Write your name here

Surname

Other names

Centre Number

Candidate Number

Mathematics B
Paper 2

Tuesday 20 May 2014 – Afternoon
Time: 2 hours 30 minutes

Paper Reference

4MB0/02

You must have: Ruler graduated in centimetres and millimetres, protractor, compasses, pen, HB pencil, eraser, calculator. Tracing paper 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.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.
- **Calculators may be used.**

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.
- Without sufficient working, correct answers may be awarded no marks.

Turn over

P43033A0132

PEARSON

Answer ALL ELEVEN questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

1   $\mathscr{E} = \{x : 2 \leqslant x \leqslant 10 \text{ and } x \text{ is an integer}\}$

   $A = \{x : 3 \leqslant x \leqslant 8\}$

   $B = \{x : x \text{ is prime}\}$

   $C = \{x : x \text{ is an even integer}\}$

   List the elements of

   (a) B'

   (1)

   (b) $A \cap C$

   (1)

   Find

   (c) $\text{n}\left(\left[A \cap C\right]' \cap B'\right)$

   (2)

(Total for Question 1 is 4 marks)

2 Given that $\begin{pmatrix} 1 & 3 \\ x & 0 \end{pmatrix}\begin{pmatrix} x \\ 2 \end{pmatrix} = \begin{pmatrix} y \\ 4 \end{pmatrix}$,

(a) find the values of x.

(3)

(b) Hence find the possible values of y.

(3)

(Total for Question 2 is 6 marks)

3 A particle is moving in a straight line through O.

The displacement, s metres, of the particle from O at time t seconds is given by

$$s = 3t^2 - 4t + 10 \qquad t \geqslant 0$$

(a) Find an expression, in terms of t, for the velocity, v m/s, of the particle at time t seconds.

(2)

(b) Calculate the value of t when the particle is instantaneously at rest.

(2)

(c) Calculate the distance, in metres, travelled by the particle in the fifth second.

(2)

Question 3 continued

P 4 3 0 3 3 A 0 5 3 2

4 A total of 50 teachers and pupils from a school had planned to go on a school trip.

There were expected to be t teachers and p pupils on the trip.

(a) Write down an equation in t and p to represent this information.

(1)

The number of pupils on the trip was expected to be four times the number of teachers on the trip.

(b) Write down another equation in t and p to represent this information.

(1)

(c) Hence find the value of t and the value of p.

(3)

On the day of the trip, 1 teacher and 5 pupils were absent and did not go on the trip.

The school had to pay £10 for each teacher and £3 for each pupil who went on the trip.

(d) Calculate how much, in total, the school had to pay.

(3)

Question 4 continued

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(Total for Question 4 is 8 marks)

P 4 3 0 3 3 A 0 7 3 2

5 (a) (i) Solve the inequality $3x - 7 < 3 - x$

   (ii) Represent your solution on the number line on page 9.

   (3)

   (b) (i) Solve the inequality $x - 12 \leqslant 3(x - 3)$

   (ii) Represent your solution on the same number line.

   (4)

   (c) Write down the range of values of x which satisfy both the inequalities
   $3x - 7 < 3 - x$ and $x - 12 \leqslant 3(x - 3)$

   (2)

Question 5 continued

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-6   -5   -4   -3   -2   -1    0    1    2    3    4    5    6
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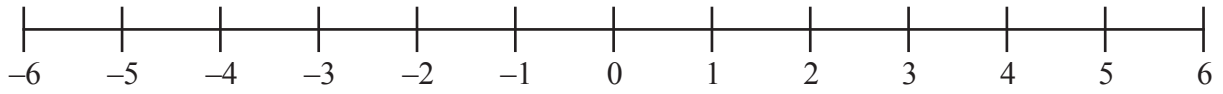
(Total for Question 5 is 9 marks)

P 4 3 0 3 3 A 0 9 3 2

6 There are 159 people living in a street.

The table below shows information about the number of people living in each of 30 houses in the street.

Number (n) of people living in a house	Number of houses with n people living in the house
1	2
2	3
3	1
4	4
5	3
6	6
7	8
8	2
9	1

(a) Find

   (i) the modal number of people living in a house,

   (ii) the median number of people living in a house,

   (iii) the mean number of people living in a house.

(5)

Two houses in the street are chosen at random.

(b) Calculate the probability that 4 people live in one of the houses and 2 people live in the other of the houses.

(2)

One of the people living in the street is chosen at random.

(c) Find the probability that this person lives in a house in which at least 5 people live.

(2)

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Question 6 continued

(Total for Question 6 is 9 marks)

7 The points (2, 3), (4, 3) and (4, 4) are the vertices of a triangle A.

   (a) On the grid, draw and label triangle A.

