Oxford Revise | Edexcel A Level Maths | Answers

- Method (**M**) marks are awarded for showing you know a method and have attempted to apply it.
- Accuracy (**A**) marks should only be awarded if the relevant M marks have been awarded.
- Unconditional accuracy (**B**) marks are awarded independently of M marks. They do not rely on method.
- The abbreviation **o.e.** means ‘or equivalent (and appropriate)’.

Please note that:

- efficient use of advanced calculators is expected
- inexact numerical answers should be given to three significant figures unless the question states otherwise; values from statistical tables should be quoted in full
- when a value of g is required, it is taken as $g = 9.8\ \text{m s}^{-2}$ unless stated otherwise in the question.

Chapter 5 Polynomials and algebraic fractions

Question	Answer	Extra information	Marks
5.1	$\begin{array}{r} x^2 + 3x + 2 \\ x-2 \overline{) x^3 + x^2 - 4x + 3} \\ \underline{x^3 - 2x^2} \\ 3x^2 - 4x \\ \underline{3x^2 - 6x} \\ 2x + 3 \\ \underline{2x - 4} \\ 7 \end{array}$ The 7 at the bottom means that the remainder is 7	For generally correct method, with at most 2 errors For completed division with no errors Correct interpretation of result	M1 M1 A1

Question	Answer	Extra information	Marks
	Total		**3 marks**
5.2 (a)	$(1)^3 + 2 \times (1)^2 - 2 \times 1 - 1$ $= 1 + 2 - 2 - 1 = 0$, therefore $(x - 1)$ is a factor.	Correct substitution Correct interpretation of result	M1 A1
5.2 (b)	$(x - 1)(x^2 + 3x + 1)$	Attempting to find the quadratic, either by algebraic division or comparing coefficients Correct factorisation	M1 A1
5.2 (c)	For the quadratic, $b^2 - 4ac = 9 - 4 = 5$, which is > 0 Therefore, the quadratic has 2 real solutions and the cubic equation has 3 real solutions.	Use of discriminant Correct interpretation	M1 A1
	Total		**6 marks**
5.3 (a)	$\begin{array}{r\|l} & x^2 + 4x + 3 \\ \hline x - 2 & x^3 + 2x^2 - 5x - 6 \\ & \underline{x^3 - 2x^2} \\ & \quad 4x^2 - 5x \\ & \quad \underline{4x^2 - 8x} \\ & \qquad 3x - 6 \\ & \qquad \underline{3x - 6} \\ & \qquad\quad 0 \end{array}$ $f(2) = 0$, therefore $x - 2$ is a factor Alternatively, if using long division: There is no remainder, therefore $x - 2$ is a factor	Attempting to calculate $f(2)$, or attempting algebraic long division, or attempting to factorise by inspection Correct interpretation of result Accept valid alternative method	M1 A1

Question	Answer	Extra information	Marks
5.3 (b)	$x^3 + 2x^2 - 5x - 6$ $= (x - 2)(x^2 + 4x + 3)$ $= (x - 2)(x + 1)(x + 3)$	Attempting quadratic factorisation to find $x^2 \ldots \pm 3$ Correct quadratic Fully correct factorisation	M1 A1 A1
5.3 (c)	$x = 2$, $x = -1$, $x = -3$	Correct solutions	B1
	Total		**6 marks**
5.4 (a)	$2 \times (-3)^3 + 2 \times (-3)^2 - 3k + 3 = 0$ $2 \times (-27) + 2 \times 9 - 3k + 3 = 0$ $-54 + 18 + 3 = 3k$ $3k = -33$ $k = -11$	Correct substitution and procedure Correct value of k	M1 A1
5.4 (b)	$2x^3 + 2x^2 - 11x + 3 = (x + 3)(ax^2 + bx + c)$ $2x^3 + 2x^2 - 11x + 3 = ax^3 + (b + 3a)x^2 + (c + 3b)x + 3c$ Therefore, $a = 2$, $c = 1$, $b + 3a = 2$ So, $b = 2 - 6 = -4$ $(x + 3)(2x^2 - 4x + 1)$	Correct procedure. Attempting to find the quadratic, either by algebraic division or comparing coefficients. Correct quadratic	M1 A1
5.4 (c)	$b^2 - 4ac = (-4)^2 - 4(2)(1) = 8$ Discriminant > 0, which means the quadratic has two real solutions. Therefore, the equation has three real solutions.	Use of discriminant Correct interpretation of result Correct interpretation of result	M1 A1 A1
	Total		**7 marks**

