IYGB GCE

Mathematics FM2

Advanced Level

Practice Paper N

Difficulty Rating: 3.2800/1.4706

Time: 1 hour 30 minutes

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 8 questions in this question paper.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

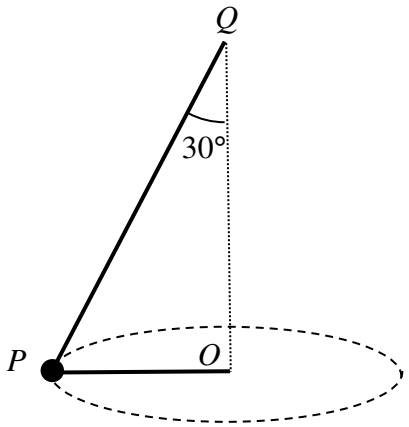
Question 1

A particle is moving in a straight line between two points A and B, with simple harmonic motion.

During this motion its greatest speed is $2.25\ \text{ms}^{-1}$. When the particle is at a distance of $21\ \text{cm}$ from the midpoint of AB its speed is $2.16\ \text{ms}^{-1}$.

Find the distance AB. **(7)**

Question 2



A particle, of mass $2\ \text{kg}$, is attached to one end, P, of a light inextensible string.

The other end of the string, Q, is attached to a fixed point.

Another light inextensible string PO, has its end P also attached to the same particle and its other end , O, attached to another fixed point, so that O is vertically below Q such that $\measuredangle OQP = 30°$.

The particle moves with constant speed v in a horizontal circle of radius 0.25 m centred at O, as shown in the figure above,

Given that the tensions in both strings are equal, find the value of v. **(7)**

Question 3

A machine component consists of a particle P, of mass 2 kg, attached to one end of a light rigid rod OP, of length 0.1 m.

The particle is made to rotate at 750 revolutions per minute in a vertical circle with centre at O.

Determine the least and the greatest magnitude of tension experienced by the rod. **(9)**

Question 4

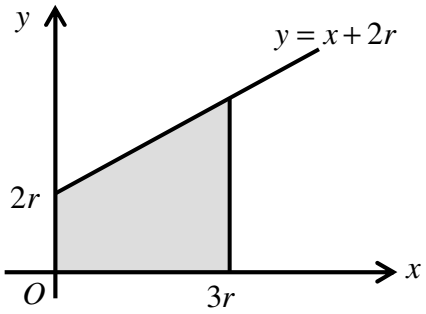


figure 1

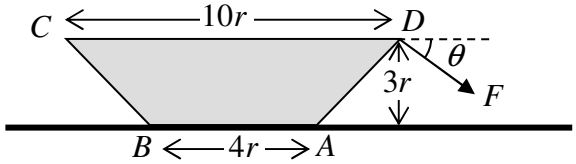


figure 2

The finite region bounded by the coordinate axes and the lines with equations $y = x + 2r$ and $x = 3r$ is shown shaded in figure 1. This region is rotated about the x axis to form a frustum of a uniform right circular cone.

a) Use integration to find the distance of the centre of mass of the frustum of the cone from O. **(8)**

The resulting frustum has weight W. The frustum is then placed on a rough horizontal surface with the plane surface of the frustum of radius $3r$ in contact with the surface. A force of magnitude , inclined at angle θ below the horizontal, is acting at a point on the circumference of the plane surface of the frustum of radius $5r$, as shown in figure 2. The frustum is at the point of toppling without sliding.

b) Given that θ can vary, determine the least value for F and the value of θ for which F takes this least value. **(6)**

Question 5

A particle P, of mass 0.5 kg, is moving on a straight horizontal line under the action of a constant force of magnitude 16 N. The motion of P is resisted by a force whose magnitude is proportional to the time $t\text{ s}$, where t is measured from a given instant.

When $t = 1$, the velocity of P is 36 ms^{-1} and its acceleration is 14 ms^{-2}.

Determine the values of t when the velocity of P is 28 ms^{-1}. **(9)**

Question 6

A particle P of mass 0.7 kg is attached to one end of a light elastic spring of natural length 0.6 m and modulus of elasticity 168 N.

The other end of the spring is attached to a fixed point A on a smooth horizontal surface on which P rests.

P is pushed in the direction PA so that the spring has length 0.4 m, and released from rest.

a) Show that the subsequent motion of P is simple harmonic and state its period. **(5)**

b) Determine the greatest speed of P. **(2)**

Question 7

The Earth is modelled as a fixed sphere of radius R.

A particle P is fired vertically upwards from a point on the surface of the Earth with speed $\sqrt{\frac{3}{2}gR}$, and moves in a straight line directly away from the centre of the Earth.

When P is at a distance x from the centre of the Earth, the gravitational force exerted by the Earth on P has magnitude inversely proportional to the square of x, and is directed towards the centre of the Earth.

Assuming that air resistance is ignored, determine the speed of P, in terms of R and g, when it is a height of $2R$ above the surface of the Earth. **(10)**

Question 8

A uniform lamina is in the shape of an isosceles right angled triangle ABC, where $\measuredangle BAC = 90°$.

The lamina is placed with AB in contact with a rough horizontal plane and C vertically above A. A gradually increasing force is applied at C, in the direction BC, until equilibrium is broken. The line of action of this force lies in the vertical plane containing the lamina.

Given that the lamina slides before it topples determine the range of possible values of the coefficient of friction between the lamina and the plane. **(12)**