   (1)

   Triangle A is transformed to triangle B under the translation $\begin{pmatrix} 0 \\ -5 \end{pmatrix}$.

   (b) On the grid, draw and label triangle B.

   (1)

   Triangle B is transformed to triangle C under the transformation with matrix $\mathbf{T}$ where

   $$\mathbf{T} = \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$$

   (c) Find the coordinates of the vertices of triangle C.

   (2)

   (d) On the grid, draw and label triangle C.

   (1)

   Triangle B is mapped to triangle C under the transformation with matrix $\mathbf{T}$ by an anticlockwise rotation about the origin of 180° followed by an enlargement with centre the origin.

   (e) Find the scale factor of this enlargement.

   (1)

   Triangle C is transformed to triangle D under the translation $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$.

   (f) On the grid, draw and label triangle D.

   (1)

   Triangle A is transformed to triangle D by a single enlargement.

   (g) Describe fully this enlargement.

   (2)

Question 7 continued

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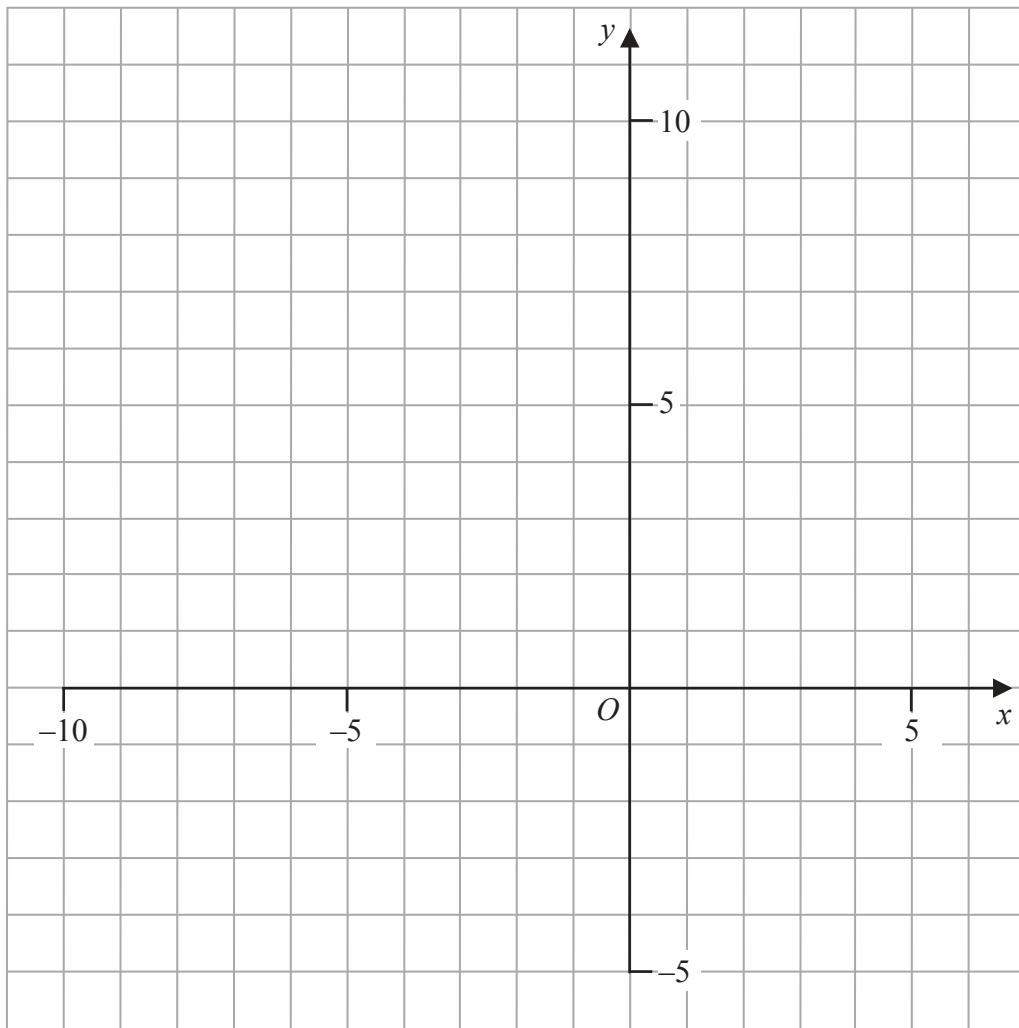
Question 7 continued

Question 7 continued

(Total for Question 7 is 9 marks)

8

Figure 1

Figure 1 shows quadrilateral *ABCD* with diagonal *BD*.

