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

Thursday 16 June 2011 – Afternoon

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	Items included with question papers
Mathematical Formulae (Pink)	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 $g = 9.8 \text{ m s}^{-2}$.
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.

Printer's Log. No.
P38163A
W850/R6679/57570 5/5/3
P 3 8 1 6 3 A 0 1 2 8

Turn over

edexcel
advancing learning, changing lives

Leave blank

1. A particle P of mass 0.5 kg moves on the positive x-axis under the action of a single force directed towards the origin O. At time t seconds the distance of P from O is x metres, the magnitude of the force is $0.375x^2$ N and the speed of P is v m s^{-1}.

When $t = 0$, $OP = 8$ m and P is moving towards O with speed 2 m s^{-1}.

(a) Show that $v^2 = 260 - \frac{1}{2}x^3$.

(4)

(b) Find the distance of P from O at the instant when $v = 5$.

(2)

Leave blank

2.

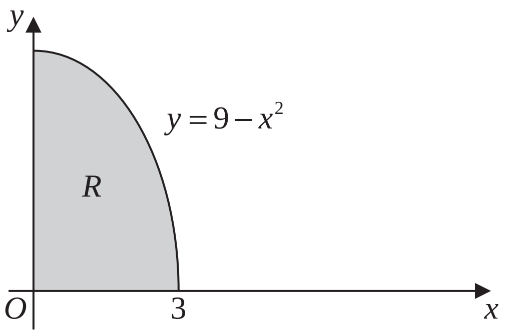

Figure 1

The shaded region R is bounded by the curve with equation $y = 9 - x^2$, the positive x-axis and the positive y-axis, as shown in Figure 1. A uniform solid S is formed by rotating R through 360° about the x-axis.

Find the x-coordinate of the centre of mass of S.

(9)

Leave blank

3.

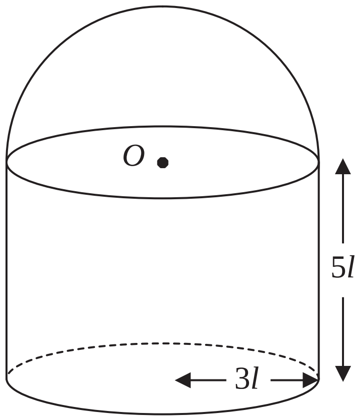

Figure 2

A solid consists of a uniform solid right cylinder of height $5l$ and radius $3l$ joined to a uniform solid hemisphere of radius $3l$. The plane face of the hemisphere coincides with a circular end of the cylinder and has centre O, as shown in Figure 2.

The density of the hemisphere is **twice** the density of the cylinder.

(a) Find the distance of the centre of mass of the solid from O.

(5)

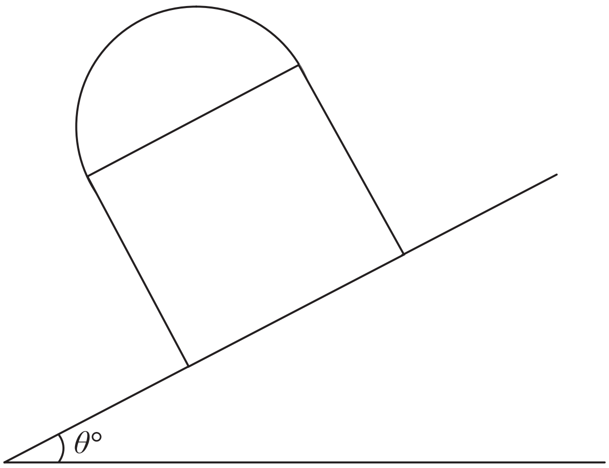

Figure 3

The solid is now placed with its circular face on a plane inclined at an angle $\theta°$ to the horizontal, as shown in Figure 3. The plane is sufficiently rough to prevent the solid slipping. The solid is on the point of toppling.

(b) Find the value of θ.

(4)

Leave blank

Question 3 continued

P 3 8 1 6 3 A 0 7 2 8

Leave blank

Question 3 continued

Leave blank

4.

