



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**ADDITIONAL MATHEMATICS**

**0606/23**

Paper 2

**October/November 2012**

**2 hours**

Candidates answer on the Question Paper.

Additional Materials:      Electronic calculator

**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.

Answer **all** 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.

**For Examiner's Use**

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<b>11</b>	
<b>12</b>	
<b>Total</b>	

This document consists of **16** printed pages.



**Mathematical Formulae**For  
Examiner's  
Use**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  $\triangle ABC$* 

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

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

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

- 1 Solve the equation  $|5x + 7| = 13$ .

[3]

*For  
Examiner's  
Use*

- 
- 2 (i) Given that  $\mathbf{A} = \begin{pmatrix} 7 & 8 \\ 4 & 6 \end{pmatrix}$ , find the inverse matrix,  $\mathbf{A}^{-1}$ .

[2]

- (ii) Use your answer to part (i) to solve the simultaneous equations

$$\begin{aligned} 7x + 8y &= 39, \\ 4x + 6y &= 23. \end{aligned}$$

[2]

- 3 Without using a calculator, simplify  $\frac{(3\sqrt{3} - 1)^2}{2\sqrt{3} - 3}$ , giving your answer in the form  $\frac{a\sqrt{3} + b}{3}$ , where  $a$  and  $b$  are integers. [4]

For  
Examiner's  
Use

- 4 The points  $X$ ,  $Y$  and  $Z$  are such that  $\overrightarrow{XY} = 3\overrightarrow{YZ}$ . The position vectors of  $X$  and  $Z$ , relative to an origin  $O$ , are  $\begin{pmatrix} 4 \\ -27 \end{pmatrix}$  and  $\begin{pmatrix} 20 \\ -7 \end{pmatrix}$  respectively. Find the unit vector in the direction  $\overrightarrow{OY}$ . [5]

*For  
Examiner's  
Use*

- 5 Find the set of values of  $m$  for which the line  $y = mx + 2$  does not meet the curve  $y = mx^2 + 7x + 11$ .

[6]

*For  
Examiner's  
Use*

- 6 (a) Given that  $\cos x = p$ , find an expression, in terms of  $p$ , for  $\tan^2 x$ .

[3]

*For  
Examiner's  
Use*

- (b) Prove that  $(\cot \theta + \tan \theta)^2 = \sec^2 \theta + \operatorname{cosec}^2 \theta$ .

[3]

7 (a) Find  $\int (x + 3) \sqrt{x} \, dx$ .

[3] *For  
Examiner's  
Use*

(b) Find  $\int \frac{20}{(2x + 5)^2} \, dx$  and hence evaluate  $\int_0^{10} \frac{20}{(2x + 5)^2} \, dx$ .

[4]



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

The points  $A(4, 5)$ ,  $B(-2, 3)$ ,  $C(1, 9)$  and  $D$  are the vertices of a trapezium in which  $BC$  is parallel to  $AD$  and angle  $BCD$  is  $90^\circ$ . Find the area of the trapezium.

[8]

*For  
Examiner's  
Use*

- 9 The table shows experimental values of two variables  $x$  and  $y$ .

$x$	1	2	3	4
$y$	9.41	1.29	-0.69	-1.77

For  
Examiner's  
Use

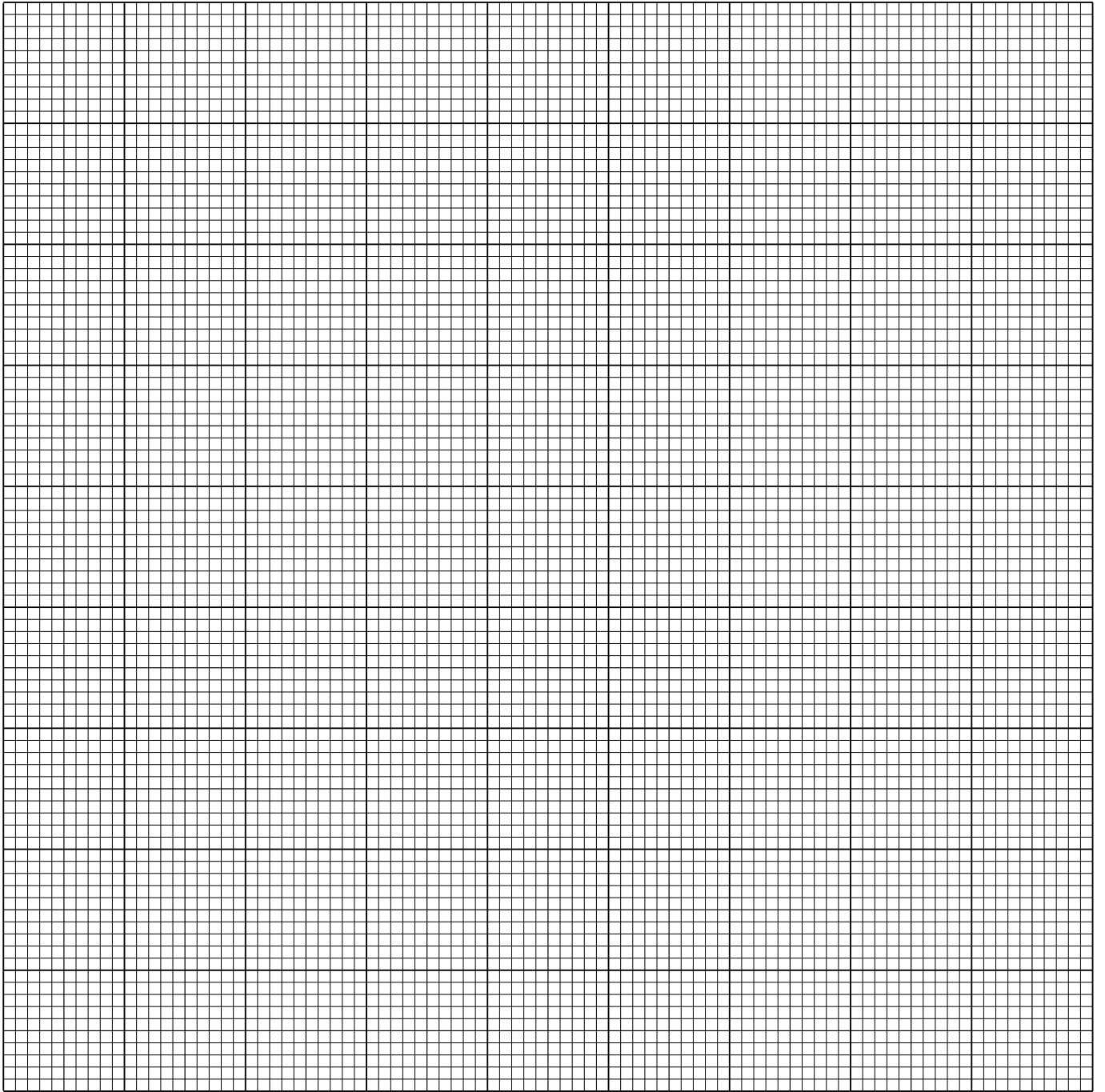
It is known that  $x$  and  $y$  are related by the equation  $y = \frac{a}{x^2} + bx$ , where  $a$  and  $b$  are constants.

