# IYGB GCE

## Mathematics FM2

## Advanced Level

### Practice Paper P

Difficulty Rating: 3.5133/1.6086

### 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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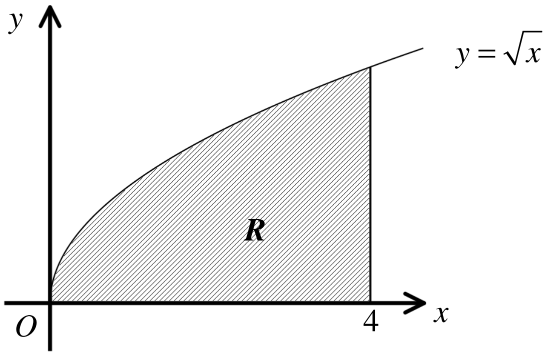
**Question 1**




The figure above shows the finite region $R$ bounded by the $x$ axis, the curve with equation $y=\sqrt{x}$ and the straight line with equation $x=4$.

$R$ is rotated about the $x$ axis forming a solid of revolution $S$.

Use integration to determine the $x$ coordinate of the centre of mass of $S$. **(5)**

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**Question 2**

The weight of a satellite of mass $M$ when it is on the surface of the Earth is $Mg$.

This satellite is moving with constant speed $V$ in a circular orbit above the Earth's equator, at a height $H$ above the surface of the Earth.

If the radius of the Earth is $m$, show that

$$H=\frac{gR^2}{V^2}-R,$$ **(6)**

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**Question 3**

A particle $P$ is moving on the $x$ axis, starting from the origin $O$, and moving in the direction of $x$ increasing with speed $8 \text{ ms}^{-1}$.

The acceleration of $P$ is in the direction of $x$ **decreasing** and has magnitude

$$\frac{3}{10}v^{\frac{1}{3}} \text{ ms}^{-2},$$

where $v$ is the velocity of the particle at time $t$.

Find an expression for the displacement of $P$ in terms of $t$. **(9)**

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**Question 4**

A particle is moving in a straight line between two points $A$ and $B$, which are $0.4$ m apart, with simple harmonic motion.

The point $C$ is $0.1$ away from $A$.

**a)** If the greatest speed of the particle during its motion is $1.6 \text{ ms}^{-1}$, determine the speed of the particle as it passes through $C$. **(4)**

At time $t = 0$, the particle is at $A$.

**b)** Determine, in terms of $\pi$, the time the particle takes until the time it passes through $C$ for the **eighth** time. **(7)**

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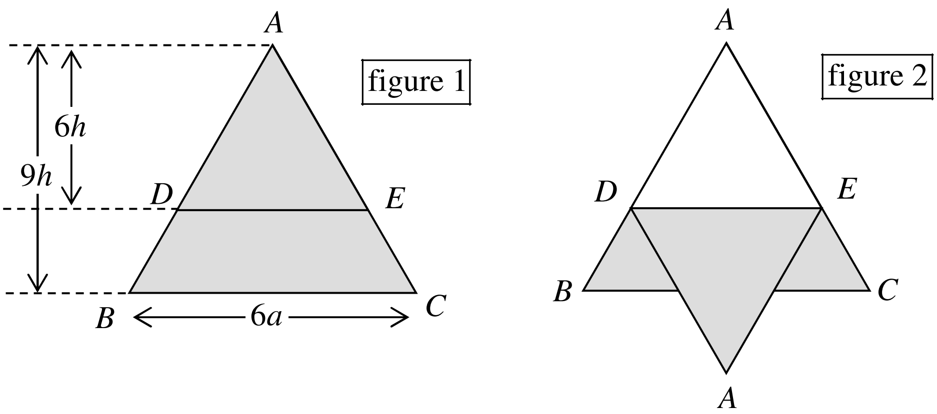
**Question 5**




A uniform lamina $ABC$ is the shape of an isosceles triangle where $AB = AC$, $BC = 6a$. The vertical height of $ABC$ is $9h$, as shown in figure 1. The lamina is to be folded along $DE$, where $DE$ is parallel to $BC$ and at a perpendicular distance of $6h$ from $A$, as shown in figure 2.

**a)** Show that the centre of mass of the **trapezium** $BDEC$ is $\frac{7}{5}h$ from $BC$. **(5)**

**b)** Determine the position of the centre of mass of the **folded lamina** from $BC$. **(4)**

The folded lamina is suspended from the point $D$ and hangs freely in equilibrium. The side $DE$ is inclined at $\arctan\frac{2}{9}$ to the vertical.

**c)** Express $a$ in terms of $h$. **(4)**

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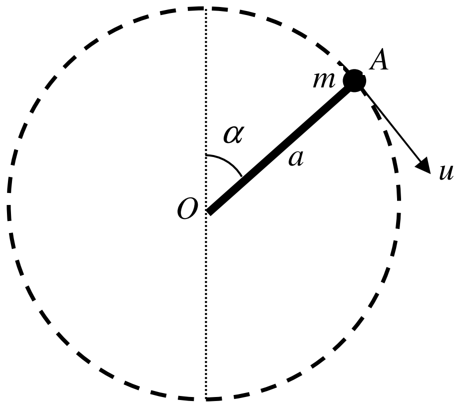
**Question 6**




One end of a **light** rigid rod, of length $a$, is freely jointed to a fixed point $O$ and the other end is attached to a particle of mass $m$.

The particle is projected with speed $u$ from a point $A$, where $OA$ makes an angle $\alpha$ with the upward vertical, as shown in the figure above. The particle moves in a complete full vertical circle with centre $O$, so that the greatest tension in the rod is 10 times as large as the minimum tension.

Given that $\alpha = \arccos\frac{1}{3}$, show that $u^2 = 3ag$. **(11)**

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**Question 7**

A particle of mass $0.75$ kg is attached to a fixed point $A$ by a light elastic string of modulus of elasticity $78$ N.

The particle is released from rest from $A$ and falls vertically without any air resistance, coming to rest at a point $C$, $4$ m below $A$.

**a)** Show by calculation that the natural length of the string is $2.6$ m. **(5)**

**b)** Show that when the extension in the string is $x$ m

$$\frac{d^2x}{dt^2} = -40x + g.$$ **(4)**

**c)** Use a suitable substitution to demonstrate that the above differential equation represents simple harmonic motion. **(2)**

**d)** Determine the maximum speed of the particle during its motion. **(3)**

**e)** Calculate, correct to 4 decimal places, the time it takes the particle to move from $A$ to $C$. **(6)**





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