OXFORD AQA
INTERNATIONAL QUALIFICATIONS

INTERNATIONAL AS
FURTHER MATHEMATICS

Further Pure Mathematics 2

Specimen paper 0X:00 GMT Time allowed: 1 hour 15 minutes

Materials
- For this paper you must have the OxfordAQA Pure Mathematics Examination Booklet (enclosed)
- You may use a graphical 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.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- The final answer to questions requiring an algebraic expression should be given in simplified form, unless stated otherwise.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise, marks may not be awarded.

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Answer **all** questions in the spaces provided.

1 (a) The matrix $\mathbf{A}$ is defined by $\mathbf{A} = \begin{bmatrix} k-2 & 5 \\ 6 & k-3 \end{bmatrix}$ where k is a constant.

It is given that $\mathbf{A}^{-1}$ does **not** exist.

Find the possible values of k

[2 marks]

Answer _____

1 (b) The matrix $\mathbf{B}$ is defined by $\mathbf{B} = \begin{bmatrix} \sqrt{3} & \sqrt{3} \\ -\sqrt{3} & \sqrt{3} \end{bmatrix}$

1 (b) (i) Show that $\mathbf{B}^4 = p\mathbf{I}$ where p is an integer and $\mathbf{I}$ is the 2×2 identity matrix.

[2 marks]

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1 (b) (ii) Use your answer to **part (b)(i)** to find the matrix $\mathbf{B}^9$

[2 marks]

Answer _____

1 (b) (iii) The matrix $\mathbf{C}$ is defined by $\mathbf{C} = \frac{1}{18}\mathbf{B}^9$

A triangle T_1 is mapped onto a triangle T_2 by the transformation represented by the matrix $\mathbf{C}$

The triangle T_1 has area 3 square units.

Find the area of triangle T_2

[3 marks]

Answer _____

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2 The function f is defined by $f(x) = 2x^3 - \frac{11}{2}x^2 - 2x + 4$

2 (a) Show that the equation $f(x) = 0$ has a root α in the interval $2 < x < 3$

[2 marks]

2 (b) Starting with the interval $2 < x < 3$, use interval bisection **twice** to find an interval of width 0.25 in which α must lie.

[3 marks]

Answer _____

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2 (c) Taking $x_1 = 2.5$ as a first approximation to α, use the Newton–Raphson method **once** to find a second approximation x_2 to α

Give your answer to three decimal places.

[4 marks]

$x_2 =$ _____

2 (d) A student wants to use the Newton–Raphson method to find roots of the equation $\mathrm{f}(x) = 0$

The student uses an initial value of $x_1 = 2$

By considering the tangent to the curve $y = \mathrm{f}(x)$ at $x = 2$, explain why the student's method will **not** work.

[2 marks]

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3 The variables x and y are related by the equation

$$y = ax^b$$

where a and b are constants.

It is given that $X = \log_{10} x$ and $Y = \log_{10} y$

3 (a) Show that there is a linear relationship between X and Y

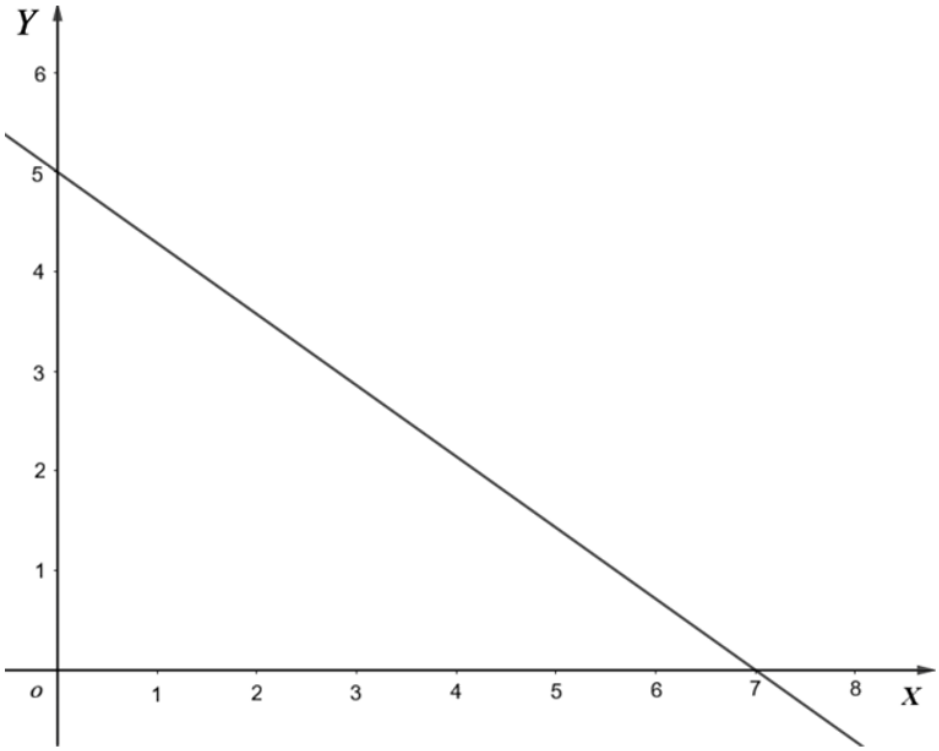
[2 marks]

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3 (b) Some values of y and x are obtained in an experiment.

