Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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Morning (Time: 1 hour 30 minutes)

Paper reference **WMA13/01**

Mathematics

International Advanced Level
Pure Mathematics P3

You must have:
Mathematical Formulae and Statistical Tables (Yellow), 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 10 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.

Turn over ▶

Pearson

1. $y = \log_{10}(2x + 1)$

(a) Express x in terms of y.

(2)

(b) Hence, giving your answer in terms of x, find $\frac{dy}{dx}$

(3)

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Question 1 continued

(Total for Question 1 is 5 marks)

2. Solve, for $0 \leqslant x \leqslant 270°$, the equation

$$\frac{\tan 2x + \tan 50°}{1 - \tan 2x \tan 50°} = 2$$

Give your answers in degrees to 2 decimal places.

(6)

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Question 2 continued

(Total for Question 2 is 6 marks)

3. Given that

$$f(x) = \frac{4}{3x + 5}, \quad x > 0$$

$$g(x) = \frac{1}{x}, \quad x > 0$$

(a) state the range of f,

(2)

(b) find $f^{-1}(x)$,

(3)

(c) find $fg(x)$.

(1)

(d) Show that the equation $fg(x) = gf(x)$ has no real solutions.

(4)

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Question 3 continued

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Question 3 continued

(Total for Question 3 is 10 marks)

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4. An area of sea floor is being monitored.

The area of the sea floor, $S\,\text{km}^2$, covered by coral reefs is modelled by the equation

$$S = pq^t$$

where p and q are constants and t is the number of years after monitoring began.

Given that

$$\log_{10} S = 4.5 - 0.006t$$

(a) find, according to the model, the area of sea floor covered by coral reefs when $t = 2$

(2)

(b) find a complete equation for the model in the form

$$S = pq^t$$

giving the value of p and the value of q each to 3 significant figures.

(3)

(c) With reference to the model, interpret the value of the constant q

(1)

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Question 4 continued

(Total for Question 4 is 6 marks)

5.

$$f(x) = x\cos\left(\frac{x}{3}\right) \qquad x > 0$$

(a) Find $f'(x)$

(2)

(b) Show that the equation $f'(x) = 0$ can be written as

$$x = k\arctan\left(\frac{k}{x}\right)$$

where k is an integer to be found.

(2)

(c) Starting with $x_1 = 2.5$ use the iteration formula

$$x_{n+1} = k\arctan\left(\frac{k}{x_n}\right)$$

with the value of k found in part (b), to calculate the values of x_2 and x_6 giving your answers to 3 decimal places.

(2)

(d) Using a suitable interval and a suitable function that should be stated, show that a root of $f'(x) = 0$ is 2.581 correct to 3 decimal places.

(2)

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 8 marks)

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6.

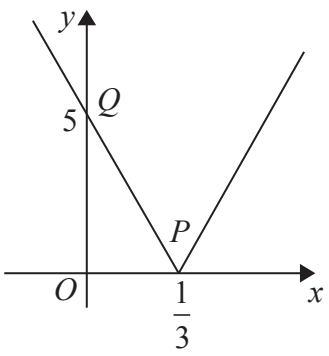

Figure 1

Figure 1 shows a sketch of the graph of $y = \mathrm{f}(x)$, $x \in \mathbb{R}$.

The point $P\left(\frac{1}{3}, 0\right)$ is the vertex of the graph.

The point $Q\,(0, 5)$ is the intercept with the y-axis.

Given that $\mathrm{f}(x) = |\,ax + b\,|$, where a and b are constants,

(a) (i) find all possible values for a and b,

(ii) hence find an equation for the graph.

(4)

(b) Sketch the graph with equation

$$y = \mathrm{f}\left(\frac{1}{2}x\right) + 3$$

showing the coordinates of its vertex and its intercept with the y-axis.

(3)

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 7 marks)

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7. The number of bacteria in a liquid culture is modelled by the formula

$$N = 3500(1.035)^t, \quad t \geqslant 0$$

where N is the number of bacteria t hours after the start of a scientific study.

