MARKING SCHEME

SUMMER 2018

LEVEL 2 CERTIFICATE IN ADDITIONAL MATHEMATICS
9550/01

INTRODUCTION

This marking scheme was used by WJEC for the 2018 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

ADDITIONAL MATHEMATICS
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			Comment
1	(a) $40x^7 - 3 - (1)x^{-2}$ (+0)	B4	B1 for $40x^7$ (not $8\times5x^7$), B1 for -3, B1 for $-(1)x^{-2}$ and B1 for +0 (or blank) provided at least one other mark awarded. If B4 penalise further incorrect working -1, e.g. treat further incorrect work with term $-(1)x^{-2}$ as ISW unless B4
	(b) $\frac{5}{8}$ $-\frac{1}{8}$ or equivalent	B1	CAO. Index needs to be simplified. ISW
	(c) $-18x^{-7}$ or $-18/x^7$	B1	CAO. Index and coefficient need to be simplified. ISW
		6	*Penalise including '+c' -1 only throughout*
2	$(7x + 1)(2x - 1)$	B2	B1 $(7x - 1)(2x + 1)$ or $7x(2x -1) + 1(2x -1)$ or $2x(7x +1) -1(7x + 1)$ Ignore sight of "=0"
	-1/7 with 1/2	B2	Must be from factorising, do not accept use of quadratic formula followed by 'factorising'. **MUST FT for their factors** FT for their factors provided equivalent difficulty, not leading to whole number solutions. B1 for each answer
		4	
3	(a) 1/64	B2	*No marks if no working.* B1 for sight of 4^{-3} or 2^{-6} or $\frac{1}{4}^3$ or $1/2^6$. Mark final answer
	(b) $\frac{1}{12 - \sqrt{11}} \times \frac{12 + \sqrt{11}}{12 + \sqrt{11}}$	M1	*No marks if no working.*
	$= \frac{12 + \sqrt{11}}{133}$	A1	Mark final answer
		4	
4	(a) $30x^{7/5}$	B1	ISW. Allow $30x^{1}{}_{2/5}$
	(b) $6x^{\frac{4}{5}}$	B1	ISW
	(c) Correctly extracting a factor of $(3)x^{1/7}$ OR correct alternative method with one correct step towards simplification	M1	At least 2 terms within the numerator brackets must be correct For an alternative method $\frac{6x^{2/7}}{6x^{1/7}} + \frac{3x^{4/7}}{6x^{1/7}} + \frac{6x^{1/7}}{6x^{1/7}}$ award M1 only when at least 2 of these 3 fraction has been simplified correctly
	$x^{1/7} + \frac{1}{2}x^{3/7} + 1$ or $\frac{2x^{1/7} + x^{3/7} + 2}{2}$	A1	CAO. Mark final answer
		4	
5	(a) $2(-3)^3 - (-3)^2 + 2(-3) + 1$ (= -54-9-6+1) -68	M1 A1	Or division method giving $2x^2 - 7x$ …
	(b)(i) Substitute x = -2 Showing f(-2) = 0	M1 A1	Or division method giving $x^2 - 8x$ … 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	CAO, but ignore sight of "=0", ISW
		8	

6	Sight of sin 60° = √3/2 (Perpendicular height =) 8 × sin60° OR sin60° = (perpendicular) height/8 (Area of the parallelogram =) 17 × 8 × √3/2 (Area of the parallelogram =) 68√3 (cm^2) QWC2: • Candidates will be expected to present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their final answer	B1 M1 m1 A1 QWC 2 6	OR perpendicular height = $\frac{8\sqrt{3}}{2}$ (cm) Or equivalent, e.g. 13 × 4√3 + 4 × 4√3 CAO <u>*Alternative (split as 2 triangles with ½ abSinC used):*</u> *Sight of sin 60° = √3/2* *B1* *(Area of triangle(s) =)(2 ×) ½ × 8 × 17 × sin60°* *M1* *(Area parallelogram =)2 ×½ × 8 × 17 × √3/2* *m1* *(Area of the parallelogram=) 68√3 (cm^2)* *A1 CAO* QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
7	$(x+9)^2$ (± …) (Minimum value at x =) -9 (Minimum value is) (+) 11	M1 A1 A1 3	Ignore 'their (± …)' or '=0' Do not accept method dy/dx =2x+18 CAO CAO

