GCE MARKING SCHEME

SUMMER 2018

MATHEMATICS – C2 (LEGACY)
0974-01

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.

Mathematics C2 May 2018

Solutions and Mark Scheme

1. (*a*)

1	0·6989700043		
1·75	0·9777236053		
2·5	1·146128036		
3·25	1·267171728		
4	1·361727836	(5 values correct)	B2

(**If B2 not awarded**, award B1 for either 3 or 4 values correct)

Correct formula with $h = 0{\cdot}75$ — M1

$I \approx \frac{0{\cdot}75}{2} \times \{0{\cdot}6989700043 + 1{\cdot}361727836 + 2(0{\cdot}9777236053 + 1{\cdot}146128036 + 1{\cdot}267171728)\}$

$I \approx 8{\cdot}842744579 \times 0{\cdot}75 \div 2$

$I \approx 3{\cdot}316029217$

$I \approx 3{\cdot}316$ (f.t. one slip) — A1

Note: Answer only with no working earns 0 marks

Special case for candidates who put $h = 0{\cdot}6$

1	0·6989700043		
1·6	0·9344984512		
2·2	1·086359831		
2·8	1·198657087		
3·4	1·28780173		
4	1·361727836	(all values correct)	B1

Correct formula with $h = 0{\cdot}6$ — M1

$I \approx \frac{0{\cdot}6}{2} \times\{0{\cdot}6989700043 + 1{\cdot}361727836 + 2(0{\cdot}9344984512 + 1{\cdot}086359831 + 1{\cdot}198657087 + 1{\cdot}28780173))$

$I \approx 11{\cdot}07533204\times 0{\cdot}6 \div 2$

$I \approx 3{\cdot}322599612$

$I \approx 3{\cdot}323$ (f.t. one slip) — A1

Note: Answer only with no working earns 0 marks

(*b*) $\int_1^4 \log_{10}\sqrt{(6x-1)}\,dx \approx 1{\cdot}658$ (f.t. candidate's answer to (*a*)) — B1

2. (*a*) $10\sin^2\theta + 3\sin\theta = 4(1 - \sin^2\theta) - 2$

(correct use of $\cos^2\theta = 1 - \sin^2\theta$) M1

An attempt to collect terms, form and solve quadratic equation in $\sin\theta$, either by using the quadratic formula or by getting the expression into the form $(a\sin\theta + b)(c\sin\theta + d)$, with $a \times c$ = candidate's coefficient of $\sin^2\theta$ and $b \times d$ = candidate's constant m1

$14\sin^2\theta + 3\sin\theta - 2 = 0 \Rightarrow (2\sin\theta + 1)(7\sin\theta - 2) = 0$

$\Rightarrow \sin\theta = -\frac{1}{2}, \sin\theta = \frac{2}{7}$ (c.a.o.) A1

$\theta = 210°, 330°$ B1 B1

$\theta = 16{\cdot}6°, 163{\cdot}4°$ B1

Note: Subtract 1 mark for each additional root in range for each branch, ignore roots outside range.
$\sin\theta = +, -$, f.t. for 3 marks, $\sin\theta = -, -$, f.t. for 2 marks
$\sin\theta = +, +$, f.t. for 1 mark

(*b*) Correct use of $\frac{\sin\phi}{\cos\phi} = \tan\phi$ (o.e.) M1

$\tan\phi = \frac{5}{3}$ A1

$\phi = 59°, 239°$ (f.t $\tan\phi = a$) B1

3. (*a*) (i) $\frac{1}{2} \times x \times (2x - 1) \times \sin 30° = 11{\cdot}25$

(substituting the correct values and expressions in the correct places in the area formula) M1

$2x^2 - x - 45 = 0$ A1

An attempt to solve quadratic equation in x, either by using the quadratic formula or by getting the expression into the form $(ax + b)(cx + d)$, with $a \times c$ = candidate's coefficient of x^2 and $b \times d$ = candidate's constant m1

$(2x + 9)(x - 5) = 0 \Rightarrow x = 5$ (convincing) A1

(ii) $AC^2 = 5^2 + 9^2 - 2 \times 5 \times 9 \times \cos 30°$

(correct use of cos rule) M1

$AC = 5{\cdot}3$ cm (c.a.o.) A1

(*b*) $\frac{\sin XZY}{29} = \frac{\sin 17°}{16}$

(substituting the correct values in the correct places in the sin rule) M1

$XZY = 32°, 148°$ (at least one value) A1

Use of angle sum of a triangle = 180° M1

$YXZ = 131°, 15°$ (both values)

(f.t. candidate's values for XZY provided both M's awarded) A1

4. This is an A.P. with $a = P$, $d = -x$ (s.i.) B1

$\frac{24}{2} \times [2 \times P + 23 \times (-x)] = 3900$ B1

$P + 7 \times (-x) = 185$ B1

An attempt to solve candidate's derived equations simultaneously M1

$P = 220$, $x = 5$ (c.a.o.) A1

Alternative mark scheme

$\frac{24}{2} \times [2a + 23d] = 3900$ (B1)

$a + 7d = 185$ (B1)

An attempt to solve candidate's derived equations simultaneously (M1)

$a = 220$, $d = -5$ (c.a.o.) (A1)

Interpretation $\therefore P = 220$, $x = 5$ (c.a.o.) (B1)

