PMT

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

Paper Reference(s)

6679/01R

Edexcel GCE

Mechanics M3

Advanced/Advanced Subsidiary

Monday 19 May 2014 – 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	
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}, and give your answer to either two significant figures or three significant figures.
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 6 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 should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. A particle P of mass 0.25 kg is moving along the positive x-axis under the action of a single force. At time t seconds P is x metres from the origin O and is moving away from O with speed v m s^{-1} where $\frac{dv}{dx} = 3$. It is given that $x = 2$ and $v = 3$ when $t = 0$

(a) Find the magnitude of the force acting on P when $x = 5$

(4)

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

(4)

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2.

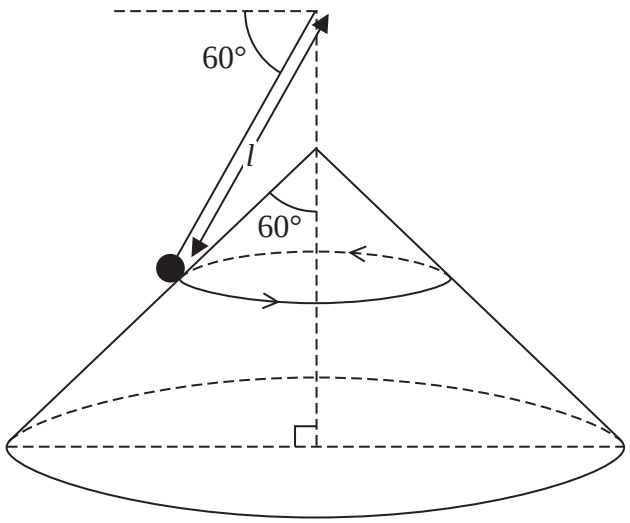

Figure 1

A cone of semi-vertical angle 60° is fixed with its axis vertical and vertex upwards. A particle of mass m is attached to one end of a light inextensible string of length l. The other end of the string is attached to a fixed point vertically above the vertex of the cone. The particle moves in a horizontal circle on the smooth outer surface of the cone with constant angular speed ω, with the string making a constant angle 60° with the horizontal, as shown in Figure 1.

(a) Find the tension in the string, in terms of m, l, ω and g.

(7)

The particle remains on the surface of the cone.

(b) Show that the time for the particle to make one complete revolution is greater than

$$2\pi\sqrt{\frac{l\sqrt{3}}{2g}}$$

(6)

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Question 2 continued

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3. One end A of a light elastic string AB, of modulus of elasticity mg and natural length a, is fixed to a point on a rough plane inclined at an angle θ to the horizontal. The other end B of the string is attached to a particle of mass m which is held at rest on the plane. The string AB lies along a line of greatest slope of the plane, with B lower than A and $AB = a$. The coefficient of friction between the particle and the plane is μ, where $\mu < \tan\theta$. The particle is released from rest.

(a) Show that when the particle comes to rest it has moved a distance $2a(\sin\theta - \mu\cos\theta)$ down the plane.

(6)

(b) Given that there is no further motion, show that $\mu \geqslant \frac{1}{3}\tan\theta$.

(5)

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Question 3 continued

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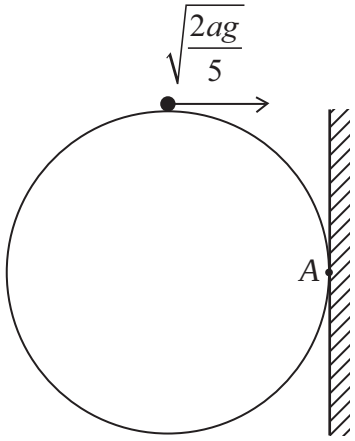

Figure 2

A smooth sphere of radius a is fixed with a point A of its surface in contact with a fixed vertical wall. A particle is placed on the highest point of the sphere and is projected towards the wall and perpendicular to the wall with horizontal speed $\sqrt{\frac{2ag}{5}}$, as shown in Figure 2.

The particle leaves the surface of the sphere with speed V.

(a) Show that $V = \sqrt{\frac{4ag}{5}}$

(7)

The particle strikes the wall at the point X.

(b) Find the distance AX.

(9)

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Question 4 continued

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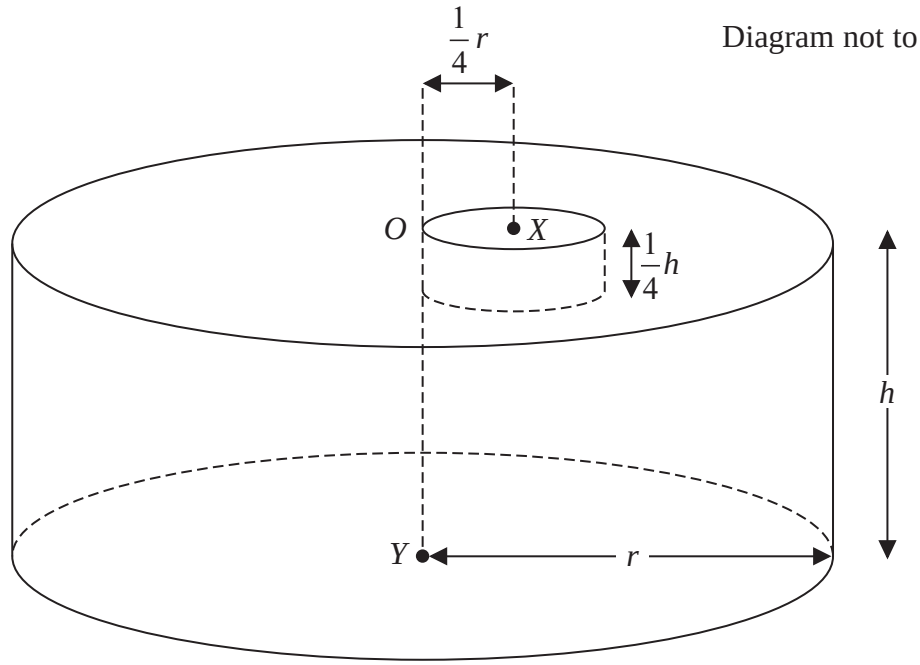

Figure 3

A uniform solid right circular cylinder has height h and radius r. The centre of one plane face is O and the centre of the other plane face is Y. A cylindrical hole is made by removing a solid cylinder of radius $\frac{1}{4}r$ and height $\frac{1}{4}h$ from the end with centre O. The axis of the cylinder removed is parallel to OY and meets the end with centre O at X, where $OX = \frac{1}{4}r$. One plane face of the cylinder removed coincides with the plane face through O of the original cylinder. The resulting solid S is shown in Figure 3.

(a) Show that the centre of mass of S is at a distance $\frac{85h}{168}$ from the plane face containing O.

(7)

The solid S is freely suspended from O. In equilibrium the line OY is inclined at an angle arctan(17) to the horizontal.

(b) Find r in terms of h.

(6)

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Question 5 continued

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6. A light elastic string, of natural length l and modulus of elasticity $4mg$, has one end attached to a fixed point A. The other end is attached to a particle P of mass m. The particle hangs freely at rest in equilibrium at the point E. The distance of E below A is $(l + e)$.

(a) Find e in terms of l.

(2)

At time $t = 0$, the particle is projected vertically downwards from E with speed $\sqrt{gl}$.

(b) Prove that, while the string is taut, P moves with simple harmonic motion.

(5)

(c) Find the amplitude of the simple harmonic motion.

(3)

(d) Find the time at which the string first goes slack.

(4)

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Question 6 continued

Q6

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

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