AS Pure Mathematics 8MA0: Specimen Paper 1 Mark Scheme

Question	Scheme	Marks	AOs
1 (a)	$y = 2x^3 - 2x^2 - 2x + 8 \Rightarrow \frac{dy}{dx} = 6x^2 - 4x - 2$	M1 A1	1.1b 1.1b
		(2)	
(b)	Attempts $6x^2 - 4x - 2 > 0 \Rightarrow (6x+2)(x-1) > 0$	M1	1.1b
	$x = -\frac{1}{3}, 1$	A1	1.1b
	Chooses outside region	M1	1.1b
	$\left\{x : x < -\frac{1}{3}\right\} \cup \{x : x > 1\}$	A1	2.5
		(4)	
			(6 marks)

Notes:

(a)

M1: Attempts to differentiate. Allow for two correct terms un-simplified

A1: $\frac{dy}{dx} = 6x^2 - 4x - 2$

(b)

M1: Attempts to find the critical values of their $\frac{dy}{dx} > 0$ or their $\frac{dy}{dx} = 0$

A1: Correct critical values $x = -\frac{1}{3}, 1$

M1: Chooses the outside region

A1: $\left\{x : x < -\frac{1}{3}\right\} \cup \{x : x > 1\}$ or $\left\{x : x \in \mathbb{R} \;\; x < -\frac{1}{3} \text{ or } x > 1\right\}$

Accept also $\left\{x : x \leqslant -\frac{1}{3}\right\} \cup \{x : x \geqslant 1\}$

Question	Scheme	Marks	AOs
2 (a)	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = 6\mathbf{i} - 3\mathbf{j} - (4\mathbf{i} + 2\mathbf{j})$	M1	1.1b
	$= 2\mathbf{i} - 5\mathbf{j}$	A1	1.1b
		(2)	
1(b)	Explains that $\overrightarrow{OC}$ is parallel to $\overrightarrow{AB}$ as $8\mathbf{i} - 20\mathbf{j} = 4\times(2\mathbf{i} - 5\mathbf{j})$	M1	1.1b
	As $\overrightarrow{OC} = 4\times\overrightarrow{AB}$ it is parallel to it and not the same length Hence $OABC$ is a trapezium.	A1	2.4
		(2)	
			(4 marks)

Notes:

(a)

M1: Attempts $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$ or equivalent. This may be implied by one correct component

A1: $2\mathbf{i} - 5\mathbf{j}$

(b)

M1: Attempts to compare vectors $\overrightarrow{OC}$ and $\overrightarrow{AB}$ by considering their directions

A1: Fully explains why *OABC* is a trapezium. (The candidate is required to state that *OC* is parallel to *AB* but not the same length as it.)

Question	Scheme	Marks	AOs
3(a)	Uses or implies that $V = at + b$	B1	3.3
	Uses both $4 = 24a + b$ and $2.8 = 60a + b$ to get either a or b	M1	3.1b
	Uses both $4 = 24a + b$ and $2.8 = 60a + b$ to get both a and b	M1	1.1b
	$\Rightarrow V = -\frac{1}{30}t + 4.8$	A1	1.1b
		(4)	
(b)	(i) States that the initial volume is 4.8 m^3	B1 ft	3.4
	(ii) Attempts to solve $0 = -\frac{1}{30}t + 4.8$	M1	3.4
	States 144 minutes	A1	1.1b
		(3)	
(c)	States any logical reason • The tank will leak more quickly at the start due to the greater water pressure • The hole will probably get larger and so will start to leak more quickly • Sediment could cause the leak to be plugged and so the tank would not empty.	B1	3.5b
		(1)	
		(8 marks)	

Notes:

(a)

B1: Uses or implies that $V = at + b$

You may award this at their final line but it must be $V = f(t)$

M1: Awarded for translating the problem in context and starting to solve. It is scored when both $4 = 24a + b$ and $2.8 = 60a + b$ are written down and the candidate proceeds to find either a or b. You may just see a line $\pm\frac{4-2.8}{60-24}$

