Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
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Centre Number | Candidate Number

# Pearson Edexcel International Advanced Level

**Time** 1 hour 30 minutes

**Paper reference** **WMA12/01**

# Mathematics

## International Advanced Subsidiary/Advanced Level
## Pure Mathematics P2

**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* ▶


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**1.** The first three terms, in ascending powers of $x$, of the binomial expansion of $(1 + kx)^{16}$ are

$$1, -4x \text{ and } px^2$$

where $k$ and $p$ are constants.

(a) Find, in simplest form,

(i) the value of $k$

(ii) the value of $p$

**(3)**

$$g(x) = \left(2 + \frac{16}{x}\right)(1 + kx)^{16}$$

Using the value of $k$ found in part (a),

(b) find the term in $x^2$ in the expansion of $g(x)$.

**(3)**

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**Question 1 continued**

**Q1**

**(Total 6 marks)**

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**2.** A sequence is defined by

$$u_1 = 6$$
$$u_{n+1} = ku_n + 3$$

where $k$ is a positive constant.

(a) Find, in terms of $k$, an expression for $u_3$

**(2)**

Given that $\sum_{n=1}^{3} u_n = 117$

(b) find the value of $k$.

**(3)**

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**Question 2 continued**

**Q2**

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**3.**

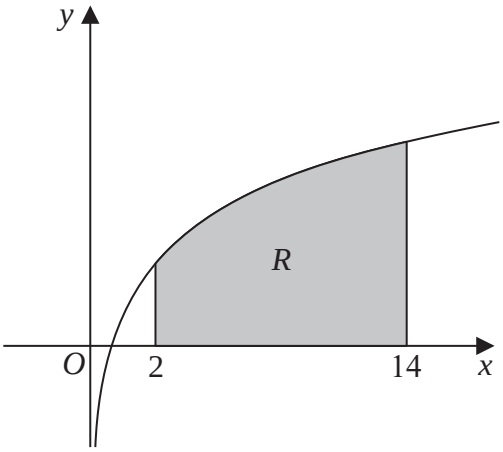


**Figure 1**

Figure 1 shows a sketch of part of the curve with equation $y = \log_{10} x$

The region $R$, shown shaded in Figure 1, is bounded by the curve, the line with equation $x = 2$, the $x$-axis and the line with equation $x = 14$

Using the trapezium rule with four strips of equal width,

(a) show that the area of $R$ is approximately 10.10

**(3)**

(b) Explain how the trapezium rule could be used to obtain a more accurate estimate for the area of $R$.

**(1)**

(c) Using the answer to part (a) and making your method clear, estimate the value of

(i) $\displaystyle\int_2^{14} \log_{10} \sqrt{x}\, dx$

(ii) $\displaystyle\int_2^{14} \log_{10} 100x^3\, dx$

**(4)**

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**Question 3 continued**

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**Question 3 continued**

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**Question 3 continued**

**Q3**

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**4.** $$f(x) = (x^2 - 2)(2x - 3) - 21$$

(a) State the value of the remainder when $f(x)$ is divided by $(2x - 3)$

**(1)**

(b) Use the factor theorem to show that $(x - 3)$ is a factor of $f(x)$

**(2)**

(c) Hence,

(i) factorise $f(x)$

(ii) show that the equation $f(x) = 0$ has only one real root.

**(5)**

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**Question 4 continued**

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**Question 4 continued**

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**Question 4 continued**

**Q4**

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**5.** A company that owned a silver mine

- extracted 480 tonnes of silver from the mine in year 1
- extracted 465 tonnes of silver from the mine in year 2
- extracted 450 tonnes of silver from the mine in year 3

and so on, forming an arithmetic sequence.

(a) Find the mass of silver extracted in year 14

**(2)**

After a total of 7770 tonnes of silver was extracted, the company stopped mining.

Given that this occurred at the end of year $N$,

(b) show that

$$N^2 - 65N + 1036 = 0$$

**(3)**

(c) Hence, state the value of $N$.

**(1)**

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**Question 5 continued**

**Q5**

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**6.** (i) The circle $C_1$ has equation

$$x^2 + y^2 + 10x - 12y = k \qquad \text{where } k \text{ is a constant}$$

(a) Find the coordinates of the centre of $C_1$

**(2)**

(b) State the possible range in values for $k$.