(a) State the number of bacteria at the start of the scientific study.

(1)

(b) Find the time taken from the start of the study for the number of bacteria to reach 10 000
Give your answer in hours and minutes, to the nearest minute.

(4)

(c) Find the rate of increase in the number of bacteria when $t = 8$.
Give your answer, in bacteria per hour, to the nearest whole number.

(3)

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Question 7 continued

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Question 7 continued

(Total for Question 7 is 8 marks)

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8. (a) Express $3\sin 2x + 5\cos 2x$ in the form $R\sin(2x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$

Give the exact value of R and give the value of α to 3 significant figures.

(3)

(b) Solve, for $0 < x < \pi$,

$$3\sin 2x + 5\cos 2x = 4$$

(*Solutions based entirely on graphical or numerical methods are not acceptable.*)

(5)

$$g(x) = 4(3\sin 2x + 5\cos 2x)^2 + 3$$

(c) Using your answer to part (a) and showing your working,

(i) find the greatest value of $g(x)$,

(ii) find the least value of $g(x)$.

(4)

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Question 8 continued

Question 8 continued

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Question 8 continued

(Total for Question 8 is 12 marks)

9. (i) Find

$$\int \frac{4}{(5y-7)^4}\,\mathrm{d}y$$

(2)

(ii) Find, in simplest form,

$$\int (1-4\tan 3x)^2\,\mathrm{d}x$$

(3)

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Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 5 marks)

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10. Ellen bungee jumps from a high platform.

Ellen's distance above the ground, H metres, is modelled by the equation

$$H = 60 + \frac{50\cos(0.5t)}{e^{0.2t}} \qquad t \in \mathbb{R},\ t \geqslant 0$$

where t is the time measured in seconds from when she jumps from the platform.

(a) (i) Find, in simplest form, $\frac{dH}{dt}$

(ii) Hence show that when $\frac{dH}{dt} = 0$, the values of t satisfy the equation

$$\tan(0.5t) = -0.4$$

(5)

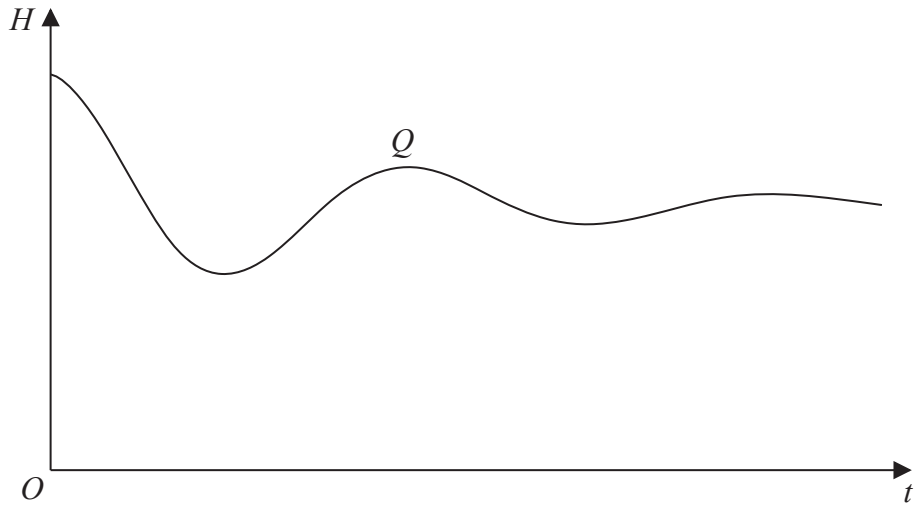

Figure 2

Figure 2 shows a sketch of H against t. The point Q, shown in Figure 2, represents the greatest distance above the ground to which Ellen bounces after jumping from the platform.

Using the answer to (a)(ii),

(b) find the value of t and the value of H at the point Q, giving your answers to 3 significant figures.

(3)

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Question 10 continued

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Question 10 continued

Question 10 continued

(Total for Question 10 is 8 marks)

TOTAL FOR PAPER IS 75 MARKS

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