Write your name here

| Surname | Other names |
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**Pearson Edexcel**
**International GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Further Pure Mathematics

## Paper 1

Tuesday 14 June 2016 – Morning
**Time: 2 hours**

Paper Reference
**4PM0/01**

**Calculators may be used.**

Total Marks

### 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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P 4 6 9 0 1 A 0 1 3 2

PEARSON

**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)**

**Question 1 continued**

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

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

**(3)**

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

(b) Obtain a series expansion for $\mathrm{f}(x)$ 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 $\mathrm{f}(x)$ is $-5$

(c) find the value of $k$.

**(1)**

**Question 2 continued**

**(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)**

**Question 3 continued**

**(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)**

**Question 4 continued**

**(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

$$3\sin(2y + 30)° = 5\sin(2y - 30)° \qquad \text{for } 90 \leqslant y < 180$$

**(4)**

**Question 5 continued**

**Question 5 continued**

**Question 5 continued**

**(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)**

**Question 6 continued**

**Question 6 continued**

**Question 6 continued**

**(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 $0 \leqslant x \leqslant 3$

**(2)**

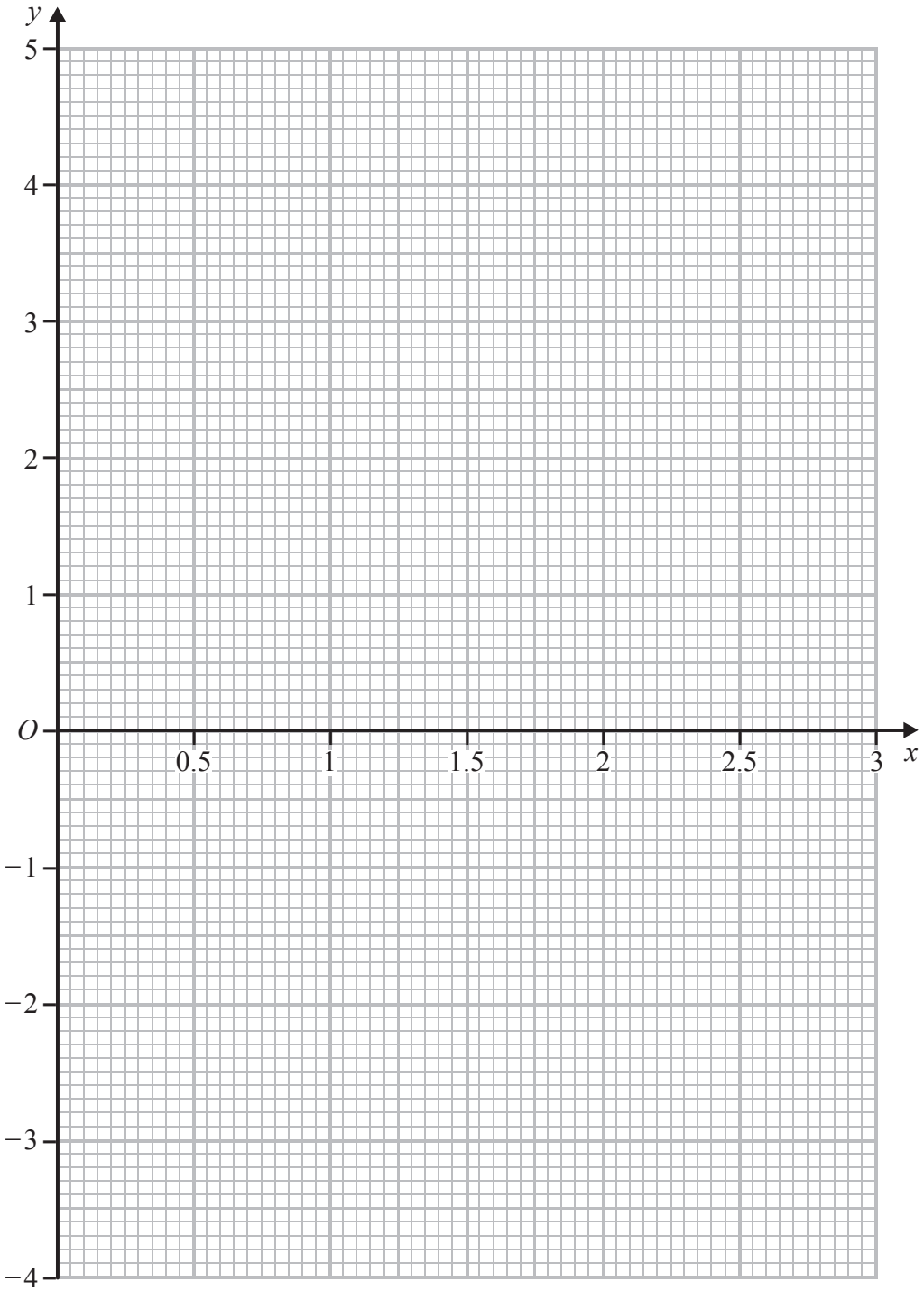
(c) Use your graph to obtain an estimate, to one decimal place, of the value of $\log_2 7$
Show clearly how you used the graph.

