REVISE
.wales

Remainder & factor theorem

Mark schemes for the Remainder & factor theorem question pack

WJEC Level 2 Additional Mathematics (9550) · Algebra

Official WJEC mark schemes for the 12 questions in the matching revise.wales question pack (95 marks total), from the 2011–2024 papers.

2	(a) $1024x^5$	B2	Indices must be simplified throughout Mark final answer B1 for nx^5 where $n \neq 0$, including $2^{10}x^5$
	(b) $7x^{3/5} - 6x^{-1}$ or $7x^{3/5} - 6/x$	B2 4	For award of B2 mark final answer B1 for sight of $x^{3/5}$, (-) $6x^{-1}$ or (-) $6/x$

6	(a) Substitution of x = -5, $4(-5)^3 - 2(-5)^2 - (-5)$ (= –500 – 50 + 5) -545	M1 A1	Or division method giving $4x^2 - 22x$ .... Allow for intention, e.g. $4(-5)^3 - 2(-5)^2 - \mathbf{5}$ (= -555) Mark final answer
	(b)(i) Substitute x = 2, $(2)^3 - 6(2)^2 - 13(2) + 42$ (= 8 - 24 - 26 + 42) Showing f(2) = 0	M1 A1	Or division method giving $x^2 - 4x$ … Accept sight of **substitution** with '=0' shown
	(ii) $(x-2)(x^2 + bx + c)$ or intention to divide by (x - 2) with x^2 shown ((x-2)) ($x^2 - 4x - 21$) (x - 2)(x + 3)(x - 7)	M1 A2 A1 8	If any values are inserted at least 1 needs to be correct. Appropriate sight of -4x or -21 implies M1 (and possible A1 to follow) A1 for -4x or -21 Or use of factor theorem A1 (x + 3), A1 (x - 7) CAO, with all 3 factors shown, ignore sight of "=0", ISW **Must** be from sight of $x^2 - 4x - 21$ previously No working to show factorising is M0 A0 A0

		4	
6	(a) $3(2)^3+4(2)^2+3(2)+1$ $(=24+16+6+1)$ 47	M1 A1	Or division method giving $3x^2+10x\ldots$
	(b)(i) Substitute x = -6 Showing f(-6) = 0	M1 A1	Or division method giving $x^2-5x\ldots$ Accept sight of **substitution** with '=0' shown
	(ii) $(x+6)(x^2+bx+c)$ or intention to divide by (x+6) with x^2 shown $(x+6)$ (x^2-5x+6) $(x+6)(x-2)(x-3)$	M1 A2 A1	If any values are inserted at least 1 needs to be correct, appropriate sight of -5x or +6 implies M1 (and A1 to follow) A1 for -5x or +6 Or use of factor theorem A1 (x - 2), A1 (x - 3) CAO, with all 3 factors shown, ignore sight of "=0", ISW Must not be from previous incorrect work
		8	