M1: Uses $4 = 24a + b$ and $2.8 = 60a + b$ to find both a and b

A1: $V = -\frac{1}{30}t + 4.8$ or exact equivalent. Eg $30V + t = 144$

(b)(i)

B1ft: Follow through on their 'b'

(b)(ii)

M1: States that $V = 0$ and finds t by attempting to solve their $0 = -\frac{1}{30}t + 4.8$

A1: States 144 minutes

(c)

B1: States any logical reason. There must be a statement and a reason that matches See scheme

Question	Scheme	Marks	AOs
4(a)	$(4, -3)$	B1	1.2
		(1)	
(b)	$x = 6$	B1	1.1b
		(1)	
(c)	$x \leqslant 4$	B1	1.1b
		(1)	
(d)	$k > 1.5$	B1	2.2a
		(1)	
			(4 marks)
Notes:			
See m/scheme			

Question	Scheme	Marks	AOs
5(a)	$\mathrm{f}(-3)=(-3)^3+3\times(-3)^2-4\times(-3)-12$	M1	1.1b
	$\mathrm{f}(-3)=0\Rightarrow(x+3)$ is a factor $\Rightarrow$ Hence $\mathrm{f}(x)$ is divisible by $(x+3)$.	A1	2.4
		(2)	
(b)	$x^3+3x^2-4x-12=(x+3)\left(x^2-4\right)$	M1	1.1b
	$=(x+3)(x+2)(x-2)$	dM1 A1	1.1b 1.1b
		(3)	
(c)	$\dfrac{x^3+3x^2-4x-12}{x^3+5x^2+6x}=\dfrac{....}{x\left(x^2+5x+6\right)}$	M1	3.1a
	$=\dfrac{(x+3)(x+2)(x-2)}{x(x+3)(x+2)}$	dM1	1.1b
	$=\dfrac{(x-2)}{x}=1-\dfrac{2}{x}$	A1	2.1
		(3)	
			(8 marks)

Notes:

(a)
M1: Attempts $\mathrm{f}(-3)$
A1: Achieves $\mathrm{f}(-3)=0$ and explains that $(x+3)$ is a factor and hence $\mathrm{f}(x)$ is divisible by $(x+3)$.

(b)
M1: Attempts to divide by $(x+3)$ to get the quadratic factor.
By division look for the first two terms. ie x^2+0x

$$\begin{array}{r} x^2\pm 0x............... \\ x+3\overline{\big)\,x^3+3x^2-4x-12} \\ \underline{x^3+3x^2}\qquad\qquad \end{array}$$

By inspection look for the first and last term $x^3+3x^2-4x-12=(x+3)\left(x^2+..x\pm 4\right)$

dM1: For an attempt at factorising their $\left(x^2-4\right)$. (Need to check first and last terms)

A1: $\mathrm{f}(x)=(x+3)(x+2)(x-2)$

(c)
M1: Takes a common factor of x out of the denominator and writes the numerator in factors.
Alternatively rewrites to $x^3+3x^2-4x-12=A\left(x^3+5x^2+6x\right)+B\left(x^2+5x+6\right)$

dM1: Further factorises the denominator and cancels
Alternatively compares terms or otherwise to find either A or B

A1: Shows that $\dfrac{x^3+3x^2-4x-12}{x^3+5x^2+6x}=1-\dfrac{2}{x}$ with no errors or omissions
In the alternative there must be a reference to

$x^3+3x^2-4x-12 \equiv 1\left(x^3+5x^2+6x\right)-2\left(x^2+5x+6\right)$ and hence $\dfrac{x^3+3x^2-4x-12}{x^3+5x^2+6x}=1-\dfrac{2}{x}$