Question	Answer	Extra information	Marks
5.5 (a)	Substituting $\frac{3}{2}$ into the expression: $2 \times \left(\frac{3}{2}\right)^3 + 11 \times \left(\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right) - 30$ $= 2 \times \left(\frac{27}{8}\right) + 11 \times \left(\frac{9}{4}\right) - \left(\frac{3}{2}\right) - 30$ $= \left(\frac{54}{8}\right) + \left(\frac{99}{4}\right) - \left(\frac{3}{2}\right) - 30$ $= 0$	Correct procedure Correct calculation	M1 A1
5.5 (b)	$2x^3 + 11x^2 - x - 30 = (2x - 3)(ax^2 + bx + c)$ $2x^3 + 11x^2 - x - 30 = 2ax^3 + (2b - 3a)x^2 + (2c - 3b)x - 3c$ Therefore, $a = 1$, $c = 10$, $2b - 3a = 11$ So, $b = (11 + 3) \div 2 = 7$ $(2x - 3)(x^2 + 7x + 10)$ $= (2x - 3)(x + 2)(x + 5)$	Correct procedure. Attempting to find the quadratic, either by algebraic division or comparing coefficients. Correct quadratic Correct factorisation	M1 M1 A1
5.5 (c)	$(2x - 3)(x + 2)(x + 5) = 0$ $x = \left(\frac{3}{2}\right)$, $x = -2$, $x = -5$	Correct solutions	B1
	Total		**6 marks**

Question	Answer	Extra information	Marks
5.6	$\frac{7x+11}{(x+1)(x+2)} = \frac{A}{x+1} + \frac{B}{x+2}$ $7x + 11 = A(x + 2) + B(x + 1)$ Substituting $x = -2 \Rightarrow B = 3$ Substituting $x = -1 \Rightarrow A = 4$ So $\frac{7x+11}{(x+1)(x+2)} = \frac{4}{x+1} + \frac{3}{x+2}$	Correct structure One variable correct Fully correct partial fractions	M1 A1 A1
	Total		**3 marks**
5.7 (a)	$8 + 4p + 2q - 24 = 0$ $-64 + 16p - 4q - 24 = 0$ $4p + 2q = 16 \Rightarrow 16p + 8q = 64$ $16p - 4q = 88 \Rightarrow 32p - 8q = 176$ $48p = 240$ $p = 5$ and $q = -2$	Correctly substituting $x = 2$ Correctly substituting $x = -4$ Creating an equation in one variable. Accept any valid method. Correct values of p and q	M1 M1 M1 A1
5.7 (b)	$x^3 + 5x - 2x - 24 = (x - 2)(x + 4)(x + c)$ Therefore $-8c = -24$, so $c = 3$ $y = (x - 2)(x + 4)(x + 3)$	Attempting to find third bracket by division or comparing coefficients Fully correct factorisation	M1 A1
	Total		**6 marks**
5.8 (a)	$g(-4) = (-4)^3 - 14(-4) + 8$ $g(-4) = -64 + 56 + 8$ $g(-4) = 0$ therefore $g(x)$ is divisible by $x + 4$	Correctly substituting $x = -4$ Correct result and statement	M1 A1

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Question	Answer	Extra information	Marks
5.8 (b)	$x^3 - 14x + 8 = (x + 4)(x^2 + px + q)$ $x^3 - 14x + 8 = x^3 + (p + 4)x^2 + (q + 4p)x + 4q$ Therefore, $q = 2$ and $p = -4$ $(x + 4)(x^2 - 4x + 2)$	Attempting algebraic division or attempting to factorise by inspection to get quadratic factor $x^2 \ldots \pm 2$ Correct factorisation	M1 A1
	Total		**4 marks**
5.9	$\frac{4x+2}{(x+1)^2} = \frac{A}{x+1} + \frac{B}{(x+1)^2}$ $4x + 2 = A(x+1) + B$ Substituting $x = -1$ or comparing coefficients: $A = 4$ and $B = -2$ So $\frac{4x+2}{(x+1)^2} = \frac{4}{x+1} - \frac{2}{(x+1)^2}$	Correct structure Correct rearrangement Attempting to solve by substitution or by comparing coefficients Fully correct partial fractions	M1 M1 M1 A1
	Total		**4 marks**
5.10	$\frac{2x^2 + 13x + 22}{(x+3)(x+4)} = A + \frac{B}{x+3} + \frac{C}{x+4}$ $2x^2 + 13x + 22 = A(x + 3)(x + 4) + B(x + 4) + C(x + 3)$ $A = 2$ Substituting $x = -3$: $1 = B$ Substituting $x = -4$: $2 = -C$, so $C = -2$	 Rearranging to remove fractions Correct whole number part Correctly using substitution or comparing coefficients to find B or C Correct B and C	 M1 B1 M1 A1
	Total		**4 marks**