Values of Y are plotted against values of X and the line of best fit is drawn, as shown in **Figure 1**

Figure 1



Find the value of a and the value of b

[3 marks]

$a =$ _____ $b =$ _____

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4 (a) Find the general solution of the equation

$$\cos\left(\frac{3}{2}x - \frac{\pi}{4}\right) = \frac{\sqrt{3}}{2}$$

Give your answer in terms of π

[5 marks]

Answer _____

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4 (b) Use your answer to **part (a)** to find the sum of all of the solutions to the equation

$$\cos\left(\frac{3}{2}x - \frac{\pi}{4}\right) = \frac{\sqrt{3}}{2}$$

that lie in the interval $0 \leq x \leq 15\pi$

Give your answer in the form $k\pi$ where k is a constant.

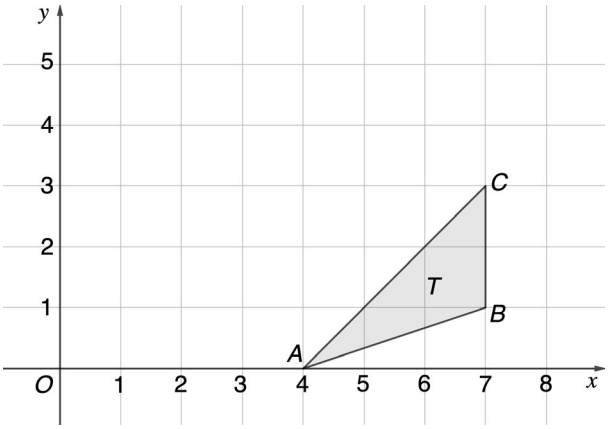
[4 marks]

Answer _____

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5 A triangle T with vertices $A(4, 0)$, $B(7, 1)$ and $C(7, 3)$ is shown in **Figure 2**

Figure 2



The matrix $\mathbf{M} = \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{bmatrix}$ is used to transform triangle T

The transformation represented by matrix **M** maps ABC onto $A'B'C'$ where A', B' and C' are the vertices of a triangle R

The point A' has coordinates $\left(2, 2\sqrt{3}\right)$

5 (a) (i) Write down the matrix **M**

Give each element as an exact value.

[1 mark]

Answer _____

5 (a) (ii) Fully describe the transformation represented by the matrix **M**

[3 marks]

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5 (b) The matrix **N** is defined by $\mathbf{N} = \begin{bmatrix} -c & d \\ d & c \end{bmatrix}$ where c and d are constants.

The point A' is invariant under the transformation represented by matrix **N**

5 (b) (i) Find the exact value of c and the exact value of d

[3 marks]

$c =$ _____ $d =$ _____

5 (b) (ii) The transformation represented by matrix **N** maps the triangle R onto a triangle S

Use your answers to **part (a)(i)** and **part (b)(i)** to find the matrix that represents the single transformation which maps triangle T onto triangle S

[2 marks]

Answer _____

5 (b) (iii) Describe the single transformation which maps triangle T onto triangle S

[3 marks]

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6 (a) A curve C has equation $y = 9x - 2x^2$

The point $P(3, 9)$ lies on C

The point Q lies on C and has x-coordinate $3 + h$

6 (a) (i) Show that the gradient of the line PQ is $-3 - 2h$

[3 marks]

6 (a) (ii) Explain how the result in **part (a)(i)** can be used to show that the tangent to C at the point P is parallel to the line with equation $3x + y = 10$

[2 marks]

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6 (b) The integral I is defined by

$$I = \int_3^{\infty} x^{-4}\left(9x - 2x^2\right)\mathrm{d}x$$

6 (b) (i) Explain why I is an improper integral.

[1 mark]

6 (b) (ii) Find the value of I

Show the limiting process used.

[3 marks]

$I =$ _____

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7 The martrix **A** is defined by $\mathbf{A} = \begin{bmatrix} 0.5 & 1.25 \\ -0.2 & 1.5 \end{bmatrix}$

Find the invariant lines of the transformation represented by **A**

[5 marks]

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Answer _____

END OF QUESTIONS

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