Question	Scheme	Marks	AOs
6(i)	Tries at least one value in the interval Eg $4^2-4-1=11$	M1	1.1b
	States that when $n=8$ it is FALSE and provides evidence $8^2-8-1=55=(11\times5)$ Hence NOT PRIME	A1	2.4
		(2)	
(ii)	Knows that an odd number is of the form $2n+1$	B1	3.1a
	Attempts to simplify $(2n+1)^3-(2n+1)^2$	M1	2.1
	……….and factorise $8n^3+8n^2+2n=2\left(4n^3+4n^2+1n\right)=$	dM1	1.1b
	with statement $2\times..$ is always even	A1	2.4
		(4)	
Alt (ii)	Let the odd number be 'n' and attempts n^3-n^2	B1	3.1a
	Attempts to factorise $n^3-n^2=n^2(n-1)$	M1	2.1
	States that n^2 is odd (odd $\times$ odd) and $(n-1)$ is even (odd -1)	dM1	1.1b
	States that the product is even (odd$\times$even)	A1	2.4
			(6 marks)

Notes: See above

(i)

M1: Attempts any n^2-n-1 for n in the interval. It is acceptable just to show $8^2-8-1=55$

A1: States that when $n=8$ it is FALSE and provides evidence. A comment that $55=11\times5$ and hence not prime is required

(ii)

See scheme for two examples of proof

Note that Alt (i) works equally well with an odd number of the form $2n-1$

For example $(2n-1)^3-(2n-1)^2=(2n-1)^2\{2n-1-1\}=(2n-1)^2\{2n-2\}=2\times(2n-1)^2\{n-1\}$

Question	Scheme	Marks	AOs
7 (a)	$\left(1+\frac{3}{x}\right)^2=1+\frac{6}{x}+\frac{9}{x^2}$	M1 A1	1.1b 1.1b
		(2)	
(b)	$\left(1+\frac{3}{4}x\right)^6=1+6\times\left(\frac{3}{4}x\right)+\ldots$	B1	1.1b
	$\left(1+\frac{3}{4}x\right)^6=1+6\times\left(\frac{3}{4}x\right)+\frac{6\times5}{2}\times\left(\frac{3}{4}x\right)^2+\frac{6\times5\times4}{3\times2}\times\left(\frac{3}{4}x\right)^3+\ldots$	M1 A1	1.1b 1.1b
	$=1+\frac{9}{2}x+\frac{135}{16}x^2+\frac{135}{16}x^3+\ldots$	A1	1.1b
		(4)	
(c)	$\left(1+\frac{3}{x}\right)^2\left(1+\frac{3}{4}x\right)^6=\left(1+\frac{6}{x}+\frac{9}{x^2}\right)\left(1+\frac{9}{2}x+\frac{135}{16}x^2+\frac{135}{16}x^3+\ldots\right)$		
	Coefficient of x $=\frac{9}{2}+6\times\frac{135}{16}+9\times\frac{135}{16}=\frac{2097}{16}$	M1 A1	2.1 1.1b
		(2)	
			(8 marks)

Notes:

(a)

M1: Attempts $\left(1+\frac{3}{x}\right)^2=A+\frac{B}{x}+\frac{C}{x^2}$

A1: $\left(1+\frac{3}{x}\right)^2=1+\frac{6}{x}+\frac{9}{x^2}$

(b)

B1: First two terms correct, may be un-simplified

M1: Attempts the binomial expansion. Implied by the correct coefficient and power of x seen at least once in term 3 or 4

A1: Binomial expansion correct and un-simplified

A1: Binomial expansion correct and simplified.

(c)

M1: Combines all relevant terms for their $\left(1+\frac{A}{x}+\frac{B}{x^2}\right)\left(1+Cx+Dx^2+Ex^3+\ldots\right)$ to find the coefficient of x.

