For this paper you must have:
• an 8-page answer book
• the blue AQA booklet of formulae and statistical tables.
You may use a graphics calculator.

Time allowed: 1 hour 30 minutes

Instructions
• Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
• Write the information required on the front of your answer book. The Examining Body for this paper is AQA. The Paper Reference is MPC2.
• Answer all questions.
• Show all necessary working; otherwise marks for method may be lost.

Information
• The maximum mark for this paper is 75.
• The marks for questions are shown in brackets.

Advice
• Unless stated otherwise, you may quote formulae, without proof, from the booklet.
1. The diagrams show a rectangle of length 6 cm and width 3 cm, and a sector of a circle of radius 6 cm and angle $\theta$ radians.

The area of the rectangle is twice the area of the sector.

(a) Show that $\theta = 0.5$.  
(b) Find the perimeter of the sector.

2. The arithmetic series

\[ 51 + 58 + 65 + 72 + \ldots + 1444 \]

has 200 terms.

(a) Write down the common difference of the series.  
(b) Find the 101st term of the series.  
(c) Find the sum of the last 100 terms of the series.

3. The diagram shows a triangle $ABC$. The length of $AC$ is 18.7 cm, and the sizes of angles $BAC$ and $ABC$ are $72^\circ$ and $50^\circ$ respectively.

(a) Show that the length of $BC = 23.2$ cm, correct to the nearest 0.1 cm.  
(b) Calculate the area of triangle $ABC$, giving your answer to the nearest $\text{cm}^2$.
4 Use the trapezium rule with four ordinates (three strips) to find an approximate value for
\[ \int_{0}^{3} \sqrt{x^2 + 3} \, dx \]
giving your answer to three decimal places. \(4 \text{ marks}\)

5 A curve, drawn from the origin \(O\), crosses the \(x\)-axis at the point \(P(4, 0)\).

The normal to the curve at \(P\) meets the \(y\)-axis at the point \(Q\), as shown in the diagram.

The curve, defined for \(x \geq 0\), has equation
\[ y = 4x^{\frac{1}{2}} - x^{\frac{3}{2}} \]

(a) (i) Find \(\frac{dy}{dx}\). \(3 \text{ marks}\)

(ii) Show that the gradient of the curve at \(P(4, 0)\) is \(-2\). \(2 \text{ marks}\)

(iii) Find an equation of the normal to the curve at \(P(4, 0)\). \(3 \text{ marks}\)

(iv) Find the \(y\)-coordinate of \(Q\) and hence find the area of triangle \(OPQ\). \(3 \text{ marks}\)

(v) The curve has a maximum point \(M\). Find the \(x\)-coordinate of \(M\). \(3 \text{ marks}\)

(b) (i) Find \(\int \left(4x^{\frac{1}{2}} - x^{\frac{3}{2}}\right) \, dx\). \(3 \text{ marks}\)

(ii) Find the total area of the region bounded by the curve and the lines \(PQ\) and \(QO\). \(3 \text{ marks}\)
6 (a) Using the binomial expansion, or otherwise:

(i) express \((1 + x)^3\) in ascending powers of \(x\);

(ii) express \((1 + x)^4\) in ascending powers of \(x\).

(b) Hence, or otherwise:

(i) express \((1 + 4x)^3\) in ascending powers of \(x\);

(ii) express \((1 + 3x)^4\) in ascending powers of \(x\).

(c) Show that the expansion of

\[(1 + 3x)^4 - (1 + 4x)^3\]

can be written in the form

\[px^2 + qx^3 + rx^4\]

where \(p\), \(q\) and \(r\) are integers.

7 (a) Given that

\[\log_a x = \log_a 16 - \log_a 2\]

write down the value of \(x\).

(b) Given that

\[\log_a y = 2 \log_a 3 + \log_a 4 + 1\]

express \(y\) in terms of \(a\), giving your answer in a form not involving logarithms.
8  (a) Sketch the graph of \( y = 3^x \), stating the coordinates of the point where the graph crosses the \( y \)-axis.  

(b) Describe a single geometrical transformation that maps the graph of \( y = 3^x \):

(i) onto the graph of \( y = 3^{2x} \);  

(ii) onto the graph of \( y = 3^{x+1} \).

(c) (i) Using the substitution \( Y = 3^x \), show that the equation

\[
9^x - 3^{x+1} + 2 = 0
\]

can be written as

\[
(Y - 1)(Y - 2) = 0
\]  

(ii) Hence show that the equation \( 9^x - 3^{x+1} + 2 = 0 \) has a solution \( x = 0 \) and, by using logarithms, find the other solution, giving your answer to four decimal places.

9  (a) Given that

\[
\frac{3 + \sin^2 \theta}{\cos \theta - 2} = 3 \cos \theta
\]

show that

\[
\cos \theta = -\frac{1}{2}
\]  

(b) Hence solve the equation

\[
\frac{3 + \sin^2 3x}{\cos 3x - 2} = 3 \cos 3x
\]

giving all solutions in degrees in the interval \( 0^\circ < x < 180^\circ \).

END OF QUESTIONS
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