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**Pearson Edexcel**  
**International GCSE**

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# Further Pure Mathematics

## Paper 1

Tuesday 14 June 2016 – Morning <b>Time: 2 hours</b>	Paper Reference <b>4PM0/01</b>
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<b>Calculators may be used.</b>	Total Marks
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**Instructions**

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

**Information**

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

**Advice**

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

*Turn over* ►

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**Answer all TEN questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1**

$$f(x) = x^3 - 7x + 6$$

(a) Show that  $(x - 2)$  is a factor of  $f(x)$  (2)

(b) Hence, or otherwise, factorise  $f(x)$  completely. (3)

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**Question 1 continued**

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**(Total for Question 1 is 5 marks)**



- 2 (a) Expand  $(1 + 3x^2)^{-\frac{1}{3}}$ ,  $3x^2 < 1$ , in ascending powers of  $x$ , up to and including the term in  $x^6$ , simplifying each term as far as possible.

(3)

$$f(x) = \frac{1 - kx^2}{(1 + 3x^2)^{\frac{1}{3}}} \text{ where } k \text{ is a constant}$$

- (b) Obtain a series expansion for  $f(x)$  in ascending powers of  $x$  up to and including the term in  $x^4$ .

(3)

Given that the coefficient of  $x^2$  in the expansion of  $f(x)$  is  $-5$

- (c) find the value of  $k$ .

(1)

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**Question 2 continued**

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**(Total for Question 2 is 7 marks)**



3 A right pyramid  $ABCDE$  has a square base  $ABCD$  of side 10 cm.  
The height of the pyramid is 8 cm.

(a) Find, to 3 significant figures, the length of  $AE$ .

(3)

(b) Find, in degrees to the nearest degree, the size of the angle between the plane  $ABE$   
and the base  $ABCD$ .

(3)

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**Question 3 continued**

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**(Total for Question 3 is 6 marks)**



4 The  $n$ th term of an arithmetic series is  $t_n$  and the sum of the first  $n$  terms of the series is  $S_n$

Given that  $S_2 = \frac{2}{3}t_5$  and that  $S_4 = t_{10} + 3$

(a) find

(i) the common difference of the series,

(ii) the first term of the series.

(5)

Given also that  $S_{p+2} - S_p = 110$

(b) find the value of  $p$ .

(3)

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**Question 4 continued**

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**(Total for Question 4 is 8 marks)**



## 5 Using the identities

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\tan A = \frac{\sin A}{\cos A}$$

(a) show that the equation

$$3 \sin(x + \alpha) = 5 \sin(x - \alpha)$$

can be written in the form  $\tan x = 4 \tan \alpha$

(5)

(b) Hence solve, to the nearest integer, the equation

$$3 \sin(2y + 30)^\circ = 5 \sin(2y - 30)^\circ \quad \text{for } 90 \leq y < 180$$

(4)

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**Question 5 continued**

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**Question 5 continued**

Area with horizontal dotted lines for writing answers.

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**Question 5 continued**

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**(Total for Question 5 is 9 marks)**



6 Solve

(a)  $\log_x 1024 = 5$  (2)

(b)  $\log_3 (7y - 3) = 4$  (2)

(c)  $\log_a 25 + 2\log_a 625 = 10$  (3)

(d)  $\log_b 7 - 2\log_7 b + 1 = 0$  (5)

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**Question 6 continued**

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**Question 6 continued**

Area with horizontal dotted lines for writing answers.

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**Question 6 continued**

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**(Total for Question 6 is 12 marks)**



- 7 (a) Complete the table of values for  $y = 2^x - 4$ , giving your answers to 2 decimal places.

$x$	0	0.5	1	1.5	2	2.5	2.75	3
$y$	-3		-2		0		2.73	4

(2)

- (b) On the grid opposite, draw the graph of  $y = 2^x - 4$  for  $0 \leq x \leq 3$

(2)

- (c) Use your graph to obtain an estimate, to one decimal place, of the value of  $\log_2 7$   
Show clearly how you used the graph.

