



Rewarding Learning

ADVANCED  
General Certificate of Education  
2011

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## Mathematics

Assessment Unit C3

*assessing*

Module C3: Core Mathematics 3

[AMC31]



FRIDAY 20 MAY, AFTERNOON

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### TIME

1 hour 30 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided.

Answer **all eight** questions.

Show clearly the full development of your answers.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 75

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is  $\ln z$  where it is noted that  $\ln z \equiv \log_e z$



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**Answer all eight questions.**

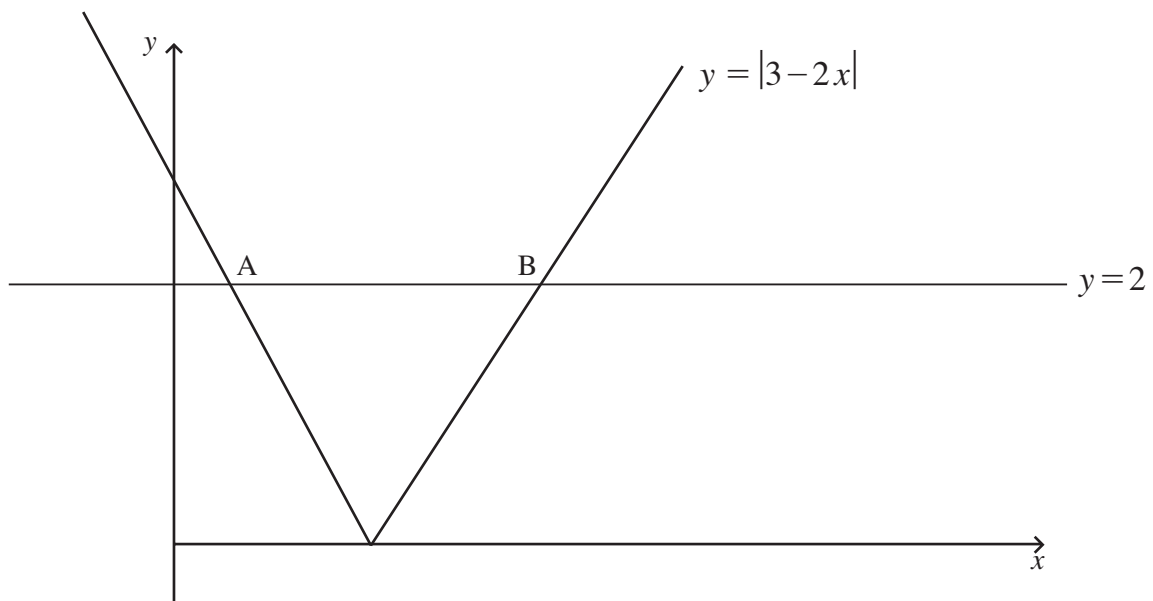
**Show clearly the full development of your answers.**

**Answers should be given to three significant figures unless otherwise stated.**

**1** Find the first 3 terms in the binomial expansion of  $\sqrt{1+2x}$  [5]

**2** Fig. 1 below shows the graphs of

$$y = |3 - 2x| \quad \text{and} \quad y = 2$$



**Fig. 1**

The graphs intersect at the points A and B.

Find the x coordinates of A and B.

[6]

3 Use partial fractions to rewrite

$$\frac{x^2 + 8x - 1}{(x - 3)(x - 1)^2}$$

in the form

$$\frac{A}{x - 3} + \frac{B}{x - 1} + \frac{C}{(x - 1)^2}$$

where  $A$ ,  $B$  and  $C$  are integers.

[5]

4 A population of microorganisms grows according to the rule

$$N = 15000e^{0.7t}$$

where  $N$  is the size of the population at time  $t$  hours.

(i) Find the initial population.

[1]

(ii) Find how long it will take for the population to treble.