7	(a) $(3)^3 + 8(3)^2 - 2(3) + 6$ (= 27 + 72 - 6 + 6) = 99	M1 A1	Or division method giving $x^2 + 11x$ …
	(b)(i) Substitute x = -3 Showing f(-3) = 0	M1 A1	Or division method giving $x^2 - 2x$ … Convincing from working shown (not if incorrect working seen), allow $(-3)^3 + (-3)^2 - 41(-3) - 105 = 0$, also allow for sight of $-3^3 + -3^2 - 41\times-3 - 105 = 0$ provided no incorrect calculation is given such as -3^2 as -9
	(ii) $(x + 3)(x^2 + bx + c)$ or intention to divide by $(x+3)$ with x^2 shown ((x + 3)) (x^2 - 2x - 35) ((x + 3))(x + 5)(x - 7)	M1 A2 A1 A1 8	A1 for -2x or -35. Or use of factor theorem A1 (x+5), A1 (x- 7) CAO. Mark final answer, *but ignore attempts to 'solve'*
8	(dy/dx=) $12x^2 - 6x$ dy/dx = 0 or $12x^2 - 6x = 0$ or $12x^2 = 6x$ x = 0 and y = 20 x = ½ and y = 19¾ $d^2y/dx^2 = 24x - 6$ (0, (20)): $d^2y/dx^2 < 0$, point is a maximum (½, (19¾)): $d^2y/dx^2 > 0$, point is a minimum	B1 M1 A1 A1 M1 A1 A1 7	FT their dy/dx form $ax^2 \pm bx$ If A0, A0 here, award A1 for x = 0 with x = ½ *Answer only, no working shown M0 A0 A0* Or first derivative test, interpretation of first derivative test. Or alternative (e.g. full graphical method with explanation) FT for their x value FT for their other x value provided this does not have the same interpretation as the first x value *Answer only, no working shown M0 A0 A0* *If $d^2y/dx^2 = cx + d$ where $c \neq 0$ and test applied correctly then SC2 instead of final A1, A1 (as M1 has not been awarded))provided one minimum and one maximum*
9	$\frac{\sqrt{3}}{2} \times \frac{1}{2} = \frac{\sqrt{3}}{4}$	B1 1	**Working must be shown**
10	(a) $FG^2 = (-4 - 8)^2 + (10 - 28)^2$ ($= 12^2 + 18^2 = 468$) FG = $6\sqrt{13}$	M1 A1	Or equivalent. Allow 1 slip or error M1, A0 for answers $\sqrt{468}$ or 21.6(3...) CAO
	(b) Gradient FG (28-10)/(8 - -4) = 18/12 (= 9/6 = 3/2)	M1 A1	Do not ignore incorrect cancelling, mark final answer
	(c) (-4 + 8)/2 or (10 + 28)/2 Mid point (2, 19)	M1 A1	Sight of (2, …) or (… , 19) implies M1 provided no incorrect working is seen
	Perpendicular gradient -2/3 (or -6/9 or -12/18)	B1	FT -1/ 'their answer in (b)'
	$\frac{y - 19}{x - 2} = \frac{-2}{3}$ or 19 = -2/3 × 2 + c	M1	OR for an alternative correct method of finding the equation of a straight line, for the idea of how an equation of a straight line can be found. FT 'their perpendicular gradient' or 'their answer in (b)' AND 'their mid point' or for 'points F or G' used
	y – 19 = -2/3(x - 2) or 3(y – 19) = -2(x – 2) or 3y = -2x + 61 or c = 20⅓ or c = 61/3	m1	**Do not allow** use gradient from their answer in (b), and/or points F or G as the mid-point of FG. Only FT for 'their perpendicular gradient' (not 'their answer' from (b)) AND 'their mid point'
	2x + 3y – 61 = 0 or -2x – 3y + 61 = 0	A1 10	CAO. Must be in this form with '=0' with terms in any order

5	(a) $2(-3)^3 - (-3)^2 + 2(-3) + 1$ $(= -54-9-6+1)$ -68	M1 A1	Or division method giving $2x^2 - 7x \ldots$
	(b)(i) Substitute $x = -2$ Showing $f(-2) = 0$	M1 A1	Or division method giving $x^2 - 8x \ldots$ Accept sight of substitution with '=0' shown
	(ii) $(x+2)(x^2 + bx + c)$ or intention to divide by $(x+2)$ with x^2 shown	M1	If any values are inserted at least 1 needs to be correct, appropriate sight of $-8x$ or -33 implies M1 (and A1 to follow)
	$(x+2)$ $(x^2 - 8x - 33)$	A2	A1 for $-8x$ or -33 Or use of factor theorem A1 $(x+3)$, A1 $(x-11)$
	$(x+2)$ $(x+3)(x-11)$	A1 8	CAO, but ignore sight of "=0", ISW

4	(a) $2(-4)^3 - 5(-4)^2 + 8(-4) - 6$ (= -128-80-32-6) -246	M1 A1	Or division method giving $2x^2 - 13x \ldots$
	(b)(i) Substitute x = 2 Showing f(2) = 0	M1 A1	Or division method giving $x^2 + 11x \ldots$ Accept sight of substitution with '=0' shown Or equivalent ie. $X^2 + 11x - 60$ with no remainder
	(ii) $(x-2)(x^2 + bx + c)$ or intention to divide by (x-2) with x^2 shown	M1	If any values are inserted at least 1 needs to be correct, appropriate sight of +11x or +30 implies M1 (and A1 to follow)
	$(x-2)(x^2 + 11x + 30)$	A2	A1 for (+)11x or (+)30 Or use of factor theorem A1 (x+5), A1 (x+6)
	$(x-2)(x+5)(x+6)$	A1 8	CAO, but ignore sight of "=0", ISW

	Additional Mathematics Summer 2017		Final Version

	Summer 2016		
10	(a) $(4)^3 + 6(4)^2 - (4) - 30$ $(= 64 + 96 - 4 - 30)$ $= 126$	M1 A1	Or division method giving $x^2 + 10x \ldots$
	(b)(i) Substitute $x = 2$ Showing $f(2) = 0$	M1 A1	Or division method giving $x^2 + 8x \ldots$ Convincing, working shown Allow $2^3 + 6(2)^2 - (2) - 30 = 0$
	(ii) $(x-2)(x^2 + bx + c)$ or intention to divide by $(x-2)$ with x^2 shown $(x - 2)(x^2 + 8x + 15)$ $(x - 2)(x + 3)(x + 5)$	M1 A2 A1 8	A1 for $+8x$ or $+15$. Or use of factor theorem A1 $(x+3)$, A1 $(x+5)$ CAO. Mark final answer, *but ignore attempts to 'solve'*