Question	Answer	Extra information	Marks
5.11 (a)	$g(-1) = (-1)^3 + (-1)^2 - (-1) - 1$ $= -1 + 1 + 1 - 1$ $= 0$ Therefore $(x + 1)$ is a factor	Correctly substituting in −1 Correct interpretation of the zero result	M1 A1
5.11 (b)	$x^3 + x^2 - x - 1 = (x + 1)(x^2 + ax + b)$ $x^3 + x^2 - x - 1 = x^3 + (a + 1)x^2 + (b + a)x + b$ Therefore, $b = -1$, $a = 0$ $x^3 + x^2 - x - 1 = (x + 1)(x^2 - 1)$ $= (x + 1)^2(x - 1)$	Using algebraic division or comparing coefficients to factorise Fully correct factorisation	M1 A1
5.11 (c)	$\frac{4x^2+4x+4}{(x-1)(x+1)^2} = \frac{A}{x-1} + \frac{B}{(x+1)} + \frac{C}{(x+1)^2}$ $4x^2+4x+4 = A(x+1)^2 + B(x+1)(x-1) + C(x-1)$ Substituting $x = -1$ or $x = 1$ or comparing coefficients: $A = 3$ $C = -2$ $B = 1$ So $\frac{4x^2+4x+4}{(x-1)(x+1)^2} = \frac{3}{x-1} + \frac{1}{(x+1)} - \frac{2}{(x+1)^2}$	Correct structure Any correct method One variable correct All variables correct Fully correct partial fractions	M1 M1 A1 A1 A1
	Total		**9 marks**

Question	Answer	Extra information	Marks
5.12	$\frac{-4x-6}{4x^2-4x-3}=\frac{-4x-6}{(2x+1)(2x-3)}$	Correctly factorising the denominator	M1
	$\frac{-4x-6}{4x^2-4x-3}=\frac{A}{2x+1}+\frac{B}{2x-3}$ $-4x-6=A(2x-3)+B(2x+1)$	Correct structure	M1
	$A = 1$ and $B = -3$	One variable correct	A1
	So $\frac{-4x-6}{4x^2-4x-3}=\frac{1}{2x+1}-\frac{3}{2x-3}$	Fully correct partial fractions	A1
	Total		**4 marks**
5.13	$$\begin{array}{r|l} & 2x^2 - 5x + 4 \\ \hline 2x+1 & 4x^3 - 8x^2 + 3x - 6 \\ & 4x^3 + 2x^2 \\ \hline & \quad -10x^2 + 3x \\ & \quad -10x^2 - 5x \\ \hline & \qquad 8x - 6 \\ & \qquad 8x + 4 \\ \hline & \qquad\quad -10 \end{array}$$	For generally correct method, with at most 2 errors For completed division with no errors	M1 M1
	$2x^2-5x+4-\frac{10}{2x+1}$	Correct interpretation and solution	A1
	Total		**3 marks**