**(2)**

(ii) The point $P(p, 0)$, the point $Q(-2, 10)$ and the point $R(8, -14)$ lie on a different circle, $C_2$

Given that

- $p$ is a positive constant
- $QR$ is a diameter of $C_2$

find the exact value of $p$.

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**Question 6 continued**

**Q6**

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**7.** (i) A geometric sequence has first term 4 and common ratio 6
Given that the $n^{\text{th}}$ term is greater than $10^{100}$, find the minimum possible value of $n$.

**(3)**

(ii) A different geometric sequence has first term $a$ and common ratio $r$.

Given that

- the second term of the sequence is $-6$
- the sum to infinity of the series is 25

(a) show that

$$25r^2 - 25r - 6 = 0$$

**(3)**

(b) Write down the solutions of

$$25r^2 - 25r - 6 = 0$$

**(1)**

Hence,

(c) state the value of $r$, giving a reason for your answer,

**(1)**

(d) find the sum of the first 4 terms of the series.

**(2)**

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**Question 7 continued**

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**Question 7 continued**

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**8.** **In this question you must show all stages of your working.**

**Solutions relying entirely on calculator technology are not acceptable.**

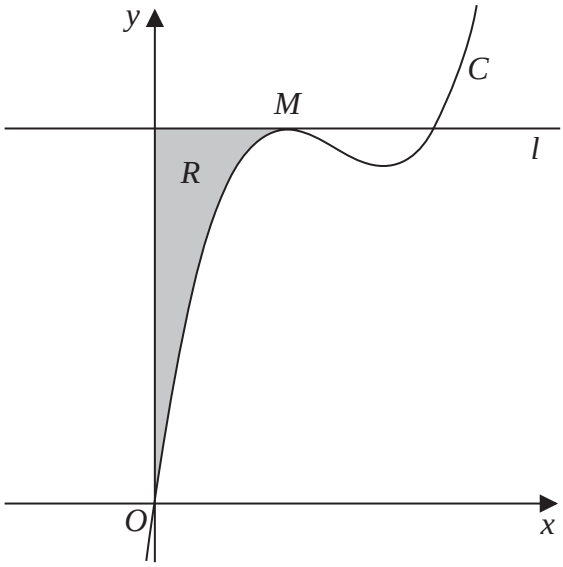


**Figure 2**

Figure 2 shows a sketch of part of the curve $C$ with equation

$$y = \frac{4}{3}x^3 - 11x^2 + kx \qquad \text{where } k \text{ is a constant}$$

The point $M$ is the maximum turning point of $C$ and is shown in Figure 2.

Given that the $x$ coordinate of $M$ is 2

(a) show that $k = 28$

**(3)**

(b) Determine the range of values of $x$ for which $y$ is increasing.

**(2)**

The line $l$ passes through $M$ and is parallel to the $x$-axis.

The region $R$, shown shaded in Figure 2, is bounded by the curve $C$, the line $l$ and the $y$-axis.

(c) Find, by algebraic integration, the exact area of $R$.

**(5)**

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**Question 8 continued**

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**9.** (a) Prove that for all positive values of $x$ and $y$,

$$\frac{x+y}{2} \geqslant \sqrt{xy}$$

**(3)**

(b) Prove by counter-example that this inequality does not hold when $x$ and $y$ are both negative.

**(1)**

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**Question 9 continued**

**Q9**

**(Total 4 marks)**

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**10.** **In this question you must show all stages of your working.**

**Solutions relying entirely on calculator technology are not acceptable.**

(i) Solve, for $-\frac{\pi}{2} < x < \frac{\pi}{2}$

$$\tan^2\left(2x + \frac{\pi}{4}\right) = 3$$

**(5)**

(ii) Solve, for $0 < \theta < 360°$

$$(2\sin\theta - \cos\theta)^2 = 1$$

giving your answers, as appropriate, to one decimal place.

**(5)**

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**Question 10 continued**

**Q10**

**(Total 10 marks)**

**TOTAL FOR PAPER IS 75 MARKS**

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