

**EXAMINATIONS COUNCIL OF ZAMBIA**

**Examination for General Certificate of Education Ordinary Level**

**Additional Mathematics 4030/1**

**Paper 1**

**Tuesday**

**26 JULY 2016**

Additional materials:

Answer Booklet

Graph paper (1 Sheet)

Mathematical tables/Electronic calculators (non-programmable)

**Time: 2 hours**

**Instructions to candidates**

Write your name, centre number and candidate number in the spaces on the Answer Booklet provided.

There are **12 questions** in this paper. Answer **all** questions.

Write your answers in the Answer Booklet provided.

If you use more than one Answer Booklet, fasten the Answer Booklets together.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

**Information for candidates**

The number of marks is shown in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 80.

**The use of a non-programmable electronic calculator is expected, where appropriate.**

**Cell phones are not allowed in the examination room.**

You are reminded of the need for clear presentation in your answers.

**Check the formulae overleaf.**

MATHEMATICS FORMULAE

1 ALGEBRA

Quadratic Equation

For the equation  $ax^2 + bx + c = 0$ ,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

*Binomial Theorem*

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where  $n$  is a positive integer and  $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2 TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for  $\Delta ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

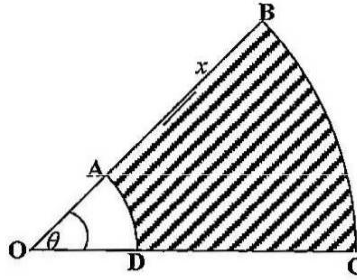
$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

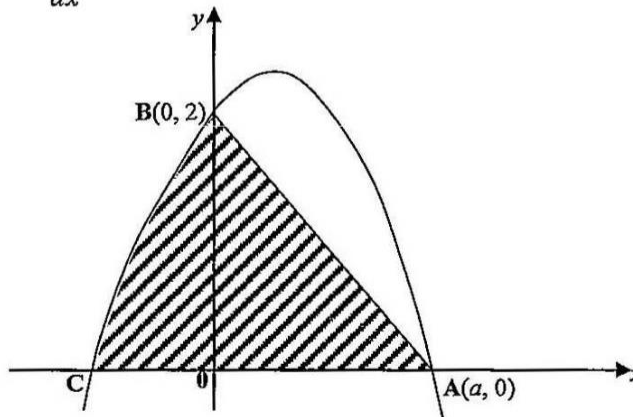
- 1 The straight line  $y + 3 = 2x$  meets the curve  $x^2 - 3x = y^2 - 21$  at **P** and **Q**.  
Calculate the coordinates of **P** and **Q**. [5]
- 2 Find the equation of the line perpendicular to the line  $2x + 4y + 3 = 0$  passing through the point  $(-5, 2)$ . [4]
- 3 Functions  $h$  and  $g$  are defined by  
 $h: x \rightarrow 3x - 2$ ,  
 $g: x \rightarrow \frac{x}{x-1}, x \neq 1$ .  
 Find  
 (a)  $hg(x)$ , [2]  
 (b)  $gh(x)$ , [1]  
 (c) the value of  $x$  for which  $hg(x) = gh(x)$ . [3]
- 4 Find the range of values of  $k$  for which the line  $y = kx + 4$  does not meet the curve  $2x^2 + xy = -6$ . [4]
- 5 (a) Find the mid-term in the expansion of  $(2 - 3x^2)^8$ . [4]  
 (b) Find the term in  $x^3$  in the expansion of  $(1 + 2x)^3(1 - \frac{3}{2}x)^4$ . [5]
- 6 Prove the identity  

$$\frac{\sin^2 \theta (1 - \tan^2 \theta)}{\cos^2 \theta - \sin^2 \theta} \equiv \tan^2 \theta$$
. [4]
- 7 On the same diagram, sketch the graphs of  $y = 1 + \sin 2x$  and  $y = 2 - \frac{x}{\pi}$  for the domain 0 to  $2\pi$ . Hence state the number of solutions to the equation  
 $1 + \sin 2x = 2 - \frac{x}{\pi}$ . [5]
- 8 **P** and **Q** have position vectors  $2i - j$  and  $ai + 4j$  respectively. The cosine of the angle between **p** and **q** is  $\frac{-2}{\sqrt{5}}$ .  
 Find  
 (a) the value of  $a$ , [4]  
 (b) the unit vector in the direction of  $\vec{PQ}$ . [3]

- 9 The diagram below shows two sectors **OBC** and **OAD** with centre **O** and  $\angle BOC = \theta$  radians. The radius of sector **OBC** is 3cm and  $AB = x$ cm.