(3)

- (d) By drawing a straight line on your graph, obtain an estimate to one decimal place of the root of the equation  $2^x + 3x = 7$  in the interval  $0 \leq x \leq 3$

(4)

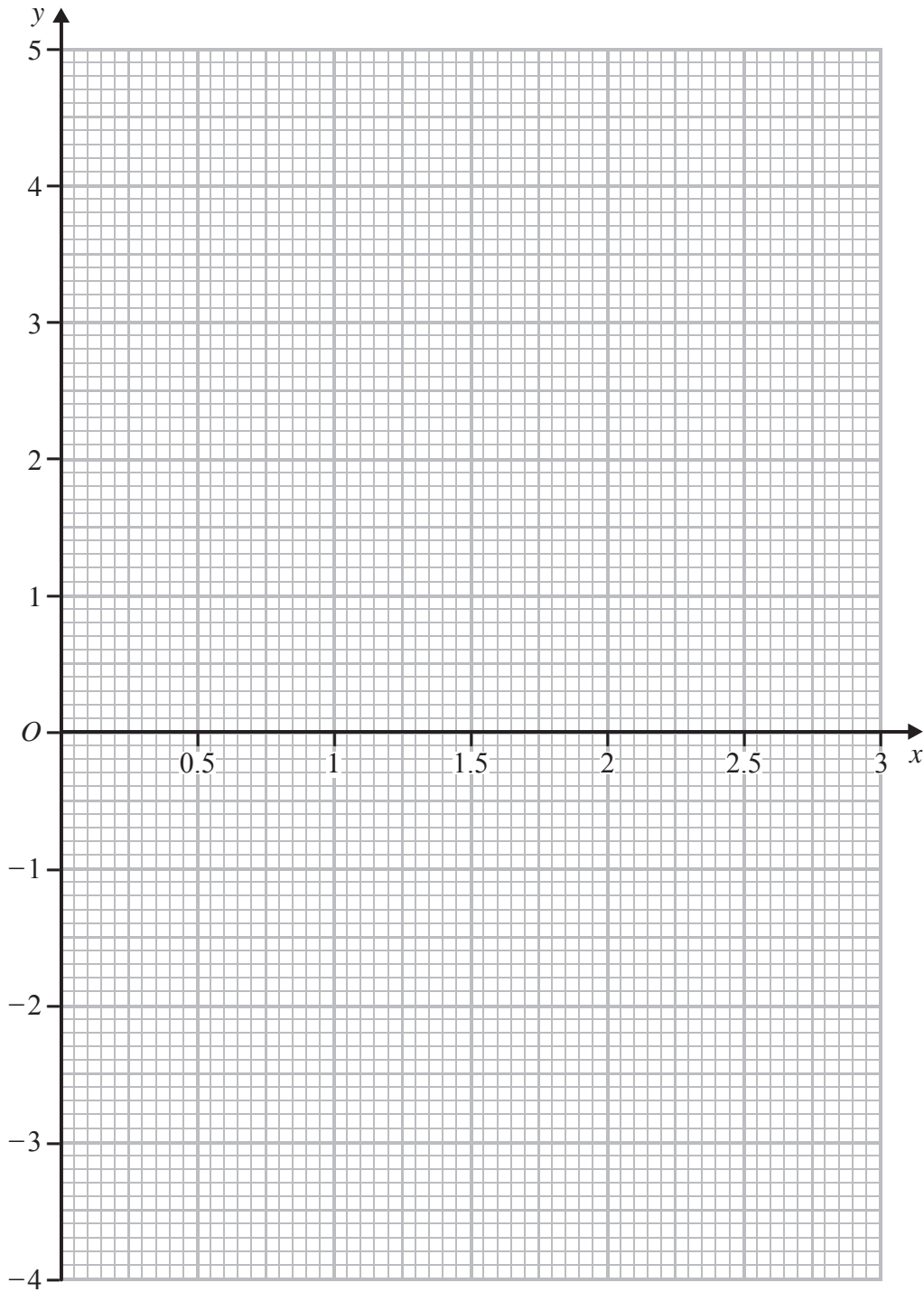
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**Question 7 continued**



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**Turn over for a spare grid if you need to redraw your graph.**



