Write your name here

Surname	Other names

Pearson
Edexcel GCE

Centre Number | | | | | |

Candidate Number | | | | |

Mechanics M3

Advanced/Advanced Subsidiary

Wednesday 18 May 2016 – Morning
Time: 1 hour 30 minutes

Paper Reference
6679/01

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

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, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- 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

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1. A particle P of mass 0.5kg is moving along the positive x-axis under the action of a resultant force. The force acts along the x-axis. At time t seconds, P is x metres from the origin O and is moving away from O in the positive x direction with speed $\frac{12}{x+3}$ m s^{-1}

(a) Find the magnitude of the force acting on P when $x = 3$

(4)

Given that $x = 4$ when $t = 2$

(b) find the value of t when $x = 10$

(5)

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2.

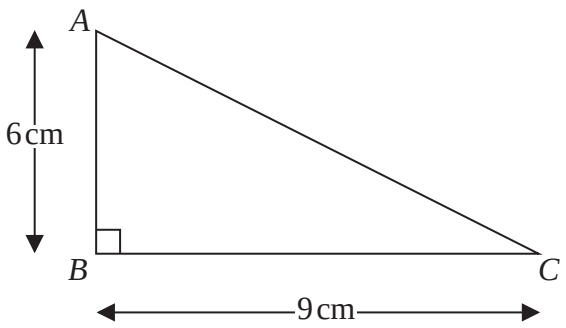

Figure 1

Figure 1 shows a uniform triangular lamina ABC in which $AB = 6\,\text{cm}$, $BC = 9\,\text{cm}$ and angle $ABC = 90°$. The centre of mass of the lamina is G. Use algebraic integration to find the distance of G from AB.

(6)

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3. One end of a light elastic string, of natural length 1.5m and modulus of elasticity 14.7N, is attached to a fixed point O on a ceiling. A particle P of mass 0.6kg is attached to the free end of the string. The particle is held at O and released from rest. The particle comes to instantaneous rest for the first time at the point A.

Find

(a) the distance OA,

(6)

(b) the magnitude of the instantaneous acceleration of P at A.

(3)

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4.

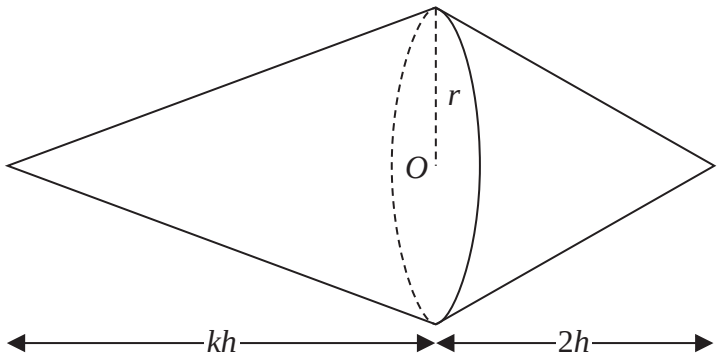

Figure 2

A uniform solid S consists of two right circular cones of base radius r. The smaller cone has height $2h$ and the centre of the plane face of this cone is O. The larger cone has height kh where $k > 2$. The two cones are joined so that their plane faces coincide, as shown in Figure 2.

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

$$\frac{h}{4}(k-2)$$

(5)

The point A lies on the circumference of the base of one of the cones. The solid is suspended by a string attached at A and hangs freely in equilibrium.

Given that $r = 3h$ and $k = 6$

(b) find the size of the angle between AO and the vertical.

(3)

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Question 4 continued

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5.

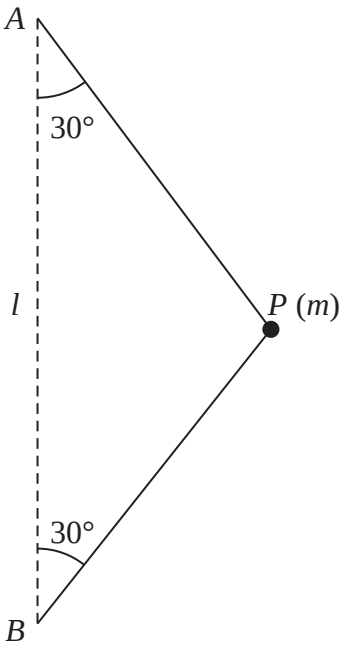

Figure 3

A particle P of mass m is attached to the ends of two light inextensible strings. The other ends of the strings are attached to fixed points A and B, where B is vertically below A and $AB = l$. The particle is moving with constant angular speed ω in a horizontal circle. Both strings are taut and inclined at 30° to AB, as shown in Figure 3.

(a) (i) Show that the tension in AP is $\frac{m\sqrt{3}}{6}(2g + l\omega^2)$

(ii) Find the tension in BP.

(9)

(b) Show that the time taken by P to complete one revolution is less than $\pi\sqrt{\frac{2l}{g}}$

(4)

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Question 5 continued

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6. One end of a light inextensible string of length l is attached to a particle P of mass $2m$. The other end of the string is attached to a fixed point A. The particle is hanging freely at rest with the string vertical. The particle is then projected horizontally with speed $\sqrt{\frac{7gl}{2}}$

(a) Find the speed of P at the instant when the string is horizontal.

(4)

When the string is horizontal and P is moving upwards, the string comes into contact with a small smooth peg which is fixed at the point B, where AB is horizontal and $AB < l$. The particle then describes a complete semicircle with centre B.

(b) Show that $AB \geqslant \frac{1}{2}l$

(9)

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Question 6 continued

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7. A particle P of mass 0.5 kg is attached to one end of a light elastic spring, of natural length 1.2 m and modulus of elasticity 15 N. The other end of the spring is attached to a fixed point A on a smooth horizontal table. The particle is placed on the table at the point B where $AB = 1.2$ m. The particle is pulled away from B to the point C, where ABC is a straight line and $BC = 0.8$ m, and is then released from rest.

(a) (i) Show that P moves with simple harmonic motion with centre B.

(ii) Find the period of this motion.

(5)

(b) Find the speed of P when it reaches B.

(2)

The point D is the midpoint of AB.

(c) Find the time taken for P to move directly from C to D.

(3)

When P first comes to instantaneous rest a particle Q of mass 0.3 kg is placed at B. When P reaches B again, P strikes and adheres to Q to form a single particle R.

(d) Show that R also moves with simple harmonic motion.

(3)

(e) Find the amplitude of this motion.

(4)

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Question 7 continued