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INTERNATIONAL A LEVEL MATHEMATICS • PURE 1

Pure Mathematics 1

Exam Questions by Topic

Pearson Edexcel International Advanced Level (WMA11/01) • Calculator allowed

Multi-step exam questions at the difficulty of the real WMA11 paper, with a full mark scheme

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Algebraic Expressions Indices, surds, expanding and factorising	10	57	own PDF	
2 Quadratics Completing the square, the discriminant, quadratic graphs	10	65	own PDF	
3 Equations and Inequalities Simultaneous equations, inequalities, regions	10	69	own PDF	
4 Graphs and Transformations Cubic and reciprocal graphs, intersections, transformations	10	68	2	
5 Straight-line Graphs Gradients, equations of lines, parallel and perpendicular	10	68	own PDF	
6 Trigonometric Ratios Sine and cosine rules, area of a triangle, trig graphs	10	66	own PDF	
7 Radians Radian measure, arc length, sector and segment areas	10	71	own PDF	
8 Differentiation Gradients, second derivatives, tangents and normals	10	71	own PDF	
9 Integration Integrating x^n , finding $y = f(x)$ from $f'(x)$	10	67	own PDF	

[Full mark scheme](#)

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CHAPTER 4 • KEY SKILLS

Graphs and Transformations

Specification P1: 1.11, 1.12 • 10 questions • 68 marks • about 80 minutes

1 Sketching cubics

Find the roots and the y intercept. A squared factor touches the x -axis. A negative x^3 term flips the shape.
e.g. $y = (x - 1)^2(x + 2)$ touches at $(1, 0)$

2 Factorise, then sketch

Take out a factor of x first, then factorise the quadratic.
e.g. $x^3 - 4x^2 + 4x = x(x - 2)^2$

3 Reciprocal graphs

$y = \frac{k}{x}$, $k > 0$: first and third quadrants.
 $y = \frac{k}{x^2}$, $k > 0$: both branches above the x -axis.

4 Asymptotes

State them as equations. They move with the graph.
e.g. $y = \frac{1}{x} + 3$ has asymptotes $x = 0$ and $y = 3$

5 Counting solutions

Rearrange to $f(x) = g(x)$ for two graphs you can sketch. The number of solutions is the number of intersections: give this reason.

6 Intersections by algebra

Set the equations equal. Look for common factors before you expand.

7 Translations

$y = f(x + a)$: a units left.
 $y = f(x) + a$: a units up.

8 Stretches

$y = af(x)$: y coordinates $\times a$.
 $y = f(ax)$: x coordinates $\div a$.

9 Equations from graphs

Roots give the factors; include a constant k .
e.g. repeated root 3: $y = kx(x - 3)^2$, then find k from one more point.

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	6	5	5	9	8	8	8	9
1 Sketching cubics	•			•		•				•
2 Factorise, then sketch	•					•	•			
3 Reciprocal graphs		•		•	•			•		
4 Asymptotes		•			•			•	•	
5 Counting solutions				•						•
6 Intersections by algebra						•	•	•		
7 Translations		•	•		•				•	•
8 Stretches			•						•	
9 Equations from graphs							•		•	
Interleaved: surds and exact answers (Chapter 1)		•				•				
Interleaved: solving quadratics (Chapter 2)							•	•		
Interleaved: inequalities from graphs (Chapter 3)						•				•

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 WMA11 paper, where one part leads into the next and skills from different topics are combined.

Must learn. Every sketch needs the coordinates of the points where it meets the axes, and the *equation* of every asymptote. $f(x) - 2$ moves the graph down; $f(x - 2)$ moves it right.



1. (a) Factorise completely $x^3 - 6x^2 + 9x$

(2)

- (b) Sketch the curve with equation $y = x^3 - 6x^2 + 9x$
showing clearly the coordinates of the points where the curve meets the coordinate axes.