- (a) Show that the area of the shaded region is  $\frac{1}{2}x\theta(6-x)$ . [4]
- (b) Given that the area of the shaded region is  $8\text{cm}^2$  and  $\theta = 2$  radians, find **OA**. [3]
- 10 (a) Find the point on the curve  $y = \frac{1}{2}x^2 + \frac{8}{x}$  at which the tangent is parallel to the x-axis. [3]
- (b) The radius of a cylinder is increased by 5%. Given that the height is constant, determine the percentage increase in the volume. [6]
- 11 (a) Find  $p$ , if  $\int_p^2 (8-4x) dx = 18$ . [3]
- (b) The diagram below shows a straight line **AB** and a curve with a gradient function  $\frac{dy}{dx} = 3 - 4x$ . The curve intersects the axes at **A**, **B** and **C**.



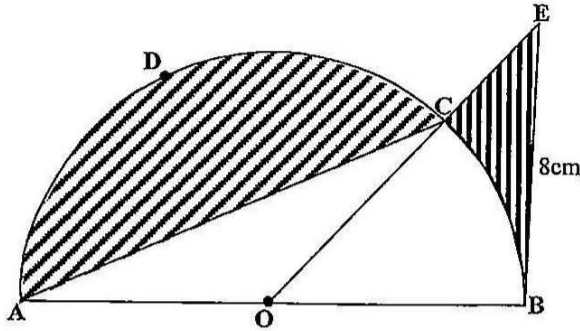
Find

- (i) the coordinates of the points **A** and **C**, [3]
- (ii) the area of the shaded part. [4]

12 Answer only one of the following alternatives:

**EITHER**

In the diagram below,  $ABCD$  is a semi-circle with centre  $O$ .  $AB$  is the diameter and  $BE$  is a tangent to the circle at  $B$ .  $BE = 8\text{cm}$  and  $OC:CE = 3:2$ .

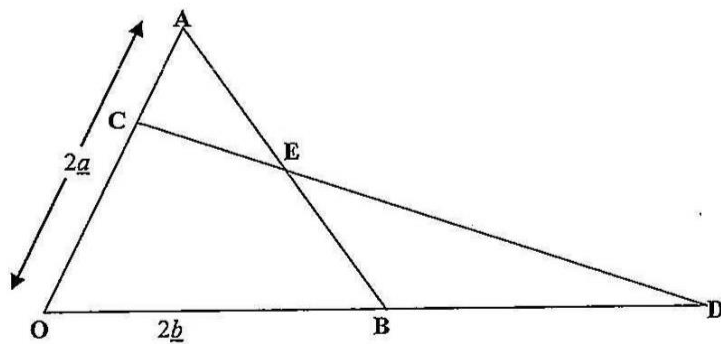


Find

- (a)  $\widehat{BOE}$  in radians, [2]
- (b) the radius of the circle, [2]
- (c) the total area of the shaded regions. [6]

**OR**

In the diagram below, the position vectors of  $A$  and  $B$  relative to the origin  $O$  are  $2\mathbf{a}$  and  $2\mathbf{b}$  respectively. The point  $C$  lies on  $OA$  such that  $OC = 2CA$ . The point  $D$  lies on  $OB$  produced, such that  $OB = BD$ . The lines  $AB$  and  $CD$  meet at  $E$ .  $\vec{CE} = \lambda\vec{CD}$  and  $\vec{AE} = \mu\vec{AB}$ .



- (a) Express  $\vec{OE}$  in terms of
  - (i)  $\mathbf{a}$ ,  $\mathbf{b}$  and  $\lambda$ , [3]
  - (ii)  $\mathbf{a}$ ,  $\mathbf{b}$  and  $\mu$ , [3]
- (b) Hence or otherwise, find the value of  $\lambda$  and of  $\mu$ . [4]