Given that ∠*BAD* = 110°, *AB* = 6 cm and *AD* = 8 cm,

(a) calculate the length, in cm to 3 significant figures, of *BD*.

(3)

Given also that ∠*BDC* = 40° and ∠*BCD* = 60°, calculate the length, in cm to 3 significant figures, of

(b) *BC*,

(3)

(c) *AC*.

(5)

$$\left[\begin{array}{l} \text{Sine Rule: } \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} \\ \text{Cosine Rule: } a^2 = b^2 + c^2 - 2bc\cos A \end{array}\right]$$

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

Question 8 continued

P 4 3 0 3 3 A 0 1 7 3 2

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

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

9 Part of the curve with equation $y = x^2 - 6x + 5$ is drawn on the grid.

(a) For $y = -x^2 + 7x - 11$ complete the table, giving your answers to 2 decimal places where necessary.

x	1	1.5	2	2.5	3	3.5	4	5
y	−5		−1		1		1	−1

(3)

(b) On the grid, plot the points from your completed table and join them to form a smooth curve.

(3)

(c) Use the two curves on the grid to find estimates for the solutions of the equation $2x^2 - 13x + 16 = 0$

(2)

The curve with equation $y = x^2 - 6x + 5$ intersects the curve with equation $y = -x^2 + 7x - 11$ at the points A and B.

(d) Work out the gradient of the straight line through A and B.