8	$2x + 3 = 5x^2 + 6x - 7$ $5x^2 + 4x - 10 = 0$	M1 A1	Must be equated to zero. '=0' may be implied in further work to solve, if no further work and not '=0' then A0 FT provided their quadratic does not factorise and equivalent level of difficulty
	$x = \frac{-4 \pm\sqrt{(4^2 - 4\times5\times-10)}}{2\times5}$	m1	Use of correct quadratic formula, allow 1 slip in substitution (not a slip with the formula) If completing the square used award m1for sight of $5(x + 4/10)^2 \pm \ldots$
	$x = \frac{-4 \pm\sqrt{216}}{10}$	A1	
	x = 1.069… or x = 1.07 **and** x = -1.869… or x = -1.87	A1	Allow truncation from correct working
	x = 1.07 with y = 5.14 **and** x = -1.87 with y = -0.74	A1	FT provided M1, m1 previously awarded using their values of x in 2x + 3 or equivalent to find y-values to 2 d.p. Accept answers given as coordinates *Alternative using x = (y - 3)/2* M1 $y = 5(\frac{y- 3}{2})^2 + 6(\frac{y- 3}{2}) - 7$ or equivalent A1 $5y^2 - 22y - 19 = 0$ or equivalent (equate to zero) m1 $y = \{22\pm\sqrt{((-22)^2 - 4\times5\times-19)}\}/2\times5$ or equivalent Allow 1 slip in substitution A1 $y = (22\pm\sqrt{864})/10$ or equivalent A1 y = 5.139… or y = 5.14 **and** y = -0.739…or y = -0.74 A1 x = 1.07, y = 5.14 with x = -1.87, y = -0.74 FT to final A1, provided M1, m1 previously awarded using their values of y in (y - 3)/2 or equivalent to find x-values to 2 d.p.
		6	
9	Diagonal = 5 (cm) or ½ diagonal = 2.5 (cm)	B1	
	Perpendicular height^2 = $6^2 - 2.5^2$ or Perpendicular height= $\sqrt{(6^2 - 2.5^2)}$ ($=\sqrt{29.75}$)	M1	FT 'their derived 2.5', provided ≠ 3, 4 or 5
	Perpendicular height is 5.45(.. cm) or 5.5(cm)	A1	
		3	
10	(a) $480x^{14}$	B2	B1 for sight of $32x^{15}$. FT to 2nd B1 from $dy/dx = kx^n$ Ignore incorrect notation
	(b) For sight of ($dy/dx =$) $3ax^2 + 2bx + c$ OR ($y =$) $\frac{12x^3}{3} + \frac{4x^2}{2} + x$ (+ constant)	B1	May be implied by 2 or 3 correct values
	a = 4 b = 2 c = 1 d = 3	B3	B2 for any 2 or 3 values correct, or B1 for 1 value correct However, do not award for c = 1 if a = 12 and b = 4 For 'd' FT from 'their 10 – a – b – c' *Accept sight of correct answers from 'uncorrected' working* *Only accept embedded answers if clearly stated unambiguously*
		6	