(3)

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Question 1 continued

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2. (a) Sketch the curve with equation $y = \frac{3}{x^2}$, $x \neq 0$

(2)

- (b) On a separate diagram, sketch the curve with equation $y = \frac{3}{x^2} - 1$, $x \neq 0$

On your sketch show clearly the equation of the horizontal asymptote and the exact coordinates of the points where the curve crosses the x -axis.

(3)

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Question 2 continued

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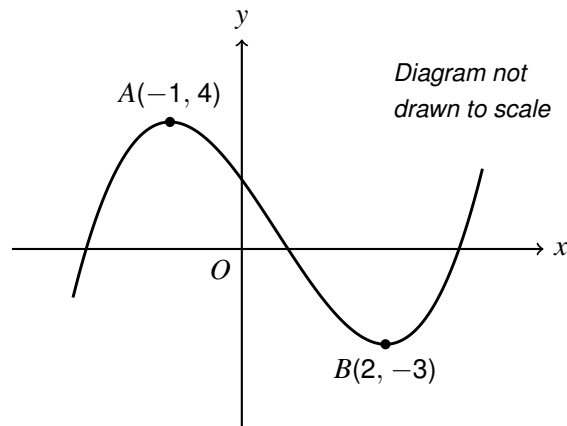


Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = f(x)$.

The curve has a maximum point at $A(-1, 4)$ and a minimum point at $B(2, -3)$.

Write down the coordinates of the maximum point and the coordinates of the minimum point on the curve with equation

(a) $y = f(x + 2)$ (2)

(b) $y = 3f(x)$ (2)

(c) $y = f(2x)$ (2)



Question 3 continued

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4. (a) On the same axes, sketch the curves with equations

$$y = x^2(x - 3) \quad \text{and} \quad y = \frac{4}{x}, \quad x \neq 0$$

On your sketch show clearly the coordinates of the points where the curve $y = x^2(x - 3)$ meets the x -axis.

(3)

- (b) Hence state the number of real solutions of the equation $x^4 - 3x^3 = 4$ giving a reason for your answer.

(2)

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Question 4 continued

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5. The curve C has equation $y = \frac{4}{x}$, $x \neq 0$

(a) The curve C is translated 3 units in the negative x direction. Write down

(i) an equation of the new curve,

(ii) the equation of the vertical asymptote of the new curve.

(2)

(b) Describe fully the single transformation that maps C onto the curve with equation $y = \frac{4}{x} - 2$

(2)

(c) Find the coordinates of the point where the curve with equation $y = \frac{4}{x} - 2$ crosses the x -axis.

(1)



Question 5 continued

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

Solutions relying on calculator technology are not acceptable.

$$f(x) = (2x + 1)^2(x - 3)$$

(a) Sketch the curve with equation $y = f(x)$, showing clearly the coordinates of the points where the curve meets the coordinate axes. (3)

(b) Using your sketch, state the set of values of x for which $f(x) > 0$ (1)

(c) Expand $f(x)$, giving your answer in the form $ax^3 + bx^2 + cx + d$, where a , b , c and d are integers. (2)

The line l passes through the point where the curve meets the y -axis and is parallel to the x -axis.

(d) Using algebra, find the exact x coordinates of the other points where l meets the curve. (3)



Question 6 continued

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Question 6 continued

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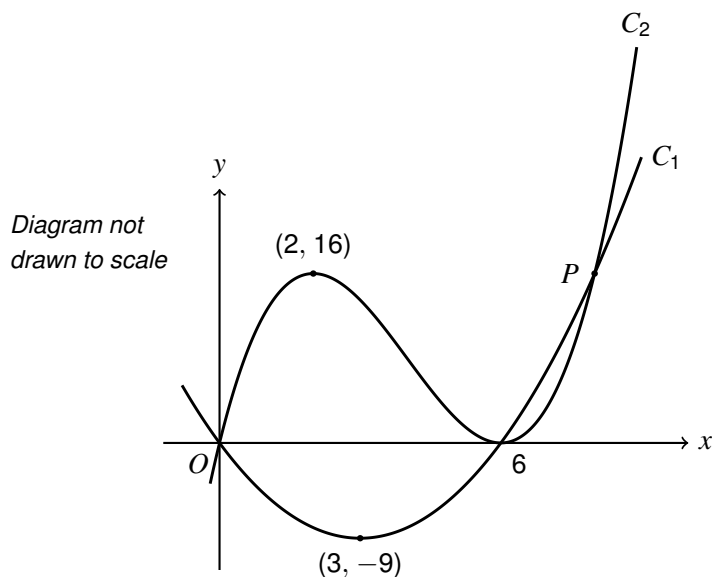


