Mark Scheme (Results)
Summer 2010

GCE

Core Mathematics C2 (6664)

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SOME GENERAL PRINCIPLES FOR C2 MARKING
(But the particular mark scheme always takes precedence)

Method mark for solving 3 term quadratic:
1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to *x* = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to *x* = ...

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c = 0,\ q \neq 0$, leading to *x* = ...

Use of a formula
Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values (but refer to the mark scheme first… the application of this principle may vary).
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

Equation of a straight line
Apply the following conditions to the M mark for the equation of a line through (a, b):
If the *a* and *b* are the wrong way round the M mark can still be given if a correct formula is seen, (e.g. $y - y_1 = m(x - x_1)$) otherwise M0.
If (*a*, *b*) is substituted into $y = mx + c$ to find *c*, the M mark is for attempting this.

Answers without working
The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Misreads
A misread must be consistent for the whole question to be interpreted as such.
These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).
Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.
If in doubt, send the response to Review.

June 2010
Core Mathematics C2 6664
Mark Scheme

Question Number	Scheme	Marks
1.	(a) 2.35, 3.13, 4.01 (One or two correct B1 B0, all correct B1 B1) Important: If part (a) is blank, or if answers have been crossed out and no replacement answers are visible, please send to Review as 'out of clip'.	B1 B1 (2)
	(b) $\frac{1}{2}\times 0.2$ ...... (or equivalent numerical value) $k\{(1+5)+2(1.65+p+q+r)\}$, k constant, $k\neq 0$ (See notes below) $= 2.828$ (awrt 2.83, allowed even after minor slips in values) The fractional answer $\frac{707}{250}$ (or other fraction wrt 2.83) is also acceptable. Answers with no working score no marks.	B1 M1 A1 A1 (4) **6**
	(a) Answers must be given to 2 decimal places. No marks for answers given to only 1 decimal place. (b) The p, q and r below are positive numbers, none of which is equal to any of: 1, 5, 1.65, 0.2, 0.4, 0.6 or 0.8 M1 A1: $k\{(1+5)+2(1.65+p+q+r)\}$ M1 A0: $k\{(1+5)+2(1.65+p+q)\}$ or $k\{(1+5)+2(p+q+r)\}$ M0 A0: $k\{(1+5)+2(1.65+p+q+r+\textit{other value}(s))\}$ Note that if the only mistake is to omit a value from the second bracket, this is considered as a slip and the M mark is allowed. Bracketing mistake: i.e. $\frac{1}{2}\times 0.2(1+5)+2(1.65+2.35+3.13+4.01)$ instead of $\frac{1}{2}\times 0.2\{(1+5)+2(1.65+2.35+3.13+4.01)\}$, so that only the (1 + 5) is multiplied by 0.1 scores B1 M1 A0 A0 unless the final answer implies that the calculation has been done correctly (then full marks can be given). Alternative: Separate trapezia may be used, and this can be marked equivalently.	

Question Number	Scheme	Marks
2	(a) Attempting to find $f(3)$ or $f(-3)$	M1
	$f(3) = 3(3)^3 - 5(3)^2 - (58\times 3) + 40 = 81 - 45 - 174 + 40 = -98$	A1 (2)
	(b) $\{3x^3 - 5x^2 - 58x + 40 = (x-5)\}\ (3x^2 + 10x - 8)$	M1 A1
	Attempt to <u>factorise</u> 3-term quadratic, or to use the quadratic formula (see general principles at beginning of scheme). This mark may be implied by the correct solutions to the quadratic.	M1
	$(3x-2)(x+4) = 0$ $x = ...$ <u>or</u> $x = \dfrac{-10 \pm \sqrt{100+96}}{6}$	A1 ft
	$\frac{2}{3}$ (or exact equiv.), -4, 5 (Allow 'implicit' solns, e.g. f(5) = 0, etc.)	A1 (5)
	Completely correct solutions without working: full marks.	**7**

(a) <u>Alternative (long division):</u>

Divide by (x – 3) to get $(3x^2 + ax + b)$, $a \neq 0, b \neq 0$. [M1]

$(3x^2 + 4x - 46)$, and –98 seen. [A1]

(If continues to say 'remainder = 98', isw)

<u>'Grid' method</u>

3	3	–5	–58	40
	0	9	12	–138
	3	4	–46	–98

(b) 1st M requires use of $(x-5)$ to obtain $(3x^2 + ax + b)$, $a \neq 0, b \neq 0$.

