Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	6	3	/	0	1	Signature	

Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary

Monday 23 May 2005 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Materials required for examination
Mathematical Formulae (Green)

Items included with question papers
Nil

Calculators may NOT be used in this examination.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
You must write your answer for each question in the space following the question.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 10 questions in this question paper. The total mark for this paper is 75.
There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

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1. (a) Write down the value of $8^{\frac{1}{3}}$.

(1)

(b) Find the value of $8^{-\frac{2}{3}}$.

(2)

Q1

(Total 3 marks)

June 2005
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
1. (a)	<u>2</u> Penalise $\pm$	B1 (1)
(b)	$8^{-\frac{2}{3}} = \frac{1}{\sqrt[3]{64}}$ or $\frac{1}{(a)^2}$ or $\frac{1}{\sqrt[3]{8^2}}$ *or* $\frac{1}{8^{\frac{2}{3}}}$ Allow $\pm$	M1
	$= \frac{1}{4}$ or 0.25	A1 (2)
		(3)
(b)	M1 for understanding that "-" power means reciprocal $8^{\frac{2}{3}} = 4$ is M0A0 and $-\frac{1}{4}$ is M1A0	
2. (a)	$\frac{dy}{dx} = 6 + 8x^{-3}$ $x^n \to x^{n-1}$	M1
	both ($6x^0$ is OK)	A1 (2)
(b)	$\int(6x - 4x^{-2})dx = \frac{6x^2}{2} + 4x^{-1} + c$	M1 A1 A1 (3)
		(5)
(b)	In (a) and (b) M1 is for a correct power of x in at least one term. This could be 6 in (a) or $+c$ in (b) 1st A1 for one correct term in x: $\frac{6x^2}{2}$ <u>or</u> $+4x^{-1}$ (or better simplified versions) 2nd A1 for all 3 terms as printed or better in one line. N.B. M1A0A1 is not possible. SC. For integrating their answer to part (a) just allow the M1 if $+c$ is present	

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2. Given that $y = 6x - \frac{4}{x^2}$, $x \neq 0$,

(a) find $\frac{\mathrm{d}y}{\mathrm{d}x}$,

(2)

(b) find $\int y \, \mathrm{d}x$.

(3)

June 2005
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
1. (a)	$\underline{2}$ Penalise $\pm$	B1 (1)
(b)	$8^{-\frac{2}{3}} = \frac{1}{\sqrt[3]{64}}$ or $\frac{1}{(a)^2}$ or $\frac{1}{\sqrt[3]{8^2}}$ *or* $\frac{1}{8^{\frac{2}{3}}}$ Allow $\pm$	M1
	$= \frac{1}{4}$ or 0.25	A1 (2)
		(3)
(b)	M1 for understanding that "-" power means reciprocal $8^{\frac{2}{3}} = 4$ is M0A0 and $-\frac{1}{4}$ is M1A0	
2. (a)	$\frac{dy}{dx} = 6 + 8x^{-3}$ $x^n \to x^{n-1}$	M1
	both ($6x^0$ is OK)	A1 (2)
(b)	$\int (6x - 4x^{-2})dx = \frac{6x^2}{2} + 4x^{-1} + c$	M1 A1 A1 (3)
		(5)
(b)	In (a) and (b) M1 is for a correct power of x in at least one term. This could be 6 in (a) or $+c$ in (b) 1st A1 for one correct term in x: $\frac{6x^2}{2}$ <u>or</u> $+4x^{-1}$ (or better simplified versions) 2nd A1 for all 3 terms as printed or better in one line. N.B. M1A0A1 is not possible. SC. For integrating their answer to part (a) just allow the M1 if $+c$ is present	

Leave blank

3.

$$x^2 - 8x - 29 \equiv (x + a)^2 + b,$$

where a and b are constants.

(a) Find the value of a and the value of b.

(3)

(b) Hence, or otherwise, show that the roots of

$$x^2 - 8x - 29 = 0$$

are $c \pm d\sqrt{5}$, where c and d are integers to be found.