A1: Fully correct

Question	Scheme	Marks	AOs
8(a)	(i) $\int_1^a \sqrt{8x}\,\mathrm{d}x = \sqrt{8}\times\int_1^a \sqrt{x}\,\mathrm{d}x = 10\sqrt{8} = 20\sqrt{2}$	M1 A1	2.2a 1.1b
	(ii) $\int_0^a \sqrt{x}\,\mathrm{d}x = \int_0^1 \sqrt{x}\,\mathrm{d}x + \int_1^a \sqrt{x}\,\mathrm{d}x = \left[\frac{2}{3}x^{\frac{3}{2}}\right]_0^1 + 10 = \frac{32}{3}$	M1 A1	2.1 1.1b
		(4)	
(b)	$R = \int_1^a \sqrt{x}\,\mathrm{d}x = \left[\frac{2}{3}x^{\frac{3}{2}}\right]_1^a$	M1 A1	1.1b 1.1b
	$\frac{2}{3}a^{\frac{3}{2}} - \frac{2}{3} = 10 \Rightarrow a^{\frac{3}{2}} = 16 \Rightarrow a = 16^{\frac{2}{3}}$	dM1	3.1a
	$\Rightarrow a = 2^{4\times\frac{2}{3}} = 2^{\frac{8}{3}}$	A1	2.1
		(4)	
		(8 marks)	

Notes:

(a)(i)

M1: For deducing that $\int_1^a \sqrt{8x}\,\mathrm{d}x = \sqrt{8}\times\int_1^a \sqrt{x}\,\mathrm{d}x$ attempting to multiply $\int_1^a \sqrt{x}\,\mathrm{d}x$ by $\sqrt{8}$

A1: $20\sqrt{2}$ or exact equivalent

(a)(ii)

M1: For identifying and attempting to use $\int_0^a \sqrt{x}\,\mathrm{d}x = \int_0^1 \sqrt{x}\,\mathrm{d}x + \int_1^a \sqrt{x}\,\mathrm{d}x$

A1: For $\frac{32}{3}$ or exact equivalent

(b)

M1: Attempts to integrate, $x^{\frac{1}{2}} \to x^{\frac{3}{2}}$

A1: $\int_1^a \sqrt{x}\,\mathrm{d}x = \left[\frac{2}{3}x^{\frac{3}{2}}\right]_1^a$

dM1: For a whole strategy to find a. In the scheme it is awarded for setting $\left[...x^{\frac{3}{2}}\right]_1^a$ =10, using both limits and proceeding using correct index work to find a. Alternatively a candidate could assume $a = 2^k$. In such a case it is awarded for setting $\left[...x^{\frac{3}{2}}\right]_1^{2^k} = 10$, using both limits and proceeding using correct index work to k=..

A1: $a = 2^{4\times\frac{2}{3}} = 2^{\frac{8}{3}}$

In the alternative case, a further statement must be seen following $k = \frac{8}{3}$ Hence True

Question	Scheme	Marks	AOs
9	$2\log_4(2-x)-\log_4(x+5)=1$		
	Uses the power law $\log_4(2-x)^2-\log_4(x+5)=1$	M1	1.1b
	Uses the subtraction law $\log_4\dfrac{(2-x)^2}{(x+5)}=1$	M1	1.1b
	$\dfrac{(2-x)^2}{(x+5)}=4 \rightarrow 3\text{TQ in } x$	dM1	3.1a
	$x^2-8x-16=0$	A1	1.1b
	$(x-4)^2=32 \Rightarrow x=$	M1	1.1b
	$x=4-4\sqrt{2}$ oe only	A1	2.3
		(6)	
		(6 marks)	

Notes:

M1: Uses the power law of logs $2\log_4(2-x)=\log_4(2-x)^2$

M1: Uses the subtraction law of logs following the above $\log_4(2-x)^2-\log_4(x+5)=\log_4\dfrac{(2-x)^2}{(x+5)}$

