

**MARK SCHEME NOTES**

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

**Types of mark**

- M** Method marks, awarded for a valid method applied to the problem.
- A** Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.
- B** Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation ‘**dep**’ is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

**Abbreviations**

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

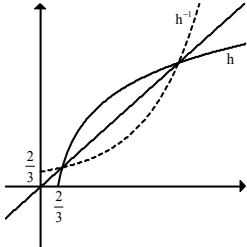
Question	Answer	Marks	Partial Marks
1	Expands right hand side and attempts to collect terms	<b>M1</b>	
	Factorises or solves <i>their</i> 3-term quadratic	<b>M1</b>	
	correct CVs $\frac{2}{5}$ , $\frac{3}{2}$	<b>A1</b>	
	$\frac{2}{5} < x < \frac{3}{2}$ mark final answer	<b>A1</b>	<b>FT</b> <i>their</i> CVs, provided both M marks awarded

Question	Answer	Marks	Partial Marks
2	Valid method to find $m$ $m = \frac{9-7}{10-6} \left[ = \frac{1}{2} \right]$	<b>M1</b>	
	Valid method to find $c$ e.g. $7 = \text{their} \frac{1}{2} \times 6 + c$	<b>M1</b>	<b>FT</b> <i>their m</i>
	$\lg y = \left( \text{their} \frac{1}{2} \right) x^3 + \text{their} 4$	<b>M1</b>	
	$y = 10^{\frac{1}{2}x^3+4}$ oe, isw	<b>A1</b>	
3	Rewrites in quadratic form soi e.g. $y = 3^x$ then $y^2 - 3y - 4 = 0$ or $(3^x)^2 - 3(3^x) - 4 = 0$	<b>M1</b>	
	Factorises or solves <i>their</i> 3-term quadratic e.g. $(y+1)(y-4) [= 0]$ or $(3^x+1)(3^x-4) [= 0]$	<b>M1</b>	
	$3^x = 4$	<b>A1</b>	ignore $3^x = -1$
	$x = \log_3 4$ or $\frac{\ln 4}{\ln 3}$ oe, only	<b>A1</b>	
4	$\overline{OC} - \overline{OA} = 4(\overline{OC} - \overline{OB})$ soi	<b>B1</b>	
	$[\overline{OC} =] \begin{pmatrix} 15 \\ -3 \end{pmatrix}$	<b>B2</b>	<b>B1</b> for $[x = ] 15$ or $[y = ] -3$
	$ \overline{OC}  = \sqrt{\text{their} 15^2 + \text{their} (-3)^2}$	<b>M1</b>	
	$\frac{1}{\sqrt{234}} \begin{pmatrix} 15 \\ -3 \end{pmatrix}$ oe	<b>A1</b>	<b>FT</b> <i>their</i> $\begin{pmatrix} 15 \\ -3 \end{pmatrix}$ and <i>their</i> $\sqrt{234}$
5(a)	Correct V shape with vertex on positive $x$ -axis	<b>B1</b>	
	$(0, 7)$	<b>B1</b>	
	$\left( \frac{7}{5}, 0 \right)$	<b>B1</b>	

Question	Answer	Marks	Partial Marks
5(b)	$x = 2$	<b>B1</b>	
	$5x - 7 = \text{their}(-3)$ oe, soi or $25x - 35 = \text{their}(-15)$ oe, soi	<b>M1</b>	
	$x = \frac{4}{5}$ oe	<b>A1</b>	
	<b>Alternative method</b>		
	$25x^2 - 70x + 40 = 0$ oe	<b>(B1</b>	
	factorising e.g. $(5x - 4)(x - 2)$	<b>M1</b>	
	$x = 2, \frac{4}{5}$	<b>A1)</b>	
6(a)	$2(6) + 6\theta = 2(6 + 5\pi)$ oe	<b>M1</b>	
	$\theta = \frac{5}{3}\pi$ oe, soi	<b>A1</b>	
	$\frac{1}{2} \times 6^2 \times \text{their}\left(\frac{5\pi}{3}\right)$	<b>M1</b>	
	94.2 or $30\pi$	<b>A1</b>	
	<b>Alternative method</b>		
	arc $AB = 10\pi$	<b>(M1</b>	
	sector is $\frac{10\pi}{12\pi} = \frac{5}{6}$ of the circle	<b>B1</b>	
	$\frac{5}{6} \times 36\pi$	<b>M1</b>	
	94.2 or $30\pi$	<b>A1)</b>	
6(b)	$2\left(7 \sin \frac{\pi}{8}\right) + \frac{7\pi}{4}$ oe, soi	<b>M2</b>	<b>M1</b> for $2\left(7 \sin \frac{\pi}{8}\right) + \text{their}\left(\frac{7\pi}{4}\right)$ or $\text{their}\left(2\left(7 \sin \frac{\pi}{8}\right)\right) + \frac{7\pi}{4}$
	10.9 or 10.85 to 10.86	<b>A1</b>	

