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INTERNATIONAL A LEVEL MATHEMATICS • PURE 2

Pure Mathematics 2

Exam Questions by Topic

Pearson Edexcel International Advanced Level (WMA12/01) • Calculator allowed

Multi-step exam questions at the difficulty of the real WMA12 paper, with a full mark scheme

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Algebraic Methods Algebraic fractions, the factor and remainder theorems, proof	10	66	own PDF	
2 Coordinate Geometry in the (x, y) Plane Equations of circles, tangents, chords and intersections	10	68	own PDF	
3 Exponentials and Logarithms Laws of logarithms, exponential equations, modelling	10	68	2	
4 The Binomial Expansion Expanding $(a + bx)^n$, coefficients and approximations	10	65	own PDF	
5 Sequences and Series Arithmetic and geometric series, sigma notation, recurrence	10	69	own PDF	
6 Trigonometric Identities and Equations $\tan \theta = \frac{\sin \theta}{\cos \theta}$, $\sin^2 \theta + \cos^2 \theta = 1$, solving equations	10	66	own PDF	
7 Differentiation Increasing and decreasing functions, stationary points, optimisation	10	67	own PDF	
8 Integration Definite integrals, areas under curves, the trapezium rule	10	67	own PDF	

[Full mark scheme](#)

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CHAPTER 3 • KEY SKILLS

Exponentials and Logarithms

Specification P2: Exponentials, Logarithms • 10 questions • 68 marks • about 80 minutes

1 Graphs of $y = a^x$

Passes through (0, 1) with asymptote $y = 0$. Transformations move the asymptote: $y = 4 - 2^x$ has asymptote $y = 4$.

2 Index and log form

$a^x = b \Leftrightarrow \log_a b = x$
e.g. $\log_2 8 = 3$, $\log_9 3 = \frac{1}{2}$

3 Laws of logarithms

$\log xy = \log x + \log y$,
 $\log \frac{x}{y} = \log x - \log y$, $\log x^k = k \log x$
 $\log(x + y) \neq \log x + \log y$

4 Log equations

Combine into one log each side, then remove the logs. Check each answer: you can only take the log of a positive number.

5 Solving $a^x = b$

Take logs of both sides: $x = \frac{\log b}{\log a}$
e.g. $3^x = 20$ gives $x = 2.73$

6 Hidden quadratics

$4^x = (2^x)^2$ and $2^{x+1} = 2 \times 2^x$: let $y = 2^x$.
Remember $2^x > 0$.

7 Change of base

$\log_a b = \frac{\log_c b}{\log_c a}$, so $\log_a b = \frac{1}{\log_b a}$ and
 $\log_4 x = \frac{1}{2} \log_2 x$

8 Intersections of exponentials

Set $a^x = k b^x$, collect the powers:
 $\left(\frac{a}{b}\right)^x = k$, then take logs.

9 Substitution in log equations

"Hence" may mean replacing x by $2y$ (or similar) in an equation you have already solved.

Skills map every skill above is tested at least once; interleaved skills come from GCSE or other chapters

Skill	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Marks	4	5	6	5	5	8	8	8	9	10
1 Graphs of $y = a^x$				•			•			
2 Index and log form	•		•	•	•	•		•	•	•
3 Laws of logarithms	•		•		•			•		•
4 Log equations			•		•			•		•
5 Solving $a^x = b$		•		•		•	•			
6 Hidden quadratics						•			•	
7 Change of base					•				•	
8 Intersections of exponentials							•			
9 Substitution in log equations										•
Interleaved: quadratics, surds, inequalities (P1)			•			•	•	•	•	•
Interleaved: graph transformations and sketching (P1)				•			•			
Interleaved: simultaneous equations (P1)								•		

Exam difficulty. Questions 1 to 5 check each skill on its own. Questions 6 to 10 are multi-step questions built like the last questions on a real WMA12 paper, where one part leads into the next and skills from different topics are combined.

Must learn. Use the power law *before* combining logs. Write the number on the other side as a log ($2 = \log_3 9$). Check every answer in the original equation.



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

Solutions relying on calculator technology are not acceptable.

