Mark Scheme (Results)
January 2008

GCE

GCE Mathematics (6663/01)

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January 2008
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks	
1.	$3x^2 \to kx^3$ or $4x^5 \to kx^6$ or $-7 \to kx$ (k a non-zero constant)	M1	
	$\frac{3x^3}{3}$ or $\frac{4x^6}{6}$ (Either of these, simplified or unsimplified)	A1	
	$x^3 + \frac{2x^6}{3} - 7x$ or equivalent unsimplified, such as $\frac{3x^3}{3} + \frac{4x^6}{6} - 7x^1$	A1	
	$+ C$ (or any other constant, e.g. $+ K$)	B1	(4)
			4
	M: Given for increasing by one the power of x in one of the three terms. A marks: 'Ignore subsequent working' after a correct unsimplified version of a term is seen. B: Allow the mark (independently) for an integration constant appearing at any stage (even if it appears, then disappears from the final answer). This B mark can be allowed even when no other marks are scored.		

Question number	Scheme	Marks
5.	(a) $\left(2x^{-\frac{1}{2}}+3x^{-1}\right)$ $\qquad p=-\frac{1}{2}, \qquad q=-1$	B1, B1 (2)
	(b) $\left(y=5x-7+2x^{-\frac{1}{2}}+3x^{-1}\right)$	
	$\left(\frac{dy}{dx}=\right)$ $\quad 5 \quad (\text{or } 5x^0)$ $\quad$ ($5x-7$ correctly differentiated)	B1
	Attempt to differentiate either $2x^p$ with a fractional *p*, giving kx^{p-1} $(k \neq 0)$, (the fraction *p* could be in decimal form) or $3x^q$ with a negative *q*, giving kx^{q-1} $(k \neq 0)$.	M1
	$\left(-\frac{1}{2}\times 2x^{-\frac{3}{2}}-1\times 3x^{-2}=\right)$ $\quad -x^{-\frac{3}{2}}, \ -3x^{-2}$	A1ft, A1ft (4)
		6
	(b): N.B. It is possible to 'start again' in (b), so the *p* and *q* may be different from those seen in (a), but note that the M mark is for the attempt to differentiate $\underline{\underline{2}}x^p$ or $\underline{\underline{3}}x^q$. However, marks for part (a) <u>cannot</u> be earned in part (b). 1st A1ft: ft their $2x^p$, but *p* must be a fraction and coefficient must be simplified (the fraction *p* could be in decimal form). 2nd A1ft: ft their $3x^q$, but *q* must be negative and coefficient must be simplified. 'Simplified' coefficient means $\frac{a}{b}$ where *a* and *b* are integers with no common factors. Only a single + or − sign is allowed (e.g. − − must be replaced by +). Having +*C* loses the B mark.	

Question number	Scheme	Marks
9.	(a) $4x \to kx^2$ or $6\sqrt{x} \to kx^{3/2}$ or $\frac{8}{x^2} \to kx^{-1}$ (k a non-zero constant)	M1
	$\text{f}(x) = 2x^2$, $-4x^{3/2}$, $-8x^{-1}$ (+ C) (+ C not required)	A1, A1, A1
	At $x = 4$, $y = 1$: $1 = (2\times16) - \left(4\times4^{3/2}\right) - \left(8\times4^{-1}\right) + C$ <u>Must be in part (a)</u>	M1
	$C = 3$	A1 (6)
	(b) $\text{f}'(4) = 16 - (6\times2) + \frac{8}{16} = \frac{9}{2}\ (= m)$ [M: Attempt $\text{f}'(4)$ with the <u>given</u> f'. <u>Must be in part (b)</u>]	M1
	Gradient of normal is $-\frac{2}{9}\left(= -\frac{1}{m}\right)$ [M: Attempt perp. grad. rule. Dependent on the use of their $\text{f}'(x)$]	M1
	Eqn. of normal: $y - 1 = -\frac{2}{9}(x-4)$ (or any equiv. form, e.g. $\frac{y-1}{x-4} = -\frac{2}{9}$)	M1 A1 (4)
	Typical answers for A1: $\left(y = -\frac{2}{9}x + \frac{17}{9}\right)$ $(2x + 9y - 17 = 0)$ $(y = -0.\dot{2}x + 1.\dot{8})$	
	Final answer: gradient $-\frac{1}{(9/2)}$ or $-\frac{1}{4.5}$ is A0 (but all M marks are available).	
		10
	(a) The first 3 A marks are awarded in the order shown, and the terms must be simplified. 'Simplified' coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or – sign is allowed (e.g. + – must be replaced by –). 2nd M: Using $x = 4$ <u>and</u> $y = 1$ (<u>not</u> $y = 0$) to form an eqn in C. (No C is M0) (b) 2nd M: Dependent upon use of their $\text{f}'(x)$. 3rd M: eqn. of a straight line through (4, 1) with any gradient except 0 or ∞. <u>Alternative for 3rd M:</u> Using (4, 1) in $y = mx + c$ to <u>find a value</u> of c, but an equation (general or specific) must be seen. Having coords the <u>wrong way round</u>, e.g. $y - 4 = -\frac{2}{9}(x-1)$, loses the 3rd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$. N.B. The A mark is scored for <u>any</u> form of the correct equation… be prepared to apply isw if necessary.	