[6]

5 Fig. 2 below shows the graphs of

$$y = \sin x \quad \text{and} \quad y = 1 - x^3$$

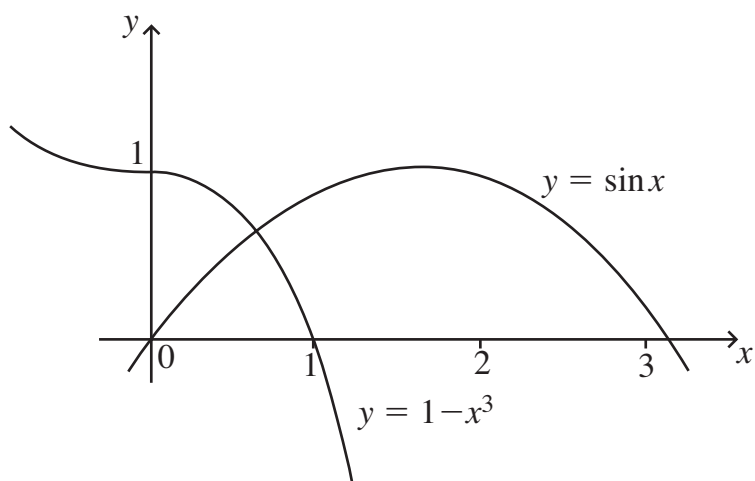


Fig. 2

(i) Show that the point of intersection of these graphs can be found by solving the equation

$$\sin x + x^3 - 1 = 0 \quad [2]$$

(ii) Verify that this value of  $x$  lies between  $x = 0$  and  $x = 1$  [3]

(iii) Taking  $x = 0.5$  as a first approximation to this value of  $x$ , use the Newton-Raphson method twice to find a better approximation. [5]

6 (a) Find

$$\int x^3 - \frac{2}{x} + \operatorname{cosec}^2 x - e^{-3x} dx$$

[5]

(b) A component of a machine is to be cut from flat steel. It can be modelled as the area between the curve  $y = \cos 2x$ , the axes and the line  $x = \frac{\pi}{6}$ . This is shown shaded in **Fig. 3** below.

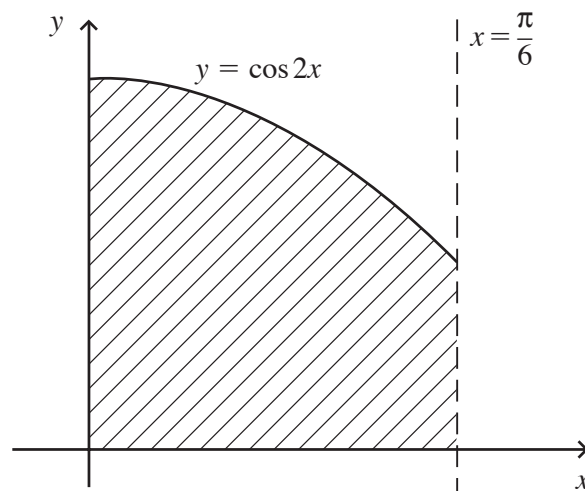


Fig. 3

Using calculus, determine the area of the component.

[6]

7 (a) Differentiate

$$\frac{x^4}{\tan^2 x}$$

[6]

(b) Find the **exact** equation of the tangent to the curve

$$y = x \ln x$$

at the point where  $x = 2$

[8]

8 (a) A circle is defined by the parametric equations

$$x = -1 + 3 \sin \theta \qquad y = 2 + 3 \cos \theta$$

(i) Find the cartesian equation of this circle. [4]

(ii) Write down the centre and radius of this circle. [3]

(b) (i) Prove the identity

$$\frac{1 - \sin \theta}{1 + \cos \theta} \times \frac{1 + \sin \theta}{1 - \cos \theta} \equiv \cot^2 \theta \quad [4]$$

(ii) Hence solve the equation

$$\frac{1 - \sin \theta}{1 + \cos \theta} \times \frac{1 + \sin \theta}{1 - \cos \theta} = \cot \theta + 2$$

where  $-\pi \leq \theta \leq \pi$  [6]

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**THIS IS THE END OF THE QUESTION PAPER**

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