GCE MARKING SCHEME

SUMMER 2016

MATHEMATICS – C1
0973/01

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 – C1

SUMMER 2016 MARK SCHEME

1.	(*a*)	(i)	Gradient of $AB = \dfrac{\text{increase in } y}{\text{increase in } x}$	M1
			Gradient of $AB = {}^1/_2$ (or equivalent)	A1
		(ii)	A correct method for finding the equation of AB using the candidate's value for the gradient of AB.	M1
			Equation of AB : $y - 2 = {}^1/_2\,(x - 4)$ (or equivalent) (f.t. the candidate's value for the gradient of AB)	A1
			Equation of AB : $2y = x$ (or equivalent) (f.t. one error if both M1's are awarded)	A1
	(*b*)		A correct method for finding the length of $AB(AC)$	M1
			$AB = \sqrt{125}$	A1
			$AC = \sqrt{80}$	A1
			$k = {}^5/_4$ (c.a.o.)	A1
	(*c*)	(i)	Equation of BD : $x = 4$	B1
		(ii)	**Either:**	
			An attempt to find the gradient of a line perpendicular to AB using the fact that the product of the gradients of perpendicular lines = –1.	M1
			An attempt to find the gradient of the line passing through C and D using the coordinates of C and D.	M1
			$-2 = \dfrac{m - 5}{4 - (-2)}$ (o.e.) (Equating candidate's derived expressions for gradient, f.t. candidate's gradient of AB)	M1
			$m = -7$ (c.a.o.)	A1
			Or:	
			An attempt to find the gradient of a line perpendicular to AB using the fact that the product of the gradients of perpendicular lines = –1.	M1
			An attempt to find the equation of line perpendicular to AB passing through C(or D) (f.t. candidate's gradient of AB)	M1
			$m - 5 = -2[4 - (-2)]$ (substituting coordinates of unused point in the candidate's derived equation)	M1
			$m = -7$ (c.a.o.)	A1

2. $\dfrac{5\sqrt{7} + 4\sqrt{2}}{3\sqrt{7} + 5\sqrt{2}} = \dfrac{(5\sqrt{7} + 4\sqrt{2})(3\sqrt{7} - 5\sqrt{2})}{(3\sqrt{7} + 5\sqrt{2})(3\sqrt{7} - 5\sqrt{2})}$ M1

Numerator: $15 \times 7 - 25 \times \sqrt{7} \times \sqrt{2} + 12 \times \sqrt{2} \times \sqrt{7} - 20 \times 2$ A1

Denominator: $63 - 50$ A1

$\dfrac{5\sqrt{7} + 4\sqrt{2}}{3\sqrt{7} + 5\sqrt{2}} = 5 - \sqrt{14}$ (c.a.o.) A1

Special case

If M1 not gained, allow B1 for correctly simplified numerator or denominator following multiplication of top and bottom by $3\sqrt{7} + 5\sqrt{2}$

3. y-coordinate at $P = 11$ B1

An attempt to differentiate, at least one non-zero term correct M1

$\dfrac{dy}{dx} = 12 \times (-2) \times x^{-3} + 7$ A1

An attempt to substitute $x = 2$ in candidate's derived expression for $\dfrac{dy}{dx}$ m1

Use of candidate's derived numerical value for $\dfrac{dy}{dx}$ as gradient in the equation of the tangent at P m1

Equation of tangent to C at P: $y - 11 = 4(x - 2)$ (or equivalent)

(f.t. only candidate's derived value for y-coordinate at P) A1

4. $(\sqrt{3} - 1)^5 = (\sqrt{3})^5 + 5(\sqrt{3})^4(-1) + 10(\sqrt{3})^3(-1)^2 + 10(\sqrt{3})^2(-1)^3$
$+ 5(\sqrt{3})(-1)^4 + (-1)^5$ (five or six terms correct) B2

(**If B2 not awarded**, award B1 for three or four correct terms)

$(\sqrt{3} - 1)^5 = 9\sqrt{3} - 45 + 30\sqrt{3} - 30 + 5\sqrt{3} - 1$ (six terms correct) B2

(**If B2 not awarded**, award B1 for three, four or five correct terms)

$(\sqrt{3} - 1)^5 = -76 + 44\sqrt{3}$ (f.t. one error) B1

5. (*a*) $a = 2$, $b = -12$ B1 B1

(*b*) $x^2 + 4x - 8 = 2x + 7$ M1

An attempt to collect terms, form and solve the quadratic equation in x either by correct use of the quadratic formula or by writing the equation in the form $(x + n)(x + m) = 0$, where $n \times m$ = candidate's constant m1

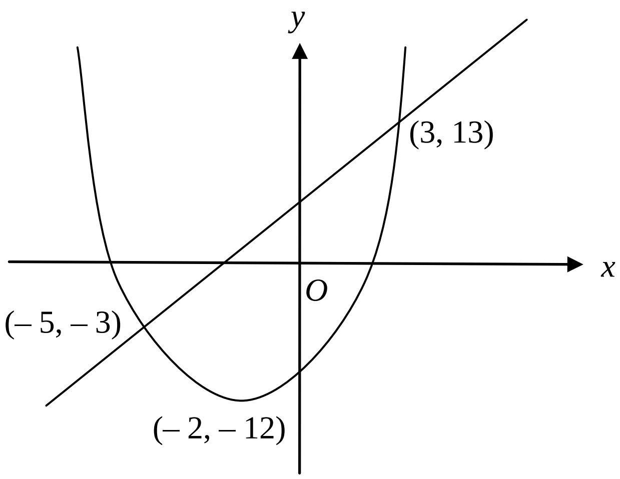
$x^2 + 2x - 15 = 0 \Rightarrow (x - 3)(x + 5) = 0 \Rightarrow x = 3, x = -5$

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

When $x = 3$, $y = 13$, when $x = -5$, $y = -3$

(both values, f.t. one slip) A1

(*c*)



A positive quadratic graph M1

Minimum point (– 2, – 12) marked

(f.t. candidate's values for a, b) A1

A straight line with positive gradient and positive y-intercept B1

Both points of intersection (– 5, – 3), (3, 13) marked

(f.t candidate's solutions to part(*b*)) B1

6. (*a*) An expression for $b^2 - 4ac$, with at least two of a, b or c correct M1

$b^2 - 4ac = 8^2 - 4 \times 9 \times (-2k)$ A1

$b^2 - 4ac > 0$ m1

$k > -{}^8/_9$ (o.e.)