11	(a) $(AB^2 =)\ (16-8)^2 + (10 - -6)^2\ (=8^2 + 16^2)$	M1	Or equivalent. Allow 1 slip in sign of substitution
	$AB = \sqrt{320}$	A1	CAO. Allow for sight of 17.88... or 17.9
	$= 8\sqrt{5}$	B1	FT 'their AB' of equivalent difficulty expressed correctly, e.g. $\sqrt{272} = 4\sqrt{17}$, needs to be in the form $a\sqrt{b}$ where $a \neq 1$ and $b \neq 1$ or simpler Sight of $8\sqrt{5}$ implies previous $\sqrt{320}$
	(b) Gradient AB $(16 - 8) / (10 - - 6)$	M1	Or equivalent
	$= 8/16\ (= ½)$	A1	CAO. Mark final answer and then FT
	Gradient perpendicular $-16/8\ (= -2)$	B1	FT -1/grad AB
	$(10 + - 6)/2, (16 + 8)/2$	M1	Accept (2, …) or (… , 12)
	Midpoint AB (2, 12) or equivalent	A1	CAO
	Use of $y=mx+c$ or $y-y_1= m(x-x_1)$ or $m = \frac{y-y_1}{x-x_1}$	M1	Method to find the equation using midpoint and perpendicular gradient (not 8/16 or ½ or 'their gradient') FT their midpoint (not A or B) & their perpendicular gradient, or FT substitution of their midpoint with their perpendicular gradient in y = mx + c (towards finding c) *If no working for finding gradient is seen, then 'their 'spurious' incorrect perpendicular gradient' must be negative*
	$y - 12 = -2(x - 2)$ or other unsimplified linear correct equation (not quotient form)	A1	FT for correct unsimplified form, not written in quotient form
	$y = -2x + 16$	A1 11	CAO
12	$12x^6/6 + 24x^4/4 - 2x + 4x^{-4}/-4$	B4	B1 for each term ISW from correct unsimplified form.
	$2x^6 + 6x^4 - 2x - x^{-4}$ or $2x^6 + 6x^4 - 2x - 1/x^4$	B1	CAO simplified form
	$+ c$ (constant)	B1 6	Awarded only if at least B1 is awarded for integration
13	$(dy/dx=)\ 6x^2 + 24x$	B1	
	$dy/dx = 0$ or $6x^2 + 24x = 0$	M1	FT their dy/dx from $ax^2 + bx$ throughout
	$x = 0$ and $y = 11$	A1	
	$x = -4$ and $y = 75$	A1	If A0, A0 here, award A1 for x = 0 with x = -4 *Answer only, no working shown M0 A0 A0* *Method for determining min or max MUST be shown, final answer only is M0 here, then A0,A0*
	$d^2y/dx^2 = 12x + 24$	M1	Or first derivative test, interpretation of first derivative test. Or alternative. FT 'their dy/dx' for M1 provided equivalent difficulty
	At (0, 11) $d^2y/dx^2 > 0$, point is a minimum	A1	FT for 'their x value'
	At (-4, 75): $d^2y/dx^2 < 0$, point is a maximum	A1	FT for 'their other x value' provided this does not have the same interpretation as the first x value *If M0A0A0, award SC1 for correct FT from 'their $d^2y/dx^2 = ax + b$, $a>0$' applied correctly provided it leads to 1 maximum and 1 minimum* *Do not accept trial & improvement methods unless both stationary points are found correctly and confirmed as stated in the mark scheme*
		7	

14	$y+\delta y = (x+\delta x)^2 + 13(x+\delta x)$ Intention to subtract $(y=) x^2 + 13x$ to find δy $\delta y = 2x\delta x + (\delta x)^2 + 13\delta x$ Dividing by δx **and** (lim) $\delta x \to 0$ $dy/dx = \lim_{\delta x \to 0} \delta y/\delta x = 2x + 13$	B1 M1 A1 M1 A1 5	Or alternative notation. Allow if final bracket omitted Accept δx^2 as meaning $(\delta x)^2$ FT equivalent level of difficulty CAO. Must follow from correct working *Use of dy/dx throughout or incorrect notation then possible maximum is only 4 marks, final A0*
15	(a) General cosine curve intersecting x-axis only at (90°,0) and (270°,0) Correct curve with 6 and -6 on y-axis (b) 99.59…(°) and 260.4059…(°) only	M1 A1 B2 4	Allow general shape as the joining of key values, but straight rather than clearly curving towards a turn at 0°, 180° and 360° in particular Must show a clear curve, not straight at turning points Accept rounded or truncated These values need to be selected, not amongst others unless unambiguously indicated as the response. B1 for sight of 99.59…(°) or 260.4059…(°)
16	Intention to integrate $-x^3/3 + 2x^2/2 + 3x$ Use of correct limits 3 & -1 in correct order **and** intention to subtract $10\frac{2}{3}$ or equivalent	M1 A2 m1 A1 5	Intention to integrate, manipulation given, hence not using given or differentiated Ignore sight of '+C. A1 one term correct. CAO. Allow 10.66(…) or 10.7, do not allow 10.6 Do not accept $10\frac{2}{3} + C$ *Answer only gets no marks* *No marks for use of the trapezium rule*
17	When x = 2, finding y = 1 dy/dx = 12x - 18 when x = 2 gradient is 6 Use of $y - y_1 = m(x - x_1)$ or $y = mx + c$ or $m = \frac{y - y_1}{x - x_1}$ $y - 1 = 6(x-2)$ or $1 = 6\times2 + c$, $c = -11$ $6x - y - 11 = 0$	B1 M1 A1 M1 A1 A1 6	 Method to form equation FT their y value (but not y=6) and their derived gradient CAO. Must be in this form with '=0' written, with different order or all operations reversed Mark final answer
18	For sight of $\frac{44}{3x+5}$ or $\frac{7}{3x-1}$ $2 \times \frac{44}{3x+5} + 3 \times \frac{7}{3x-1}$ or equivalent $2\times44(3x-1) + 3\times7(3x+5)$ as a numerator $(3x+5)(3x-1)$ as a denominator $\frac{327x + 17}{(3x+5)(3x-1)}$	B1 M2 A1 A1 A1 6	 M1 for either $2 \times \frac{44}{3x+5}$ or $3 \times \frac{7}{3x-1}$ FT from M1 provided there is a sum of 2 terms with equivalent level of difficulty denominators CAO. Mark final answer If the denominator is expanded it must be correct