(3)

Question Number	Scheme	Marks
3. (a)	$x^2 - 8x - 29 \equiv (x-4)^2 - 45$ $\qquad (x \pm 4)^2$ $(x-4)^2 - 16 + (-29)$ $(x \pm 4)^2 - 45$	M1 A1 A1 (3)
ALT	Compare coefficients $\quad -8 = 2a \quad$ equation for a $a = -4$ <u>AND</u> $a^2 + b = -29$ $b = -45$	M1 A1 A1 (3)
(b)	$(x-4)^2 = 45$ $\quad$ (follow through their a and b from (a)) $\Rightarrow x - 4 = \pm\sqrt{45}$ $\quad c = 4$ $x = 4 \pm 3\sqrt{5}$ $\quad d = 3$ ($\pm$ OK)	M1 A1 A1 (3) **(6)**
(a) (b)	M1 for $(x \pm 4)^2$ or an equation for a (allow sign error ± 4 or ± 8 on ALT) 1stA1 for $(x-4)^2 - 16(-29)$ can ignore -29 <u>or</u> for stating $a = -4$ and an equation for b 2nd A1 for $b = -45$ Note M1A0 A1 is possible for $(x+4)^2 - 45$ **N.B. On EPEN these marks are called B1M1A1 but apply them as M1A1A1** M1 for a full method leading to $x - 4 = \ldots$ or $x = \ldots$ (condone $x - 4 = \sqrt{-n}$) N.B. $(x-4)^2 - 45 = 0$ leading to $(x-4) \pm \sqrt{45} = 0$ is M0A0A0 A1 for c and A1 for d N.B. M1 and A1 for c do not need $\pm$ (so this is a special case for the formula method) but $\pm$ must be present for the d mark) <u>Note</u> Use of formula that ends with $\frac{8 \pm 6\sqrt{5}}{2}$ scores M1 A1 A0 (but must be $\sqrt{5}$) i.e. only penalise non-integers by one mark.	

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4.

Figure 1

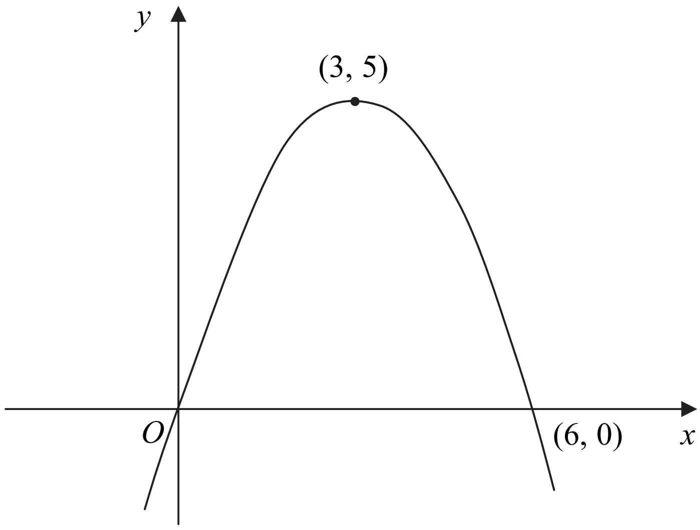


Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$. The curve passes through the origin O and through the point (6, 0). The maximum point on the curve is (3, 5).

On separate diagrams, sketch the curve with equation

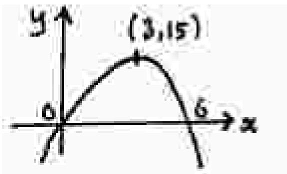
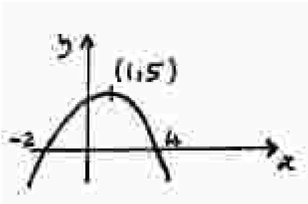
(a) $y = 3\mathrm{f}(x)$,

(2)

(b) $y = \mathrm{f}(x + 2)$.

(3)

On each diagram, show clearly the coordinates of the maximum point and of each point at which the curve crosses the x-axis.

