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INTERNATIONAL A LEVEL MATHEMATICS • PURE 3

Pure Mathematics 3

Exam Questions by Topic

Pearson Edexcel International Advanced Level (WMA13/01) • Calculator allowed

Multi-step exam questions at the difficulty of the real WMA13 paper, with a full mark scheme

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Algebraic Methods Algebraic fractions, improper fractions and algebraic division	10	69	2	
2 Functions and Graphs Modulus, composite and inverse functions, transformations	10	76	own PDF	
3 Trigonometric Functions sec, cosec, cot, identities, inverse trigonometric functions	10	72	own PDF	
4 Trigonometric Addition Formulae Addition and double-angle formulae, $R\cos(\theta \pm \alpha)$	10	75	own PDF	
5 Exponentials and Logarithms e^x , $\ln x$, modelling, logarithmic graphs	10	78	own PDF	
6 Differentiation Chain, product and quotient rules, trigonometric and exponential functions	10	76	own PDF	
7 Integration Standard integrals, $f(ax+b)$, trigonometric identities, reverse chain rule	10	77	own PDF	
8 Numerical Methods Locating roots, iteration	10	77	own PDF	

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CHAPTER 1 • KEY SKILLS

1

Algebraic Methods

Specification P3: Algebraic methods • 10 questions • 69 marks • about 85 minutes

1 Factorise and cancel

Factorise the numerator and the denominator fully, then cancel common factors, never terms.

e.g. $\frac{x^2 - 9}{x^2 + 3x} = \frac{x - 3}{x}$

2 Multiplying and dividing

To divide, multiply by the reciprocal.
Factorise everything before cancelling.

3 Adding and subtracting

Use the lowest common denominator: factorise the denominators first to find it.

4 Equations with fractions

Multiply through by the common denominator. Reject any value that makes a denominator zero.

5 Improper fractions

The numerator's degree is at least the denominator's: divide first.

e.g. $\frac{3x^2 - 5x + 4}{x - 2} = 3x + 1 + \frac{6}{x - 2}$

6 Algebraic division

Long division by $(x + a)$ or by a quadratic: the remainder has lower degree than the divisor.

7 Identities

$\equiv$ means true for all x : multiply out and compare coefficients, or substitute convenient values of x .

8 “Show that”

Show every step: the common denominator, the expanded numerator and the factor that cancels.

9 Excluded values

x values that make *any* denominator zero are excluded, even if the factor later cancels.

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	9	8	8	9	10
1 Factorise and cancel	•	•	•		•	•		•		
2 Multiplying and dividing		•						•		
3 Adding and subtracting	•		•		•				•	•
4 Equations with fractions		•	•	•	•	•		•		•
5 Improper fractions		•		•		•	•			•
6 Algebraic division		•		•		•	•			
7 Identities		•	•				•		•	•
8 “Show that”	•		•			•	•	•	•	•
9 Excluded values		•			•	•		•		•
Interleaved: factor theorem, sigma notation (P2)						•			•	
Interleaved: quadratics, surds and inequalities (P1)			•	•	•		•		•	•
Interleaved: graphs and asymptotes (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 WMA13 paper, where one part leads into the next and skills from different topics are combined.

Must learn. When asked for A , B and C , also write the whole expression out in the required form. Factorise with integer coefficients, e.g. $(3x - 5)$, not $(x - \frac{5}{3})$.