(3)
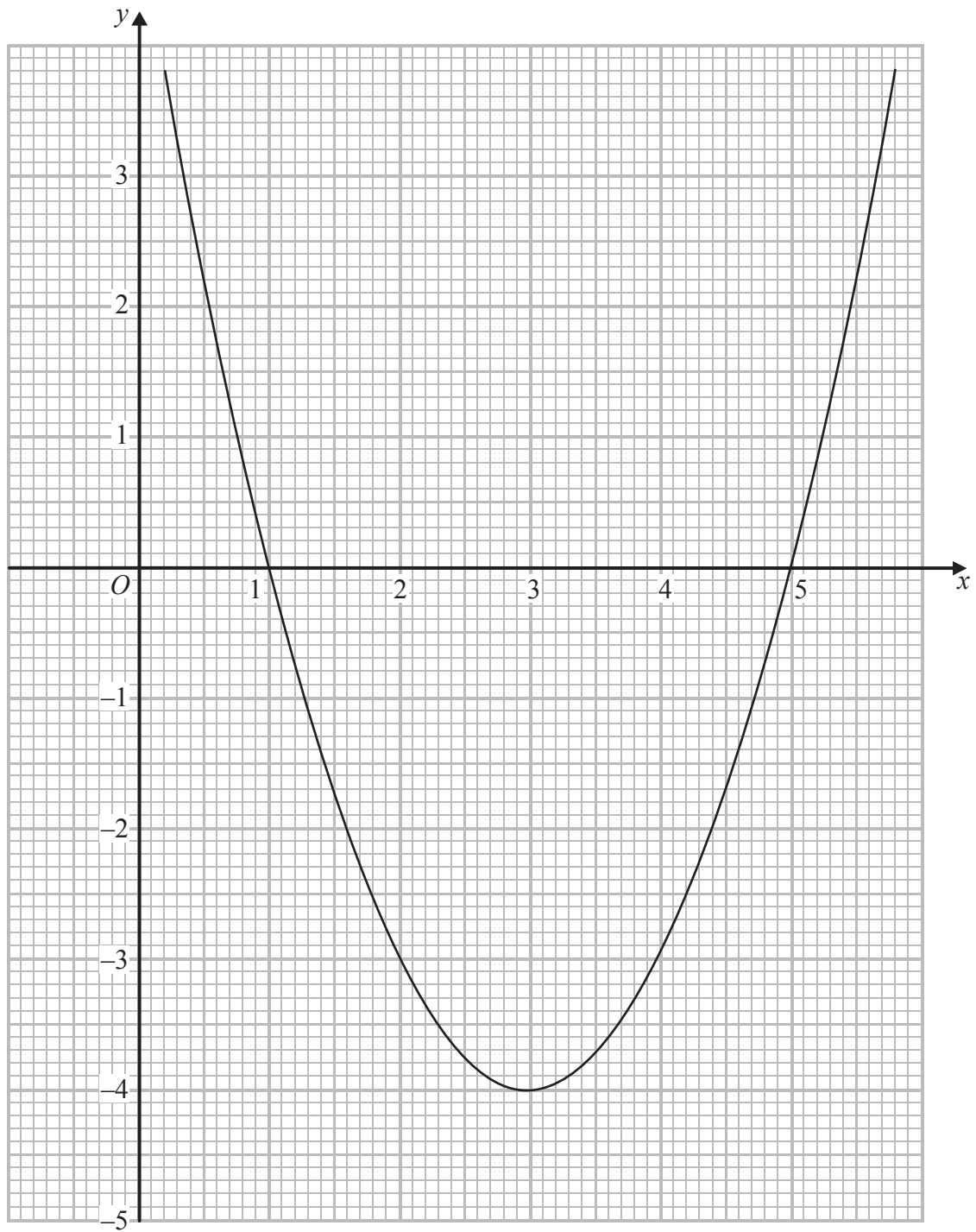
P 4 3 0 3 3 A 0 2 0 3 2

Question 9 continued

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Question 9 continued

Question 9 continued

(Total for Question 9 is 11 marks)

10 f and g are the two functions such that

$$f(x) = \frac{2}{x-1} \qquad x \neq 1$$
$$g(x) = x^2 - 3$$

(a) Find the value of gf(3)

(1)

(b) Find $f^{-1}(x)$ in terms of x.

(2)

(c) Show that $gf^{-1}(x) = \frac{4 + 4x - 2x^2}{x^2}$

(3)

(d) State the value of x which must be excluded from any domain of gf^{-1}

(1)

(e) Find the values of x for which $gf^{-1}(x) = 1$

(5)

Question 10 continued

P4 3 0 3 3 A 0 2 5 3 2

Question 10 continued

P 4 3 0 3 3 A 0 2 6 3 2

Question 10 continued

(Total for Question 10 is 12 marks)

11

Diagram **NOT** accurately drawn
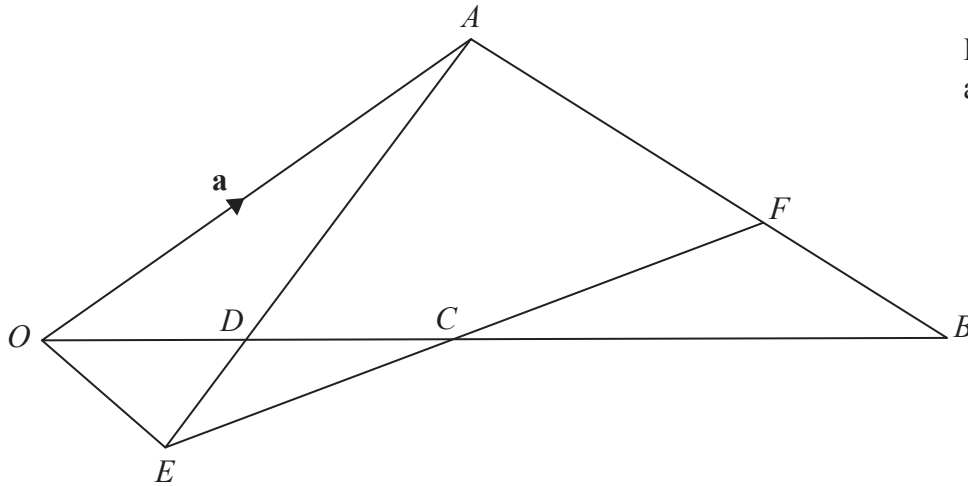
Figure 2

In Figure 2, the points O, A and B are such that $\overrightarrow{OA}$ = **a** and $\overrightarrow{OB}$ = 2**b**.

The point C is the midpoint of OB.

The point F is on the line AB such that $AF : FB = 2 : 1$

(a) Express in terms of **a** or **b** or **a** and **b**, simplifying your answers where possible,

   (i) $\overrightarrow{AB}$,   (ii) $\overrightarrow{BC}$,   (iii) $\overrightarrow{FB}$,   (iv) $\overrightarrow{FC}$.

(5)

The point D is on the line OB such that $OD : OB = 1 : 4$

(b) Express in terms of **a** or **b** or **a** and **b**, simplifying your answers where possible,

   (i) $\overrightarrow{OD}$,   (ii) $\overrightarrow{AD}$.

(3)

The point E is such that ADE and FCE are straight lines.

Given that $\overrightarrow{FE} = \lambda \overrightarrow{FC}$, where λ is a scalar,

(c) find an expression, in terms of **a**, **b** and λ, for $\overrightarrow{FE}$.

(1)

Given that $AD : AE = 3 : 4$

(d) find and simplify an expression, in terms of **a** and **b**, for $\overrightarrow{FE}$.

(3)

(e) Hence calculate the value of λ.

(3)

Question 11 continued

Question 11 continued

(Total for Question 11 is 15 marks)

TOTAL FOR PAPER IS 100 MARKS

P 4 3 0 3 3 A 0 3 1 3 2

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