| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Candidate No. | | | | | | 6 | 6 | 7 | 9 | / | 0 | 1 | Signature | |

Paper Reference(s)

**6679/01**

# Edexcel GCE

## Mechanics M3

## Advanced/Advanced Subsidiary

Monday 28 January 2013 – Morning

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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| Question Number | Leave Blank |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| Total | |

**Materials required for examination**

Mathematical Formulae (Pink)

**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 or symbolic differentiation/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 to each question in the space following the question.
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 28 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 should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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P 4 1 4 7 9 A 0 1 2 8

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PEARSON

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**1.** A particle $P$ is moving along the positive $x$-axis. When the displacement of $P$ from the origin is $x$ metres, the velocity of $P$ is $v$ m s$^{-1}$ and the acceleration of $P$ is $9x$ m s$^{-2}$.

When $x = 2$, $v = 6$

Show that $v^2 = 9x^2$.

**(4)**



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**Question 1 continued**

**Q1**

**(Total 4 marks)**

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**2.**

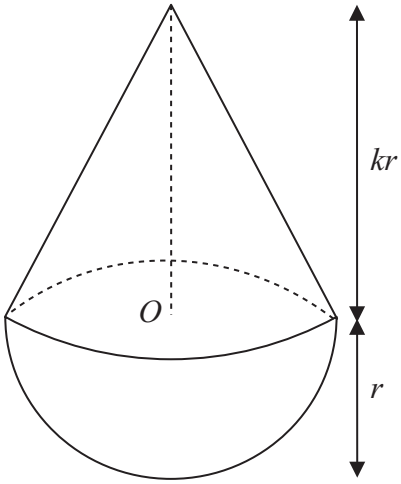


**Figure 1**

A uniform solid consists of a right circular cone of radius $r$ and height $kr$, where $k > \sqrt{3}$, fixed to a hemisphere of radius $r$. The centre of the plane face of the hemisphere is $O$ and this plane face coincides with the base of the cone, as shown in Figure 1.

(a) Show that the distance of the centre of mass of the solid from $O$ is

$$\frac{(k^2 - 3)r}{4(k+2)}$$

**(5)**

The point $A$ lies on the circumference of the base of the cone. The solid is suspended by a string attached at $A$ and hangs freely in equilibrium. The angle between $AO$ and the vertical is $\theta$, where $\tan\theta = \frac{11}{14}$

(b) Find the value of $k$.

**(4)**



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**Question 2 continued**

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**Question 2 continued**

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**Question 2 continued**

**Q2**

**(Total 9 marks)**

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**3.** A particle $P$ of mass 0.6 kg is moving along the $x$-axis in the positive direction. At time $t = 0$, $P$ passes through the origin $O$ with speed 15 m s$^{-1}$. At time $t$ seconds the distance $OP$ is $x$ metres, the speed of $P$ is $v$ m s$^{-1}$ and the resultant force acting on $P$ has magnitude $\frac{12}{(t+2)^2}$ newtons. The resultant force is directed towards $O$.

(a) Show that $v = 5\left(\frac{4}{t+2} + 1\right)$.

**(5)**

(b) Find the value of $x$ when $t = 5$

**(5)**



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**Question 3 continued**

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**Question 3 continued**

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**Question 3 continued**

**Q3**

**(Total 10 marks)**



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**4.**

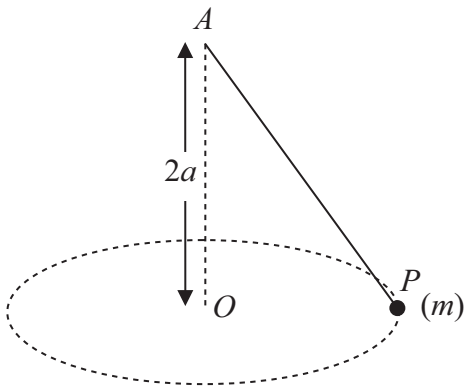


**Figure 2**

A particle $P$ of mass $m$ is attached to one end of a light elastic string, of natural length $2a$ and modulus of elasticity $6mg$. The other end of the string is attached to a fixed point $A$. The particle moves with constant speed $v$ in a horizontal circle with centre $O$, where $O$ is vertically below $A$ and $OA = 2a$, as shown in Figure 2.

