Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Monday 13 May 2019

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **WFM01/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Further Pure Mathematics F1

You must have:
Mathematical Formulae and Statistical Tables (Blue), calculator

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).
- **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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

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Answer ALL questions. Write your answers in the spaces provided.

1.

$$f(x) = 5 + 4x^2 - \frac{4}{3}x^3 - \frac{7}{2x} \quad x > 0$$

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

(2)

A root α of the equation $f(x) = 0$ lies in the interval [0.5, 0.6].

(b) Using 0.5 as a first approximation to α, apply the Newton-Raphson process once to $f(x)$ to find a second approximation to α. Give your answer to 3 decimal places.

(3)

(c) Show that the equation $f(x) = 0$ has a root β in the interval [3, 3.5].

(2)

(d) Use linear interpolation once on the interval [3, 3.5] to find an approximation to β. Give your answer to 2 decimal places.

(3)

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Question 1 continued

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Question 1 continued

Q1

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2.

$$\mathbf{M} = \begin{pmatrix} k-12 & 3 \\ 4 & k \end{pmatrix}, \text{ where } k \text{ is a real constant}$$

The transformation represented by the matrix **M** transforms hexagon *R* to hexagon *S*.

The area of hexagon *R* is 20 square units and the area of hexagon *S* is 320 square units.

Find the possible values of *k*.

(5)

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Question 2 continued

Q2

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3. (i) Given that

$$z^* - 3z = \frac{5\mathrm{i}}{3 - \mathrm{i}}$$

find z, giving your answer in the form $a + b\mathrm{i}$, where a and b are real constants. You must show all your working.

(5)

(ii)

$$w = -4 + 5\mathrm{i}$$

(a) Find arg w, giving your answer in radians correct to 2 decimal places.

(2)

Given that

$$\arg(w + k) = \frac{\pi}{2}, \text{ where } k \text{ is a real constant}$$

(b) write down the value of k.

(1)

Given that

$$|w + c\mathrm{i}| = 4\sqrt{5}, \text{ where } c \text{ is a real constant}$$

(c) find the possible values of c.

(4)

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Question 3 continued

Q3

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4. Use the standard results for summations to

(a) show that for all positive integers k

$$\sum_{r=1}^{3k}(4r+1) = pk(2k+1)$$

where p is an integer to be determined,

(3)

(b) find the positive value of k that satisfies

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

(3)

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Question 4 continued

Q4

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5.

$$\mathbf{A} = \begin{pmatrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$$

(a) Describe fully the single geometrical transformation represented by the matrix **A**.

(3)

(b) Hence write down the matrix $\mathbf{A}^6$

(1)

The transformation represented by the matrix **C** followed by the transformation represented by the matrix **B** is equivalent to the transformation represented by the matrix **A**.

Given that

$$\mathbf{B} = \begin{pmatrix} 2\sqrt{3} & -7 \\ -4 & 5\sqrt{3} \end{pmatrix}$$

(c) find the matrix **C**, giving your answer in simplest form.

(4)

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Question 5 continued

Q5

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6. The quadratic equation

$$2x^2 + x + 4 = 0$$

has roots α and β

Without solving the quadratic equation,

(a) write down the value of $(\alpha + \beta)$ and the value of $\alpha\beta$

(1)

(b) find the value of

(i) $\alpha^2 + \beta^2$

(ii) $\alpha^3 + \beta^3$

(4)

(c) find a quadratic equation that has roots

$$\left(\alpha^3 + \frac{1}{\beta}\right) \text{ and } \left(\beta^3 + \frac{1}{\alpha}\right)$$

giving your answer in the form $px^2 + qx + r = 0$, where p, q and r are integers.

(4)

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Question 6 continued

Q6

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7.

$$f(z) = z^4 - 6z^3 + az^2 - 44z + b$$

where a and b are real constants.

Given that $-1 - 3i$ is a root of the equation $f(z) = 0$

(a) write down another complex root of this equation.

(1)

(b) Hence find the other roots of the equation $f(z) = 0$

(6)

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Question 7 continued

Q7

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8. Prove by induction that for all positive integers n,

$$f(n) = 3^{4n-2} + 2^{6n-3} \text{ is divisible by } 17$$

(6)

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9. The parabola C has cartesian equation $y^2 = 4ax$, where a is a positive constant.

The point $P(ap^2, 2ap)$ lies on C.

The line l is the normal to C at the point P.

The line l passes through the point B with coordinates $(10a, 0)$.

Given that $p > 0$

(a) use calculus to find, in terms of a only, the coordinates of P.

(7)

The point S is the focus of the parabola C.

(b) Find, in terms of a, the exact area of triangle SBP.

(2)

A circle has equation

$$(x - 10a)^2 + y^2 = \frac{9}{4}a^2$$

Given that the line l cuts this circle at the point R, where $y > 0$

(c) find, in terms of a, the distance PR.

(3)

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TOTAL FOR PAPER: 75 MARKS

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