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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	own PDF	
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	2	
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 5 • KEY SKILLS

5

Sequences and Series

Specification P2: 4.1 to 4.4 • 10 questions • 69 marks • about 85 minutes

1 Recurrence relations

 $u_{n+1} = f(u_n)$: substitute one term to get the next.e.g. $u_1 = 4$, $u_{n+1} = 3u_n - 4$: 4, 8, 20, ...

2 Types of sequence

Increasing: $u_{n+1} > u_n$. Decreasing: $u_{n+1} < u_n$. Periodic: the terms repeat with period k .

3 Arithmetic sequences

$$u_n = a + (n-1)d$$

Two terms give two equations in a and d .

4 Arithmetic series

$$S_n = \frac{n}{2}(2a + (n-1)d) = \frac{n}{2}(a+l)$$

Know the proof: write S_n forwards and backwards, then add.

5 Sigma notation

$$\sum_{r=1}^n r = \frac{1}{2}n(n+1). \text{ Count the terms: } \sum_{r=k}^n$$

has $n - k + 1$ terms.

6 Geometric sequences

 $u_n = ar^{n-1}$. Three consecutive terms:

$$\frac{u_2}{u_1} = \frac{u_3}{u_2}, \text{ so } u_2^2 = u_1 u_3$$

7 Geometric series

$$S_n = \frac{a(1-r^n)}{1-r}; S_\infty = \frac{a}{1-r} \text{ only if}$$

$$|r| < 1$$

Proof: subtract rS_n from S_n .8 Finding n with logsSolve $r^n > k$ with logs. If $\log r < 0$ the inequality reverses. n is a whole number: round in the right direction.

9 Modelling

Decide whether the change is by a fixed amount (arithmetic) or a fixed percentage (geometric). Year n is the n th term.**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	5	5	5	5	5	9	8	8	9	10
1 Recurrence relations	•				•			•		
2 Types of sequence					•			•		
3 Arithmetic sequences		•					•			•
4 Arithmetic series		•		•			•			•
5 Sigma notation	•			•	•			•		
6 Geometric sequences			•			•			•	•
7 Geometric series and proof			•			•			•	•
8 Finding n with logs						•			•	•
9 Modelling							•			•
Interleaved: logarithms (Chapter 3)						•			•	•
Interleaved: quadratics and inequalities (P1)						•	•	•		
Interleaved: simultaneous equations and proof (P1, Ch 1)		•		•			•			

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. The proofs of both sum formulae. Check which term is “year n ”: a starting value is often u_1 , so year n uses r^{n-1} . Give n as a whole number that satisfies the condition.



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1. A sequence is defined by

$$u_1 = 4 \quad u_{n+1} = 3u_n - k$$

where k is a constant.

- (a) Find, in terms of k , the values of u_2 and u_3

(2)

- (b) Given that $u_3 = 20$, find the value of k .

(2)

- (c) Find the value of $\sum_{r=1}^4 u_r$

(1)

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Question 1 continued

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(Total for Question 1 is 5 marks)



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2. The 4th term of an arithmetic sequence is 23 and the 10th term is 53

(a) Find the first term and the common difference.

(3)

(b) Find the sum of the first 20 terms.

(2)

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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. A geometric series has first term 81 and common ratio $\frac{2}{3}$
- (a) Find the 5th term. (1)
- (b) Find the sum of the first 10 terms, giving your answer to 3 significant figures. (2)
- (c) Find the sum to infinity. (1)
- (d) Find the difference between the sum to infinity and the sum of the first 10 terms, to 3 significant figures. (1)

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Question 3 continued

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(Total for Question 3 is 5 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

4. (a) Prove that the sum of the first n terms of an arithmetic series with first term a and common difference d is

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

(3)

- (b) Hence find $\sum_{r=1}^{40} (3r+2)$

(2)

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Question 4 continued

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5. A sequence is defined by

$$u_1 = 2 \quad u_{n+1} = \frac{1}{1 - u_n}$$

- (a) Find the values of u_2 , u_3 and u_4

(2)

- (b) Describe the behaviour of the sequence.

(1)

- (c) Find the value of $\sum_{r=1}^{100} u_r$

(2)

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Question 5 continued

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

The first three terms of a geometric sequence are

$$(k+3) \quad 2k \quad (3k-2)$$

where k is a constant.

- (a) Show that $k^2 - 7k + 6 = 0$ (2)
- (b) Find the two possible values of k . (1)
- (c) For the value of k for which the series has a sum to infinity, find the sum to infinity. (3)
- (d) For the other value of k , find the least number of terms for which the sum of the series exceeds 1000 (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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In the 6th month, 340 bottles are recycled. In the first 10 months, a total of 3230 bottles are recycled.

- (b)** Find the first month in which the total number of bottles recycled since the start exceeds 10 000



Question 7 continued

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(Total for Question 7 is 8 marks)



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8. A sequence is defined by

$$u_1 = 2 \quad u_{n+1} = au_n + 2a - 1$$

where a is a constant.

- (a) Find u_2 and u_3 in terms of a , simplifying your answers.

(3)

Given that $\sum_{n=1}^3 u_n = 21$

- (b) show that $4a^2 + 5a - 21 = 0$

(2)

- (c) Given also that the sequence is increasing, find the value of a and the value of u_4

(3)

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Question 8 continued

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(Total for Question 8 is 8 marks)



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9. A geometric series has first term a and common ratio r , where $r \neq 1$

(a) Prove that the sum of the first n terms of the series is

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

(3)

The sum to infinity of the series is 4 times the first term, and the sum of the first three terms is 74

(b) Find the value of r and the value of a .

(3)

(c) Find the least value of n for which the sum to infinity exceeds the sum of the first n terms by less than 0.01

(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)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

Scheme B: £28 000 in the first year, increasing by 5% each year.

- (a) Find the salary in the 5th year under each scheme, giving scheme B to the nearest pound. (2)
- (b) Show that the total earned in the first 10 years under scheme A is £367 500 (2)
- (c) Find the total earned in the first 10 years under scheme B , to the nearest pound. (2)
- (d) Show that the total earned under scheme B first exceeds £1 000 000 after n years, where n is the least integer satisfying

$$1.05^n > \frac{39}{14}$$

and hence find n .

Question 10 continued

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Question 10 continued

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(Total for Question 10 is 10 marks)**TOTAL FOR CHAPTER 5 IS 69 MARKS****Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk