June 2012

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 14 June 2012 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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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. At time $t = 0$, P is at the origin O. At time t seconds, P is x metres from O and has velocity $v = 2e^{-x}$ m s^{-1} in the direction of x increasing.

(a) Find the acceleration of P in terms of x.

(3)

(b) Find x in terms of t.

(6)

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2. A particle P moves in a straight line with simple harmonic motion about a fixed centre O. The period of the motion is $\frac{\pi}{2}$ seconds. At time t seconds the speed of P is v m s^{-1}. When $t = 0$, P is at O and $v = 6$. Find

(a) the greatest distance of P from O during the motion,

(3)

(b) the greatest magnitude of the acceleration of P during the motion,

(2)

(c) the smallest positive value of t for which P is 1 m from O.

(3)

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Question 2 continued

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3.

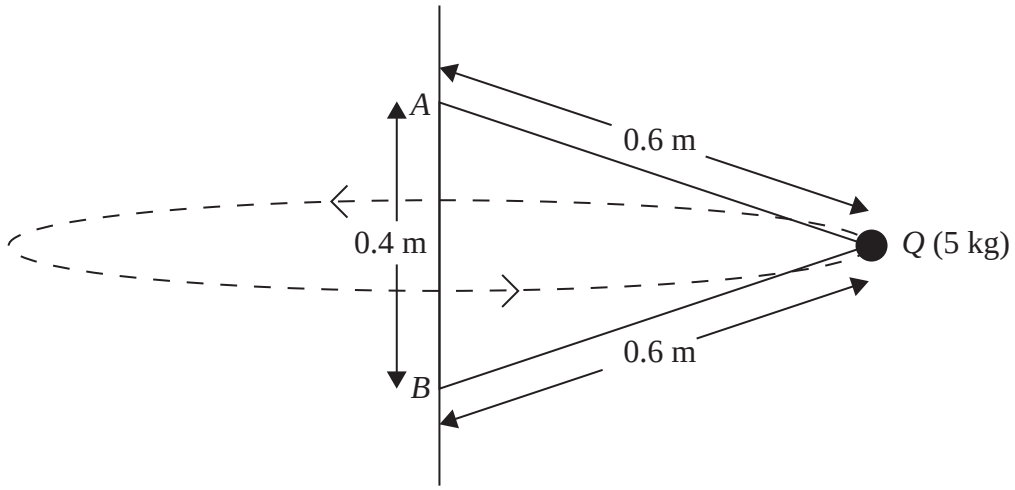

Figure 1

A particle Q of mass 5 kg is attached by two light inextensible strings to two fixed points A and B on a vertical pole. Each string has length 0.6 m and A is 0.4 m vertically above B, as shown in Figure 1.

Both strings are taut and Q is moving in a horizontal circle with constant angular speed 10 rad s^{-1}.

Find the tension in

(i) AQ,

(ii) BQ.

(10)

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Question 3 continued

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4.

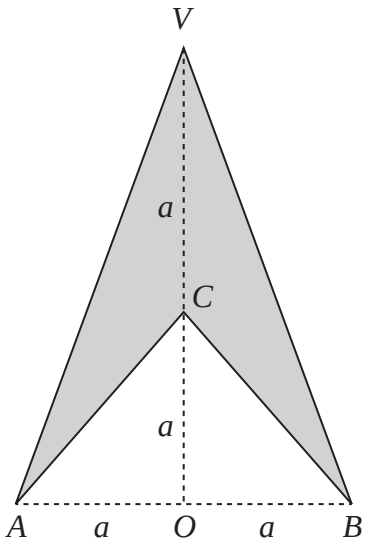

Figure 2

Figure 2 shows the cross-section $AVBC$ of the solid S formed when a uniform right circular cone of base radius a and height a, is removed from a uniform right circular cone of base radius a and height $2a$. Both cones have the same axis VCO, where O is the centre of the base of each cone.

(a) Show that the distance of the centre of mass of S from the vertex V is $\frac{5}{4}a$.

(5)

The mass of S is M. A particle of mass kM is attached to S at B. The system is suspended by a string attached to the vertex V, and hangs freely in equilibrium. Given that VA is at an angle 45° to the vertical through V,

(b) find the value of k.

(5)

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Question 4 continued

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5. A fixed smooth sphere has centre O and radius a. A particle P is placed on the surface of the sphere at the point A, where OA makes an angle α with the upward vertical through O. The particle is released from rest at A. When OP makes an angle θ to the upward vertical through O, P is on the surface of the sphere and the speed of P is v.

Given that $\cos\alpha = \frac{3}{5}$

(a) show that

$$v^2 = \frac{2ga}{5}(3 - 5\cos\theta)$$

(4)

(b) find the speed of P at the instant when it loses contact with the sphere.

(8)

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Question 5 continued

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6.

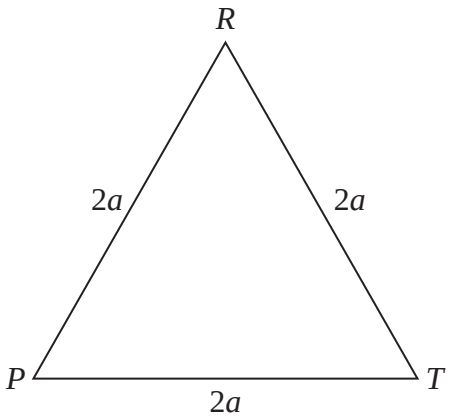

Figure 3

Figure 3 shows a uniform equilateral triangular lamina PRT with sides of length $2a$.

(a) Using calculus, prove that the centre of mass of PRT is at a distance $\frac{2\sqrt{3}}{3}a$ from R.

(6)

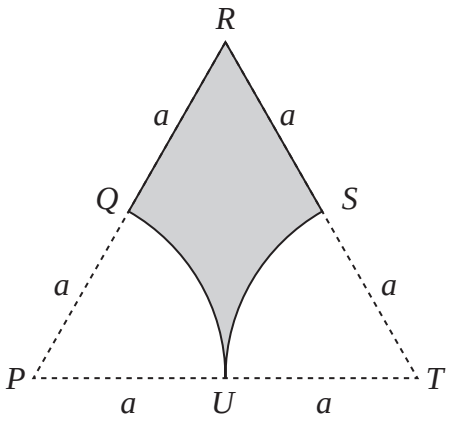

Figure 4

The circular sector PQU, of radius a and centre P, and the circular sector TUS, of radius a and centre T, are removed from PRT to form the uniform lamina $QRSU$ shown in Figure 4.

(b) Show that the distance of the centre of mass of $QRSU$ from U is $\frac{2a}{3\sqrt{3}-\pi}$

(6)

Leave blank

Question 6 continued

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7. A particle B of mass 0.5 kg is attached to one end of a light elastic string of natural length 0.75 m and modulus of elasticity 24.5 N. The other end of the string is attached to a fixed point A. The particle is hanging in equilibrium at the point E, vertically below A.

(a) Show that $AE = 0.9$ m.

(3)

The particle is held at A and released from rest. The particle first comes to instantaneous rest at the point C.

(b) Find the distance AC.

(5)

(c) Show that while the string is taut, B is moving with simple harmonic motion with centre E.

(4)

(d) Calculate the maximum speed of B.

(2)

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Question 7 continued