Mark Scheme Summer 2009

GCE

GCE Mathematics (8371/8374; 9371/9374)

A PEARSON COMPANY

Question Number	Scheme	Marks
Q3 (a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 6x^2 - 6x^{-3}$	M1 A1 A1 (3)
(b)	$\frac{2x^4}{4} + \frac{3x^{-1}}{-1}(+C)$	M1 A1
	$\frac{x^4}{2} - 3x^{-1} + C$	A1 (3) **[6]**
(a)	M1 for an attempt to differentiate $x^n \to x^{n-1}$ 1st A1 for $6x^2$ 2nd A1 for $-6x^{-3}$ or $-\frac{6}{x^3}$ Condone $+ -6x^{-3}$ here. Inclusion of $+c$ scores A0 here.	
(b)	M1 for some attempt to integrate an x term of the given y. $x^n \to x^{n+1}$ 1st A1 for **both** x terms correct but unsimplified- as printed or better. Ignore $+c$ here 2nd A1 for both x terms correct and simplified and $+c$. Accept $-\frac{3}{x}$ but <u>NOT</u> $+ -3x^{-1}$ Condone the $+c$ appearing on the first (unsimplified) line but missing on the final (simplified) line Apply ISW if a correct answer is seen If part (b) is attempted first and this is clearly labelled then apply the scheme and allow the marks. Otherwise assume the first solution is for part (a).	

Question Number	Scheme	Marks
Q9 (a)	$\left[(3-4\sqrt{x})^2=\right]9-12\sqrt{x}-12\sqrt{x}+(-4)^2x$	M1
	$9x^{-\frac{1}{2}}+16x^{\frac{1}{2}}-24$	A1, A1 (3)
(b)	$\mathrm{f}'(x)=-\frac{9}{2}x^{-\frac{3}{2}},\ +\frac{16}{2}x^{-\frac{1}{2}}$	M1 A1, A1ft
		(3)
(c)	$\mathrm{f}'(9)=-\frac{9}{2}\times\frac{1}{27}+\frac{16}{2}\times\frac{1}{3}=-\frac{1}{6}+\frac{16}{6}=\frac{5}{2}$	M1 A1 (2)
		[8]
(a)	M1 for an attempt to expand $\left(3-4\sqrt{x}\right)^2$ with at least 3 terms correct- as printed or better Or $9-k\sqrt{x}+16x\ \ (k\neq 0)$. See also the MR rule below 1st A1 for their coefficient of $\sqrt{x}$ = 16. Condone writing $(\pm)9x^{(\pm)\frac{1}{2}}$ instead of $9x^{-\frac{1}{2}}$ 2nd A1 for B = - 24 or their constant term = - 24	
(b)	M1 for an attempt to differentiate an x term $x^n\to x^{n-1}$ 1st A1 for $-\frac{9}{2}x^{-\frac{3}{2}}$ <u>and</u> their constant B differentiated to zero. NB $-\frac{1}{2}\times 9x^{-\frac{3}{2}}$ is A0 2nd A1ft follow through their $Ax^{\frac{1}{2}}$ but can be scored without a value for A, i.e. for $\frac{A}{2}x^{-\frac{1}{2}}$	
(c)	M1 for some correct substitution of x = 9 in <u>their</u> expression for $\mathrm{f}'(x)$ including an attempt at $(9)^{\pm\frac{k}{2}}$ (k odd) somewhere that leads to some appropriate multiples of $\frac{1}{3}$ or 3 A1 accept $\frac{15}{6}$ or any exact equivalent of 2.5 e.g. $\frac{45}{18},\frac{135}{54}$ or even $\frac{67.5}{27}$ <u>Misread (MR)</u> Only allow MR of the form $\frac{\left(3-k\sqrt{x}\right)^2}{\sqrt{x}}$ N.B. Leads to answer in (c) of $\frac{k^2-1}{6}$ Score as M1A0A0, M1A1A1ft, M1A1ft	

