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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	own PDF	
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	2	
9 Integration Integrating x^n , finding $y = f(x)$ from $f'(x)$	10	67	own PDF	

[Full mark scheme](#)

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CHAPTER 8 • KEY SKILLS

Differentiation

Specification P1: 4.1, 4.2, 4.3 • 10 questions • 71 marks • about 85 minutes

1 Differentiating x^n

$$\frac{d}{dx}(ax^n) = anx^{n-1} \text{ for any rational } n.$$

e.g. $\frac{d}{dx}(4x^{-2}) = -8x^{-3}$

2 Rewrite first

Expand brackets and split fractions into powers of x before differentiating.

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

3 Gradients and rates of change

Substitute into $\frac{dy}{dx}$, showing the

powers exactly. $\frac{dV}{dt} < 0$ means V is decreasing.

4 Second derivative

Differentiate $\frac{dy}{dx}$ again to get $\frac{d^2y}{dx^2}$ or $f''(x)$.

5 Gradient as a limit

Gradient of the chord from x to $x+h$, then let $h \rightarrow 0$.

e.g. chord gradient $5+h \rightarrow 5$

6 Tangents

Gradient $m = f'(a)$ at $(a, f(a))$, then

$$y - y_1 = m(x - x_1).$$

7 Normals

The normal is perpendicular to the

tangent: gradient $-\frac{1}{m}$

8 A given gradient

Solve $f'(x) = m$. It may be a hidden quadratic, e.g. in x^2 .

9 Equations with unknowns

Use given gradients or $f' = f''$ at a point to form an equation for the unknown constant.

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	6	6	8	9	9	8	10
1 Differentiating x^n	•	•		•	•	•	•	•	•	•
2 Rewrite first		•				•				•
3 Gradients and rates of change				•	•	•	•	•		•
4 Second derivative	•							•		
5 Gradient as a limit			•							
6 Tangents					•	•	•		•	•
7 Normals					•			•		•
8 A given gradient							•		•	
9 Equations with unknowns								•	•	
Interleaved: indices and surds (Chapter 1)		•		•					•	•
Interleaved: quadratics, hidden quadratics (Chapter 2)							•	•	•	
Interleaved: cubics, lines and areas (Chapters 4, 5)						•	•			•

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. Differentiation of x^n is *not* in the formula booklet. A tangent uses $f'(a)$, not $f(a)$. Never add “+c” after differentiating.



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1. Given that

$$y = 4x^3 - \frac{6}{x^2} + 5\sqrt{x} \quad x > 0$$

(a) find $\frac{dy}{dx}$, giving each term in simplest form,

(3)

(b) find $\frac{d^2y}{dx^2}$

(2)

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Question 1 continued

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(Total for Question 1 is 5 marks)



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

$$y = \frac{3x^2 - 4}{2\sqrt{x}} \quad x > 0$$

(a) Write y in the form $Ax^p + Bx^q$, where A , B , p and q are constants to be found.

(3)

(b) Hence find $\frac{dy}{dx}$, giving each coefficient in simplest form.

(2)

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Question 2 continued

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(Total for Question 2 is 5 marks)



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3. The curve C has equation $y = x^2 - 3x$

The point $P(4, 4)$ lies on C . The point Q also lies on C and has x coordinate $4 + h$, where $h \neq 0$

- (a) Show that the gradient of the chord PQ is $5 + h$

(3)

- (b) Explain how this result can be used to find the gradient of the tangent to C at P , and state its value.

(2)

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Question 3 continued

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(Total for Question 3 is 5 marks)



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Question 4 continued

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(Total for Question 4 is 6 marks)



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5. The curve C has equation $y = x^3 - 4x^2 + 7$

(a) Verify that the point $P(2, -1)$ lies on C .

(1)

(b) Find an equation of the tangent to C at P , giving your answer in the form $y = mx + c$

(3)

(c) Find an equation of the normal to C at P , giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(2)

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Question 5 continued

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(Total for Question 5 is 6 marks)



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6.

