Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Monday 13 May 2019

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **6667/01**

Further Pure Mathematics FP1

Advanced/Advanced Subsidiary

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1. $f(z) = z^3 + az^2 + bz - 26$

where a and b are real constants.

Given that $z = 3i - 2$ is a solution of the equation $f(z) = 0$

(a) Use algebra to solve $f(z) = 0$ completely.

(5)

(b) Find the value of a and the value of b.

(3)

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Question 1 continued

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Question 1 continued

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Question 1 continued

(Total 8 marks)

Q1

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2. $\mathbf{M} = \begin{pmatrix} 9 + k & -3 \\ 4 - k & 2 \end{pmatrix}$, where k is a constant

The triangle T has vertices at the points (2, 1), (7, 1) and (7, 12).

Triangle T is transformed onto triangle T' by the transformation represented by the matrix **M**.

(a) Find, in terms of k, the coordinates of the vertices of the triangle T'

(3)

Given that the area of triangle T' is 770 square units,

(b) find the two possible values of k.

(4)

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Question 2 continued

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Question 2 continued

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Question 2 continued

(Total 7 marks)

Q2

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3. The rectangular hyperbola H has equation

$$xy = 10$$

The point P (5, 2) lies on H.

(a) Using calculus, find an equation of the normal to H at the point P, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(5)

The normal at P meets H again at the point Q.

(b) Find the coordinates of Q.

(5)

(c) Find the exact area of triangle OPQ, where O is the origin.

(4)

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Question 3 continued

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Question 3 continued

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Question 3 continued

(Total 14 marks)

Q3

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4. (i) $$f(x) = 3x^2 - \frac{1}{2\sqrt{x}} - 5x, \quad x > 0$$

(a) Show that the equation $f(x) = 0$ has a root α in the interval $[1, 2]$.

(2)

(b) Find $f'(x)$.

(2)

(c) Using $x_0 = 2$ as a first approximation to α, apply the Newton-Raphson procedure once to $f(x)$ to find a second approximation to α, giving your answer to 2 decimal places.

(2)

(ii) $$g(\theta) = 3\theta + 6 - \tan\left(\frac{\theta}{3}\right), \quad -\pi < \theta < 0$$

The equation $g(\theta) = 0$ has a root β in the interval $[-3, -2]$. Use linear interpolation once on the interval $[-3, -2]$ to find an approximation for β, giving your answer to 3 decimal places.

(4)

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Question 4 continued

(Total 10 marks)

Q4

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5. (a) Use the standard results for $\sum_{r=1}^{n} r^2$ and $\sum_{r=1}^{n} r^3$ to show that, for all positive integers n,

$$\sum_{r=1}^{n} r^2(4 + r) = \frac{1}{12} n(n + 1)(an^2 + bn + c)$$

where a, b and c are integers to be found.

(4)

(b) Hence find the sum of the series

$$5^2 \times 10 + 6^2 \times 11 + 7^2 \times 12 + ... + 20^2 \times 25$$

(4)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 8 marks)

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6. $$z = \frac{a + 2\mathrm{i}}{a + 5\mathrm{i}} \quad a \in \mathbb{R}, a > 0$$

Given that the real part of z is $\frac{13}{28}$, find

(a) the value of a,

(4)

(b) $\arg(z)$, giving your answer in radians to 2 decimal places,

(3)

(c) the value of zz^* in its simplest form.

(2)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total 9 marks)

Q6

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7. $$\mathbf{P} = \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$$

(a) Describe fully the single geometrical transformation U represented by the matrix $\mathbf{P}$.

(2)

The transformation V, represented by the matrix $\mathbf{Q}$, is a reflection in the line $y = -x$

(b) Write down the matrix $\mathbf{Q}$.

(1)

The transformation U followed by the transformation V is the transformation T.

Transformation T is represented by the matrix $\mathbf{R}$.

(c) Find the matrix $\mathbf{R}$.

(2)

(d) Find the exact value of the real constant k for which the transformation T maps the point $(1, k)$ onto itself.

(4)

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Question 7 continued

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Question 7 continued

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Question 7 continued

(Total 9 marks)

Q7

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8. (i) Prove by induction, that for $n \in \mathbb{Z}^+$

$$\begin{pmatrix} -3 & -2 \\ 8 & 5 \end{pmatrix}^n = \begin{pmatrix} 1-4n & -2n \\ 8n & 1+4n \end{pmatrix}$$

(5)

(ii) Prove by induction, that for $n \in \mathbb{Z}^+$

$$\sum_{r=1}^{n} \frac{1}{r(r+1)(r+2)} = \frac{n(n+3)}{4(n+1)(n+2)}$$

(5)

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Question 8 continued

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Question 8 continued

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Question 8 continued

Q8

(Total 10 marks)

TOTAL FOR PAPER: 75 MARKS

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