**Question 7 continued**

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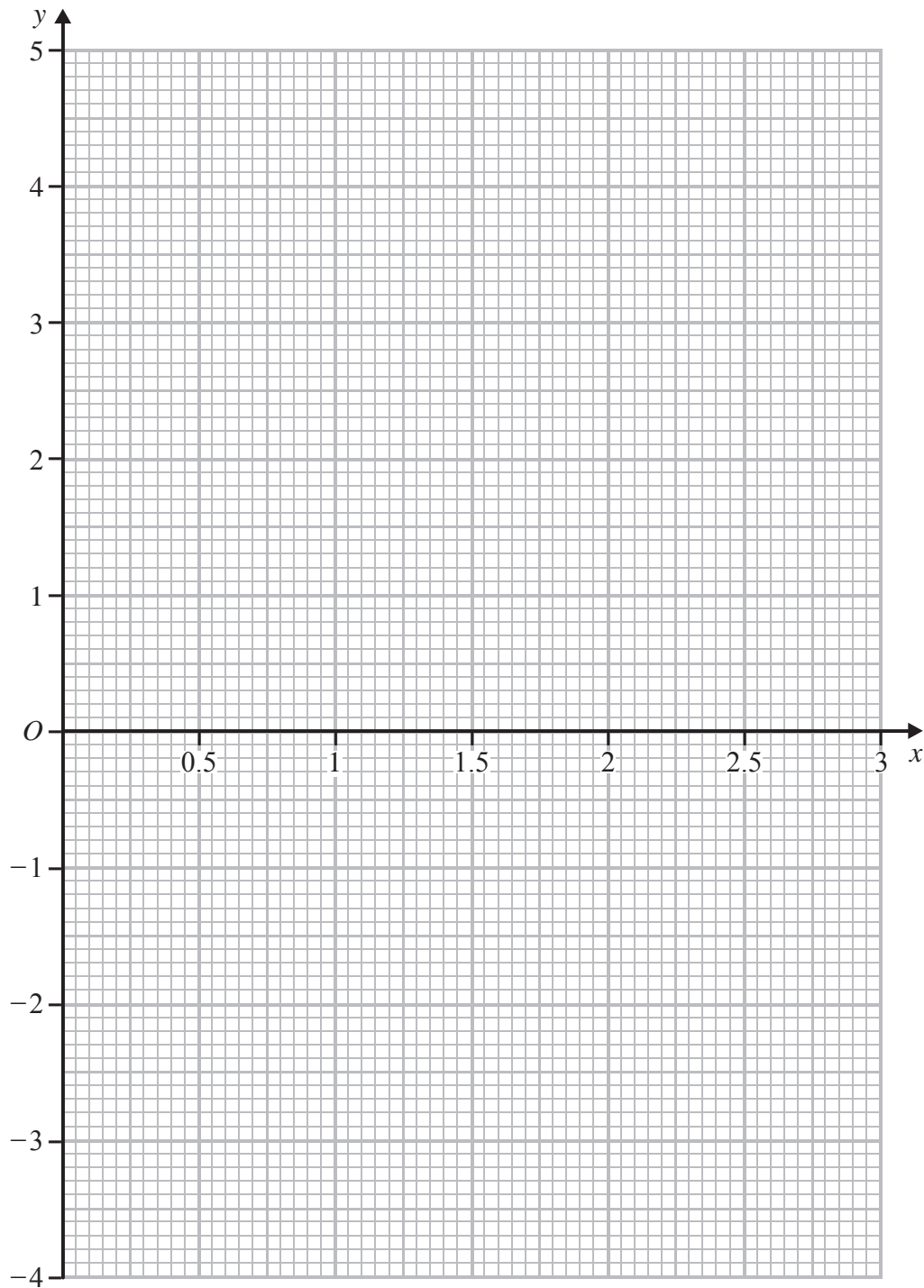
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**Question 7 continued**

**Only use this grid if you need to redraw your graph**



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**(Total for Question 7 is 11 marks)**





**Question 8 continued**

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**Question 8 continued**

Area with horizontal dotted lines for writing answers.

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**Question 8 continued**

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**(Total for Question 8 is 13 marks)**



9

$$f(x) = 3x^2 - 5x - 4$$

The roots of the equation  $f(x) = 0$  are  $\alpha$  and  $\beta$

(a) Without solving the equation  $f(x) = 0$ , form an equation, with integer coefficients, which has

(i) roots  $\frac{\alpha}{\beta}$  and  $\frac{\beta}{\alpha}$  (6)

(ii) roots  $2\alpha + \beta$  and  $\alpha + 2\beta$  (5)

(b) Express  $f(x)$  in the form  $A(x + B)^2 + C$ , stating the values of the constants  $A$ ,  $B$  and  $C$ . (3)

(c) Hence, or otherwise, show that the equation  $f(x) = -8$  has no real roots. (2)

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**Question 9 continued**

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**Question 9 continued**

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**Question 9 continued**

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**(Total for Question 9 is 16 marks)**



**10** The points  $A$  and  $B$  have coordinates  $(2, 4)$  and  $(5, -2)$  respectively.  
The point  $C$  divides  $AB$  in the ratio  $1:2$

(a) Find the coordinates of  $C$ . (2)

The point  $D$  has coordinates  $(1, 1)$

(b) Show that  $DC$  is perpendicular to  $AB$ . (3)

(c) Find the equation of  $DC$  in the form  $py = x + q$  (2)

The point  $E$  is such that  $DCE$  is a straight line and  $DC = CE$ .

(d) Find the coordinates of  $E$ . (2)

(e) Calculate the area of quadrilateral  $ADBE$ . (4)

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**Question 10 continued**

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