REVISE
.wales

Completing the square & minimum values

Mark schemes for the Completing the square & minimum values question pack

WJEC Level 2 Additional Mathematics (9550) · Algebra

Official WJEC mark schemes for the 7 questions in the matching revise.wales question pack (31 marks total), from the 2011–2024 papers.

16	$(x+14)^2$ (± …) or $(x+28/2)^2$ (± …) or $(x+a)^2+b$ with $a=14$ or equivalent (Minimum value when x =) -14 (Minimum value is) -96	M1 A1 A1 3	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+28 CAO. Must be from $(x+14)^2$ CAO. Must be from completing the square, $(x+14)^2-96$ or $(x+14)^2-196+100$ Use of quadratic formula is awarded M0 A0 A0

2	$x^2 = 20x - 28$ written correctly showing correct completing of the square, e.g., for sight of any one of the following: • $(x-10)^2 - 100 = -28$ • $(x-10)^2 - 100 + 28 = 0$ • $100 - (x-10)^2 = 28$ • $100 - (x-10)^2 - 28 = 0$ • $(x-10)^2 = 100 - 28$ • $-(x-10)^2 + 100 = 28$ • $-(x-10)^2 + 100 - 28 = 0$ • $-(x-10)^2 = -100 + 28$ • $(x-10)^2 = 72$ • $(x-10)^2 - 72 = 0$ • $-(x-10)^2 = -72$ • $-(x-10)^2 + 72 = 0$ • $-(-x+10)^2 + 100 - 28 = 0$ • $-(-x+10)^2 + 72 = 0$ or equivalent $(x =) 10 \pm 6\sqrt{2}$ or $(x =) 10 + 6\sqrt{2}$ with $10 - 6\sqrt{2}$	M2 A2	*No working, no marks* '=0' may be implied in previous working, e.g., from sight of $x^2 - 20x + 28 (= 0)$, or further working M1 for sight of any one of the following, including if embedded in incorrect working: • $(x-10)^2$ (-100) • $-(x-10)^2$ $(+100)$ • $-(-x+10)^2$ $(+100)$ OR Allow M1 for any one of the following, if not corrected in further correct working (which may then be M2): • $(x-10\mathbf{x})^2 - 100 + 28$ • $-(x-10\mathbf{x})^2 + 100 - 28$ • $(x+10)^2 - 100 + 28$ ISW for award of A2 or A1 Allow A2 for strict FT from M1 **and**: • $(x-10)^2 = 100 + 28$ for an answer of $10 \pm 8\sqrt{2}$ • $(x+10)^2 = 100 - 28$ for an answer of $-10 \pm 6\sqrt{2}$ A1 for any of the following, $(x =)$ • $10 \pm 2\sqrt{18}$ • $10 \pm 3\sqrt{8}$ • $10 + 6\sqrt{2}$ • $10 - 6\sqrt{2}$ OR A1 for strict FT from M1 and $(x-10)^2 = 100 + 28$, for: • $10 \pm 2\sqrt{32}$ • $10 \pm 4\sqrt{8}$ • $10 + 8\sqrt{2}$ • $10 - 8\sqrt{2}$ OR A1 for strict FT from M1 and $(x+10)^2 = 100 - 28$, for: • $-10 \pm 2\sqrt{18}$ • $-10 \pm 3\sqrt{8}$ • $-10 + 6\sqrt{2}$ • $-10 - 6\sqrt{2}$ If no marks, Award SC1 for either: • $-10 \pm 8\sqrt{2}$ from $(x+10)^2 = 128$ • 'their simplified $a \pm b\sqrt{c}$' from their $(x \ldots.)^2 = \ldots$ provided equivalent level of difficulty with $a > 0$, $c > 0$ and b is a product of at least 2 integers No FT for A mark when attempting to write the square root of a negative number, e.g. $\sqrt{-72}$ or $\sqrt{-128}$ If no marks, award SC1 for $\sqrt{72} = \pm 6\sqrt{2}$ or $\sqrt{128} = \pm 8\sqrt{2}$
		4	