5. (*a*) $S_n = a + ar + \ldots + ar^{n-1}$ (at least 3 terms, one at each end) B1

$rS_n = \quad ar + \ldots + ar^{n-1} + ar^n$

$S_n - rS_n = a - ar^n$ (multiply first line by r and subtract) M1

$(1 - r)S_n = a(1 - r^n)$

$S_n = \frac{a(1 - r^n)}{1 - r}$ (convincing) A1

(*b*) (i) $a + ar^2 = 340$ B1

$ar^3 + ar^5 = 73{\cdot}44$ B1

A correct method for solving the candidate's equations simultaneously e,g

multiplying the first equation by r^3 and subtracting

or eliminating a and $(1 + r^2)$ M1

$340r^3 = 73{\cdot}44$ (o.e.) A1

$r = 0{\cdot}6$ (convincing) A1

(ii) $a + a \times 0{\cdot}6^2 = 340 \Rightarrow a = 250$ B1

$S_\infty = \frac{250}{1 - 0{\cdot}6}$ (correct use of formula for S_∞, f.t. candidate's derived value for a) M1

$S_\infty = 625$ (f.t. candidate's derived value for a) A1

6. (*a*) $\dfrac{x^{4/3}}{4/3} - 4 \times \dfrac{x^{-5/2}}{-5/2} + c$ (–1 if no constant term present) B1, B1

(*b*) Use of integration to find the area under the curve M1

$\int 25\mathrm{d}x = 25x$ $\int x^2\,\mathrm{d}x = (1/3)x^3$ (both correct) A1

Correct method of substitution of candidate's limits m1

$[25x - (1/3)x^3]_3^5 = (125 - 125/3) - (75 - (27/3)) = 52/3$

Use of a correct method to find the area of the triangle M1

Use of correct limits and trying to find the total area by adding the area of the triangle to the area under the curve m1

Shaded area = 64 + 52/3 = 244/3 (c.a.o.) A1

7. (*a*) Let $p = \log_a x$, $q = \log_a y$

Then $x = a^p$, $y = a^q$ (the relationship between log and power) B1

$xy = a^p \times a^q = a^{p+q}$ (the laws of indices) B1

$\log_a xy = p + q$ (the relationship between log and power)

$\log_a xy = p + q = \log_a x + \log_a y$ (convincing) B1

(*b*) $\log_a(11x^2 + 16x + 5) - \log_a(4x^2 + 1) = \log_a \left(\dfrac{11x^2 + 16x + 5}{4x^2 + 1}\right)$

(subtraction law) B1

$3\log_a 2 = \log_a 2^3$ (power law) B1

$\dfrac{11x^2 + 16x + 5}{4x^2 + 1} = 2^3$ (removing logs) M1

An attempt to collect terms, form and solve quadratic equation with three terms in *x*, either by using the quadratic formula or by getting the expression into the form

$(ax + b)(cx + d)$, with $a \times c$ = candidate's coefficient of x^2 and

$b \times d$ = candidate's constant m1

$21x^2 - 16x + 3 = 0 \Rightarrow (7x - 3)(3x - 1) = 0 \Rightarrow x = {}^3/_7, {}^1/_3$

(both values, c.a.o.) A1

Note: Answer only with no working earns 0 marks

8.	(*a*)	(i)	$r^2 = (6-2)^2 + (1-(-1))^2$	B1
			Equation of C_1: $(x-2)^2 + (y-(-1))^2 = 20$	
			(f.t. candidate's derived value for r^2)	M1
			Equation of C_1: $x^2 + y^2 - 4x + 2y - 15 = 0$	
			(convincing)	A1
		(ii)	A correct method for finding Q	M1
			$Q(-2, -3)$	A1
		(iii)	Gradient $AP = \dfrac{\text{inc in } y}{\text{inc in } x}$	M1
			Gradient $AP = \dfrac{1-(-1)}{6-2} = \dfrac{1}{2}$ (o.e.)	A1
			Use of $m_{\tan} \times m_{\text{rad}} = -1$	M1
			Equation of tangent is:	
			$y - 1 = -2(x - 6)$ (f.t. candidate's gradient for AP)	A1
	(*b*)		Distance between centres of C_1 and $C_2 = 10$	B1
			Use of the fact that the shortest distance between the circles = distance between centres – sum of the radii	M1
			Shortest distance between the circles = $10 - \sqrt{8} - \sqrt{20} = 2{\cdot}7$	
			(f.t. candidate's radius for C_1 and their distance between centres, provided the answer is positive)	A1
9.	(*a*)		$r + r + r\theta = 27$	B1
			$\dfrac{r^2\theta}{2} = 45$	B1
	(*b*)		A correct method for eliminating θ	M1
			$2r^2 - 27r + 90 = 0$ (convincing)	A1
	(c)		An attempt to solve given quadratic equation in r, either by using the quadratic formula or by getting the expression into the form $(ar + b)(cr + d)$, with $a \times c = 2$ and $b \times d = 90$	M1
			$(r-6)(2r-15) = 0 \Rightarrow r = 6,\ r = 7{\cdot}5$ (c.a.o.)	A1
			$\theta = 2{\cdot}5,\ \theta = 1{\cdot}6$ (f.t. $r = 6$, 7.5 using one of their equations in (*a*))	A1