Alternatively uses the addition law following use of $1=\log_4 4$ That is $1+\log_4(x+5)=\log_4 4(x+5)$

dM1: This can be awarded for the overall strategy leading to a 3TQ in x. It is dependent upon the correct use of both previous M's and for undoing the logs to reach a 3TQ equation in x

A1: For a correct equation in x

M1: For the correct method of solving their 3TQ =0

A1: $x=4-4\sqrt{2}$ or exact equivalent only. (For example accept $x=4-\sqrt{32}$)

Question	Scheme	Marks	AOs
10(a)	Attempts to find the radius $\sqrt{(2--2)^2+(5-3)^2}$ or radius ^{2}	M1	1.1b
	Attempts $(x-2)^2+(y-5)^2='r'^2$	M1	1.1b
	Correct equation $(x-2)^2+(y-5)^2=20$	A1	1.1b
		(3)	
(b)	Gradient of radius OP where O is the centre of C $=\frac{5-3}{2--2}=\left(\frac{1}{2}\right)$	M1	1.1b
	Equation of l is $-2=\frac{y-3}{x+2}$	dM1	3.1a
	Any correct form $y=-2x-1$	A1	1.1b
	Method of finding k Substitute $x=2$ into their $y=-2x-1$	M1	2.1
	$k=-5$	A1	1.1b
		(5)	
		(8 marks)	

Notes:

(a)

M1: As scheme or states form of circle is $(x-2)^2+(y-5)^2='r'^2$

M1: As scheme or substitutes $(-2,3)$ into $(x-2)^2+(y-5)^2='r'^2$

A1: For a correct equation

If students use $x^2+y^2+2fx+2gy+c=0$ **M1:** $f=2, g=5$ **M1:** substitutes $(2,5)$ to find value of c

A1: $x^2+y^2-4x-10y+9=0$

(b)

M1: Attempts to find the gradient of OP where O is the centre of C

dM1: For a complete strategy of finding the equation of l using the perpendicular gradient to OP and the point $(-2,3)$..

A1: Any correct form of l Eg $y=-2x-1$

M1: Scored for the key step of finding k. In this method they are required to substitute $(2,k)$ in their $y=-2x-1$ and solve for k.

A1: $k=-5$

Alt using Pythagoras' theorem

M1: Attempts Pythagoras to find both PQ and OQ in terms of k (where O is centre of C)

dM1: For the complete strategy of using Pythagoras theorem on triangle POQ to form an equation in k

A1: A correct equation in k Eg. $20+(k-3)^2+16=(k-5)^2$

M1: Scored for a correct attempt to solve their quadratic to find k.

A1: $k=-5$

Question	Scheme	Marks	AOs
11(i)	$(2\theta+10°)=\arcsin(-0.6)$	M1	1.1b
	$(2\theta+10°)=-143.13°, -36.87°, 216.87°, 323.13°$ (Any two)	A1	1.1b
	Correct order to find $\theta = ...$	dM1	1.1b
	Two of $\theta=-76.6°, -23.4°, 103.4°, 156.6°$.	A1	1.1b
	$\theta=-76.6°, -23.4°, 103.4°, 156.6°$, only	A1	2.1
		(5)	
(ii)	(a) Explains that the student has not considered the negative value of $x(=-29.0°)$ when solving $\cos x=\frac{7}{8}$	B1	2.3
	Explains that the student should check if any solutions of $\sin x=0$ (the cancelled term) are solutions of the given equation. $x=0°$ should have been included as a solution	B1	2.3
	(b) Attempts to solve $4\alpha+199°=(360-29.0)°$	M1	2.2a
	$\alpha=33.0°$	A1	1.1b
		(4)	
			(9 marks)

Notes:

(i)

M1: Attempts $\arcsin(-0.6)$ implied by any correct answer

A1: Any two of $-143.13°, -36.87°, 216.87°, 323.13°$

dM1: Correct method to find any value of θ

A1: Any two of $\theta=-76.6°, -23.4°, 103.4°, 156.6°$.