(Working need not be seen… this could be done 'by inspection'.)

<u>'Grid' method</u>

3	3	–5	–58	40
	0	15	50	–40
	3	10	–8	0

$(3x^2 + 10x - 8)$ ⟵

2nd M for the attempt to <u>factorise</u> their 3-term quadratic, or to solve it using the quadratic formula.

Factorisation: $(3x^2 + ax + b) = (3x + c)(x + d)$, where $|cd| = |b|$.

A1ft: Correct factors for their 3-term quadratic <u>followed by a solution</u> (at least one value, which might be incorrect), <u>or</u> numerically correct expression from the quadratic formula for their 3-term quadratic.

<u>Note</u> therefore that if the quadratic is correctly factorised but no solutions are given, the last 2 marks will be lost.

<u>Alternative (first 2 marks):</u>

$(x-5)(3x^2 + ax + b) = 3x^3 + (a-15)x^2 + (b-5a)x - 5b = 0$,

then compare coefficients to find <u>values</u> of a and b. [M1]

$a = 10$, $b = -8$ [A1]

<u>Alternative 1</u>: (factor theorem)

M1: Finding that $f(-4) = 0$

A1: Stating that $(x+4)$ is a factor.

M1: Finding third factor $(x-5)(x+4)(3x \pm 2)$.

A1: Fully correct factors (no ft available here) <u>followed by a solution</u>, (which might be incorrect).

A1: All solutions correct.

<u>Alternative 2</u>: (direct factorisation)

M1: Factors $(x-5)(3x+p)(x+q)$ A1: $pq = -8$

M1: $(x-5)(3x \pm 2)(x \pm 4)$

Final A marks as in Alternative 1.

Throughout this scheme, allow $\left(x \pm \frac{2}{3}\right)$ as an alternative to $(3x \pm 2)$.

Question Number	Scheme	Marks
3	(a) $\left(\frac{dy}{dx}=\right)\ 2x-\frac{1}{2}kx^{-\frac{1}{2}}$ (Having an extra term, e.g. $+C$, is A0)	M1 A1 (2)
	(b) Substituting $x = 4$ into their $\frac{dy}{dx}$ and 'compare with zero' (The mark is allowed for : $<, >, =, \leq, \geq$) $8-\frac{k}{4}<0$ $k > 32$ (or $32 < k$) Correct inequality needed	M1 A1 (2) **4**
	(a) M: $x^2 \rightarrow cx$ or $k\sqrt{x} \rightarrow cx^{-\frac{1}{2}}$ (c constant, $c \neq 0$) (b) Substitution of $x = 4$ into y scores M0. However, $\frac{dy}{dx}$ is sometimes called y, and in this case the M mark can be given. $\frac{dy}{dx}=0$ may be 'implied' for M1, when, for example, a value of k or an inequality solution for k is found. Working must be seen to justify marks in (b), i.e. $k > 32$ alone is M0 A0.	

Question Number	Scheme	Marks
4	(a) $(1+ax)^7 = 1+7ax....$ or $1+7(ax)....$ (Not unsimplified versions)	B1
	$+\frac{7\times 6}{2}(ax)^2 + \frac{7\times 6\times 5}{6}(ax)^3$ Evidence from one of these terms is enough	M1
	$+21a^2x^2$ or $+21(ax)^2$ or $+21(a^2x^2)$	A1
	$+35a^3x^3$ or $+35(ax)^3$ or $+35(a^3x^3)$	A1 (4)
	(b) $21a^2 = 525$	M1
	$a = \pm 5$ (Both values are required) (The answer a = 5 with no working scores M1 A0)	A1 (2) **6**
	(a) The terms can be 'listed' rather than added. M1: Requires correct structure: a correct binomial coefficient in any form (perhaps from Pascal's triangle) with the correct power of *x*. Allow missing *a*'s and wrong powers of *a*, e.g. $\frac{7\times 6}{2}ax^2$, $\frac{7\times 6\times 5}{3\times 2}x^3$ However, $21+a^2x^2+35+a^3x^3$ or similar is M0. $1+7ax+21+a^2x^2+35+a^3x^3 = 57+.....$ scores the B1 (isw). $\binom{7}{2}$ and $\binom{7}{3}$ or equivalent such as $^7C_2$ and $^7C_3$ are acceptable, but not $\left(\frac{7}{2}\right)$ or $\left(\frac{7}{3}\right)$ (unless subsequently corrected). 1st A1: Correct x^2 term. 2nd A1: Correct x^3 term (The binomial coefficients must be simplified). Special case: If $(ax)^2$ and $(ax)^3$ are seen within the working, but then lost… … A1 A0 can be given if $21ax^2$ and $35ax^3$ are both achieved. *a*'s omitted throughout: Note that only the M mark is available in this case. (b) M: Equating their coefficent of x^2 to 525. An equation in a or a^2 alone is required for this M mark, but allow 'recovery' that shows the required coefficient, e.g. $21a^2x^2 = 525 \Rightarrow 21a^2 = 525$ is acceptable, but $21a^2x^2 = 525 \Rightarrow a^2 = 25$ is not acceptable. After $21ax^2$ in the answer for (a), allow 'recovery' of a^2 in (b) so that full marks are available for (b) (but not retrospectively for (a)).	

