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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	own PDF	
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	2	
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	

[Full mark scheme](#)

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CHAPTER 3 • KEY SKILLS

3

Trigonometric Functions

Specification P3: Trigonometry • 10 questions • 72 marks • about 85 minutes

1 Reciprocal functions

$$\sec x = \frac{1}{\cos x}, \quad \operatorname{cosec} x = \frac{1}{\sin x},$$

$$\cot x = \frac{1}{\tan x} = \frac{\cos x}{\sin x}$$

2 Graphs

$\sec x$ and $\operatorname{cosec} x$: range ≤ -1 or ≥ 1 ;
asymptotes where $\cos x$ or $\sin x$ is 0.
 $\cot x$: period π .

3 Pythagorean identities

$$1 + \tan^2 x \equiv \sec^2 x$$

$$1 + \cot^2 x \equiv \operatorname{cosec}^2 x$$

(from $\sin^2 x + \cos^2 x \equiv 1$)

4 Proving identities

Start from the more complicated side;
write in $\sin$ and $\cos$; show every step
to the other side.

5 Quadratic trig equations

Use an identity so only one function
remains, factorise, then reject
impossible values (e.g. $|\sin x| > 1$).

6 Intervals and arguments

For $\tan(2\theta - 30^\circ)$ with $\theta > 0$, the
argument starts at -30° . "Second
smallest" needs all solutions in order.

7 Inverse trig functions

$$\arcsin: [-1, 1] \rightarrow \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]; \arccos:$$

$$[-1, 1] \rightarrow [0, \pi]; \arctan: \mathbb{R} \rightarrow \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

8 Triangles for inverses

If $\theta = \arccos x$, draw a right-angled
triangle with $\cos \theta = x$: then
 $\sin \theta = \sqrt{1 - x^2}$

9 Using a result

"Hence" means use the identity or
answer just found; do not start again.

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	6	5	5	5	9	9	9	9	10
1 Reciprocal functions	•	•	•	•		•	•			•
2 Graphs			•							•
3 Pythagorean identities	•	•				•	•			
4 Proving identities				•		•			•	
5 Quadratic trig equations		•					•			
6 Intervals and arguments		•				•	•			•
7 Inverse trig functions					•			•	•	
8 Triangles for inverses					•				•	
9 Using a result				•		•	•		•	
Interleaved: functions: range, inverse, modulus (Chapter 2)			•					•		•
Interleaved: algebraic fractions (Chapter 1)				•		•				
Interleaved: quadratics and 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 WMA13 paper, where one part leads into the next and skills from different topics are combined.

Must learn. Check degrees or radians before you start. Give every solution in the interval and no others; with a transformed argument, change the interval first.



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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 $\sec \theta = -3$ and that θ is obtuse, find the exact value of

(a) $\tan \theta$

(3)

(b) $\operatorname{cosec} \theta$, giving your answer in the form $a\sqrt{2}$, where a is a rational number.

(2)

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Question 1 continued

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(Total for Question 1 is 5 marks)



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

$$3 \operatorname{cosec}^2 x - 4 \cot x = 4$$

giving your answers to 3 significant figures.

(6)

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Question 2 continued

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(Total for Question 2 is 6 marks)**Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

3. (a) Sketch the graph of $y = \sec x$ for $0 \leq x \leq 2\pi$. Show the equations of the asymptotes and the coordinates of the turning points.

(3)

The function f is defined by $f(x) = 3 - 2\sec x$, $0 \leq x \leq 2\pi$, $x \neq \frac{\pi}{2}, \frac{3\pi}{2}$

- (b) Find the range of f .

(2)

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

Solutions relying on calculator technology are not acceptable.

(a) Prove that $\sec x - \cos x \equiv \sin x \tan x$

(3)

(b) Hence, or otherwise, show that $(\operatorname{cosec} x - \sin x)(\sec x - \cos x) \equiv \sin x \cos x$

(2)

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Question 4 continued

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

Solutions relying on calculator technology are not acceptable.

- (a) Sketch the graph of $y = \arccos x$, showing the coordinates of its end points and of the point where it crosses the y -axis.

(2)

- (b) Solve $\arccos(2x - 1) = \frac{\pi}{3}$

(1)

- (c) Show that $\sin(\arccos x) = \sqrt{1 - x^2}$ for $-1 \leq x \leq 1$

(2)

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Question 5 continued

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Solutions relying on calculator technology are not acceptable.

- (3)**

- $$\frac{\tan^2 2x}{\sec 2x - 1} = 3$$

(4)

- (2)**

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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7. (a) Show that the equation $3\sec^2 x - 5\tan x - 5 = 0$ can be written as $3\tan^2 x - 5\tan x - 2 = 0$ (2)

(b) Hence solve, for $0 \leq x < 360^\circ$, $3\sec^2 x - 5\tan x - 5 = 0$, giving your answers to one decimal place. (4)

(c) Hence find the second smallest positive solution of

$$3\sec^2(2\theta - 30^\circ) - 5\tan(2\theta - 30^\circ) - 5 = 0$$

(3)

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Question 7 continued

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Question 7 continued

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Solutions relying on calculator technology are not acceptable.

- (2)**

$$h(x) = \frac{\pi}{4} + \arctan(2x) \quad x \in \mathbb{R}$$

- (2)**

- (3)**

- (2)**

Question 8 continued

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Question 8 continued

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

Solutions relying on calculator technology are not acceptable.

- (a) Given that $y = \arcsin x$, where $-1 \leq x \leq 1$, show that $\arccos x = \frac{\pi}{2} - y$ and hence that

$$\arcsin x + \arccos x = \frac{\pi}{2}$$

(3)

- (b) Hence solve the equation $\arcsin x = 2 \arccos x$, giving your answer in exact form.

(3)

- (c) Find the exact value of $\tan\left(\arccos \frac{1}{3}\right)$

(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. The function f is defined by

$$f(x) = 2 + \operatorname{cosec} x \quad 0 < x < 2\pi, x \neq \pi$$

- (a) Sketch the graph of $y = f(x)$ and state the range of f . (3)
- (b) Solve the equation $f(x) = 5$, giving your answers to 3 significant figures. (3)
- (c) Find the set of values of k for which the equation $f(x) = k$ has no solutions. (2)
- (d) Find the number of solutions of the equation $|f(x)| = 2$, giving a reason. (2)

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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 3 IS 72 MARKS

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