A1: A full solution leading to all four answers and no extras
$\theta=-76.6°, -23.4°, 103.4°, 156.6°$, only

(ii)(a)

B1: See scheme

B1: See scheme

(ii)(b)

M1: For deducing the smallest positive solution occurs when $4\alpha+199°=(360-29.0)°$

A1: $\alpha=33°$

Question	Scheme		Marks	AOs
12(a)	Sets $3x-2\sqrt{x}=8x-16$		B1	1.1a
	$2\sqrt{x}=16-5x$ $4x=(16-5x)^2 \Rightarrow x=..$	$5x+2\sqrt{x}-16=0$ $\Rightarrow(5\sqrt{x}\pm8)(\sqrt{x}\pm2)=0$	M1	3.1a
	$25x^2-164x+256=0$	$(5\sqrt{x}-8)(\sqrt{x}+2)=0$	A1	1.1b
	$(25x-64)(x-4)=0 \Rightarrow x=..$	$\sqrt{x}=\frac{8}{5},(-2) \Rightarrow x=..$	M1	1.1b
	$x=\frac{64}{25}$ only		A1	2.3
			(5)	
(b)	Attempts to solve $3x-2\sqrt{x}=0$		M1	2.1
	Correct solution $x=\frac{4}{9}$		A1	1.1b
	$y\leqslant 3x-2\sqrt{x}$, $y>8x-16$ $x\geqslant\frac{4}{9}$		B1ft	1.1b
			(3)	
				(8 marks)

Notes:

(a)

B1: Sets the equations equal to each other and achieves a correct equation

M1: Awarded for the key step in solving the problem. This can be awarded via two routes. Both routes must lead to a value for *x*.

- Making the $\sqrt{x}$ term the subject and squaring both sides (not each term)
- Recognising that this is a quadratic in $\sqrt{x}$ and attempting to factorise $\Rightarrow(5\sqrt{x}\pm8)(\sqrt{x}\pm2)=0$

A1: A correct intermediate line $25x^2-164x+256=0$ or $(5\sqrt{x}-8)(\sqrt{x}+2)=0$

M1: A correct method to find at least one value for *x*. Way One it is for factorising (usual rules), Way Two it is squaring at least one result of their $\sqrt{x}$

A1: Realises that $x=\frac{64}{25}$ is the only solution $x=\frac{64}{25},4$ is A0

(b) **M1:** Attempts to solve $3x-2\sqrt{x}=0$ For example

Allow $3x=2\sqrt{x}\Rightarrow 9x^2=4x\Rightarrow x=...$

Allow $3x=2\sqrt{x}\Rightarrow x^{\frac{1}{2}}=\frac{2}{3}\Rightarrow x=...$

A1: Correct solution to $3x-2\sqrt{x}=0\Rightarrow$ $x=\frac{4}{9}$

B1: For a **consistent** solution defining *R* using either convention

Either $y\leqslant 3x-2\sqrt{x}$, $y>8x-16$ $x\geqslant\frac{4}{9}$ Or $y<3x-2\sqrt{x}$, $y\geqslant 8x-16$ $x>\frac{4}{9}$

Question	Scheme	Marks	AOs
13(a)	0.2 m^2	B1	3.4
		(1)	
(b)	$A=0.2\text{e}^{0.3t}$ Rate of change = gradient $=\frac{\text{d}A}{\text{d}t}=0.06\text{e}^{0.3t}$	M1	3.1b
	At $t=5\Rightarrow$ Rate of Growth is $0.06\text{e}^{1.5}=0.269\ \text{m}^2\text{/day}$	A1	1.1b
		(2)	
(c)	$100=0.2\text{e}^{0.3t}\Rightarrow \text{e}^{0.3t}=500$	M1 A1	3.1a 1.1b
	$\Rightarrow t=\frac{\ln(500)}{0.3}=20.7$ days 20 days 17 hours	M1 A1	1.1b 3.2a
		(4)	
	At $t=5\Rightarrow$ Rate of Growth is $0.06\text{e}^{1.5}=0.269\ \text{m}^2\text{/day}$	A1	1.1b
		(2)	
(d)	The model given suggests that the pond is fully covered after 20 days 17 hours. Observed data is inconsistent with this as the pond is only 90% covered by the end of one month (28/29/30/31 days). Hence the model is not accurate	B1	3.5a
		(1)	
			(8 marks)

