Question	Answer	Marks	Partial Marks
1(a)	[Distance between centres =] $\sqrt{(15-3)^2+(-4-2)^2}$ oe	**M1**	
	29 – 17 < 13[.41…] < 29 + 17 oe	**A1**	
1(b)	$y - 17 = 2(x + 5)$ oe	**B2**	**B1** for gradient $\frac{17-(-0.6)}{-5+13.8}$ oe, soi or for $600 + 30x - 8y - 6x + 9 - 4y + 4 = 17^2$ oe
2(a)	[When $x^4 = 0$] $\lg y = 4$	**B2**	**B1** for $\frac{7-5}{6-2}$ oe and correct use of a point and *their* $\frac{1}{2}$ to find the intercept of the straight line
2(b)	$\lg y = \frac{1}{2}x^4 + 4$ soi	**B1**	**FT** *their* $\frac{1}{2}$ and *their* 4
	$y = 10^{\frac{1}{2}x^4+4}$	**M1**	**FT** *their* $\frac{1}{2}$ and *their* 4
	$A = 10^4$ or 10 000, $b = 10$, $C = \frac{1}{2}$	**A1**	May be embedded
3	$12(8) + a(4) - 12(2) + b = 0$ oe	**B1**	
	$12(-1) + a[1] - 12(-1) + b = -15$ oe	**B1**	
	Correct method of solution	**M1**	**FT** *their* pair of linear equations in a and b
	$a = -19$, $b = 4$	**A2**	**A1** for either correct
	$12x^2 + 5x - 2$	**M2**	**M1** for quadratic factor with 2 correct terms
	$(4x - 1)$ and $(3x + 2)$	**A1**	
4(a)	100	**3**	**M2** for a fully correct method e.g. [starts 2 and ends 4] 1 × 5 × 4 × 1 or 20 [starts 1, 3 and ends 2, 4] 2 × 5 × 4 × 2 or 80 OR [ends 4 and starts 1, 2, 3] 3 × 5 × 4 × 1 or 60 [ends 2 and starts 1, 3] 2 × 5 × 4 × 1 or 40 or **M1** for a partially correct method equivalent to one of the above statements

Question	Answer	Marks	Partial Marks
4(b)	260	3	**M2** for a fully correct method e.g. [starts 4 and ends 2, 3, 5, 7] $1 \times 5 \times 4 \times 4$ or 80 [starts 2, 3, 5 and ends 7 or any two of 2, 3, 5] $3 \times 5 \times 4 \times 3$ or 180 OR [ends 7 and starts 2, 3, 4, 5] $4 \times 5 \times 4 \times 1$ or 80 [ends 2, 3, 5 and starts 4 or any two of 2, 3, 5] $3 \times 5 \times 4 \times 3$ or 180 or **M1** for a partially correct method equivalent to one of the above statements
5	$128 + 448ax + 672a^2x^2 + 560a^3x^3$ soi or $448a = b$ $672a^2 = c$ $560a^3 = -15\,120$ soi	**M3**	**M2** for any 3 correct terms or 2 correct equations or **M1** for any 2 correct terms or 1 correct equation or for correct but insufficiently simplified expansion e.g. $2^7 + 7(2^6)(ax) + \frac{7 \times 6}{2}(2^5)(ax)^2 + \frac{7 \times 6 \times 5}{3 \times 2}(2^4)(ax)^3$
	$a = -3$	**A1**	
	$b = -1344$	**A1**	**FT** 448 × *their a*, providing at least **M1** awarded
	$c = 6048$	**A1**	**FT** 672 × (*their a*)^2, providing at least **M1** awarded
6(a)	$V = 2x^3 - 195x^2 + 4500x$	**B3**	**B2** for an otherwise correct expression with at most one error or **B1** for $(75 - 2x)(60 - x)x$ soi
6(b)	$\left[\frac{dV}{dx} =\right] 6x^2 - 390x + 4500$	**B1**	**FT** *their* integer values of *a*, *b* and *c*
	Equates *their* $\frac{dV}{dx}$ to 0 and solves for x	**M1**	**FT** *their* values of *a*, *b* and *c*
	$x = 15$ as the only solution	**A1**	

Question	Answer	Marks	Partial Marks
7(a)	$\dfrac{\cos x(1+\sin x)+\cos x(1-\sin x)}{1-\sin^2 x}$	**M1**	
	$\dfrac{\cos x+\cos x\sin x+\cos x-\cos x\sin x}{1-\sin^2 x}$ or $\dfrac{\cos x(1+\sin x)+\cos x(1-\sin x)}{\cos^2 x}$	**A1**	
	$\dfrac{2\cos x}{1-\sin^2 x}$ or $\dfrac{1+\sin x+1-\sin x}{\cos x}$ or $\dfrac{2\cos x}{\cos^2 x}$	**A1**	
	Completion to the given answer: $\dfrac{2}{\cos x}=2\sec x$ oe	**A1**	must be fully justified and with all previous steps correct
7(b)(i)	$\tan x=\dfrac{5}{4}$	**M1**	
	51.3 or 51.34[0…] rot to 2 or more decimal places –128.7 or –128.65[98…] rot to 2 or more decimal places	**A2**	and no extras in range **A1** for either correct, ignoring extras
7(b)(ii)	$10(1-\cos^2 2x)-9=3\cos 2x$	**M1**	
	$10\cos^2 2x+3\cos 2x-1$ [= 0]	**A1**	
	$(5\cos 2x-1)(2\cos 2x+1)$ [= 0]	**M1**	**FT** *their* 3-term quadratic in solvable form
	$\dfrac{\pi}{3}, \dfrac{2\pi}{3}$ 0.685 or 0.6847[19…] rot to 4 or more significant figures, 2.46 or 2.456[87…] rot to 4 or more significant figures	**A2**	and no extras in range **A1** for one correct, ignoring extras
8(a)(i)	Valid supported explanation: The function is one-one on this domain with support e.g. [it is quadratic and] the turning point is at $x=-1$	**B2**	**B1** for a correct but incomplete statement e.g. The function is one-one on this domain or [it is quadratic and] the turning point is at $x=-1$