Question	Answer	Marks	Partial Marks
7	Eliminates one variable e.g. $x^2 = 5(x^2 - 2x + 1) - 1$ or $y = 5y - 1 - 2\sqrt{5y - 1} + 1$	<b>M1</b>	
	Collects terms ready to solve e.g. $4x^2 - 10x + 4 = 0$ or $4y^2 - 5y + 1 = 0$	<b>A1</b>	
	Factorises, applies the formula or completes the square e.g. $2(2x - 1)(x - 2)$ or $(4y - 1)(y - 1)$	<b>M1</b>	
	Both (0.5, 0.25) and (2, 1)	<b>A2</b>	<b>A1</b> for either (0.5, 0.25) or (2, 1) provided nfww or $x = 0.5, 2$ or $y = 0.25, 1$
8(a)	Valid explanation e.g. Each value of $x$ is mapped to a unique value of $y$ .	<b>B1</b>	
8(b)	$-5 \leq f \leq 1$	<b>B1</b>	
8(c)	$a = 3, b = 0.75$ oe, $c = -2$	<b>B4</b>	<b>B1</b> for $a = 3$ <b>B1</b> for $c = -2$ <b>M1</b> for $\frac{2\pi}{b} = \frac{8\pi}{3}$ oe <b>A1</b> for $b = 0.75$ oe

Question	Answer	Marks	Partial Marks
9	$\frac{d(e^{3x})}{dx} = 3e^{3x}$ soi	<b>B1</b>	
	Applies product rule to e.g. numerator: <i>their</i> $(3e^{3x})\sin x + e^{3x}\cos x$	<b>M1</b>	or to $x^{-2}\sin x : x^{-2}\cos x + (-2x^{-3})\sin x$ or to $e^{3x} \times x^{-2} :$ $e^{3x} \times (-2x^{-3}) + \textit{their}(3e^{3x}) \times x^{-2}$
	Correct quotient rule: $\frac{x^2(\textit{their}(3e^{3x}\sin x + e^{3x}\cos x)) - 2x(e^{3x}\sin x)}{x^4}$	<b>M1</b>	or applies product rule for a second time e.g. : $x^{-2}(\textit{their}(3e^{3x})\sin x + e^{3x}\cos x) + (-2x^{-3})(e^{3x}\sin x)$
	Fully correct derivative; isw	<b>A1</b>	
	$\delta y = \textit{their}\left(\frac{dy}{dx}\Big _{x=0.5}\right) \times h$	<b>M1</b>	
	7.14h or 7.137[66...]h with coefficient rot to 4 or more figs isw	<b>A1</b>	Answer only, without working, scores <b>SC1</b>
10(a)(i)	Correct method to find inverse	<b>M1</b>	
	$g^{-1}(x) = \frac{1}{x-3}$ oe	<b>A1</b>	
10(a)(ii)	$g^{-1} \geq 1$ or $[1, \infty)$	<b>B1</b>	
10(a)(iii)	$3 < x \leq 4$ or $(3, 4]$	<b>B2</b>	<b>B1</b> for 3 and 4 in an incorrect inequality or for $x > 3$ or $x \leq 4$

