GCE MARKING SCHEME

SUMMER 2016

Mathematics – C2
0974/01

INTRODUCTION

This marking scheme was used by WJEC for the Summer 2016 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.

GCE MATHEMATICS – C2

SUMMER 2016 MARK SCHEME

1.

3	0·6032888847		
3·75	0·5666103111		
4·5	0·5348655099		
5·25	0·5067878888		
6	0·4815614791	(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

$$I \approx \frac{0{\cdot}75}{2} \times \{0{\cdot}6032888847 + 0{\cdot}4815614791 + 2(0{\cdot}5666103111 + 0{\cdot}5348655099 + 0{\cdot}5067878888)\}$$

$I \approx 4{\cdot}301377783 \times 0{\cdot}75 \div 2$

$I \approx 1{\cdot}613016669$

$I \approx 1{\cdot}613$ (f.t. one slip) A1

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

3	0·6032888847		
3·6	0·5734992875		
4·2	0·5470655771		
4·8	0·5232474385		
5·4	0·5015353186		
6	0·4815614791	(all values correct)	B1

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

$$I \approx \frac{0{\cdot}6}{2} \times \{0{\cdot}6032888847 + 0{\cdot}4815614791 + 2(0{\cdot}5734992875 + 0{\cdot}5470655771 + 0{\cdot}5232474385 + 0{\cdot}5015353186)\}$$

$I \approx 5{\cdot}375545607 \times 0{\cdot}6 \div 2$

$I \approx 1{\cdot}612663682$

$I \approx 1{\cdot}613$ (f.t. one slip) A1

Note: Answer only with no working shown earns 0 marks

2. (*a*) $6\sin^2\theta + 1 = 2(1 - \sin^2\theta) - 2\sin\theta$

(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

$8\sin^2\theta + 2\sin\theta - 1 = 0 \Rightarrow (4\sin\theta - 1)(2\sin\theta + 1) = 0$

$\Rightarrow \sin\theta = \frac{1}{4}, \quad \sin\theta = -\frac{1}{2}$ (c.a.o.) A1

$\theta = 14{\cdot}48°, 165{\cdot}52°$ B1

$\theta = 210°, 330°$ B1, 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*) $3x - 57° = -39°, 141°, 321°, 501°$ (one correct value) B1

$x = 6°, 66°, 126°$ B1 B1 B1

Note: Subtract (from final three marks) 1 mark for each additional root in range, ignore roots outside range.

(*c*) $\sin\phi \geq -1, \cos\phi \geq -1$ and thus $2\sin\phi + 4\cos\phi > -7$ E1

3. (*a*) $(x + 5)^2 = 7^2 + x^2 - 2 \times 7 \times x \times -\frac{3}{5}$ (correct use of cos rule) M1

$x^2 + 10x + 25 = 49 + x^2 + 8{\cdot}4x$ A1

$1{\cdot}6x = 24 \Rightarrow x = 15$ (convincing) A1

(*b*) $\sin B\hat{A}C = \frac{4}{5}$ B1

Area of triangle $ABC = \frac{1}{2} \times 7 \times 15 \times \frac{4}{5}$

(substituting the correct values in the correct places in the area formula, f.t. candidate's derived value for $\sin B\hat{A}C$) M1

Area of triangle ABC = 42 (cm^2) A1

(*c*) $\frac{1}{2} \times 20 \times AD = 42$

(f.t. candidate's derived value for area of triangle ABC) M1

$AD = 4{\cdot}2$ (cm)

(f.t. candidate's derived value for area of triangle ABC) A1

4. (*a*) This is an A.P. with $a = 6$, $d = 2$ (s.i.) M1

(i) 20th term $= 6 + 2 \times 19$

(f.t. candidate's values for a and d) M1

20th term $= 44$ (c.a.o.) A1

(ii) $\frac{n}{2}[2 \times 6 + (n - 1) \times 2] = 750$

(f.t. candidate's values for a and d) M1

Rewriting above equation in a form ready to be solved

$2n^2 + 10n - 1500 = 0$ or $n^2 + 5n - 750 = 0$ or $n(n + 5) = 750$ or

$n^2 + 5n = 750$ (f.t. candidate's values for a and d) A1

$n = 25$ (c.a.o.) A1

(*b*) (i) $t_{11} + t_{14} = 50$ B1

(ii) $S_{24} = \frac{24}{2} \times 50$ M1

$S_{24} = 600$ A1

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*) **Either:** $\frac{a(1 - r^5)}{1 - r} = 275$