Question Number	Scheme	Marks
Q11 (a)	$x=2$: $y=8-8-2+9=7$ (*)	B1 (1)
(b)	$\frac{dy}{dx}=3x^2-4x-1$	M1 A1
	$x=2$: $\frac{dy}{dx}=12-8-1(=3)$	A1ft
	$y-7=3(x-2)$, $\underline{y=3x+1}$	M1, <u>A1</u> (5)
(c)	$m=-\frac{1}{3}$ (for $-\frac{1}{m}$ with their m)	B1ft
	$3x^2-4x-1=-\frac{1}{3}$, $9x^2-12x-2=0$ or $x^2-\frac{4}{3}x-\frac{2}{9}=0$ (o.e.)	M1, A1
	$\left(x=\frac{12+\sqrt{144+72}}{18}\right)$ $\left(\sqrt{216}=\sqrt{36}\sqrt{6}=6\sqrt{6}\right)$ or $(3x-2)^2=6\to 3x=2\pm\sqrt{6}$	M1
	$x=\frac{1}{3}\left(2+\sqrt{6}\right)$ (*)	A1cso (5)
		[11]
(a)	B1 there must be a clear attempt to substitute $x=2$ leading to 7 e.g. $2^3-2\times2^2-2+9=7$	
(b)	1st M1 for an attempt to differentiate with at least one of the given terms fully correct. 1st A1 for a fully correct expression 2nd A1ft for sub. $x=2$ in <u>their</u> $\frac{dy}{dx}(\neq y)$ accept for a correct expression e.g. $3\times(2)^2-4\times2-1$ 2nd M1 for use of their "3" (provided it comes from their $\frac{dy}{dx}(\neq y)$ and x=2) to find equation of tangent. Alternative is to use (2, 7) in $y=mx+c$ to <u>find a value</u> for c. Award when $c=\dots$ is seen. **No attempted use of $\frac{dy}{dx}$ in (b) scores 0/5**	
(c)	1st M1 for forming an equation from their $\frac{dy}{dx}(\neq y)$ and their $-\frac{1}{m}$ (must be changed from m) 1st A1 for a correct 3TQ all terms on LHS (condone missing =0) 2nd M1 for proceeding to $x=\dots$ or $3x=\dots$ by formula or completing the square for a 3TQ. Not factorising. Condone $\pm$ 2nd A1 for proceeding to given answer with no incorrect working seen. Can still have $\pm$.	
ALT	<u>Verify (for M1A1M1A1)</u> 1st M1 for attempting to square need $\geq$ 3 correct values in $\frac{4+6+4\sqrt{6}}{9}$, 1st A1 for $\frac{10+4\sqrt{6}}{9}$ 2nd M1 Dependent on 1st M1 in this case for substituting in all terms of their $\frac{dy}{dx}$ 2nd A1cso for cso <u>with a full comment</u> e.g. "the x co-ord of Q is ..."	

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6664 Core Mathematics C2
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Question Number	Scheme	Marks
Q1	$\int\left(2x+3x^{\frac{1}{2}}\right)\,\mathrm{d}x=\frac{2x^2}{2}+\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}$	M1 A1A1
	$\int_1^4\left(2x+3x^{\frac{1}{2}}\right)\,\mathrm{d}x=\left[x^2+2x^{\frac{3}{2}}\right]_1^4=(16+2\times8)-(1+2)$	M1
	$=29$ (29 + C scores A0)	A1 (5)
		[5]

1st M1 for attempt to integrate $x\to kx^2$ or $x^{\frac{1}{2}}\to kx^{\frac{3}{2}}$.

1st A1 for $\frac{2x^2}{2}$ or a simplified version.

2nd A1 for $\frac{3x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ or $\frac{3x\sqrt{x}}{\left(\frac{3}{2}\right)}$ or a simplified version.