8	$(x+20)^2$ (± …)	M1	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+40
	(Minimum value at x =) -20	A1	CAO
	(Minimum value is) - 300	A1	CAO, from $(x+20)^2$ - 300
		3	

GCSE ADDITIONAL MATHEMATICS

SUMMER 2019 MARK SCHEME

		Mark	Comment
1	(a)(i)$(9x+5)(3x-1)$	B2	Mark final answer. *Ignore inclusion of '=0"*
			B1 $(9x \pm 5)(3x \pm 1)$ or $9x(3x-1)+5(3x-1)$ or or $(x-1/3)(27x+15)$ or $\frac{(27x-9)(27x+15)}{27}$ or sight of $(9x+5)$ AND $(3x-1)$
	(ii) -5/9 with 1/3 or equivalent or -0.55(5...) or -0.556 with 0.33(3...)	B2	If a restart in (ii) to factorise, do not alter marking in (i), unless the candidate is clearly replacing their answer (i) Ignore sight of "=0" Must be from factorising. STRICT FT for their factors. B1 for each answer Do not accept from the use of the quadratic formula
	(b)(i) $(x+5)^2 \pm \ldots$	B1	
	…….. $+10$	B1	Sight of $(x+5)^2$. Ignore sight of '=0' Do not accept '= -10' or '=10' *$(x+5)^2+10$, B1, B1 ISW* Allow +35 -25 for 10 provided 10 seen in later working
	(ii) Least value (+)10	B1	Must follow completing the square FT their value but not 35 or - 10
	(iii) (x =) -5	B1	FT from 'their $(x+5)^2$' Do not accept (-5, 10)
	(c) $(x-22/2)^2 -121 = -5$ or $(x-22/2)^2 -121+5=0$	M1	Allow for sight of $(x-22/2)^2 -121+5$ or $(x-22/2)^2 -116$
	$(x-11)^2 = 121-5$	M1	
	$x = 11 \pm 2\sqrt{29}$	A2	FT from 1 slip, e.g. for sight of $(x-11)^2 = 126$ or $(x-11)^2 - 126 = 0$ Allow A2 for $x = 11 \pm\sqrt{116}$ ISW A1 for $11+\sqrt{116}$ or $11+2\sqrt{29}$ or $11-\sqrt{116}$ or $11-2\sqrt{29}$ or FT $11 \pm \sqrt{126}$ or $11 \pm 3\sqrt{14}$
		12	*No working in (c), no marks*
2	(a) $40x^3+6x$ (+0)	B3	*Penalise '+c' shown -1 only throughout* B1 for $40x^3$ (not $10\times4x^3$), B1 for +6x (not $3\times2x$), and B1 for +0 (or blank) provided at least 1 other mark awarded. Mark final answer
	(b) $-22x^{12}$ or $\frac{-22}{x^{12}}$	B1	Mark final answer
	(c) $\frac{7}{8}x^{-1/8}$ or $\frac{7}{8x^{1/8}}$	B1	Index needs to be simplified. Mark final answer
		5	

		5	
7	$(x+9)^2$ (± …)	M1	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+18
	(Minimum value at x =) -9	A1	CAO
	(Minimum value is) (+) 11	A1	CAO
		3	

3	$(x+11)^2$ (± …) or $(x+22/2)^2$ (± …)	M1	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+22
	(Minimum value at x =) -11	A1	CAO. Must be from sight of completing the square
	(Minimum value is) (+) 2	A1	CAO. Must be from sight of completing the square
		3	

		4	
2	(a) $(x+7)^2$ (± …)	M1	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+14
	(Minimum value at x =) -7	A1	Unsupported -7 is M0, A0
	(b) -40	B1	CAO Must be given in (b), do not accept shown in (a). Do not accept reversed answers of '-40' in (a) and '-7' in (b), maximum mark would be possible M1 in (a) However, if no marks in (a), but a full statement, e.g. 'minimum value -40 when x = -7' is given in (b), then award B1 in (b) and M1, A0 in (a)
		3	

End of solutions