(a) Show that the extension in the string is $\frac{2}{5}a$.

**(6)**

(b) Find $v^2$ in terms of $a$ and $g$.

**(5)**



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**Question 4 continued**

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**Question 4 continued**

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**Question 4 continued**

**Q4**

**(Total 11 marks)**



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**5.** A particle $P$ is moving in a straight line with simple harmonic motion on a smooth horizontal floor. The particle comes to instantaneous rest at points $A$ and $B$ where $AB$ is 0.5 m. The mid-point of $AB$ is $O$. The mid-point of $OA$ is $C$. The mid-point of $OB$ is $D$. The particle takes 0.2 s to travel directly from $C$ to $D$. At time $t = 0$, $P$ is moving through $O$ towards $A$.

(a) Show that the period of the motion is $\frac{6}{5}$ s.

**(5)**

(b) Find the distance of $P$ from $B$ when $t = 2$ s.

**(3)**

(c) Find the maximum magnitude of the acceleration of $P$.

**(2)**

(d) Find the maximum speed of $P$.

**(2)**

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**Question 5 continued**

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**Question 5 continued**

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**Question 5 continued**

**Q5**

**(Total 12 marks)**



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**6.**

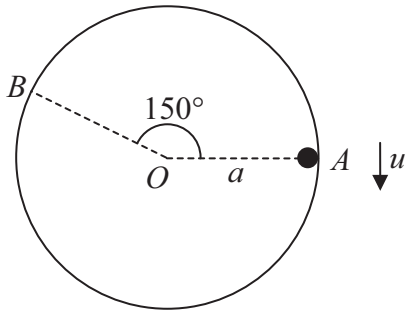


**Figure 3**

A smooth hollow cylinder of internal radius $a$ is fixed with its axis horizontal. A particle $P$ moves on the inner surface of the cylinder in a vertical circle with radius $a$ and centre $O$, where $O$ lies on the axis of the cylinder. The particle is projected vertically downwards with speed $u$ from point $A$ on the circle, where $OA$ is horizontal. The particle first loses contact with the cylinder at the point $B$, where $\angle AOB = 150°$, as shown in Figure 3. Given that air resistance can be ignored,

(a) show that the speed of $P$ at $B$ is $\sqrt{\left(\frac{ag}{2}\right)}$,

**(3)**

(b) find $u$ in terms of $a$ and $g$.

**(4)**

After losing contact with the cylinder, $P$ crosses the diameter through $A$ at the point $D$. At $D$ the velocity of $P$ makes an angle $\theta°$ with the horizontal.

(c) Find the value of $\theta$.

**(7)**



P 4 1 4 7 9 A 0 2 0 2 8

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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.** A particle $P$ of mass 1.5 kg is attached to the mid-point of a light elastic string of natural length 0.30 m and modulus of elasticity $\lambda$ newtons. The ends of the string are attached to two fixed points $A$ and $B$, where $AB$ is horizontal and $AB = 0.48$ m. Initially $P$ is held at rest at the mid-point, $M$, of the line $AB$ and the tension in the string is 240 N.

(a) Show that $\lambda = 400$

**(3)**

The particle is now held at rest at the point $C$, where $C$ is 0.07 m vertically below $M$. The particle is released from rest at $C$.

(b) Find the magnitude of the initial acceleration of $P$.

**(6)**

(c) Find the speed of $P$ as it passes through $M$.

**(6)**

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

Q7

**(Total 15 marks)**

**TOTAL FOR PAPER: 75 MARKS**

**END**



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