Or: $a + ar + ar^2 + ar^3 + ar^4 = 275$ B1

$\frac{a}{1 - r} = 243$ B1

An attempt to solve these equations simultaneously by eliminating a

M1

$243r^5 = -32$ (or $-243r^5 = 32$) A1

$r = -\frac{2}{3}$ (c.a.o.) A1

$a = 405$ (f.t. candidate's derived value for r) A1

6. (*a*) $3 \times \dfrac{x^{3/4}}{3/4} - 9 \times \dfrac{x^{7/2}}{7/2} + c$ B1, B1

(–1 if no constant term present)

(*b*) Area = $\displaystyle\int_1^4 \left(2x^2 + \frac{6}{x^2}\right) \mathrm{d}x$ (use of integration) M1

$\dfrac{2x^3}{3} + 6 \times (-1) \times x^{-1}$ (correct integration) A1, A1

Area = (128/3 – 6/4) – (2/3 – 6/1) (an attempt to substitute limits) m1

Area = 93/2 or 46·5 (c.a.o.) A1

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

Then $x = a^p$ (relationship between log and power) B1

$x^n = a^{pn}$ (the laws of indices) B1

$\therefore \log_a x^n = pn$ (relationship between log and power)

$\therefore \log_a x^n = pn = n \log_a x$ (convincing) B1

(*b*) **Either:**

$(3x + 1)\log_{10} 4 = \log_{10} 22$

(taking logs on both sides and using the power law) M1

$x = \dfrac{\log_{10} 22 - \log_{10} 4}{3\log_{10} 4}$ (o.e.) A1

$x = 0{\cdot}41$ (f.t. one slip, see below) A1

Or:

$3x + 1 = \log_4 22$ (rewriting as a log equation) M1

$x = \dfrac{\log_4 22 - 1}{3}$ A1

$x = 0{\cdot}41$ (f.t. one slip, see below) A1

Note: an answer of $x = -0{\cdot}41$ from $x = \dfrac{\log_{10} 4 - \log_{10} 22}{3\log_{10} 4}$

earns M1 A0 A1

an answer of $x = 1{\cdot}08$ from $x = \dfrac{\log_{10} 22 + \log_{10} 4}{3\log_{10} 4}$

earns M1 A0 A1

Note: Answer only with no working shown earns 0 marks

(*c*) Correct use of power law B1

At least one correct use of addition or subtraction law B1

$\log_d (36/9z) = 1$ (o.e.) (f.t. one incorrect term) B1

$z = \dfrac{4}{d}$ (c.a.o.) B1

8.	(*a*)	(i)	$A(-3, 10)$	B1
			A correct method for finding the radius	M1
			Radius = $\sqrt{50}$	A1
		(ii)	Use of shortest distance = OA – radius	M1
			Shortest distance = $\sqrt{109} - \sqrt{50} = 3{\cdot}37$	
			(f.t. candidate's derived radius)	A1
	(*b*)	(i)	An attempt to substitute $(3x - 1)$ for y in the equation of C_1	M1
			$x^2 - 6x + 8 = 0$ (or $10x^2 - 60x + 80 = 0$)	A1
			$x = 2, x = 4$	
			(correctly solving candidate's quadratic, both values)	A1
			Points of intersection P and Q are (2, 5), (4, 11) (c.a.o.)	A1
		(ii)	$BP^2(BQ^2) = 20$ or $BP(BQ) = \sqrt{20}$	
			(f.t. candidate's derived coordinates for P or Q)	B1
			Use of $(x - 6)^2 + (y - 7)^2 = BP^2(BQ^2)$	
			(f.t. candidate's derived coordinates for P or Q)	M1
			$(x - 6)^2 + (y - 7)^2 = 20$ (c.a.o.)	A1

9.	Area of sector $AOB = \frac{1}{2} \times r^2 \times 2{\cdot}15$	B1
	Area of sector $BOC = \frac{1}{2} \times r^2 \times (\pi - 2{\cdot}15)$	B1
	$\frac{1}{2} \times r^2 \times 2{\cdot}15 - \frac{1}{2} \times r^2 \times (\pi - 2{\cdot}15) = 26$	M1
	$r^2 = \dfrac{52}{4{\cdot}3 - \pi}$ (o.e.)	A1
	$r = 6{\cdot}7$	A1