Question Number	Scheme	Marks	
5	(a) $\tan\theta = \frac{2}{5}$ (or 0.4) (i.s.w. if a value of θ is subsequently found) Requires the correct value with no incorrect working seen.	B1	(1)
	(b) awrt 21.8 (α) (Also allow awrt 68.2, ft from $\tan\theta = \frac{5}{2}$ in (a), but no other ft) (This value must be seen in part (b). It may be implied by a correct solution, e.g. 10.9)	B1	
	$180+\alpha$ $(=201.8)$, or $90+(\alpha/2)$ (if division by 2 has already occurred) (α found from $\tan 2x = ...$ or $\tan x = ...$ or $\sin 2x = \pm...$ or $\cos 2x = \pm...$)	M1	
	$360+\alpha$ $(=381.8)$, or $180+(\alpha/2)$ (α found from $\tan 2x = ...$ or $\sin 2x = ...$ or $\cos 2x = ...$) OR $540+\alpha$ $(=561.8)$, or $270+(\alpha/2)$ (α found from $\tan 2x = ...$)	M1	
	Dividing at least one of the angles by 2 (α found from $\tan 2x = ...$ or $\sin 2x = ...$ or $\cos 2x = ...$)	M1	
	$x = 10.9,\ 100.9,\ 190.9,\ 280.9$ (Allow awrt)	A1	(5) **6**

(b) Extra solution(s) in range: Loses the final A mark.
Extra solutions outside range: Ignore (whether correct or not).

Common answers:
10.9 and 100.9 would score B1 M1 M0 M1 A0 (Ensure that these M marks are awarded)
10.9 and 190.9 would score B1 M0 M1 M1 A0 (Ensure that these M marks are awarded)

Alternatives:
(i) $2\cos 2x - 5\sin 2x = 0$ $\quad R\cos(2x+\lambda) = 0$ $\quad \lambda = 68.2 \Rightarrow 2x + 68.2 = 90$ B1
$2x + \lambda = 270$ M1
$2x + \lambda = 450$ or $2x + \lambda = 630$ M1
Subtracting λ and dividing by 2 (at least once) M1

(ii) $25\sin^2 2x = 4\cos^2 2x = 4(1-\sin^2 2x)$
$29\sin^2 2x = 4$ $\quad 2x = 21.8$ B1
The M marks are scored as in the main scheme, but extra solutions will be likely, losing the A mark.

Using radians:
B1: Can be given for awrt 0.38 (β)
M1: For $\pi + \beta$ or $180 + \beta$
M1: For $2\pi + \beta$ or $3\pi + \beta$ (Must now be consistently radians)
M1: For dividing at least one of the angles by 2
A1: For this mark, the answers must be in degrees.

(Correct) answers only (or by graphical methods):
B and M marks can be awarded by implication, e.g.
10.9 scores B1 M0 M0 M1 A0
10.9, 100.9 scores B1 M1 M0 M1 A0
10.9, 100.9, 190.9, 280.9 scores full marks.
Using 11, etc. instead of 10.9 can still score the M marks by implication.

