IYGB GCE

Mathematics FM2

Advanced Level

Practice Paper R

Difficulty Rating: 3.6667/1.7143

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 7 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.

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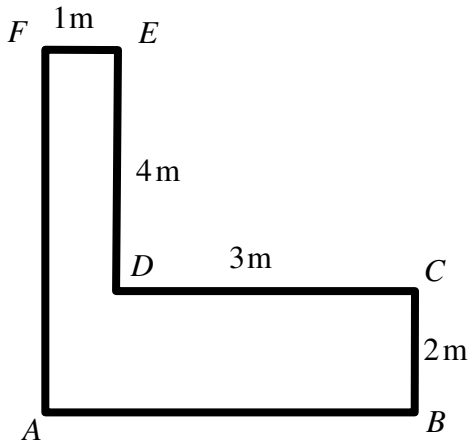
Question 1



The figure above shows a rigid framework $ABCDEF$, consisting of 6 uniform rods all of equal cross-section and of equal mass density.

It is further given that all the corners of the framework are right angles and $|BC| = 2\,\text{m}$, $|CD| = 3\,\text{m}$, $|DE| = 4\,\text{m}$ and $|EF| = 1\,\text{m}$.

a) Find the position of the centre of mass of the framework from AB and AF. **(7)**

The framework is suspended freely though a smooth pivot at F and hangs in equilibrium under its own weight.

b) Show that the tangent of the angle which DC makes with the vertical is $\frac{18}{7}$. **(3)**

Question 2

A car of mass 1250 kg is accelerating along a straight, horizontal road with the engine of the car producing a constant power of magnitude 31.5 kW.

The car is modelled as a particle with any other resistances to its motion ignored.

Find the distance covered by the car as its speed increases from $3\ \text{ms}^{-1}$ to $6\ \text{ms}^{-1}$. **(8)**

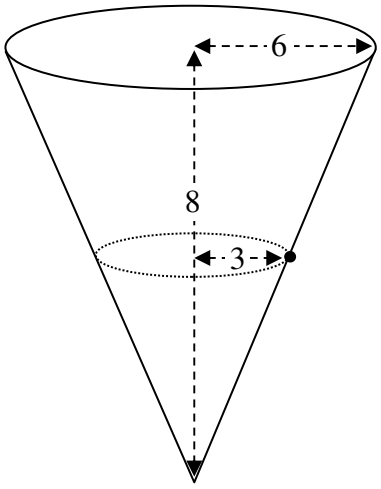
Question 3

A particle is moving with simple harmonic motion on a straight line with centre at O.

When the particle is passing through a point P, heading towards O, its speed is $3\ \text{ms}^{-1}$ and its acceleration $8\ \text{ms}^{-2}$.

Calculate the time taken for the particle to return to P for the first time. **(10)**

Question 4



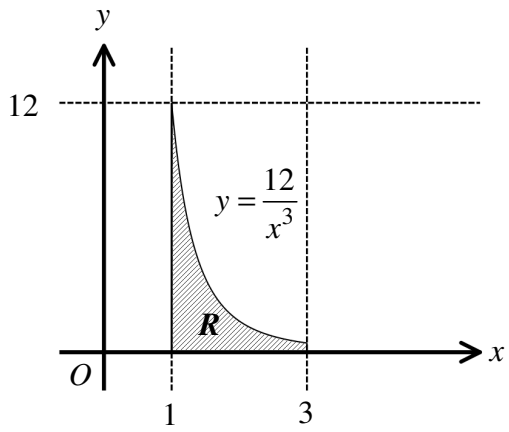
The figure above shows a particle on the rough inner surface of a hollow inverted right circular cone of radius 6 m and height 8 m, whose axis of symmetry is vertical .

When the cone rotates about its axis of symmetry with constant angular velocity the particle moves with constant speed $4.2\ \text{ms}^{-1}$ in a horizontal circle of radius 3 m.

The cone rotates sufficiently fast for the particle to stay in contact with the cone.

Determine the smallest possible value of the coefficient of friction between the cone and the particle. **(10)**

Question 5



The figure above shows the finite region R bounded by the x axis, the curve with equation $y = \dfrac{60}{x^3}$ and the straight lines with equations $x = 1$ and $x = 3$.

A uniform lamina whose shape is that of R, is suspended from the point $(1,12)$ and hangs freely under gravity.

Determine the angle the longer straight edge of the lamina makes with the vertical. **(12)**

Question 6

One end of a light inextensible string is attached to a fixed point O, and the other end is attached to a particle. Initially the particle is hanging in equilibrium vertically below O, with the string taut.

An impulse sets the particle in motion with a horizontal speed of 8.4 ms^{-1}, which consequently traces part of a vertical circle with centre at O.

The string becomes slack when the speed of the particle is 3.5 ms^{-1}.

a) Determine the length of the string. **(8)**

b) Calculate the vertical displacement of the particle from its initial position when the string becomes slack. **(6)**

Question 7

Two fixed points A and B lie on a smooth horizontal surface, so that the distance between them is 4.2 m.

A particle P of mass 0.25 kg is attached to one end of a light elastic string S_A and the other end of S_A is attached to A.

A second light elastic string S_B is also attached to P while the other end of S_B is attached to B.

The natural length of S_A is 1.8 m and its modulus of elasticity is 20 N, while the natural length of S_B is 1.2 m and its modulus of elasticity is 40 N.

P rests in equilibrium at some point O between A and B.

a) Show by calculation that $|OA| = 2.7$. **(6)**

P is then displaced from its equilibrium position O to a new position C, and released from rest.

b) Given that when P is at C, both strings are taut, show further that in the subsequent motion, P moves with simple harmonic motion, stating its period. **(5)**