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Candidate surname					Other names								
Pearson Edexcel International Advanced Level					Centre Number					Candidate Number			
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Monday 11 May 2020													
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 8 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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1.
$$f(x) = x^3 - \frac{10\sqrt{x} - 4x}{x^2} \quad x > 0$$

(a) Show that the equation $f(x) = 0$ has a root α in the interval $[1.4, 1.5]$ (2)

(b) Determine $f'(x)$. (3)

(c) Using $x_0 = 1.4$ as a first approximation to α , apply the Newton-Raphson procedure once to $f(x)$ to calculate a second approximation to α , giving your answer to 3 decimal places. (2)

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2. The quadratic equation

$$5x^2 - 2x + 3 = 0$$

has roots α and β .

Without solving the equation,

(a) write down the value of $(\alpha + \beta)$ and the value of $\alpha\beta$ (1)

(b) determine, giving each answer as a simplified fraction, the value of

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

(ii) $\alpha^3 + \beta^3$ (4)

(c) determine a quadratic equation that has roots

$$(\alpha + \beta^2) \text{ and } (\beta + \alpha^2)$$

giving your answer in the form $px^2 + qx + r = 0$ where p , q and r are integers. (4)

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4. (a) Use the standard results for $\sum_{r=1}^n r^2$ and $\sum_{r=1}^n r$ to show that

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

for all positive integers n .

(5)

- (b) Hence find the exact value of the sum of the squares of the odd numbers between 200 and 500

(4)

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5. The rectangular hyperbola H has equation $xy = 64$

The point $P\left(8p, \frac{8}{p}\right)$, where $p \neq 0$, lies on H .

(a) Use calculus to show that the normal to H at P has equation

$$p^3x - py = 8(p^4 - 1) \quad (5)$$

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

(b) Determine, in terms of p , the coordinates of Q , giving your answers in simplest form. (4)

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

The line l with equation $3x - 4y + 48 = 0$ is a tangent to C at the point P .

(a) Show that $a = 9$ (4)

(b) Hence determine the coordinates of P . (2)

Given that the point S is the focus of C and that the line l crosses the directrix of C at the point A ,

(c) determine the exact area of triangle PSA . (4)

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

$$\sum_{r=1}^n \frac{2r^2 - 1}{r^2(r+1)^2} = \frac{n^2}{(n+1)^2} \quad (6)$$

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

$$f(n) = 12^n + 2 \times 5^{n-1}$$

is divisible by 7 (6)

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