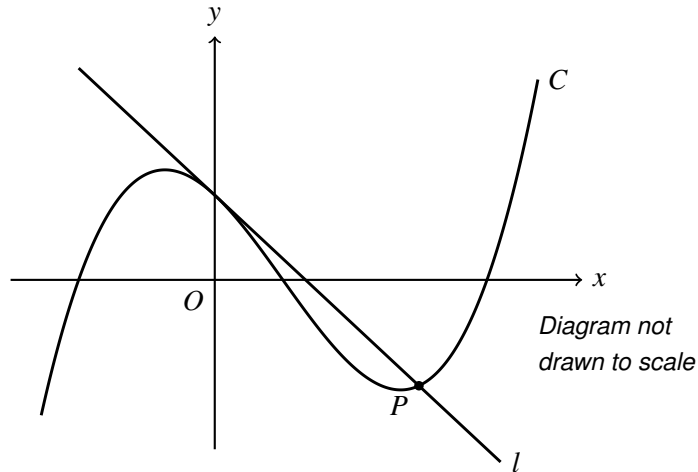


Figure 1

Figure 1 shows a sketch of the curve C with equation $y = f(x)$, where

$$f(x) = (x+2)(x-1)(x-4)$$

(a) Expand $f(x)$, writing your answer as a polynomial in simplest form.

(2)

The straight line l is the tangent to C at the point where C crosses the y -axis.

(b) Find an equation of l .

(3)

The line l meets C again at the point P , as shown in Figure 1.

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

(Solutions relying on calculator technology are not acceptable.)

(3)



Question 6 continued

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(Total for Question 6 is 8 marks)



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- (a) Find $\frac{dy}{dx}$

(2)

- (2)

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

(3)

- (d) Show that the midpoint of RP also lies on C .

(2)

Question 7 continued

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Question 7 continued

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(Total for Question 7 is 9 marks)



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8.

$$f(x) = 2x^3 + kx^2 - 12x + 1$$

where k is a constant. Given that $f'(2) = f''(2)$

(a) show that $k = 6$

(3)

(b) Find the x coordinate of the other point on the curve $y = f(x)$ at which $f'(x) = f''(x)$, and the y coordinate of this point.

(3)

(c) Find an equation of the normal to the curve $y = f(x)$ at the point where $x = 1$, giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(3)

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Question 8 continued

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Question 8 continued

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(Total for Question 8 is 9 marks)



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

Solutions relying on calculator technology are not acceptable.

The curve C has equation $y = x^3 + \frac{2}{x}$, $x > 0$

(a) Find $\frac{dy}{dx}$

(2)

The line with equation $y = 5x + c$, where c is a constant, is a tangent to C .

(b) Show that the x coordinate of the point where the line touches C satisfies $3x^4 - 5x^2 - 2 = 0$

(2)

(c) Hence find the exact value of c .

(4)

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Question 9 continued

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(Total for Question 9 is 8 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.

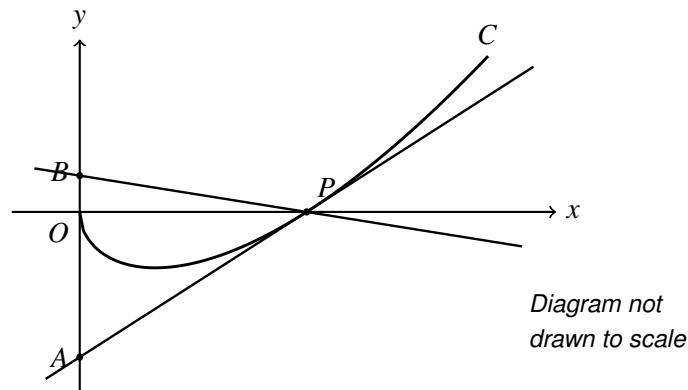


Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = (x - 4)\sqrt{x} \quad x \geq 0$$

The point P lies on C and has x coordinate 4

- (a) Find $\frac{dy}{dx}$ (3)

- (b) Show that the tangent to C at P has equation $y = 2x - 8$ (2)

The tangent to C at P meets the y -axis at A . The normal to C at P meets the y -axis at B .

- (c) Find an equation of the normal to C at P . (2)

- (d) Find the area of the triangle APB . (3)



Question 10 continued

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Question 10 continued

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(Total for Question 10 is 10 marks)

TOTAL FOR CHAPTER 8 IS 71 MARKS

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