

Write your name here

Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Mechanics M3

Advanced/Advanced Subsidiary

Monday 19 May 2014 – Morning

Time: 1 hour 30 minutes

Paper Reference

WME03/01**You must have:**

Mathematical Formulae and Statistical Tables (Blue)

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 $g = 9.8 \text{ m s}^{-2}$, 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 moves in a straight line with simple harmonic motion. The period of the motion is $\frac{\pi}{4}$ seconds. At time $t = 0$, P is at rest at the point A and the acceleration of P has magnitude 20 m s^{-2} .

Find

- (a) the amplitude of the motion, (3)
- (b) the greatest speed of P during the motion, (1)
- (c) the time P takes to travel a total distance of 1.5 m after it has first left A . (4)



Question 2 continued

Lined area for writing the answer to Question 2.



P 4 4 5 2 1 A 0 5 2 8

3.

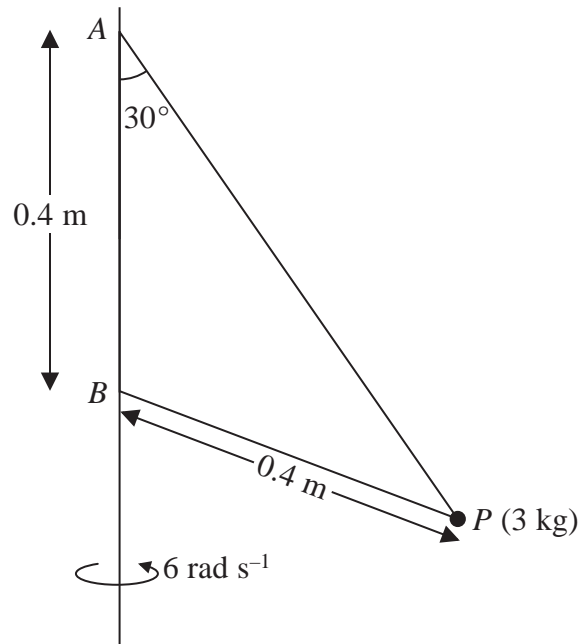


Figure 2

A particle P of mass 3 kg is attached by two light inextensible strings to two fixed points A and B on a fixed vertical pole. Both strings are taut and P is moving in a horizontal circle with constant angular speed 6 rad s^{-1} . String AP is inclined at 30° to the vertical. String BP has length 0.4 m and A is 0.4 m vertically above B , as shown in Figure 2.

Find the tension in

- (i) AP ,
(ii) BP .

(9)



Question 3 continued

Lined area for writing the answer to Question 3 continued.



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blank

Question 4 continued

Lined writing area for the answer.



6. A particle of mass m is attached to one end of a light elastic string, of natural length $6a$ and modulus of elasticity $9mg$. The other end of the string is attached to a fixed point A on a ceiling. The particle hangs in equilibrium at the point B , where B is vertically below A and $AB = (6 + p)a$.

(a) Show that $p = \frac{2}{3}$ (2)

The particle is now released from rest at a point C vertically below B , where $AC < \frac{22}{3}a$.

(b) Show that the particle moves with simple harmonic motion. (4)

(c) Find the period of this motion. (2)

(d) Explain briefly the significance of the condition $AC < \frac{22}{3}a$. (1)

The point D is vertically below A and $AD = 8a$. The particle is now released from rest at D . The particle first comes to instantaneous rest at the point E .

(e) Find, in terms of a , the distance AE . (4)



7.

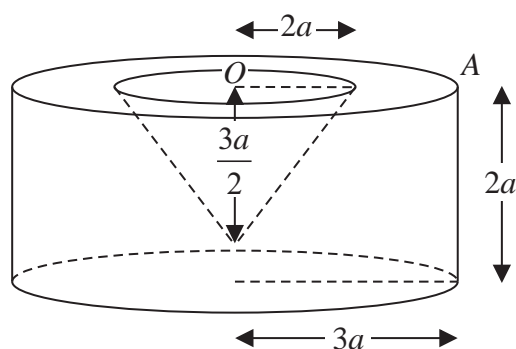
Diagram not
drawn to scale

Figure 4

A uniform right circular solid cylinder has radius $3a$ and height $2a$. A right circular cone of height $\frac{3a}{2}$ and base radius $2a$ is removed from the cylinder to form a solid S , as shown in Figure 4. The plane face of the cone coincides with the upper plane face of the cylinder and the centre O of the plane face of the cone is also the centre of the upper plane face of the cylinder.

- (a) Show that the distance of the centre of mass of S from O is $\frac{69a}{64}$. (5)

The point A is on the open face of S such that $OA = 3a$, as shown in Figure 4. The solid is now suspended from A and hangs freely in equilibrium.

- (b) Find the angle between OA and the horizontal. (3)

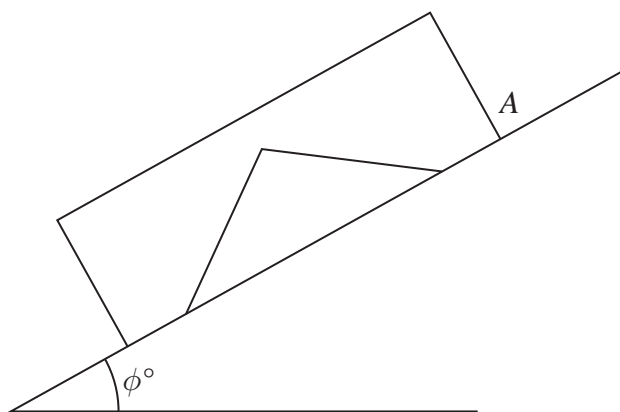


Figure 5

The solid is now placed on a rough inclined plane with the face through A in contact with the inclined plane, as shown in Figure 5. The solid rests in equilibrium on this plane. The coefficient of friction between the plane and S is 0.6 and the plane is inclined at an angle ϕ° to the horizontal. Given that S is on the point of sliding down the plane,

- (c) show that $\phi = 31$ to 2 significant figures. (4)



