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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	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	2	
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	

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CHAPTER 6 • KEY SKILLS

6

Trigonometric Identities and Equations

Specification P2: 6.1, 6.2 • 10 questions • 66 marks • about 80 minutes

1 The tan identity

 $\tan x \equiv \frac{\sin x}{\cos x}$, so $a \sin x = b \cos x$ gives

$$\tan x = \frac{b}{a} \text{ (if } \cos x \neq 0 \text{)}$$

2 The Pythagorean identity

 $\sin^2 x + \cos^2 x \equiv 1$. Exact values from one ratio: use the quadrant to choose the sign.

3 Proving identities

Start from one side and transform it into the other. Factorise, e.g.

$$a^2 - b^2 = (a - b)(a + b).$$

4 Basic equations

Principal value from the calculator, then the second value by symmetry.

$$\sin: 180^\circ - \alpha. \quad \cos: 360^\circ - \alpha. \quad \tan: \alpha + 180^\circ$$

5 Transformed arguments

For $\cos(2x + 40^\circ)$, change the interval first: $0 \leq x < 180^\circ$ gives $40^\circ \leq 2x + 40^\circ < 400^\circ$

6 Quadratics in one function

Use $\sin^2 x = 1 - \cos^2 x$ (or the reverse) so only one function remains, then factorise.

7 Never divide by a trig function

Dividing by $\sin x$ loses the solutions of $\sin x = 0$. Factorise instead.

8 Impossible values

$-1 \leq \sin x \leq 1$ and $-1 \leq \cos x \leq 1$: reject values outside this range and say why.

9 Radians and exact answers

Give answers as multiples of π when the interval is in radians, e.g.

$$\sin x = \frac{\sqrt{3}}{2}: x = \frac{\pi}{3}, \frac{2\pi}{3}$$

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	4	6	4	8	8	8	9	10
1 The tan identity	•					•	•		•	•
2 The Pythagorean identity	•			•		•		•		•
3 Proving identities				•						
4 Basic equations		•		•		•	•		•	•
5 Transformed arguments			•		•	•	•		•	•
6 Quadratics in one function						•		•	•	
7 Never divide by a trig function							•			
8 Impossible values						•		•		
9 Radians and exact answers			•					•		
Interleaved: quadratics and factorising (P1)				•		•	•	•	•	
Interleaved: trig graphs, periods and exact values (P1)	•		•				•	•		
Interleaved: area and cosine rule, surds (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. Both identities are *not* in the formula booklet. Give every solution in the interval and no others. Work to 1 decimal place in degrees unless told otherwise.



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

Solutions relying on calculator technology are not acceptable.

Given that $\sin \theta = \frac{\sqrt{5}}{3}$ and that θ is obtuse, find the exact value of

(a) $\cos \theta$

(2)

(b) $\tan \theta$

(2)

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(Total for Question 1 is 4 marks)



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2. Solve, for $0 \leq x < 360^\circ$, giving your answers to one decimal place,

(a) $4 \sin x = 3$

(2)

(b) $3 \tan x + 5 = 0$

(3)

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Question 2 continued

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(Total for Question 2 is 5 marks)



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

Solutions relying on calculator technology are not acceptable.

Solve, for $0 \leq x < 2\pi$,

$$2 \sin \left(x - \frac{\pi}{6} \right) = \sqrt{3}$$

giving your answers as exact multiples of π .

(4)

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(Total for Question 3 is 4 marks)



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4. (a) Prove that $\cos^4 x - \sin^4 x \equiv 1 - 2\sin^2 x$

(3)

- (b) Hence solve, for $0 \leq x < 360^\circ$,

$$\cos^4 x - \sin^4 x = \frac{1}{2}$$

(3)

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Question 4 continued

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(Total for Question 4 is 6 marks)



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5. Solve, for $0 \leq x < 180^\circ$,

$$\tan(2x - 30^\circ) = \sqrt{3}$$

(4)

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(Total for Question 5 is 4 marks)



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6. (a) Show that the equation

$$3 \tan x \sin x = 8$$

can be written as $3 \cos^2 x + 8 \cos x - 3 = 0$

(3)

- (b) Hence solve, for $0 \leq x < 360^\circ$, $3 \tan x \sin x = 8$, giving your answers to one decimal place.

(3)

- (c) Hence solve, for $0 \leq \theta < 180^\circ$, $3 \tan 2\theta \sin 2\theta = 8$, giving your answers to one decimal place.

(2)

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Question 6 continued

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(Total for Question 6 is 8 marks)



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7. A student is asked to solve the equation $5 \sin x = 2 \tan x$ for $0 \leq x \leq 360^\circ$. The student's working is shown below.

$$5 \sin x = \frac{2 \sin x}{\cos x} \quad \text{so} \quad 5 \sin x \cos x = 2 \sin x$$

$$\text{Divide by } \sin x: \quad 5 \cos x = 2, \quad \cos x = 0.4$$

$$x = 66.4^\circ \text{ or } x = 293.6^\circ$$

- (a) Identify the error made by the student. (2)
- (b) Solve the equation correctly, giving your answers to one decimal place where necessary. (4)
- (c) Hence state the number of solutions of $5 \sin 3x = 2 \tan 3x$ for $0 \leq x \leq 360^\circ$ (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

Solutions relying on calculator technology are not acceptable.

- $$4 \sin^2 x + 4 \sin x - 3 = 0$$

(2)

- (4)

- (2)

Question 8 continued

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

9. (a) Show that the equation

$$2 \sin^2 x + 5 \sin x \cos x = 3 \cos^2 x$$

can be written as $2 \tan^2 x + 5 \tan x - 3 = 0$, explaining why $\cos x \neq 0$ for any solution.

(3)

- (b) Hence solve, for $0 \leq x < 360^\circ$, $2 \sin^2 x + 5 \sin x \cos x = 3 \cos^2 x$, giving your answers to one decimal place.

(4)

- (c) Given that x is an acute angle satisfying the equation, find the exact value of $\sin x$, giving your answer in the form $\frac{\sqrt{a}}{b}$, where a and b are integers.

(2)

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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 the triangle ABC , $AB = 5$ cm, $AC = 8$ cm and angle $BAC = \theta$. The area of the triangle is 12 cm^2

(a) Show that $\sin \theta = \frac{3}{5}$ (1)

(b) Find the two possible exact values of $\cos \theta$. (2)

(c) Find the two possible exact lengths of BC , giving your answers in simplest surd form where appropriate. (3)

(d) For the triangle in which θ is obtuse, write down the exact value of $\tan \theta$. (1)

(e) Solve, for $0 \leq x < 360^\circ$,
$$5 \sin(x - 20^\circ) = 3 \cos(x - 20^\circ)$$

giving your answers to one decimal place. (3)



Question 10 continued

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Question 10 continued

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