



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**ADDITIONAL MATHEMATICS**

**4037/22**

Paper 2

**May/June 2013**

**2 hours**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** the questions.

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.

The use of an electronic calculator is expected, where appropriate.

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

At the end of the examination, fasten all your work securely together.

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

The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.



## 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 $\triangle ABC$

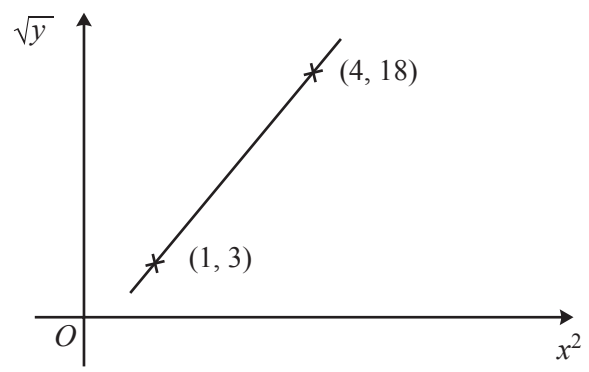
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

3

1



Variables  $x$  and  $y$  are such that when  $\sqrt{y}$  is plotted against  $x^2$  a straight line graph passing through the points  $(1, 3)$  and  $(4, 18)$  is obtained. Express  $y$  in terms of  $x$ . [4]

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- 2 (a) Solve the equation  $3^{p+1} = 0.7$ , giving your answer to 2 decimal places.

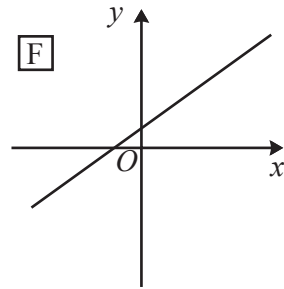
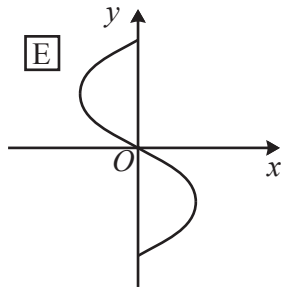
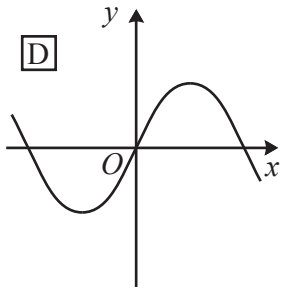
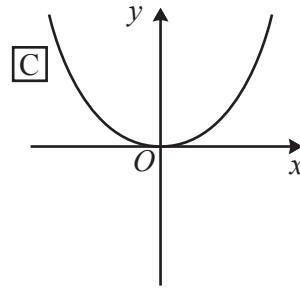
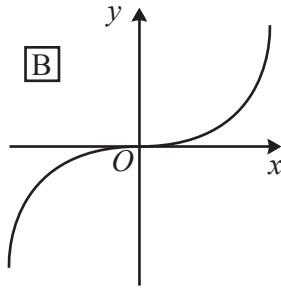
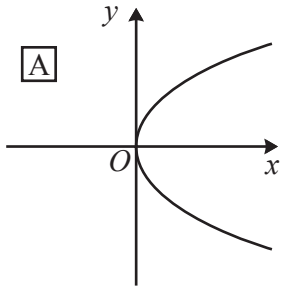
[3]

For  
Examine  
Use

- (b) Express  $\frac{y \times (4x^3)^2}{\sqrt{8y^3}}$  in the form  $2^a \times x^b \times y^c$ , where  $a$ ,  $b$  and  $c$  are constants.

[3]

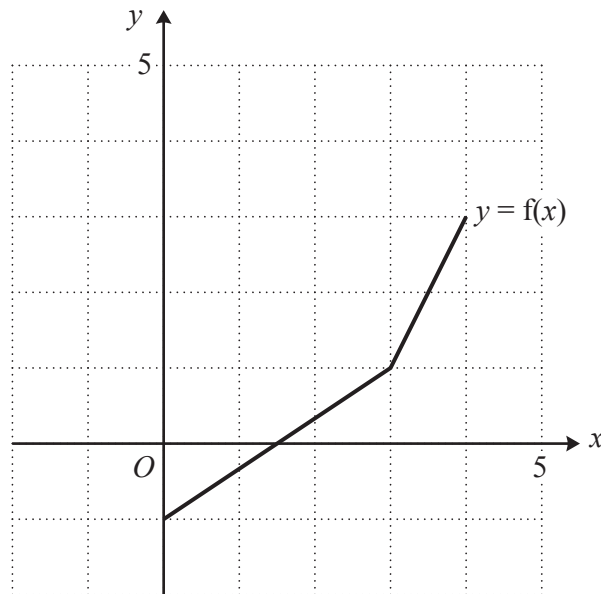
3 (a)



(i) Write down the letter of each graph which does **not** represent a function. [2]

(ii) Write down the letter of each graph which represents a function that does **not** have an inverse. [2]

(b)



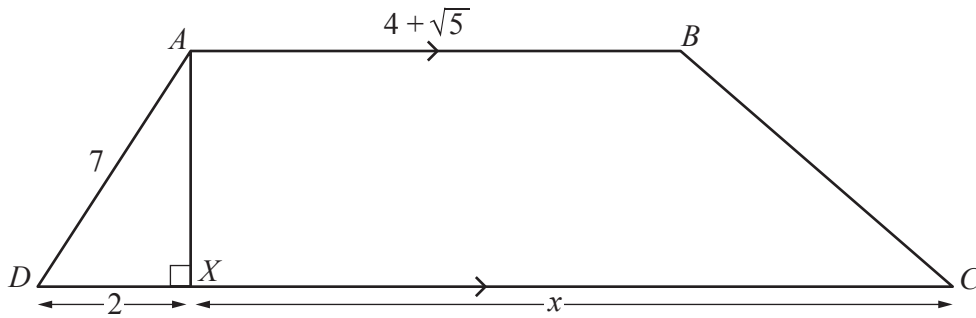
The diagram shows the graph of a function  $y = f(x)$ . On the same axes sketch the graph of  $y = f^{-1}(x)$ . [2]

4 The position vectors of the points  $A$  and  $B$ , relative to an origin  $O$ , are  $4\mathbf{i} - 21\mathbf{j}$  and  $22\mathbf{i} - 30\mathbf{j}$  respectively. The point  $C$  lies on  $AB$  such that  $\overrightarrow{AB} = 3\overrightarrow{AC}$ .