Question Number	Scheme	Marks
4. (a)	Shape Points 	B1 B1 (2)
(b)		M1
	-2 and 4 max	A1 A1 (3) **(5)**
(a) (b)	Marks for shape: graphs must have curved sides and round top. Don't penalise twice. (If both graphs are really straight lines then penalise B0 in part (a) only) 1st B1 for $\cap$ shape through (0, 0) and $((k,0)$ where $k>0)$ 2nd B1 for max at (3, 15) and 6 labelled or (6, 0) seen Condone (15,3) if 3 and 15 are correct on axes. Similarly (5,1) in (b) M1 for $\cap$ shape NOT through (0, 0) but must cut x-axis twice. 1st A1 for -2 and 4 labelled or (-2, 0) and (4, 0) seen 2nd A1 for max at (1, 5). Must be clearly in 1st quadrant	
5.	$x=1+2y$ and sub $\rightarrow (1+2y)^2+y^2=29$ $\Rightarrow 5y^2+4y-28(=0)$ i.e. $(5y+14)(y-2)=0$ $(y=)2$ or $-\frac{14}{5}$ (o.e.) (both) $y=2 \Rightarrow x=1+4=5$; $y=-\frac{14}{5} \Rightarrow x=-\frac{23}{5}$ (o.e)	M1 A1 M1 A1 M1A1 f.t. **(6)**
	1st M1 Attempt to sub leading to equation in 1 variable Condone sign error such as $1-2y$, x = -(1+2y) penalise 1st A1 only 1st A1 Correct 3TQ (condone = 0 missing) 2nd M1 Attempt to solve 3TQ leading to 2 values for y. 2nd A1 Condone mislabelling x = for y = … but then M0A0 in part (c). 3rd M1 Attempt to find at least one x value (must use a correct equation) 3rd A1 f.t. f.t. only in $x=1+2y$ (3sf if not exact) Both values. N.B False squaring. (e.g. $x^2+4y^2=1$) can only score the last 2 marks.	

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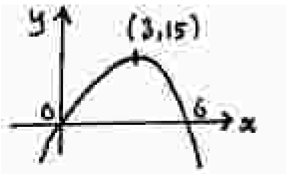
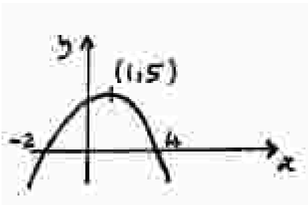
5. Solve the simultaneous equations

$$x - 2y = 1,$$

$$x^2 + y^2 = 29.$$

(6)

Question Number	Scheme	Marks
4. (a)	 Shape Points	B1 B1 (2)
(b)	 -2 and 4 max	M1 A1 A1 (3) **(5)**
(a) (b)	Marks for shape: graphs must have curved sides and round top. Don't penalise twice. (If both graphs are really straight lines then penalise B0 in part (a) only) 1st B1 for $\cap$ shape through (0, 0) and $((k,0)$ where $k>0)$ 2nd B1 for max at (3, 15) and 6 labelled or (6, 0) seen Condone (15,3) if 3 and 15 are correct on axes. Similarly (5,1) in (b) M1 for $\cap$ shape NOT through (0, 0) but must cut x-axis twice. 1st A1 for -2 and 4 labelled or (-2, 0) and (4, 0) seen 2nd A1 for max at (1, 5). Must be clearly in 1st quadrant	
5.	$x=1+2y$ and sub $\rightarrow (1+2y)^2+y^2=29$ $\Rightarrow 5y^2+4y-28(=0)$ i.e. $(5y+14)(y-2)=0$ $(y=)2$ or $-\frac{14}{5}$ (o.e.) (both) $y=2 \Rightarrow x=1+4=5$; $y=-\frac{14}{5} \Rightarrow x=-\frac{23}{5}$ (o.e)	M1 A1 M1 A1 M1A1 f.t. **(6)**
	1st M1 Attempt to sub leading to equation in 1 variable Condone sign error such as $1-2y$, x = -(1+2y) penalise 1st A1 only 1st A1 Correct 3TQ (condone = 0 missing) 2nd M1 Attempt to solve 3TQ leading to 2 values for y. 2nd A1 Condone mislabelling x = for y = … but then M0A0 in part (c). 3rd M1 Attempt to find at least one x value (must use a correct equation) 3rd A1 f.t. f.t. only in $x=1+2y$ (3sf if not exact) Both values. N.B False squaring. (e.g. $x^2+4y^2=1$) can only score the last 2 marks.	