Question	Answer	Extra information	Marks
5.14 (a)	$2(-5)^3 + p(-5)^2 + q(-5) - 5 = 0$	Correctly substituting $x = -5$	M1
	$2(2)^3 + p(2)^2 + q(2) - 5 = 35$	Correctly substituting $x = 2$	M1
	$25p - 5q = 255$	Correctly forming two simultaneous equations	A1
	$4p + 2q = 24$	Solving two simultaneous equations	M1
	$p = 9$ and $q = -6$	Correct values of p and q	A1
5.14 (b)	Using the fact that $(x + 5)$ is one of the brackets:	This follows from the first substitution	M1
	$2x^3 + 9x^2 - 6x - 5 = (x + 5)(ax^2 + bx + c)$ $2x^3 + 9x^2 - 6x - 5 = ax^3 + (b + 5a)x^2 + (c + 5b)x + 5c$ Therefore, $a = 2$, $c = -1$ and $b + 5a = 9$ So, $b = 9 - 10 = -1$ $2x^3 + 9x^2 - 6x - 5 = (x + 5)(2x^2 - x - 1)$	Finding the quadratic. Any appropriate method, such as algebraic division or comparing coefficients.	M1
	$= (x + 5)(2x + 1)(x - 1)$	Fully correct factorisation	A1
	Total		**8 marks**
5.15 (a)	$1^3 + 1^2 - 10(1) + 8$ $= 1 + 1 - 10 + 8$ $= 0$	Correct substitution	M1
	Therefore $(x - 1)$ is a factor	Correct interpretation of result	A1
5.15 (b)	$x^3 + x^2 - 10x + 8 = (x - 1)(x^2 + ax + b)$ $x^3 + x^2 - 10x + 8 = x^3 + (a - 1)x^2 + (b - a)x - b$ Therefore, $a = 2$ and $b = -8$ $x^3 + x^2 - 10x + 8 = (x - 1)(x^2 + 2x - 8)$	Correct method for completing the factorisation, using algebraic division or comparing coefficients	M1
	$= (x - 1)(x - 2)(x + 4)$	Fully correct factorisation	A1

Question	Answer	Extra information	Marks
5.15 (c)	$\frac{3x^2+14x-22}{(x-1)(x-2)(x+4)}=\frac{A}{x-1}+\frac{B}{x-2}+\frac{C}{x+4}$ $3x^2+14x-22=A(x-2)(x+4)+B(x-1)(x+4)+C(x-1)(x-2)$	Correct structure	M1
	Substituting $x = 2$, $x = -4$ or $x = 1$ or comparing coefficients:	Correct method	M1
	$A = 1$, $B = 3$ and $C = -1$	One variable correct	A1
	So $\frac{3x^2+14x-22}{(x-1)(x-2)(x+4)}=\frac{1}{x-1}+\frac{3}{x-2}-\frac{1}{x+4}$	Fully correct partial fractions	A1
	Total		**8 marks**
5.16	$\frac{5x^2+10x+3}{x^3+3x^2-4}=\frac{5x^2+10x+3}{(x-1)(x+2)^2}$	Using the factor theorem Finding one factor of the denominator	M1 A1
	$\frac{5x^2+10x+3}{x^3+3x^2-4}=\frac{A}{x-1}+\frac{B}{x+2}+\frac{C}{(x+2)^2}$	Fully factorising denominator	M1
	$5x^2+10x+3=A(x+2)^2+B(x-1)(x+2)+C(x-1)$	Correct structure	M1
	Substituting $x = -2$ or $x = 1$ or comparing coefficients:	Correct method	M1
	$A = 2$ and $C = -1$	One variable correct	A1
	$B = 3$	Correct value of B	A1
	So $\frac{5x^2+10x+3}{x^3+3x^2-4}=\frac{2}{x-1}+\frac{3}{x+2}-\frac{1}{(x+2)^2}$	Fully correct partial fractions	A1
	Total		**8 marks**

Question	Answer	Extra information	Marks
5.17	$x^2 + 2x - 5x - 10 < 18$ $x^2 - 3x - 28 < 0$ $x = 7$ and $x = -4$ $-4 < x < 7$	Correct expansion of brackets Collecting and moving terms to one side Both 7 and −4 seen Correct inequality	M1 M1 M1 A1
	Total		**4 marks**
5.18 (a)	$\frac{1}{2}(24+3k)\times k \geq 30$ $\frac{3}{2}k^2 + 12k - 30 \geq 0$ $3k^2 + 24k - 60 \geq 0$ $k^2 + 8k - 20 \geq 0$	Using the formula for the area of a trapezium Deriving the quadratic inequality	M1 A1
5.18 (b)	$(k + 10)(k - 2) \geq 0$ $k \leq -10$ or $k \geq 2$ Since length $k > 0$, $n = 2$	Factorising correctly. Can be implied from correct solutions Solving quadratic inequality Correct interpretation within the context of the question	M1 M1 A1
	Total		**5 marks**