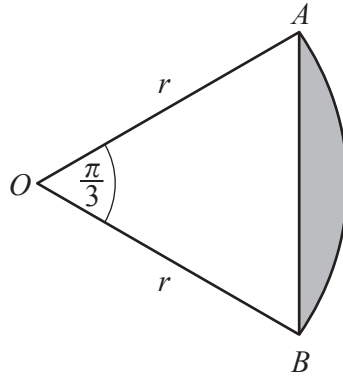
(i) Find the position vector of  $C$  relative to  $O$ . [4]

(ii) Find the unit vector in the direction  $\overrightarrow{OC}$ . [2]

## 5 Calculators must not be used in this question.



The diagram shows a trapezium  $ABCD$  in which  $AD = 7$  cm and  $AB = (4 + \sqrt{5})$  cm.  $AX$  is perpendicular to  $DC$  with  $DX = 2$  cm and  $XC = x$  cm. Given that the area of trapezium  $ABCD$  is  $15(\sqrt{5} + 2)$  cm<sup>2</sup>, obtain an expression for  $x$  in the form  $a + b\sqrt{5}$ , where  $a$  and  $b$  are integers. [6]



The shaded region in the diagram is a segment of a circle with centre  $O$  and radius  $r$  cm.

Angle  $AOB = \frac{\pi}{3}$  radians.

(i) Show that the perimeter of the segment is  $r \left( \frac{3 + \pi}{3} \right)$  cm. [2]

(ii) Given that the perimeter of the segment is 26 cm, find the value of  $r$  and the area of the segment. [5]



7 Differentiate, with respect to  $x$ ,

(i)  $(3 - 5x)^{12}$ ,

[2]

Examine.  
Use

(ii)  $x^2 \sin x$ ,

[2]

(iii)  $\frac{\tan x}{1 + e^{2x}}$ .

[4]

8 Solutions to this question by accurate drawing will not be accepted.

The points  $A(-6, 2)$ ,  $B(2, 6)$  and  $C$  are the vertices of a triangle.

(i) Find the equation of the line  $AB$  in the form  $y = mx + c$ . [2]

(ii) Given that angle  $ABC = 90^\circ$ , find the equation of  $BC$ . [2]

- (iii) Given that the length of  $AC$  is 10 units, find the coordinates of each of the two possible positions of point  $C$ . [4]

For  
Examiners  
Use

- 9 (a) The graph of  $y = k(3^x) + c$  passes through the points  $(0, 14)$  and  $(-2, 6)$ . Find the value of  $k$  and of  $c$ . [3]

- (b) The variables  $x$  and  $y$  are connected by the equation  $y = e^x + 25 - 24e^{-x}$ .

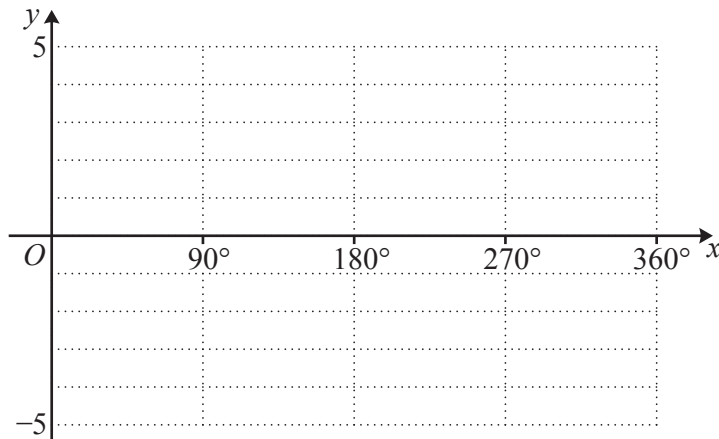
- (i) Find the value of  $y$  when  $x = 4$ . [1]

- (ii) Find the value of  $e^x$  when  $y = 20$  and hence find the corresponding value of  $x$ . [4]

10 (a) The function  $f$  is defined, for  $0^\circ \leq x \leq 360^\circ$ , by  $f(x) = 1 + 3 \cos 2x$ .

(i) Sketch the graph of  $y = f(x)$  on the axes below.

[4]



(ii) State the amplitude of  $f$ .

[1]

(iii) State the period of  $f$ .

[1]

(b) Given that  $\cos x = p$ , where  $270^\circ < x < 360^\circ$ , find  $\operatorname{cosec} x$  in terms of  $p$ .

[3]

11 A curve has equation  $y = 3x + \frac{1}{(x-4)^3}$ .

(i) Find  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$ . [4]

(ii) Show that the coordinates of the stationary points of the curve are (5, 16) and (3, 8). [2]

(iii) Determine the nature of each of these stationary points. [2]

(iv) Find  $\int \left( 3x + \frac{1}{(x-4)^3} \right) dx$ .

[2]

For  
Examine  
Use

- (v) Hence find the area of the region enclosed by the curve, the line  $x = 5$ , the  $x$ -axis and the line  $x = 6$ . [2]

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