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7 (a)	Either solving $0 = x(6 - x)$ and showing $x = 6$ (and $x = 0$) or showing (6,0) (and $x = 0$) satisfies $y = 6x - x^2$ [allow for showing x = 6]	B1 (1)
(b)	Solving $2x = 6x - x^2$ $(x^2 = 4x)$ to x = .. $x = 4$ (and $x = 0$) Conclusion: when $x = 4$, $y = 8$ and when $x = 0$, $y = 0$,	M1 A1 A1 (3)
(c)	(Area =) $\int_{(0)}^{(4)} (6x - x^2)\,dx$ Limits not required Correct integration $3x^2 - \frac{x^3}{3}$ (+ c) Correct use of correct limits on their result above (see notes on limits) [" $3x^2 - \frac{x^3}{3}$ "]^4 – [" $3x^2 - \frac{x^3}{3}$ "]$_0$ with limits substituted $[= 48 - 21\frac{1}{3} = 26\frac{2}{3}]$ Area of triangle = $2 \times 8 = 16$ (Can be awarded even if no M scored, i.e. B1) Shaded area = $\pm$(area under curve – area of triangle) applied correctly $(= 26\frac{2}{3} - 16) = 10\frac{2}{3}$ (awrt 10.7)	M1 A1 M1 A1 M1 A1 (6)**[10]**
Notes	(b) In scheme first A1: need only give $x = 4$ If *verifying approach* used: Verifying (4,8) satisfies both the line and the curve M1(attempt at both), Both shown successfully A1 For final A1, (0,0) needs to be mentioned ; accept " clear from diagram" (c) **Alternative** Using Area = $\pm \int_{(0)}^{(4)} \{(6x - x^2); \quad -2x\}\,dx$ approach (i) If candidate integrates separately can be marked as main scheme If combine to work with = $\pm \int_{(0)}^{(4)} (4x - x^2)\,dx$, **first** M mark and **third** M mark $= (\pm)\,[2x^2 - \frac{x^3}{3}$ (+ c)] A1, Correct use of correct limits on their result **second** M1, Totally correct, unsimplified ± expression (may be implied by correct ans.) A1 10⅔ A1 [Allow this if, having given - 10⅔, they correct it] M1 *for correct use of correct limits*: Must substitute correct limits for their strategy into a changed expression and subtract, either way round, e.g $\pm\{[\ ]^4 - [\ ]_0\}$ If a long method is used, e,g, finding three areas, this mark only gained for correct strategy and all limits need to be correct for this strategy. Use of trapezium rule: M0A0MA0,possibleA1for triangle M1(if correct application of trap. rule from $x = 0$ to $x = 4$) A0	

9 (a)	(Total area) = $3xy + 2x^2$	B1
	(Vol:) $x^2y = 100$ $\quad (y = \frac{100}{x^2}, xy = \frac{100}{x})$	B1
	Deriving expression for area in terms of x only (Substitution, or clear use of, y or xy into expression for area)	M1
	(Area =) $\frac{300}{x} + 2x^2$ **AG**	A1 cso (4)
(b)	$\frac{dA}{dx} = -\frac{300}{x^2} + 4x$	M1A1
	Setting $\frac{dA}{dx} = 0$ and finding a value for correct power of x, for cand. M1 [$x^3 = 75$] $x = 4.2172$ awrt 4.22 (allow exact $\sqrt[3]{75}$)	A1 (4)
(c)	$\frac{d^2A}{dx^2} = \frac{600}{x^3} + 4$ = positive therefore minimum	M1A1 (2)
(d)	Substituting found value of x into (a) (Or finding y for found x and substituting both in $3xy + 2x^2$)	M1
	$[y = \frac{100}{4.2172^2} = 5.6228]$ Area = 106.707 awrt 107	A1 (2) **[12]**
Notes	(a) First B1: Earned for correct unsimplified expression, isw. (c) For M1: Find $\frac{d^2A}{dx^2}$ and explicitly consider its sign, state > 0 or "positive" A1: Candidate's $\frac{d^2A}{dx^2}$ must be correct for their $\frac{dA}{dx}$, sign must be + ve and conclusion "so minimum", (allow QED, √). (may be wrong x, or even no value of x found) <u>Alternative:</u> M1: Find value of $\frac{dA}{dx}$ on either side of "$x = \sqrt[3]{75}$" and consider sign A1: Indicate sign change of negative to positive for $\frac{dA}{dx}$, and conclude minimum. OR M1: Consider values of A on either side of "$x = \sqrt[3]{75}$" and compare with"107" A1: Both values greater than "$x = 107$" and conclude minimum. Allow marks for (c) and (d) where seen; even if part labelling confused.	