**(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 $0 \leqslant x \leqslant 3$

**(4)**

**Question 7 continued**

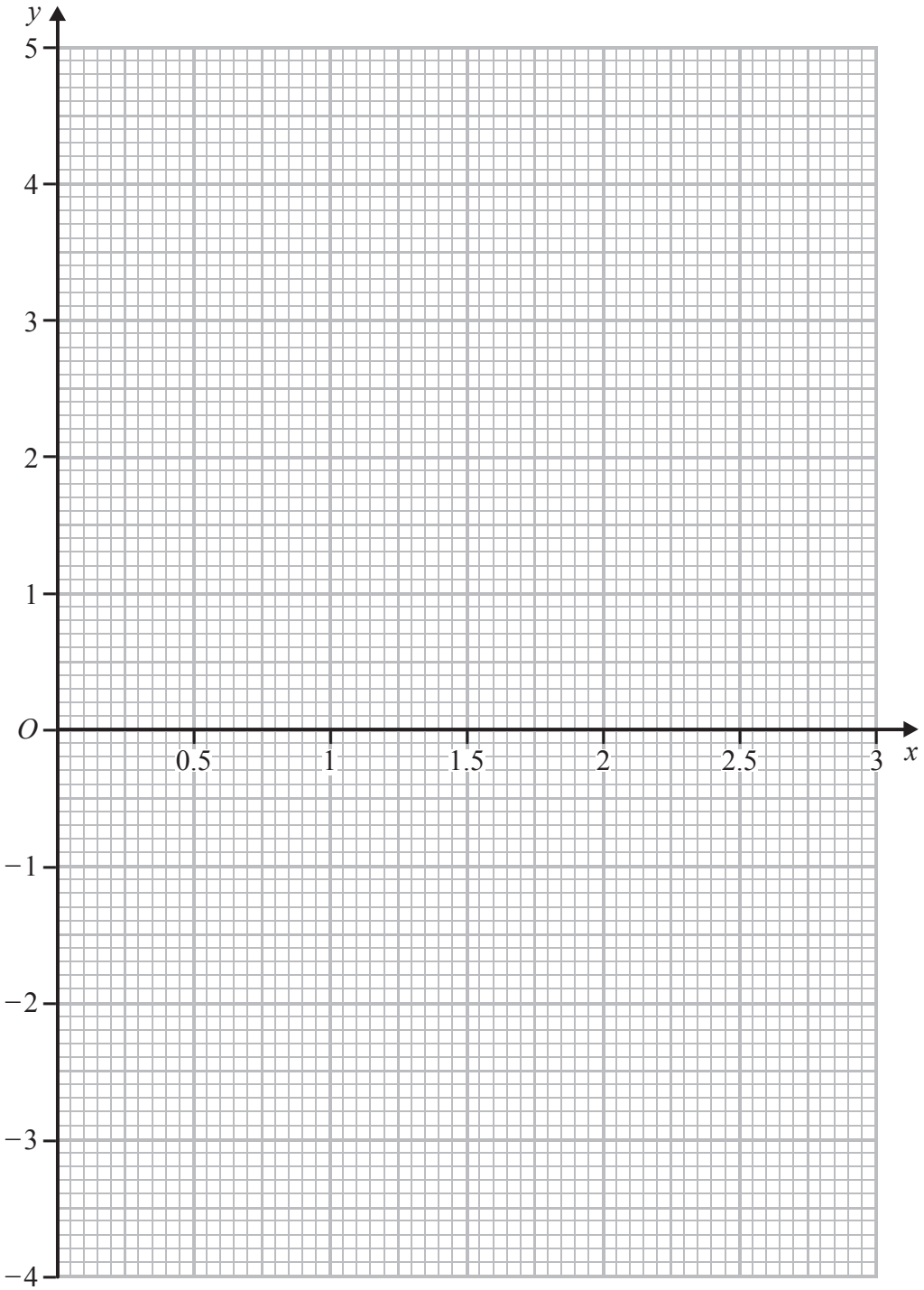



**Turn over for a spare grid if you need to redraw your graph.**

**Question 7 continued**

**Question 7 continued**

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




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

**8**

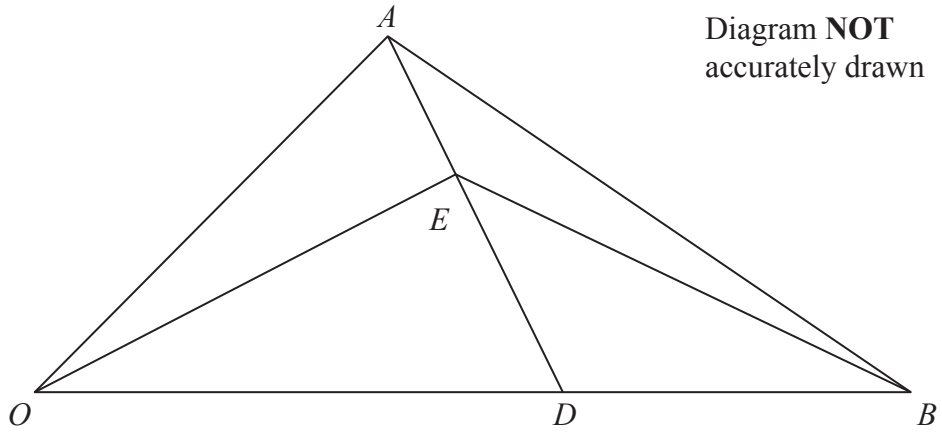



Diagram **NOT** accurately drawn

**Figure 1**

In Figure 1, $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OD} = \frac{2}{3}\mathbf{b}$

The point $E$ divides $AD$ in the ratio $2:3$

(a) Find as simplified expressions in terms of **a** and **b**

(i) $\overrightarrow{AD}$ (ii) $\overrightarrow{OE}$ (iii) $\overrightarrow{BE}$

**(5)**

The point $F$ lies on $OA$ such that $\overrightarrow{OF} = \lambda\overrightarrow{OA}$ and $F$, $E$ and $B$ are collinear.

(b) Find the value of $\lambda$.

**(5)**

The area of triangle $OFB$ is 5 square units.

(c) Find the area of triangle $OAD$.

Give your answer in the form $\frac{p}{q}$, where $p$ and $q$ are integers.

**(3)**

**Question 8 continued**

**Question 8 continued**

**Question 8 continued**

**(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)**

**Question 9 continued**

**Question 9 continued**

**Question 9 continued**

**(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)**

**Question 10 continued**

**Question 10 continued**

**(Total for Question 10 is 13 marks)**

**TOTAL FOR PAPER IS 100 MARKS**