Ignore + C, if seen, but two correct terms and an extra non-constant term scores M1A1A0.

2nd M1 for correct use of correct limits ('top' – 'bottom'). Must be used in a 'changed function', not just the original. (The changed function may have been found by differentiation).

Ignore 'poor notation' (e.g. missing integral signs) if the intention is clear.

No working:
The answer 29 with no working scores M0A0A0M1A0 (1 mark).

Question Number	Scheme	Marks
Q9 (a)	(Arc length =) $r\theta = r \times 1 = r$. Can be awarded by implication from later work, e.g. $3rh$ or $(2rh + rh)$ in the S formula. (Requires use of $\theta = 1$).	B1
	(Sector area =) $\frac{1}{2}r^2\theta = \frac{1}{2}r^2 \times 1 = \frac{r^2}{2}$. Can be awarded by implication from later work, e.g. the correct volume formula. (Requires use of $\theta = 1$).	B1
	Surface area = 2 sectors + 2 rectangles + curved face ($= r^2 + 3rh$) (See notes below for what is allowed here)	M1
	Volume = $300 = \frac{1}{2}r^2h$	B1
	Sub for h: $S = r^2 + 3 \times \frac{600}{r} = r^2 + \frac{1800}{r}$ (*)	A1cso (5)
(b)	$\frac{dS}{dr} = 2r - \frac{1800}{r^2}$ or $2r - 1800r^{-2}$ or $2r + -1800r^{-2}$	M1A1
	$\frac{dS}{dr} = 0 \Rightarrow r^3 = \ldots$, $r = \sqrt[3]{900}$, or AWRT 9.7 (NOT -9.7 or ± 9.7)	M1, A1 (4)
(c)	$\frac{d^2S}{dr^2} = \ldots.$ and consider sign, $\frac{d^2S}{dr^2} = 2 + \frac{3600}{r^3} >$ 0 so point is a minimum	M1, A1ft (2)
(d)	$S_{\min} = (9.65...)^2 + \frac{1800}{9.65...}$	
	(Using their value of r, however found, in the <u>given</u> S formula)	M1
	$= 279.65\ldots$ (AWRT: 280) (Dependent on full marks in part (b))	A1 (2) **[13]**
(a)	M1 for attempting a formula (with terms added) for surface area. May be incomplete or wrong and may have extra term(s), but must have an r^2 (or $r^2\theta$) term and an rh (or $rh\theta$) term.	
(b)	<u>In parts (b), (c) and (d), ignore labelling of parts</u> 1st M1 for attempt at differentiation (one term is sufficient) $r^n \to kr^{n-1}$ 2nd M1 for setting their derivative (a 'changed function') = 0 and solving as far as $r^3 = \ldots$ (depending upon their 'changed function', this could be $r = \ldots$ or $r^2 = \ldots$, etc., but the algebra <u>must deal with a negative power</u> of r and should be sound apart from possible <u>sign</u> errors, so that $r^n = \ldots$ is consistent with their derivative).	
(c)	M1 for attempting second derivative (one term is sufficient) $r^n \to kr^{n-1}$, <u>and considering its sign</u>. Substitution of a value of r is not required. (<u>Equating it to zero is M0</u>). A1ft for a correct second derivative (or correct ft from their first derivative) <u>and</u> a valid reason (e.g. > 0), <u>and</u> conclusion. The actual <u>value</u> of the second derivative, if found, can be ignored. To score this mark as ft, their second derivative must indicate a minimum. <u>Alternative</u>: M1: Find <u>value</u> of $\frac{dS}{dr}$ on each side of their value of r and consider sign. A1ft: Indicate sign change of negative to positive for $\frac{dS}{dr}$, and conclude minimum. <u>Alternative</u>: M1: Find <u>value</u> of S on each side of their value of r and compare with their 279.65. A1ft: Indicate that both values are more than 279.65, and conclude minimum.	