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

Solutions relying on calculator technology are not acceptable.

$$f(x) = \frac{3x^2 - 27}{2x^2 + x - 15} + \frac{4}{2x - 5} \quad x > \frac{5}{2}$$

Show that $f(x) = \frac{3x - 5}{2x - 5}$

(4)

(Total for Question 1 is 4 marks)



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

Solutions relying on calculator technology are not acceptable.

$$f(x) = \frac{2x^4 + 7x^3 + 2x^2 + 2x}{x^2 + 3x} \quad x > 0$$

(a) Find the values of the constants A , B , C and D such that

$$f(x) = Ax^2 + Bx + C + \frac{D}{x+3}$$

(4)

(b) Hence solve the equation $f(x) = 2x^2 + x$

(1)



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.****(a)** Show that

$$\frac{3}{x+2} + \frac{2}{x-1} - \frac{7x-1}{x^2+x-2}$$

can be written as $\frac{a}{x+b}$, where a and b are integers to be found.**(4)****(b)** Hence show that the equation

$$\frac{3}{x+2} + \frac{2}{x-1} - \frac{7x-1}{x^2+x-2} = x+1$$

has no real solutions.

(2)

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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.

$$f(x) = \frac{6x^2 + 5x - 4}{2x + 3} \quad x \neq -\frac{3}{2}$$

(a) Write $f(x)$ in the form $Ax + B + \frac{C}{2x+3}$, where A , B and C are constants to be found.

(3)

(b) Hence find the set of values of x for which $f(x) > 3x - 2$

(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.

Solve the equation

$$\frac{3x}{x-2} - \frac{4}{x+1} = \frac{12}{x^2 - x - 2}$$

explaining clearly why one of the solutions of your working must be rejected.

(5)

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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.

Solutions relying on calculator technology are not acceptable.

$$f(x) = \frac{x^3 + 3x^2 - 4}{x^2 + x - 2} \quad x \neq 1, x \neq -2$$

(a) Use the factor theorem to show that $(x - 1)$ is a factor of $x^3 + 3x^2 - 4$

(2)

(b) Hence show that $f(x) = x + 2$

(4)

(c) Explain why the graph of $y = f(x)$ is a straight line with two points missing, and find the coordinates of the two missing points.

(3)

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Question 6 continued

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Question 6 continued

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(Total for Question 6 is 9 marks)



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Solutions relying on calculator technology are not acceptable.

$$g(x) = \frac{x^4 + 2x^3 + 7x + 7}{x^2 + 1} \quad x \in \mathbb{R}$$

- (5)**

- $$\frac{Dx + E}{x^2 + 1} > 1$$

(3)

Question 7 continued

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(Total for Question 7 is 8 marks)



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8.

$$h(x) = \frac{x^2 - 4}{x^2 + 3x + 2} \div \frac{x^2 - 5x + 6}{x^2 - 2x - 3}$$

- (a) Show that $h(x) = 1$ for all values of x for which it is defined. (4)
- (b) State the values of x for which $h(x)$ is not defined. (2)
- (c) Hence show that the equation $h(x) = x^2 - 3$ has no solutions. (2)

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Question 8 continued

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(Total for Question 8 is 8 marks)



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9. (a) Show that $\frac{1}{r} - \frac{1}{r+1} \equiv \frac{1}{r(r+1)}$

(2)

(b) Hence show that

$$\sum_{r=1}^n \frac{1}{r(r+1)} = \frac{n}{n+1}$$

(4)

(c) Find the least value of n for which $\sum_{r=1}^n \frac{1}{r(r+1)} > 0.99$

(3)

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Question 9 continued

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Question 9 continued

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(Total for Question 9 is 9 marks)



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

Solutions relying on calculator technology are not acceptable.

$$f(x) = \frac{2x^2 + kx - 3}{x + 2} \quad x \neq -2$$

where k is a constant. Given that $f(x) \equiv 2x + 1 + \frac{C}{x + 2}$, where C is a constant,

(a) find the value of k and the value of C .

(4)

(b) Find the x coordinate of the point where the curve $y = f(x)$ meets the line $y = 2x - 1$

(2)

(c) Explain why, for $x > -2$, the curve $y = f(x)$ lies below the line $y = 2x + 1$

(1)

(d) Find the set of values of x for which $f(x) > 2x$

(3)

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Question 10 continued

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Question 10 continued

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(Total for Question 10 is 10 marks)

TOTAL FOR CHAPTER 1 IS 69 MARKS

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