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6. Find the set of values of x for which

(a) $3(2x + 1) > 5 - 2x$,

(2)

(b) $2x^2 - 7x + 3 > 0$,

(4)

(c) **both** $3(2x + 1) > 5 - 2x$ **and** $2x^2 - 7x + 3 > 0$.

(2)

Question Number	Scheme	Marks
6. (a)	$6x+3 > 5-2x \quad \Rightarrow 8x > 2$	M1
	$x > \frac{1}{4}$ or 0.25 or $\frac{2}{8}$	A1
		(2)
(b)	$(2x-1)(x-3) \quad (>0)$	M1
	Critical values $x = \frac{1}{2},\ 3$ (both)	A1
	 Choosing "outside" region	M1
	$x > 3$ or $x < \frac{1}{2}$	A1 f.t.
		(4)
(c)	$x > 3$ or $\frac{1}{4} < x < \frac{1}{2}$ $\quad [(3,\infty)$ or $(\frac{1}{4},\frac{1}{2})$ is OK]	B1f.t. B1f.t.
		(2)
		(8)
(a)	M1 Multiply out and collect terms (allow one slip and allow use of = here)	
(b)	1st M1 Attempting to factorise 3TQ $\rightarrow x = \dots$	
	2nd M1 Choosing the outside region	
	2nd A1 f.t. f.t. their critical values N.B.($x>3$, $x > \frac{1}{2}$ is M0A0)	
(c)	**f.t. their answers to (a) and (b)**	
	1st B1 a correct f.t. leading to an <u>infinite</u> region 2nd B1 a correct f.t. leading to a <u>finite</u> region	
	Penalise $\leq$ or $\geq$ once only at first offence. For $p < x < q$ where $p > q$ penalise the final A1 in (b) .	
	e.g. (a) | (b) | (c) | Mark	
	$x > \frac{1}{4}$ | $\frac{1}{2} < x < 3$ | $\frac{1}{2} < x < 3$ | B0 B1	
	$x > \frac{1}{4}$ | $x > 3,\ x > \frac{1}{2}$ | $x > 3$ | B1 B0	

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7. (a) Show that $\dfrac{(3-\sqrt{x})^2}{\sqrt{x}}$ can be written as $9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}}$.

(2)

Given that $\dfrac{dy}{dx} = \dfrac{(3-\sqrt{x})^2}{\sqrt{x}}$, $x > 0$, and that $y = \frac{2}{3}$ at $x = 1$,

(b) find y in terms of x.

(6)

Question Number	Scheme	Marks
7. (a)	$(3-\sqrt{x})^2 = 9 - 6\sqrt{x} + x$	M1
	$\div by\sqrt{x} \quad \rightarrow 9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}}$	A1 c.s.o.
		(2)
(b)	$\int (9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}})dx = \dfrac{9x^{\frac{1}{2}}}{\frac{1}{2}} - 6x + \dfrac{x^{\frac{3}{2}}}{\frac{3}{2}} (+c)$	M1 A2/1/0
	use $y = \frac{2}{3}$ and $x = 1$: $\quad \frac{2}{3} = 18 - 6 + \frac{2}{3} + c$	M1
	c = - 12	A1 c.s..o.
	So $\quad y = 18x^{\frac{1}{2}} - 6x + \frac{2}{3}x^{\frac{3}{2}}$ -12	A1f.t.
		(6)
		(8)
(a)	M1 Attempt to multiply out $(3-\sqrt{x})^2$. Must have 3 or 4 terms, allow one sign error A1 cso Fully correct solution to printed answer. Penalise invisible brackets or wrong working	
(b)	1st M1 Some correct integration: $x^n \rightarrow x^{n+1}$ A1 At least 2 correct unsimplified terms Ignore + c A2 All 3 terms correct (unsimplified) 2nd M1 Use of $y = \frac{2}{3}$ and $x = 1$ to find c. No + c is M0. A1c.s.o. for -12. (o.e.) Award this mark if " $c = -12$ " stated i.e. not as part of an expression for y A1f.t. for 3 simplified x terms with $y = \dots$ and a numerical value for c. Follow through their value of c but it must be a number.	
Question	Scheme	Marks

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8. The line l_1 passes through the point $(9, -4)$ and has gradient $\frac{1}{3}$.