Question Number	Scheme	Marks
6	(a) $r\theta = 9 \times 0.7 = 6.3$ (Also allow 6.30, or awrt 6.30)	M1 A1 (2)
	(b) $\frac{1}{2}r^2\theta = \frac{1}{2} \times 81 \times 0.7 = 28.35$ (Also allow 28.3 or 28.4, or awrt 28.3 or 28.4) (Condone 28.35^2 written instead of $28.35\,\text{cm}^2$)	M1 A1 (2)
	(c) $\tan 0.7 = \frac{AC}{9}$ $AC = 7.58$ (Allow awrt) NOT 7.59 (see below)	M1 A1 (2)
	(d) Area of triangle $AOC = \frac{1}{2}(9 \times \text{their } AC)$ (or other complete method) Area of R = "34.11" – "28.35" (triangle – sector) or (sector – triangle) (needs a value for each) = 5.76 (Allow awrt)	M1 M1 A1 (3) **9**
	(a) M: Use of $r\theta$ (with θ in radians), or equivalent (could be working in degrees with a correct degrees formula). (b) M: Use of $\frac{1}{2}r^2\theta$ (with θ in radians), or equivalent (could be working in degrees with a correct degrees formula). (c) M: Other methods must be fully correct, e.g. $\frac{AC}{\sin 0.7} = \frac{9}{\sin\left(\frac{\pi}{2} - 0.7\right)}$ $(\pi - 0.7)$ instead of $\left(\frac{\pi}{2} - 0.7\right)$ here is not a fully correct method. Premature approximation (e.g. taking angle C as 0.87 radians): This will often result in loss of A marks, e.g. $AC = 7.59$ in (c) is A0.	

Question Number	Scheme	Marks
7	(a) $2\log_3(x-5) = \log_3(x-5)^2$	B1
	$\log_3(x-5)^2 - \log_3(2x-13) = \log_3 \frac{(x-5)^2}{2x-13}$	M1
	$\log_3 3 = 1$ seen or used correctly	B1
	$\log_3\left(\frac{P}{Q}\right) = 1 \Rightarrow P = 3Q \quad \left\{ \frac{(x-5)^2}{2x-13} = 3 \Rightarrow (x-5)^2 = 3(2x-13) \right\}$	M1
	$x^2 - 16x + 64 = 0$ (*)	A1 cso (5)
	(b) $(x-8)(x-8) = 0 \Rightarrow x = 8$ Must be seen in part (b). Or: Substitute $x = 8$ into original equation and verify. Having additional solution(s) such as $x = -8$ loses the A mark. $x = 8$ with no working scores both marks.	M1 A1 (2) 7

(a) Marks may be awarded if equivalent work is seen in part (b).

1st M: $\log_3(x-5)^2 - \log_3(2x-13) = \frac{\log_3(x-5)^2}{\log_3(2x-13)}$ is M0

$2\log_3(x-5) - \log_3(2x-13) = 2\log\frac{x-5}{2x-13}$ is M0

2^{nd} M: After the first mistake above, this mark is available only if there is 'recovery' to the required $\log_3\left(\frac{P}{Q}\right) = 1 \Rightarrow P = 3Q$. Even then the final mark (cso) is lost.

'Cancelling logs', e.g. $\frac{\log_3(x-5)^2}{\log_3(2x-13)} = \frac{(x-5)^2}{2x-13}$ will also lose the 2^{nd} M.

A typical wrong solution:

$$\log_3\frac{(x-5)^2}{2x-13} = 1 \Rightarrow \log_3\frac{(x-5)^2}{2x-13} = 3 \Rightarrow \frac{(x-5)^2}{2x-13} = 3 \Rightarrow (x-5)^2 = 3(2x-13)$$

(Wrong step here)

This, with no evidence elsewhere of $\log_3 3 = 1$, scores B1 M1 B0 M0 A0

However, $\log_3\frac{(x-5)^2}{2x-13} = 1 \Rightarrow \frac{(x-5)^2}{2x-13} = 3$ is correct and could lead to full marks.

(Here $\log_3 3 = 1$ is implied).

No log methods shown:

It is not acceptable to jump immediately to $\frac{(x-5)^2}{2x-13} = 3$. The only mark this scores is the 1st B1 (by generous implication).

(b) M1: Attempt to solve the given quadratic equation (usual rules), so the factors $(x-8)(x-8)$ with no solution is M0.