(a) Write down the value of $\log_3 81$

(1)

(b) Express $2\log_a 5 + \log_a 4 - \log_a 10$ as a single logarithm, simplifying your answer.

(3)

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(Total for Question 1 is 4 marks)



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2. Find, giving each answer to 3 significant figures, the value of x for which

(a) $5^x = 12$

(2)

(b) $3^{2x-1} = 7^x$

(3)

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Question 2 continued

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(Total for Question 2 is 5 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

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

Solutions relying on calculator technology are not acceptable.

Solve

$$\log_3(2x+3) + \log_3(x-1) = 2 + \log_3(x+1)$$

giving your answer in the form $a + \sqrt{b}$, where a and b are integers. Explain why any other value must be rejected.

(6)

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Question 3 continued

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(Total for Question 3 is 6 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

4. (a) Sketch the curve with equation $y = 4 - 2^x$
On your sketch show clearly the coordinates of the points where the curve meets the coordinate axes and state the equation of the asymptote.

(3)

- (b) Find the exact x coordinate of the point where the curve meets the line $y = 1$

(2)

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Question 4 continued

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(Total for Question 4 is 5 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

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

Solutions relying on calculator technology are not acceptable.

(a) Show that $\log_4 x = \frac{1}{2} \log_2 x$

(2)

(b) Hence solve $\log_2 x + \log_4 x = 6$

(3)

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Question 5 continued

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(Total for Question 5 is 5 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

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

(a) Given that $y = 2^x$, show that the equation

$$2^{2x+1} - 11 \times 2^x + 12 = 0$$

can be written as $2y^2 - 11y + 12 = 0$

(2)

(b) Hence solve $2^{2x+1} - 11 \times 2^x + 12 = 0$, giving any non-integer answer to 3 significant figures.

(4)

(c) Hence find the set of values of x for which $2^{2x+1} - 11 \times 2^x + 12 < 0$

(2)

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Question 6 continued

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(Total for Question 6 is 8 marks)



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The curves C_1 and C_2 have equations $y = 5^x$ and $y = 2^{x+1}$ respectively. The curves meet at the point P .

- (a) On the same axes, sketch C_1 and C_2 , showing clearly the coordinates of the points where each curve meets the y -axis. (3)
- (b) Show that the x coordinate of P is
$$\frac{\log 2}{\log 2.5}$$
 (3)
- (c) Hence find the set of values of x for which $5^x > 2^{x+1}$, giving the boundary value to 3 significant figures. (2)



Question 7 continued

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(Total for Question 7 is 8 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

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

Solutions relying on calculator technology are not acceptable.

(a) Given that $\log_a x = p$ and $\log_a y = q$, express $\log_a \left(\frac{x^2 \sqrt{y}}{a} \right)$ in terms of p and q .

(3)

(b) Solve the simultaneous equations

$$\log_2(x + y) = 3$$

$$\log_2 x + \log_2 y = \log_2 15$$

(5)

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Question 8 continued

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(Total for Question 8 is 8 marks)



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Solutions relying on calculator technology are not acceptable.

(a) show that the equation $\log_a y + 2 = 3 \log_y a$ can be written as

$$(\log_a y)^2 + 2\log_a y - 3 = 0$$

(3)

(3)

(c) find the value of a .

(3)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Question 9 continued

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Question 9 continued

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(Total for Question 9 is 9 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

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

Solutions relying on calculator technology are not acceptable.

(a) Show that the equation

$$\log_2(x^2) - \log_2(x - 1) = 3 \quad x > 1$$

can be written as $x^2 - 8x + 8 = 0$

(3)

(b) Hence solve $\log_2(x^2) - \log_2(x - 1) = 3$, giving your answers in the form $a \pm b\sqrt{2}$, where a and b are integers. Show that each answer is valid.

(4)

(c) Hence, or otherwise, solve

$$\log_2(4y^2) - \log_2(2y - 1) = 3 \quad y > \frac{1}{2}$$

giving your answers in exact form.

(3)



Question 10 continued

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Question 10 continued

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(Total for Question 10 is 10 marks)**TOTAL FOR CHAPTER 3 IS 68 MARKS****Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk