| Please check the examination details bel               | ow before ente     | ring your candidate information |
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| Candidate surname                                      |                    | Other names                     |
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| Pearson Edexcel Inter                                  | nation             | al Advanced Level               |
| Wednesday 31 May                                       | 2023               |                                 |
| Morning (Time: 1 hour 30 minutes)                      | Paper<br>reference | WMA13/01                        |
| Mathematics  |                    | ◊ •                             |
| International Advanced Le                              | evel               |                                 |
|  |                    |                                 |
| You must have:<br>Mathematical Formulae and Statistica | al Tables (Ye      | llow), calculator               |

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 ▶







1. 
$$g(x) = x^6 + 2x - 1000$$

(a) Show that g(x) = 0 has a root  $\alpha$  in the interval [3, 4]

**(2)** 

Using the iteration formula

$$x_{n+1} = \sqrt[6]{1000 - 2x_n}$$
 with  $x_1 = 3$ 

- (b) (i) find, to 4 decimal places, the value of  $x_2$ 
  - (ii) find, by repeated iteration, the value of  $\alpha$ . Give your answer to 4 decimal places.

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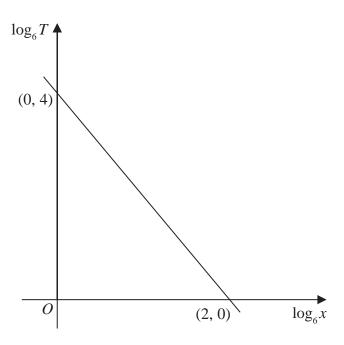


Figure 1

Figure 1 shows the linear relationship between  $\log_6 T$  and  $\log_6 x$ 

The line passes through the points (0, 4) and (2, 0) as shown.

- (a) (i) Find an equation linking  $\log_6 T$  and  $\log_6 x$ 
  - (ii) Hence find the exact value of T when x = 216

**(3)** 

(b) Find an equation, not involving logs, linking T with x

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3. (i) Find  $\frac{d}{dx} \ln(\sin^2 3x)$  writing your answer in simplest form.

**(2)** 

(ii) (a) Find  $\frac{d}{dx}(3x^2-4)^6$ 

**(2)** 

(b) Hence show that

$$\int_0^{\sqrt{2}} x \left(3x^2 - 4\right)^5 \mathrm{d}x = R$$

where R is an integer to be found.

(Solutions relying on calculator technology are not acceptable.)

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**4.** The function f is defined by

$$f(x) = 2x^2 - 5 x \ge 0 x \in \mathbb{R}$$

(a) State the range of f

**(1)** 

On the following page there is a diagram, labelled Diagram 1, which shows a sketch of the curve with equation y = f(x).

(b) On Diagram 1, sketch the curve with equation  $y = f^{-1}(x)$ .

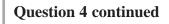
**(2)** 

The curve with equation y = f(x) meets the curve with equation  $y = f^{-1}(x)$  at the point P

Using algebra and showing your working,

(c) find the exact x coordinate of P





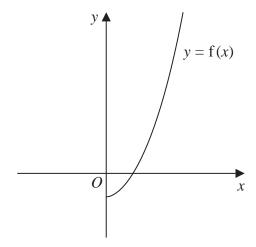


Diagram 1

(Total for Question 4 is 6 marks)

In this question you must show all stages of your working. 5. Solutions relying entirely on calculator technology are not acceptable.

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

$$(x-2)(\sqrt{3}\sec x + 2) = 0$$

**(3)** 

(ii) Solve, for 
$$0 < \theta < 360^{\circ}$$

$$10\sin\theta = 3\cos 2\theta$$

**(4)** 



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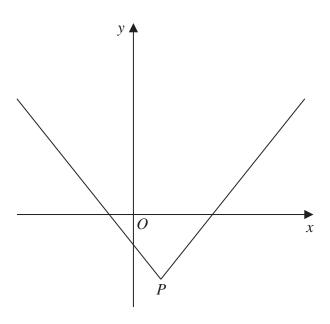


Figure 2

Figure 2 shows a sketch of the graph y = f(x), where

$$f(x) = 3|x - 2| - 10$$

The vertex of the graph is at point P, shown in Figure 2.

(a) Find the coordinates of P

**(2)** 

(b) Find ff(0)

**(2)** 

(c) Solve the inequality

$$3|x-2| - 10 < 5x + 10$$

**(2)** 

(d) Solve the equation

$$f(|x|) = 0$$

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7. A scientist is studying two different populations of bacteria.

The number of bacteria N in the first population is modelled by the equation

$$N = Ae^{kt}$$
  $t \geqslant 0$ 

where A and k are positive constants and t is the time in hours from the start of the study.

Given that

- there were 2500 bacteria in this population at the start of the study
- there were 10000 bacteria 8 hours later
- (a) find the exact value of A and the value of k to 4 significant figures.

**(3)** 

The number of bacteria N in the second population is modelled by the equation

$$N = 60\,000e^{-0.6t} \qquad t \geqslant 0$$

where *t* is the time in hours from the start of the study.

(b) Find the rate of decrease of bacteria in this population exactly 5 hours from the start of the study. Give your answer to 3 significant figures.

**(2)** 

When t = T, the number of bacteria in the two different populations was the same.

(c) Find the value of T, giving your answer to 3 significant figures.

(Solutions relying entirely on calculator technology are not acceptable.)

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8.

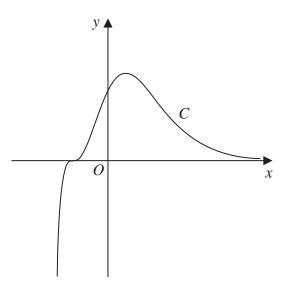


Figure 3

Figure 3 shows a sketch of the curve C with equation y = f(x), where

$$f(x) = (2x+1)^3 e^{-4x}$$

(a) Show that

$$f'(x) = A(2x + 1)^2 (1 - 4x) e^{-4x}$$

where *A* is a constant to be found.

**(4)** 

(b) Hence find the exact coordinates of the two stationary points on C.

**(3)** 

The function g is defined by

$$g(x) = 8f(x-2)$$

(c) Find the coordinates of the maximum stationary point on the curve with equation y = g(x).

**(2)** 

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## 9. In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

(a) Show that

$$\frac{\cos 2x}{\sin x} + \frac{\sin 2x}{\cos x} \equiv \csc x \qquad x \neq \frac{n}{2} \qquad n \in \mathbb{Z}$$
(3)

(b) Hence solve, for  $0 < \theta < \frac{\pi}{2}$ 

$$\left(\frac{\cos 2\theta}{\sin \theta} + \frac{\sin 2\theta}{\cos \theta}\right)^2 = 6\cot \theta - 4$$

giving your answers to 3 significant figures as appropriate.

**(5)** 

(c) Using the result from part (a), or otherwise, find the exact value of

$$\int_{-\frac{\pi}{6}}^{\frac{\pi}{4}} \left( \frac{\cos 2x}{\sin x} + \frac{\sin 2x}{\cos x} \right) \cot x \, dx$$

**(2)** 



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**10.** 

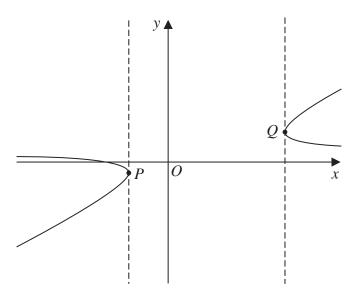


Figure 4

Figure 4 shows a sketch of the curve with equation

$$x = \frac{2y^2 + 6}{3y - 3}$$

(a) Find  $\frac{dx}{dy}$  giving your answer as a fully simplified fraction.

**(4)** 

The tangents at points P and Q on the curve are parallel to the y-axis, as shown in Figure 4.

(b) Use the answer to part (a) to find the equations of these two tangents.

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