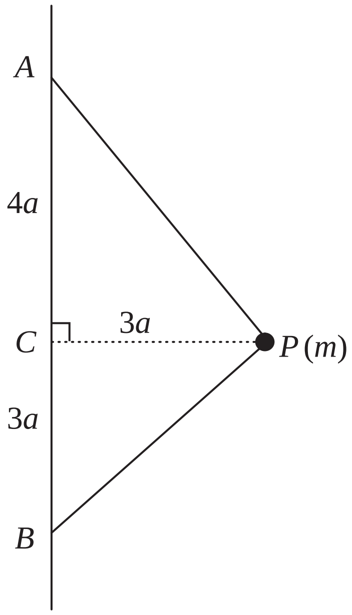

Figure 4

A light inextensible string has its ends attached to two fixed points A and B. The point A is vertically above B and $AB = 7a$. A particle P of mass m is fixed to the string and moves in a horizontal circle of radius $3a$ with angular speed ω. The centre of the circle is C where C lies on AB and $AC = 4a$, as shown in Figure 4. Both parts of the string are taut.

(a) Show that the tension in AP is $\frac{5}{7}m\left(3a\omega^2 + g\right)$.

(8)

(b) Find the tension in BP.

(2)

(c) Deduce that $\omega \geqslant \frac{1}{2}\sqrt{\left(\frac{g}{a}\right)}$.

(2)

P 3 8 1 6 3 A 0 1 0 2 8

Leave blank

Question 4 continued

P 3 8 1 6 3 A 0 1 1 2 8

Turn over

Leave blank

5. A particle P of mass m is attached to one end of a light elastic string of natural length l and modulus of elasticity $3mg$. The other end of the string is attached to a fixed point O on a rough horizontal table. The particle lies at rest at the point A on the table, where $OA = \frac{7}{6}l$. The coefficient of friction between P and the table is μ.

(a) Show that $\mu \geqslant \frac{1}{2}$.

(4)

The particle is now moved along the table to the point B, where $OB = \frac{3}{2}l$, and released from rest. Given that $\mu = \frac{1}{2}$, find

(b) the speed of P at the instant when the string becomes slack,

(5)

(c) the total distance moved by P before it comes to rest again.

(3)

Leave blank

Question 5 continued

P 3 8 1 6 3 A 0 1 5 2 8

Turn over

Leave blank

6.

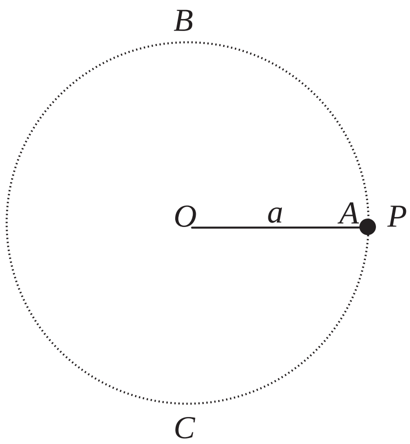

Figure 5

A particle P is attached to one end of a light inextensible string of length a. The other end of the string is attached to a fixed point O. The particle is held at the point A, where $OA = a$ and OA is horizontal. The point B is vertically above O and the point C is vertically below O, with $OB = OC = a$, as shown in Figure 5. The particle is projected vertically upwards with speed $3\sqrt{(ag)}$.

(a) Show that P will pass through B.

(6)

(b) Find the speed of P as it reaches C.

(2)

As P passes through C it receives an impulse. Immediately after this, the speed of P is $\frac{5}{12}\sqrt{(11ag)}$ and the direction of motion of P is unchanged.

(c) Find the angle between the string and the downward vertical when P comes to instantaneous rest.

(4)

P 3 8 1 6 3 A 0 1 8 2 8

Leave blank

Question 6 continued

Leave blank

7. A particle P of mass 0.5 kg is attached to the mid-point of a light elastic string of natural length 1.4 m and modulus of elasticity 2 N. The ends of the string are attached to the points A and B on a smooth horizontal table, where $AB = 2$ m. The mid-point of AB is O and the point C is on the table between O and B where $OC = 0.2$ m. At time $t = 0$ the particle is released from rest at C. At time t seconds the length of the string AP is $(1+x)$ m.

(a) Show that the tension in BP is $\frac{2}{7}(3-10x)$ N.
(2)

(b) Find, in terms of x, the tension in AP.
(1)

(c) Show that P performs simple harmonic motion with period $2\pi\sqrt{\left(\frac{7}{80}\right)}$ s.
(6)

(d) Find the greatest speed of P during the motion.
(2)

The point D lies between O and A, where $OD = 0.1$ m.

(e) Find the time taken by P to move directly from C to D.
(4)

Leave blank

Question 7 continued