Question Number	Scheme	Marks
8	(a) $\frac{dy}{dx} = 3x^2 - 20x + k$ (Differentiation is required)	M1 A1
	At $x = 2$, $\frac{dy}{dx} = 0$, so $12 - 40 + k = 0$ $k = 28$ (*)	A1 cso
	N.B. The '= 0' must be seen at some stage to score the final mark.	
	Alternatively: (using $k = 28$)	
	$\frac{dy}{dx} = 3x^2 - 20x + 28$ (M1 A1)	
	'Assuming' $k = 28$ only scores the final cso mark if there is justification that $\frac{dy}{dx} = 0$ at $x = 2$ represents the maximum turning point.	(3)
	(b) $\int (x^3 - 10x^2 + 28x)\,dx = \frac{x^4}{4} - \frac{10x^3}{3} + \frac{28x^2}{2}$ Allow $\frac{kx^2}{2}$ for $\frac{28x^2}{2}$	M1 A1
	$\left[\frac{x^4}{4} - \frac{10x^3}{3} + 14x^2\right]_0^2 = ...$ $\left(= 4 - \frac{80}{3} + 56 = \frac{100}{3}\right)$	M1
	(With limits 0 to 2, substitute the limit 2 into a 'changed function')	
	y-coordinate of $P = 8 - 40 + 56 = 24$ Allow if seen in part (a)	B1
	(The B1 for 24 may be scored by implication from later working)	
	Area of rectangle = $2 \times$ (their y-coordinate of P)	
	Area of R = (their 48) $-\left(\text{their } \frac{100}{3}\right) = \frac{44}{3}$ $\left(14\frac{2}{3} \text{ or } 14.\dot{6}\right)$	M1 A1
	If the subtraction is the 'wrong way round', the final A mark is lost.	(6) **9**
	(a) M: $x^n \to cx^{n-1}$ (c constant, $c \neq 0$) for one term, seen in part (a). (b) 1st M: $x^n \to cx^{n+1}$ (c constant, $c \neq 0$) for one term. Integrating the gradient function loses this M mark. 2ndM: Requires use of limits 0 and 2, with 2 substituted into a 'changed function'. (It may, for example, have been differentiated). Final M: Subtract their values either way round. This mark is dependent on the use of calculus and a correct method attempt for the area of the rectangle. A1: Must be exact, not 14.67 or similar, but isw after seeing, say, $\frac{44}{3}$. Alternative: (effectively finding area of rectangle by integration) $\int \{24 - (x^3 - 10x^2 + 28x)\}\,dx = 24x - \left(\frac{x^4}{4} - \frac{10x^3}{3} + \frac{28x^2}{2}\right)$, etc. This can be marked equivalently, with the 1st A being for integrating the same 3 terms correctly. The 3rd M (for subtraction) will be scored at the same stage as the 2nd M. If the subtraction is the 'wrong way round', the final A mark is lost.	

Question Number	Scheme	Marks	
9	(a) $25\,000 \times 1.03 = 25750$ $\left\{25000 + 750 = 25750, \text{ or } 25000\frac{(1-0.03^2)}{1-0.03} = 25750\right\}$ (*)	B1	(1)
	(b) $r = 1.03$ Allow $\frac{103}{100}$ or $1\frac{3}{100}$ but no other alternatives	B1	(1)
	(c) $25000r^{N-1} > 40000$ (Either letter r or their r value) Allow ' = ' or '<'	M1	
	$r^M > 1.6 \Rightarrow \log r^M > \log 1.6$ Allow ' = ' or '<' (<u>See below</u>) OR (by change of base), $\log_{1.03} 1.6 < M \Rightarrow \frac{\log 1.6}{\log 1.03} < M$	M1	
	$(N-1)\log 1.03 > \log 1.6$ (Correct bracketing required) (*)	A1 cso	
	Accept work for part (c) seen in part (d)		(3)
	(d) Attempt to evaluate $\frac{\log 1.6}{\log 1.03} + 1$ {or $25000(1.03)^{15}$ <u>and</u> $25000(1.03)^{16}$ }	M1	
	N = 17 (<u>not</u> 16.9 and not e.g. $N \geq 17$) Allow '17th year'	A1	
	Accept work for part (d) seen in part (c)		(2)
	(e) Using formula $\frac{a(1-r^n)}{1-r}$ with values of a and r, and n = 9, 10 or 11	M1	
	$\frac{25000(1-1.03^{10})}{1-1.03}$	A1	
	287 000 (<u>must</u> be rounded to the nearest 1 000) Allow 287000.00	A1	(3)
			10

(c) 2nd M: Requires $\frac{40000}{25000}$ to be dealt with, and 'two' logs introduced.