Differentiating from first principles. Marking guide.

Q14.

14	$y+\delta y = (x+\delta x)^2 + 13(x+\delta x)$ Intention to subtract (y=) $x^2 + 13x$ to find δy $\delta y = 2x\delta x + (\delta x)^2 + 13\delta x$ Dividing by δx and (lim) $\delta x \to 0$ $dy/dx = \lim_{\delta x \to 0} \delta y/\delta x = 2x + 13$	B1 M1 A1 M1 A1 5	Or alternative notation. Allow if final bracket omitted Accept δx^2 as meaning $(\delta x)^2$ FT equivalent level of difficulty CAO. Must follow from correct working Use of dy/dx throughout or incorrect notation then possible maximum is only 4 marks, final A0

B1 For sight of $(x+\delta x)^2 + 13(x+\delta x)$ or $(x+h)^2 + 13(x+h)$ or using alternative notation. This mark is given whether $(x+\delta x)^2 + 13(x+\delta x)$ stands alone or is embedded in an expression or a formula.

M1 For the intent to subtract $x^2 + 13x$ from the above.
So $(x+\delta x)^2 + 13(x+\delta x) - x^2 + 13x$ will gain the M1 even though there are missing brackets.
It can also be awarded to those who have expanded $(x+\delta x)^2 + 13(x+\delta x)$ and then crossed out the x^2 term and the $+13x$ term.
Those who reverse the subtraction will gain M0 unless there is evidence later on of dividing by $-\delta x$.

A1 For sight of $2x\delta x + (\delta x)^2 + 13\delta x$ (Accept δx^2 as meaning $(\delta x)^2$) with no other terms. Treat as a CAO.
$2x + \delta x + 13$ will imply the above if division by δx has already been done.

M1 A FT, if of equivalent difficulty, is possible for this M1 (but not the subsequent A1).
A correct division by δx has to be done
(so if a FT it has to be correct for their $2x\delta x + (\delta x)^2 + 13\delta x$)
AND we must see 'lim $\delta x \to 0$' OR '$\delta x \to 0$' OR 'δx tends to 0'.
It is M0 for '$\delta x = 0$' OR '$\delta x \approx 0$' OR ' δx is so small we can forget about it'.

All of the above marks can be gained even if there is no l.h.s. shown.

Final A1. Must be for a 'text book' quality presentation. E.g.
Has to be a correct l.h.s. for each line, 'δy' or '$\delta y/\delta x$'

AND at some point '$dy/dx = \lim_{\delta x \to 0} \delta y/\delta x$' or '$dy/dx = \lim_{\delta x \to 0} 2x + \delta x + 13$'