7	(a) $3(-2)^3 - 2(-2)^2 + 5(-2) - 1$ $(= -24-8-10-1)$ -43	M1 A1	Or division method giving $3x^2 - 8x \ldots$
	(b)(i) Substitute $x = 2$ Showing $f(2) = 0$	M1 A1	Or division method giving $x^2 + 10x \ldots$ Accept sight of substitution with '=0' shown
	(ii) $(x-2)(x^2 + bx + c)$ or intention to divide by $(x-2)$ with x^2 shown	M1	If any values are inserted at least 1 needs to be correct, appropriate sight of $+10x$ or $+21$ implies M1 (and A1 to follow)
	$(x-2)$ $(x^2 + 10x + 21)$	A2	A1 for $(+)10x$ or $(+)21$ Or use of factor theorem A1 $(x+3)$, A1 $(x+7)$
	$(x-2)$ $(x+3)(x+7)$	A1 8	CAO, but ignore sight of "=0", ISW

			Mark final answer
10	(a) $(3)^3 + 5(3)^2 + 2(3) - 8$ $(= 27 + 45 + 6 - 8)$	M1	Or division method giving $x^2 + 8x \ldots$
		A1	
	$= 70$	M1	Or division method giving $x^2 + 6x \ldots$
	(b)(i) Substitute $x = 1$	A1	Convincing, working shown $(1 + 5 + 2 - 8)$
	Showing $f(1) = 0$		Allow $1^3 + 5(1)^2 + 2(1) - 8 = 0$
		M1	
	(ii) $(x-1)(x^2 + bx + c)$		
	or intention to divide by $(x-1)$ with x^2 shown	A2	A1 for $+6x$ or $+8$. Or use of factor theorem A1 $(x+4)$, A1 $(x+2)$
	$((x - 1))$ $(x^2 + 6x + 8)$	A1	CAO. Mark final answer, *but ignore attempts to 'solve'*
	$((x-1))(x+4)(x+2)$	8	

		11	*Answer only, no working shown M0 A0 A0*
8	(a) $7(2)^3 - 4(2)^2 + (2) - 2$ $(= 56 - 16 + 2 - 2)$ $= 40$	M1 A1	Or division method giving $7x^2 + 10x \ldots$
	(b)(i) Substitute $x = -3$ Showing $f(-3) = 0$	M1 A1	Or division method giving $x^2 + x \ldots$ Accept sight of substitution with equate to zero
	(ii) $(x+3)(x^2 + bx + c)$ or intention to divide by $(x+3)$ with x^2 shown $(x+3)$ $(x^2 + x - 20)$ $(x+3)$ $(x - 4)(x + 5)$	M1 A2 A1 8	A1 for $+1x$ or -20. Or use of factor theorem A1 $(x-4)$, A1 $(x+5)$ CAO. Final answer, but ignore sight of "=0"

Q	Additional Mathematics Summer 2013	Marks	Final

4	(a) $(-3)^3 - 2(-3)^2 - 9(-3) + 18$	M1	
	$= 0$	A1	
	(x+3) is a factor OR divisible by x+3	E1	Depends on M1, A1. Do not accept contradictions
	(b) $(\mathbf{x+3})(ax^2 + bx + c)$ or intention to $\div (x+3)$	M1	Division method needs to show x^2 and attempt to find the next term May be division by x-3 or x-2, mark in the same way as described for division by x+3
	$(\mathbf{x+3})(x^2 - 5x + 6)$	A2	A1 for -5x or +6. Or use of factor theorem A1 for each factor
	$(x+3)(x-3)(x-2)$	A1	CAO. Mark final answer. Do not ignore continuing to solve.
		7	*An answer of $(x-2)(x^2-9)$ is awarded M1, A2*

		4	
5	(a) $6(-3)^3 - 13(-3)^2 + (-3) + 2$ (= -162-117-3+2)	M1	Or division method giving $6x^2$ -31x …
	= -280	A1	
	(b)(i) Substitute x = 2	M1	Or division method giving $6x^2$ - x …
	Showing f(2) = 0	A1	Convincing, working shown (48 – 52 + 2 + 2)
	(ii) $(x-2)(6x^2 + bx + c)$		
	or intention to divide by (x-2) with $6x^2$ shown	M1	
	((x -2)) ($6x^2$ -x -1)	A2	A1 for -x or -1. Or use of factor theorem A1 (3x+1), A1 (2x-1)
	((x-2))(3x+1)(2x-1) ISW	A1	CAO
		8	

End of solutions