(a) Find an equation for l_1 in the form $ax + by + c = 0$, where a, b and c are integers.
(3)

The line l_2 passes through the origin O and has gradient -2. The lines l_1 and l_2 intersect at the point P.

(b) Calculate the coordinates of P.
(4)

Given that l_1 crosses the y-axis at the point C,

(c) calculate the exact area of $\triangle OCP$.
(3)

N 2 3 4 9 1 C 0 1 6 2 4

Number		
8. (a)	$y-(-4)=\frac{1}{3}(x-9)$ or $\frac{y-(-4)}{x-9}=\frac{1}{3}$	M1 A1
	$3y-x+21=0$ (o.e.) (condone 3 terms with integer coefficients e.g. $3y+21=x$)	A1
		(3)
(b)	Equation of l_2 is: $y=-2x$ (o.e.)	B1
	Solving l_1 and l_2 : $-6x-x+21=0$	M1
	p is point where $x_p=3$, $y_p=-6$ x_p or y_p	A1
	y_p or x_p	A1f.t. $(-2x)$
		(4)
(c)	(l_1 is $y=\frac{1}{3}x-7$) C is (0, -7) or OC = 7	B1f.t.
	Area of $\Delta OCP=\frac{1}{2}OC\times x_p$, $=\frac{1}{2}\times 7\times 3=10.5$ or $\frac{21}{2}$	M1 A1c.a.o.
ALT	By Integration: M1 for $\pm\int_0^{x_P}(l_1-l_2)\,dx$,	(3)
	B1 ft for correct integration (follow through their l_1) , then A1cao.	**(10)**
(a)	M1 for full method to find equation of l_1 1stA1 any unsimplified form	
(b)	M1 Attempt to solve two linear equations leading to linear equation in one variable 2^{nd} A1 f.t. only f.t. their x_p or y_p in $y=-2x$ N.B. A fully correct solution by drawing, or correct answer with no working can score all the marks in part (b), but a partially correct solution by drawing only scores the first B1.	
(c)	B1f.t. Either a correct OC or f.t. from their l_1 M1 for correct attempt in letters or symbols for ΔOCP A1 c.a.o. $-\frac{1}{2}\times 7\times 3$ scores M1 A0	
MR	(x-axis for y-axis) Get C = (21, 0) Area of $\Delta OCP=\frac{1}{2}OC\times y_p=\frac{1}{2}\times 21\times 6=63$ (B0M1A0)	

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9. An arithmetic series has first term a and common difference d.

(a) Prove that the sum of the first n terms of the series is

$$\tfrac{1}{2}n[2a+(n-1)d].$$

(4)

Sean repays a loan over a period of n months. His monthly repayments form an arithmetic sequence.

He repays £149 in the first month, £147 in the second month, £145 in the third month, and so on. He makes his final repayment in the nth month, where $n > 21$.

(b) Find the amount Sean repays in the 21st month.

(2)

Over the n months, he repays a total of £5000.

(c) Form an equation in n, and show that your equation may be written as

$$n^2 - 150n + 5000 = 0.$$

(3)

(d) Solve the equation in part (c).

(3)

(e) State, with a reason, which of the solutions to the equation in part (c) is **not** a sensible solution to the repayment problem.

(1)