Figure 2

Figure 2 shows a sketch of the curve C_1 with equation $y = f(x)$, where $f(x)$ is a quadratic expression, and the curve C_2 with equation $y = g(x)$, where $g(x)$ is a cubic expression.

- C_1 passes through O and $(6, 0)$ and has a minimum point at $(3, -9)$
- C_2 passes through O , touches the x -axis at $(6, 0)$ and has a maximum point at $(2, 16)$

(a) Find $f(x)$.

(2)

(b) Find $g(x)$.

(3)

The curves also meet at the point P , shown in Figure 2.

(c) Using algebra, find the coordinates of P .

(3)



Question 7 continued

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(a) Sketch C , stating the equations of its asymptotes and the coordinates of the point where C crosses the x -axis.

(3)

The line l meets C at the point P , where P has x coordinate -3

(b) Find the value of k .

(2)

The line l meets C again at the point Q .

(c) Using algebra, find the coordinates of Q .

(Solutions relying entirely on calculator technology are not acceptable.)

(3)

Question 8 continued

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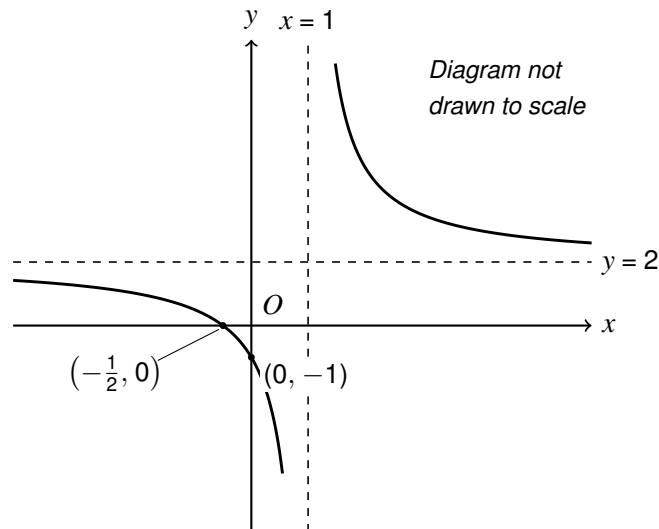


Figure 3

Figure 3 shows a sketch of the curve with equation $y = f(x)$.

The curve has asymptotes $x = 1$ and $y = 2$, crosses the x -axis at $(-\frac{1}{2}, 0)$ and crosses the y -axis at $(0, -1)$.

On separate diagrams, sketch the curve with equation

(a) $y = f(x) - 2$ (3)

(b) $y = f\left(\frac{1}{2}x\right)$ (3)

On each sketch, show clearly the equations of the asymptotes and the coordinates of any points where the curve meets the coordinate axes.

Given that $f(x) = a + \frac{b}{x-1}$, where a and b are constants,

(c) find the value of a and the value of b . (2)



Question 9 continued

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10.

$$f(x) = (x + 1)(x - 2)^2$$

The curve with equation $y = f(x)$ has a maximum point at $(0, 4)$.

- (a) Sketch the curve with equation $y = f(x)$, showing clearly the coordinates of the points where the curve meets the coordinate axes. (3)
- (b) Find the set of values of k for which the equation $f(x) = k$ has three distinct real solutions. (2)
- (c) State the number of real solutions of the equation $f(x + 3) = 2$ giving a reason for your answer. (2)
- (d) Find the values of the constant c for which the curve with equation $y = f(x) + c$ touches the x -axis. (2)

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Question 10 continued

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Question 10 continued

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