horizontal and in equilibrium, and that the magnitude of the normal reaction between the plank and the leg at $Q$ is now twice the magnitude of the normal reaction between the plank and the leg at $R$,

(b) find the distance $QX$.

**(6)**

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**Question 4 continued**



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**Question 4 continued**

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**Question 4 continued**

**Q4**

**(Total 13 marks)**

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**5.**

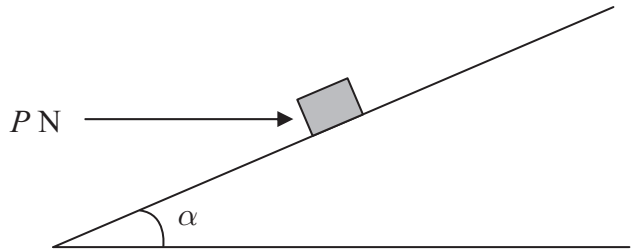


**Figure 2**

A small package of mass 1.1 kg is held in equilibrium on a rough plane by a horizontal force. The plane is inclined at an angle $\alpha$ to the horizontal, where $\tan \alpha = \frac{3}{4}$. The force acts in a vertical plane containing a line of greatest slope of the plane and has magnitude $P$ newtons, as shown in Figure 2.

The coefficient of friction between the package and the plane is 0.5 and the package is modelled as a particle. The package is in equilibrium and on the point of slipping down the plane.

(a) Draw, on Figure 2, all the forces acting on the package, showing their directions clearly.

**(2)**

(b) (i) Find the magnitude of the normal reaction between the package and the plane.

(ii) Find the value of $P$.

**(11)**

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**Question 5 continued**



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**Question 5 continued**

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**Question 5 continued**

**Q5**

**(Total 13 marks)**

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**6.** Two forces, $(4\mathbf{i} - 5\mathbf{j})$ N and $(p\mathbf{i} + q\mathbf{j})$ N, act on a particle $P$ of mass $m$ kg. The resultant of the two forces is $\mathbf{R}$. Given that $\mathbf{R}$ acts in a direction which is parallel to the vector $(\mathbf{i} - 2\mathbf{j})$,

(a) find the angle between $\mathbf{R}$ and the vector $\mathbf{j}$,

**(3)**

(b) show that $2p + q + 3 = 0$.

**(4)**

Given also that $q = 1$ and that $P$ moves with an acceleration of magnitude $8\sqrt{5}$ m s$^{-2}$,

(c) find the value of $m$.

**(7)**

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**Question 6 continued**



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**Question 6 continued**



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**Question 6 continued**

**Q6**

**(Total 14 marks)**

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**7.**

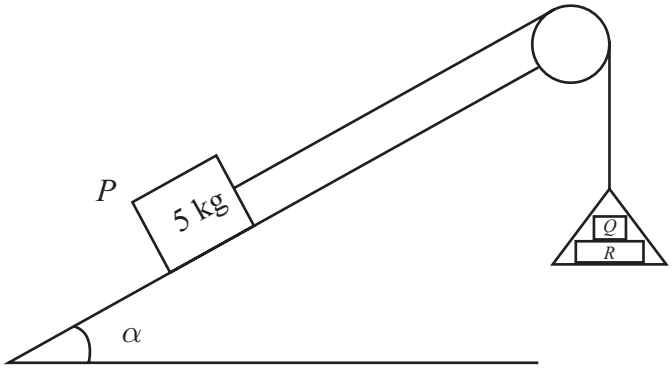


**Figure 3**

One end of a light inextensible string is attached to a block $P$ of mass 5 kg. The block $P$ is held at rest on a smooth fixed plane which is inclined to the horizontal at an angle $\alpha$, where $\sin\alpha = \frac{3}{5}$. The string lies along a line of greatest slope of the plane and passes over a smooth light pulley which is fixed at the top of the plane. The other end of the string is attached to a light scale pan which carries two blocks $Q$ and $R$, with block $Q$ on top of block $R$, as shown in Figure 3. The mass of block $Q$ is 5 kg and the mass of block $R$ is 10 kg. The scale pan hangs at rest and the system is released from rest. By modelling the blocks as particles, ignoring air resistance and assuming the motion is uninterrupted, find

(a) (i) the acceleration of the scale pan,

(ii) the tension in the string,

**(8)**

(b) the magnitude of the force exerted on block $Q$ by block $R$,

**(3)**

(c) the magnitude of the force exerted on the pulley by the string.

**(5)**

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**Question 7 continued**



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**Question 7 continued**



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**Question 7 continued**

**Q7**

**(Total 16 marks)**

**TOTAL FOR PAPER: 75 MARKS**

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