

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# AS MATHEMATICS

## Unit Further Pure 1

Wednesday 15 June 2016

Morning

Time allowed: 1 hour 30 minutes

### Materials

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

### Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

### Information

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

### Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



Answer **all** questions.

Answer each question in the space provided for that question.

**1** The quadratic equation  $x^2 - 6x + 14 = 0$  has roots  $\alpha$  and  $\beta$ .

**(a)** Write down the value of  $\alpha + \beta$  and the value of  $\alpha\beta$ .

**[2 marks]**

**(b)** Find a quadratic equation, with integer coefficients, which has roots  $\frac{\alpha}{\beta}$  and  $\frac{\beta}{\alpha}$ .

**[5 marks]**

QUESTION  
PART  
REFERENCE

**Answer space for question 1**





- 2** A curve  $C$  has equation  $y = (2 - x)(1 + x) + 3$ .
- (a)** A line passes through the point  $(2, 3)$  and the point on  $C$  with  $x$ -coordinate  $2 + h$ .  
Find the gradient of the line, giving your answer in its simplest form. **[3 marks]**
- (b)** Show how your answer to part **(a)** can be used to find the gradient of the curve  $C$  at the point  $(2, 3)$ . State the value of this gradient. **[2 marks]**

QUESTION  
PART  
REFERENCE**Answer space for question 2**



- 3 The variables  $y$  and  $x$  are related by an equation of the form

$$y = a(b^x)$$

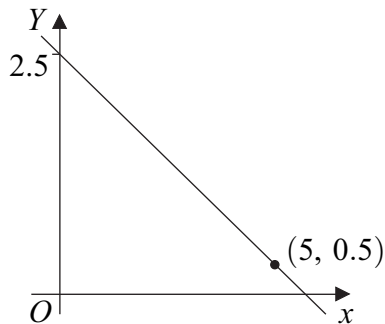
where  $a$  and  $b$  are positive constants.

Let  $Y = \log_{10} y$ .

- (a) Show that there is a linear relationship between  $Y$  and  $x$ .

[2 marks]

- (b) The graph of  $Y$  against  $x$ , shown below, passes through the points  $(0, 2.5)$  and  $(5, 0.5)$ .



- (i) Find the gradient of the line.

[1 mark]

- (ii) Find the value of  $a$  and the value of  $b$ , giving each answer to three significant figures.

[4 marks]

QUESTION  
PART  
REFERENCE

Answer space for question 3





4 (a) Given that  $\sin \frac{\pi}{3} = \cos \frac{\pi}{k}$ , state the value of the integer  $k$ .

[1 mark]

(b) Hence, or otherwise, find the general solution of the equation

$$\cos\left(2x - \frac{5\pi}{6}\right) = \sin \frac{\pi}{3}$$

giving your answer, in its simplest form, in terms of  $\pi$ .

[4 marks]

(c) Hence, given that  $\cos\left(2x - \frac{5\pi}{6}\right) = \sin \frac{\pi}{3}$ , show that there is only one finite value for  $\tan x$  and state its exact value.

[2 marks]

QUESTION  
PART  
REFERENCE

Answer space for question 4







5 (a) Use the formulae for  $\sum_{r=1}^n r^2$  and  $\sum_{r=1}^n r$  to show that  $\sum_{r=1}^n (6r - 3)^2 = 3n(4n^2 - 1)$ .

[5 marks]

(b) Hence express  $\sum_{r=1}^{2n} r^3 - \sum_{r=1}^n (6r - 3)^2$  as a product of four linear factors in terms of  $n$ .

[4 marks]

QUESTION  
PART  
REFERENCE

Answer space for question 5





**6** A parabola with equation  $y^2 = 4ax$ , where  $a$  is a constant, is translated by the vector  $\begin{bmatrix} 2 \\ 3 \end{bmatrix}$  to give the curve  $C$ . The curve  $C$  passes through the point  $(4, 7)$ .

**(a)** Show that  $a = 2$ .

**[3 marks]**

**(b)** Find the values of  $k$  for which the line  $ky = x$  does **not** meet the curve  $C$ .

**[6 marks]**

QUESTION  
PART  
REFERENCE

**Answer space for question 6**























9 A curve  $C$  has equation  $y = \frac{x-1}{(x-2)(2x-1)}$ .

The line  $L$  has equation  $y = \frac{1}{2}(x-1)$ .

(a) Write down the equations of the asymptotes of  $C$ . **[2 marks]**

(b) By forming and solving a suitable cubic equation, find the  $x$ -coordinates of the points of intersection of  $L$  and  $C$ . **[3 marks]**

(c) Given that  $C$  has no stationary points, sketch  $C$  and  $L$  on the same axes. **[3 marks]**

(d) Hence solve the inequality  $\frac{x-1}{(x-2)(2x-1)} \geq \frac{1}{2}(x-1)$ . **[3 marks]**

QUESTION  
PART  
REFERENCE

**Answer space for question 9**