Question	Answer	Marks	Partial Marks
8(a)(ii)	$x^2 + 2x + 5 - y = 0$ or $y = (x+1)^2 + 4$	**M1**	
	$x = \dfrac{-2 \pm \sqrt{2^2 - 4(1)(5-y)}}{2}$ oe, soi or $x = -1 \pm \sqrt{y-4}$	**A1**	
	Justifies the choice of square root	**B1**	
	$f^{-1}(x) = -1 + \sqrt{x-4}$	**A1**	
8(b)(i)	Valid supported explanation: The range of f is a subset of the domain of g with support e.g. $f \geqslant 5$ oe	**B2**	**B1** for a correct but incomplete statement e.g. The range of f is a subset of the domain of g or $f \geqslant 5$ oe
8(b)(ii)	$\dfrac{5(x^2+2x+5)}{x^2+2x+5+2} = 4$ oe	**M1**	
	$x^2 + 2x - 3$ [= 0]	**A1**	
	$(x-1)(x+3)$ [= 0]	**M1**	**FT** *their* 3-term quadratic in solvable form
	$x = 1$ as the only solution	**A1**	
9(a)	first term = $3(1.25)^{19}$ and an attempt at S_{12}	**M1**	
	Correct sum $S_{12} = \dfrac{208.166...(1-1.25^{12})}{1-1.25}$ oe	**M2**	**M1 FT** *their* first term for $S_{12} = \dfrac{\textit{their}\ 208.166...(1-1.25^{12})}{1-1.25}$
	11 284	**A1**	
	Alternative $S_{19} = \dfrac{3(1-1.25^{19})}{1-1.25}$ and $S_{31} = \dfrac{3(1-1.25^{31})}{1-1.25}$ oe	**(B2)**	**B1** for $S_{19} = \dfrac{3(1-1.25^{19})}{1-1.25}$ or $S_{31} = \dfrac{3(1-1.25^{31})}{1-1.25}$ oe
	Correct plan: $S_{31} - S_{19}$ oe attempted	**(M1)**	
	11 284	**(A1)**	

Question	Answer	Marks	Partial Marks
9(b)	$S_{5n} = \frac{5n}{2}\{2(5) + (5n-1)(3)\}$ and $S_n = \frac{n}{2}\{2(5) + (n-1)(3)\}$	**B2**	**B1** for either sum correct
	Forms a correct equation: $\frac{5n}{2}\{2(5) + (5n-1)(3)\} = \frac{23n}{2}\{2(5) + (n-1)(3)\}$ oe	**M1**	**FT** *their* sums providing at least **B1** awarded
	$n = 21$	**A1**	
10(a)(i)	Straight line starting at $\left(\frac{\pi}{2}, 1\right)$ and ending at $(\pi, 0)$	**B1**	
10(a)(ii)	[Distance $\frac{\pi}{2}$ to π: $\frac{1}{2} \times \frac{\pi}{2}$ [× 1] =] $\frac{\pi}{4}$	**B1**	
	$\left[2\tan\frac{t}{2} - t\right]_0^{\frac{\pi}{2}}$	**M2**	**M1** for $k\tan\frac{t}{2}$ soi
	$2\tan\frac{1}{2}\left(\frac{\pi}{2}\right) - \frac{\pi}{2}[-0]$	**M1**	**dep** on at least **M1** earned
	$2 - \frac{\pi}{4}$ or 1.21 or 1.214[60…] rot to 4 or more significant figures	**A1**	
10(b)(i)	$v = -e^{2t} + 3e^{-2t}$	**B1**	
	$3 - (e^{2t})^2 = 0$ or $3 - e^{4t} = 0$ oe	**M1**	**FT** *their* v providing it is of the form $me^{2t} + ne^{-2t}$, where m and n are constants
	$2t = \ln\sqrt{3}$ or $4t = \ln 3$ oe	**M1**	**dep** on previous **M1**; **FT** *their* 3 which must be > 0
	$t = 0.2747$ cao; nfww	**A1**	
10(b)(ii)	$\frac{4 - e^{2(\textit{their } 0.2747)} - 3e^{-2(\textit{their } 0.2747)}}{2} + \left(\frac{4 - e^{2(\textit{their } 0.2747)} - 3e^{-2(\textit{their } 0.2747)}}{2} - \frac{4 - e^{2(0.5)} - 3e^{-2(0.5)}}{2}\right)$ soi	**M2**	**FT** *their* $t \neq 0$ **M1** for $\frac{4 - e^{2(\textit{their } 0.2747)} - 3e^{-2(\textit{their } 0.2747)}}{2}$ or 0.268 or 0.2679[49…] rot to 4 or more decimal places
	0.447 or 0.4468[58…] rot to 4 or more decimal places	**A1**	