With, say, N instead of $N-1$, this mark is still available.

<u>Jumping</u> straight from $1.03^{N-1} > 1.6$ to $(N-1)\log 1.03 > \log 1.6$ can score only M1 M0 A0.
(The intermediate step $\log 1.03^{N-1} > \log 1.6$ must be seen).

<u>Longer methods</u> require correct log work throughout for 2nd M, e.g.:

$\log(25000r^{N-1}) > \log 40000 \Rightarrow \log 25000 + \log r^{N-1} > \log 40000 \Rightarrow$

$\log r^{N-1} > \log 40000 - \log 25000 \Rightarrow \log r^{N-1} > \log 1.6$

(d) Correct answer with no working scores both marks.

Evaluating $\log\left(\frac{1.6}{1.03}\right) + 1$ does <u>not</u> score the M mark.

(e) M1 can also be scored by a "year by year" method, <u>with terms added</u>.
(Allow the M mark if there is evidence of adding 9, 10 or 11 terms).
1st A1 is scored if the 10 correct terms have been added (allow terms to be to the nearest 100).
To the nearest 100, these terms are:
25000, 25800, 26500, 27300, 28100, 29000, 29900, 30700, 31700, 32600

<u>No</u> working shown: Special case: 287 000 scores 1 mark, scored on ePEN as 1, 0, 0.
(Other answers with no working score no marks).

Question Number	Scheme	Marks
10	(a) $(10-2)^2+(7-1)^2$ or $\sqrt{(10-2)^2+(7-1)^2}$	M1 A1
	$(x\pm 2)^2+(y\pm 1)^2=k$ (k a positive value)	M1
	$(x-2)^2+(y-1)^2=100$ (Accept 10^2 for 100)	A1
	(Answer only scores full marks)	(4)
	(b) (Gradient of radius =) $\frac{7-1}{10-2}=\frac{6}{8}$ (or equiv.) Must be seen in part (b)	B1
	Gradient of tangent $=\frac{-4}{3}$ (Using perpendicular gradient method)	M1
	$y-7=m(x-10)$ Eqn., in any form, of a line through (10, 7) with any numerical gradient (except 0 or ∞)	M1
	$y-7=\frac{-4}{3}(x-10)$ or equiv (ft gradient of radius, dep. on both M marks)	A1ft
	$\{3y=-4x+61\}$ (N.B. The A1 is only available as ft after B0) The unsimplified version scores the A mark (isw if necessary... subsequent mistakes in simplification are not penalised here. The equation must at some stage be exact, not, e.g. $y=-1.3x+20.3$	
		(4)
	(c) $\sqrt{r^2-\left(\frac{r}{2}\right)^2}$ Condone sign slip if there is evidence of correct use of Pythag.	M1
	$=\sqrt{10^2-5^2}$ or numerically exact equivalent	A1
	$PQ\ \left(=2\sqrt{75}\right)=10\sqrt{3}$ Simplest surd form $10\sqrt{3}$ required for final mark	A1
		(3) **11**
	(b) 2nd M: Using (10, 7) to find the equation, in any form, of a straight line through (10, 7), with any numerical gradient (except 0 or ∞). Alternative: 2nd M: Using (10, 7) and an m value in $y = mx + c$ to find a value of c. (b) Alternative for first 2 marks (differentiation): $2(x-2)+2(y-1)\frac{dy}{dx}=0$ or equiv. B1 Substitute $x = 10$ and $y = 7$ to find a value for $\frac{dy}{dx}$ M1 (This M mark can be awarded generously, even if the attempted 'differentiation' is not 'implicit'). (c) Alternatives: To score M1, must be a fully correct method to obtain $\frac{1}{2}PQ$ or PQ. 1st A1: For alternative methods that find PQ directly, this mark is for an exact numerically correct version of PQ.	

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