Question Number	Scheme	Marks
9 (a)	$(S=)a+(a+d)+\ldots \quad \ldots+[a+(n-1)d]$ $(S=)[a+(n-1)d]+\ldots \quad \ldots+a$ $2S=[2a+(n-1)d]+\ldots \quad \ldots+[2a+(n-1)d]$ } either $2S=n[2a+(n-1)d]$ $S=\frac{n}{2}[2a+(n-1)d]$	B1 M1 dM1 A1 c.s.o (4)
(b)	$(a=149,\ d=-2)$ $u_{21}=149+20(-2)=£109$	M1 A1 (2)
(c)	$S_n=\frac{n}{2}[2\times149+(n-1)(-2)] \quad (=n(150-n))$ $S_n=5000 \Rightarrow n^2-150n+5000=0 \quad (*)$	M1 A1 A1 c.s.o (3)
(d)	$(n-100)(n-50)=0$ $n=50$ or 100	M1 A2/1/0 (3)
(e)	$u_{100}<0 \quad \therefore n=100$ not sensible	B1 f.t. (1) **(13)**
(a)	B1 requires at least 3 terms, must include first and last terms, an adjacent term and dots! There must be + signs for the B1 (or at least implied see snippet 9D) 1st M1 for reversing series. Must be arithmetic with *a*, *n* and *d* or *l*. (+ signs not essential here) 2nd dM1 for adding, must have 2*S* and be a genuine attempt. Either line is sufficient. Dependent on 1st M1 (NB Allow first 3 marks for use of *l* for last term but as given for final mark)	
(b)	M1 for using a = 149 and $d = \pm 2$ in $a+(n-1)d$ formula.	
(c)	M1 for using their a, d in S_n A1 any correct expression A1cso for putting S_n=5000 and simplifying to given expression. No wrong work **NB EPEN has B1M1A1 here but apply marks as M1A1A1 as in scheme**	
(d)	M1 Attempt to solve leading to $n=\ldots$ A2/1/0 Give A1A0 for 1 correct value and A1A1 for both correct	
(e)	B1 f.t. Must mention 100 and state u_{100} < 0 (or loan paid or equivalent) If giving f.t. then must have $n \geq 76$.	

Leave blank

10. The curve C has equation $y = \frac{1}{3}x^3 - 4x^2 + 8x + 3$.

The point P has coordinates (3, 0).

(a) Show that P lies on C.

(1)

(b) Find the equation of the tangent to C at P, giving your answer in the form $y = mx + c$, where m and c are constants.

(5)

Another point Q also lies on C. The tangent to C at Q is parallel to the tangent to C at P.

(c) Find the coordinates of Q.

(5)

Question Number	Scheme	Marks
10 (a)	$x = 3, \quad y = 9 - 36 + 24 + 3 = 0$ (9 – 36 + 27=0 is OK)	B1 (1)
(b)	$\frac{dy}{dx} = \frac{3}{3}x^2 - 2\times 4\times x + 8 \qquad (x^2 - 8x + 8)$	M1 A1
	When $x = 3$, $\frac{dy}{dx} = 9 - 24 + 8 \Rightarrow m = -7$	M1
	Equation of tangent: $y - 0 = -7(x - 3)$	M1
	$y = -7x + 21$	A1 c.a.o (5)
(c)	$\frac{dy}{dx} = m$ gives $x^2 - 8x + 8 = -7$	M1
	$(x^2 - 8x + 15 = 0)$	
	$(x - 5)(x - 3) = 0$	M1
	$x = (3)$ or 5 5	A1
	$\therefore y = \frac{1}{3}5^3 - 4\times 5^2 + 8\times 5 + 3$	M1
	$y = -15\frac{1}{3}$ or $-\frac{46}{3}$	A1 (5)
		(11)
(b)	1st M1 some correct differentiation ($x^n \to x^{n-1}$ for one term) 1st A1 correct unsimplified (all 3 terms) 2nd M1 substituting $x_P (= 3)$ in their $\frac{dy}{dx}$ clear evidence 3rd M1 using their m to find tangent at p .The m must be from their $\frac{dy}{dx}$ at $x_P (= 3)$ Use of $\frac{1}{7}$ here scores M0A0 but Could get all 3 Ms in Part (c).	
(c)	1st M1 forming a correct equation " their $\frac{dy}{dx}$ = gradient of their tangent" 2nd M1 for solving a quadratic based on their $\frac{dy}{dx}$ leading to x = ... The quadratic could be simply $\frac{dy}{dx}$ =0. 3rd M1 for using their x value (obtained from their quadratic) in y to obtain y coordinate. Must have one of the other two M marks to score this.	
MR	For misreading (0, 3) for (3, 0) award B0 and then M1A1 as in scheme. Then allow all M marks but no A ft. (Max 7)	