[f.t. only for $k < {}^8/_9$ from $b^2 - 4ac = 8^2 - 4 \times 9 \times (2k)$] A1

(*b*) Attempting to rewrite the inequality in the form $5x^2 - 7x - 6 \geq 0$ and an attempt to find the critical values M1

Critical values $x = -0{\cdot}6$, $x = 2$ A1

A statement (mathematical or otherwise) to the effect that

$x \leq -0{\cdot}6$ or $2 \leq x$ (or equivalent)

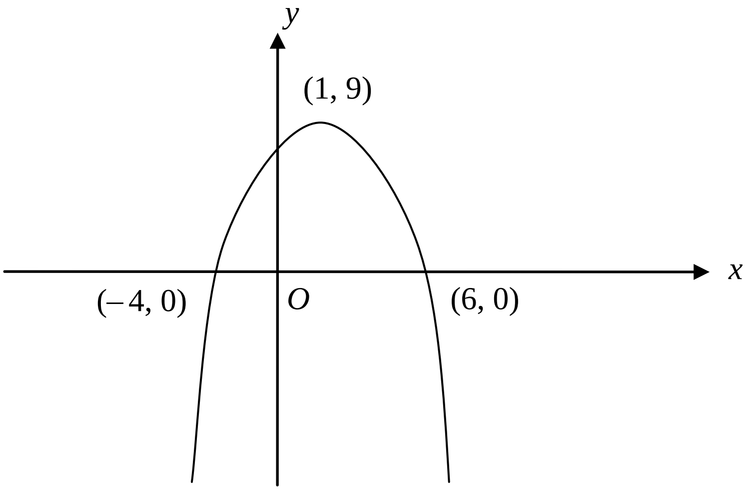
(f.t. candidate's derived critical values) A2

Deduct 1 mark for each of the following errors

the use of strict inequalities

the use of the word 'and' instead of the word 'or'

7. (*a*)



Concave down curve with x-coordinate of maximum = 1	B1
y-coordinate of maximum = 9	B1
Both points of intersection with x-axis	B1

(*b*)

$g(x) = f(-x)$	B1
$g(x) = f(x + 2)$	B1

8. (*a*)

$y + \delta y = 10(x + \delta x)^2 - 7(x + \delta x) - 13$		B1
Subtracting y from above to find δy		M1
$\delta y = 20x\delta x + 10(\delta x)^2 - 7\delta x$		A1
Dividing by δx and letting $\delta x \to 0$		M1
$\dfrac{dy}{dx} = \lim\limits_{\delta x \to 0} \dfrac{\delta y}{\delta x} = 20x - 7$	(c.a.o.)	A1

(*b*)

$\dfrac{dy}{dx} = 4 \times \dfrac{1}{2} \times x^{-1/2} + (-1) \times 45 \times x^{-2}$		B1, B1
Either $9^{-1/2} = \dfrac{1}{3}$ **or** $9^{-2} = \dfrac{1}{81}$ (or equivalent fraction)		B1
$\dfrac{dy}{dx} = \dfrac{1}{9}$ (or equivalent)	(c.a.o.)	B1

9. (*a*) **Either:** showing that $f(2) = 0$
Or: trying to find $f(r)$ for at least two values of r M1
$f(2) = 0 \Rightarrow x - 2$ is a factor A1
$f(x) = (x - 2)(8x^2 + ax + b)$ with one of a, b correct M1
$f(x) = (x - 2)(8x^2 + 18x - 5)$ A1
$f(x) = (x - 2)(4x - 1)(2x + 5)$
(f.t. only $8x^2 - 18x - 5$ in above line) A1

Special case
Candidates who, after having found $x - 2$ as one factor, then find one of the remaining factors by using e.g. the factor theorem, are awarded B1 for final 3 marks

(*b*) **Either:** $f(2{\cdot}25) = 0{\cdot}25 \times 8 \times 9{\cdot}5$
(at least two terms correct, f.t. candidate's derived expression for f) M1
$f(2{\cdot}25) = 19$ [f.t. only for $f(2{\cdot}25) = -1{\cdot}25$ from $f(x) = (x - 2)(4x + 1)(2x - 5)$] A1
Or: $f(2{\cdot}25) = 91{\cdot}125 + 10{\cdot}125 - 92{\cdot}25 + 10$
(at least two of the first three terms correct) M1
$f(2{\cdot}25) = 19$ (c.a.o.) A1

10. (*a*) $V = x(24 - 2x)(9 - 2x)$ M1
$V = 4x^3 - 66x^2 + 216x$ (convincing) A1

(*b*) $\dfrac{dV}{dx} = 12x^2 - 132x + 216$ B1
Putting derived $\dfrac{dV}{dx} = 0$ M1
$x = 2, (9)$ (f.t. candidate's $\dfrac{dV}{dx}$) A1
Stationary value of V at $x = 2$ is 200 (c.a.o) A1
A correct method for finding nature of the stationary point yielding a maximum value (for $0 < x < 4{\cdot}5$) B1