Question	Answer	Marks	Partial Marks
10(b)	Correct graph for h	<b>B1</b>	
	$h^{-1}$ the reflection of h in $y = x$	<b>B1</b>	<b>FT</b> <i>their</i> h
	Both graphs drawn over the correct domain	<b>B1</b>	<b>FT</b> <i>their</i> h and $h^{-1}$
		<b>B1</b>	Correct graphs intersecting twice
11	$h = \frac{1000}{\pi r^2}$ or $r = \sqrt{\frac{1000}{\pi h}}$ soi	<b>B1</b>	
	$S = \pi r^2 + 2\pi r \left( \frac{1000}{\pi r^2} \right)$ oe or $S = \pi \left( \frac{1000}{\pi h} \right) + 2\pi \sqrt{\frac{1000}{\pi h}} (h)$ oe	<b>M1</b>	
	$S = \pi r^2 + 2 \left( \frac{1000}{r} \right)$ or better or $S = \frac{1000}{h} + 2\pi \sqrt{\frac{1000}{\pi}} \left( h^{\frac{1}{2}} \right)$	<b>A1</b>	
	$\frac{dS}{dr} = 2\pi r - 2000r^{-2}$ or $\frac{dS}{dh} = -1000h^{-2} + \sqrt{1000\pi} h^{-\frac{1}{2}}$	<b>B2</b>	<b>B1 FT</b> for each term correct
	$\frac{dS}{dr} = 0, \quad r^3 = \frac{1000}{\pi}$ oe or $\frac{dS}{dh} = 0, \quad h^{\frac{3}{2}} = \sqrt{\frac{1000}{\pi}}$ oe	<b>M1</b>	
	$S = \pi \left( \sqrt[3]{\frac{1000}{\pi}} \right)^2 + \frac{2000}{\sqrt[3]{\frac{1000}{\pi}}}$ or $S = \frac{1000}{\sqrt[3]{\frac{1000}{\pi}}} + 2\sqrt{1000\pi} \left( \sqrt[3]{\frac{1000}{\pi}} \right)^{\frac{1}{2}}$	<b>M1</b>	
	439 or 439.3 to 439.4	<b>A1</b>	

Question	Answer	Marks	Partial Marks
12(a)	$v = -6t + c$ soi	<b>B1</b>	
	$v = -6t + 18$	<b>M1</b>	
	$-6t + 18 = 0, t = 3$	<b>A1</b>	
12(b)	$s = \frac{-6t^2}{2} + 18t$ soi	<b>B1</b>	
	$(-3(3)^2 + 18(3)) - (-3(2)^2 + 18(2))$	<b>M1</b>	<b>FT</b> <i>their s</i> provided it is from an attempt to integrate
	3 (metres)	<b>A1</b>	Not from wrong working
13(a)(i)	$a + ar = 10$ soi	<b>B1</b>	
	$ar^2 = 9$ soi	<b>B1</b>	
	Solves <i>their</i> equations	<b>M1</b>	
	$r = -\frac{3}{5}, \frac{3}{2}$ and $a = 25, 4$	<b>A2</b>	<b>A1</b> for either $r = -\frac{3}{5}, \frac{3}{2}$ or $a = 25, 4$ or for $r = -\frac{3}{5}$ <b>and</b> $a = 25$ or for $r = \frac{3}{2}$ <b>and</b> $a = 4$
13(a)(ii)	$\frac{125}{8}$ or 15.625 or $15\frac{5}{8}$ only	<b>B1</b>	

Question	Answer	Marks	Partial Marks
13(b)	$d = 8$	<b>B1</b>	
	$[S_{200} - S_{99} =]$ $\frac{200}{2}\{2(-10) + 199(\text{their } 8)\} -$ $\frac{99}{2}\{2(-10) + 98(\text{their } 8)\}$ oe	<b>M2</b>	<b>M1</b> for either sum correct or correct <b>FT</b> their $d$
	119382 cao	<b>A1</b>	
	<b>Alternative method 1</b>		
	$d = 8$	<b>(B1</b>	
	$u_{100} = -10 + 99 \times 8 [= 782]$ and $u_{200} = -10 + 199 \times 8 [= 1582]$ and $n = 101$	<b>M1</b>	
	$\frac{1}{2}(101)(782 + 1582)$	<b>M1</b>	
	119382 cao	<b>A1)</b>	
	<b>Alternative method 2</b>		
	$d = 8$	<b>(B1</b>	
	$u_{100} = -10 + 99 \times 8 [= 782]$ and $n = 101$	<b>M1</b>	
	$\frac{1}{2}(101)(2 \times 782 + (101 - 1) \times 8)$	<b>M1</b>	
	119382 cao	<b>A1)</b>	