Notes:

(a)

B1: 0.2 m^2 oe

(b)

M1: Links rate of change to gradient and differentiates $0.2\text{e}^{0.3t}\to k\text{e}^{0.3t}$

A1: Correct answer $0.269\ \text{m}^2\text{/day}$

(c)

M1: Substitutes $A=100$ and proceeds to $\text{e}^{0.3t}=k$

A1: $\text{e}^{0.3t}=500$

M1: Correct method when proceeding from $\text{e}^{0.3t}=k\Rightarrow t=..$

A1: 20 days 17 hours

(d)

B1: Valid conclusion following through on their answer to (c).

Question	Scheme	Marks	AOs
14	$y=(x-2)^2(x+3)=(x^2-4x+4)(x+3)=x^3-1x^2-8x+12$	B1	1.1b
	An attempt to find x coordinate of the maximum point. To score this you must see either • an attempt to expand $(x-2)^2(x+3)$, an attempt to differentiate the result, followed by an attempt at solving $\frac{dy}{dx}=0$ • an attempt to differentiate $(x-2)^2(x+3)$ by the product rule followed by an attempt at solving $\frac{dy}{dx}=0$	M1	3.1a
	$y=x^3-1x^2-8x+12 \Rightarrow \frac{dy}{dx}=3x^2-2x-8$	M1	1.1b
	Maximum point occurs when $\frac{dy}{dx}=0 \Rightarrow (x-2)(3x+4)=0$ $\Rightarrow x=-\frac{4}{3}$	M1 A1	1.1b 1.1b
	An attempt to find the area under $y=(x-2)^2(x+3)$ between two values. To score this you must see an attempt to expand $(x-2)^2(x+3)$ followed by an attempt at using two limits	M1	3.1a
	Area = $\int (x^3-1x^2-8x+12)dx=\left[\frac{x^4}{4}-\frac{x^3}{3}-4x^2+12x\right]$	M1	1.1b
	Uses a top limit of 2 and a bottom limit of their $x=-\frac{4}{3}$ $R=\left[\frac{x^4}{4}-\frac{x^3}{3}-4x^2+12x\right]_{-\frac{4}{3}}^{2}$	M1	2.2a
	Uses $=\frac{28}{3}--\frac{1744}{81}=\frac{2500}{81}$	A1	2.1
		(9)	
			(9 marks)

Notes:

B1: Expands $(x-2)^2(x+3)$ to $x^3-1x^2-8x+12$ seen at some point in their solution. It may appear just on their integral for example.
M1: This is a problem solving mark for knowing the method of finding the maximum point. You should expect to see the key points used (i) differentiation (ii) solution of their $\frac{dy}{dx}=0$

M1: For correctly differentiating their cubic with at least two terms correct (for their cubic).

M1: For setting their $\frac{dy}{dx} = 0$ and solves using a correct method (including calculator methods)

A1: $\Rightarrow x = -\frac{4}{3}$

M1: This is a problem solving mark for knowing how integration is used to find the area underneath a curve between two points.

M1: For correctly integrating their cubic with at least two correct terms (for their cubic).

M1: For deducing the top limit is 2, the bottom limit is their $x = -\frac{4}{3}$ and applying these correctly within their integration.

A1: Shows above steps clearly and proceeds to $R = \frac{2500}{81}$