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

Team Leader's use only

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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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.

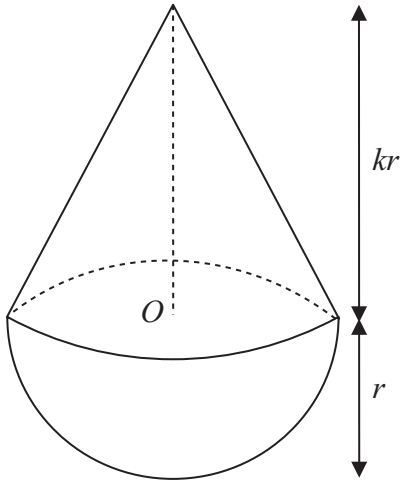

Figure 1

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

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

(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 θ, 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

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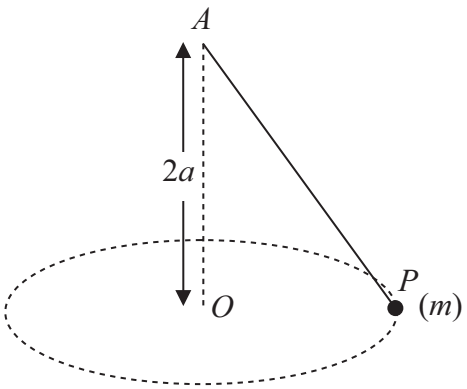

Figure 2

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.

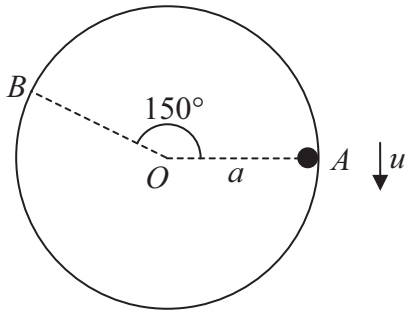

Figure 3

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 θ.

(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. 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 λ 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

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