- (i) A straight line graph is to be drawn to represent this information. Given that  $x^2y$  is plotted on the vertical axis, state the variable to be plotted on the horizontal axis. [1]

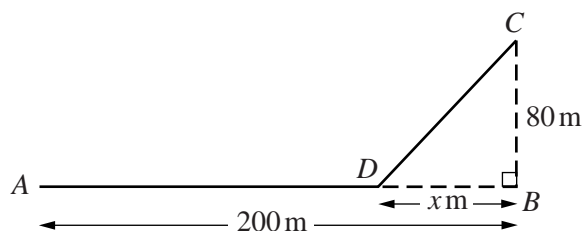
- (ii) On the grid opposite, draw this straight line graph. [3]

- (iii) Use your graph to estimate the value of  $a$  and of  $b$ . [3]

- (iv) Estimate the value of  $y$  when  $x$  is 3.7. [2]



10

For  
Examiner's  
Use

A track runs due east from  $A$  to  $B$ , a distance of 200 m. The point  $C$  is 80 m due north of  $B$ . A cyclist travels on the track from  $A$  to  $D$ , where  $D$  is  $x$  m due west of  $B$ . The cyclist then travels in a straight line across rough ground from  $D$  to  $C$ . The cyclist travels at  $10 \text{ m s}^{-1}$  on the track and at  $6 \text{ m s}^{-1}$  across rough ground.

- (i) Show that the time taken,  $T$  s, for the cyclist to travel from  $A$  to  $C$  is given by

$$T = \frac{200 - x}{10} + \frac{\sqrt{(x^2 + 6400)}}{6} \quad [2]$$

- (ii) Given that  $x$  can vary, find the value of  $x$  for which  $T$  has a stationary value and the corresponding value of  $T$ . [6]

- 11 (a) Solve  $(2^{x-2})^{\frac{1}{2}} = 100$ , giving your answer to 1 decimal place.

[3]

*For  
Examiner's  
Use*

- (b) Solve  $\log_y 2 = 3 - \log_y 256$ .

[3]

- (c) Solve  $\frac{6^{5z-2}}{36^z} = \frac{216^{z-1}}{36^{3-z}}$ .

[4]

**12** Answer only **one** of the following alternatives.

For  
Examiner's  
Use

**EITHER**

- (i) Express  $4x^2 + 32x + 55$  in the form  $(ax + b)^2 + c$ , where  $a$ ,  $b$  and  $c$  are constants and  $a$  is positive. [3]

The functions  $f$  and  $g$  are defined by

$$f : x \mapsto 4x^2 + 32x + 55 \text{ for } x > -4,$$

$$g : x \mapsto \frac{1}{x} \text{ for } x > 0.$$

- (ii) Find  $f^{-1}(x)$ . [3]

- (iii) Solve the equation  $fg(x) = 135$ . [4]

**OR**

The functions  $h$  and  $k$  are defined by

$$h : x \mapsto \sqrt{2x - 7} \text{ for } x \geq c,$$

$$k : x \mapsto \frac{3x - 4}{x - 2} \text{ for } x > 2.$$

- (i) State the least possible value of  $c$ . [1]

- (ii) Find  $h^{-1}(x)$ . [2]

- (iii) Solve the equation  $k(x) = x$ . [3]

- (iv) Find an expression for the function  $k^2$ , in the form  $k^2 : x \mapsto a + \frac{b}{x}$  where  $a$  and  $b$  are constants. [4]

Indicate which question you are answering.

<b>EITHER</b>	
<b>OR</b>	

[illegible]

[illegible]

0606/23/O/N/12