Question	Answer	Marks	Partial Marks
1	$x = \frac{13}{14}$ oe	B1	
	$7x - 3 = -3.5$ oe, soi or $28x - 12 = -14$ oe, soi	M1	
	$x = -\frac{1}{14}$ oe	A1	
	Alternative method $196x^2 - 168x - 13 = 0$ oe	(B1)	
	factorising e.g. $(14x - 13)(14x + 1)$	(M1)	
	$x = \frac{13}{14}, -\frac{1}{14}$	(A1)	
2	$(\sqrt{2} + 1)^2 = 3 + 2\sqrt{2}$ $\left[\text{leading to} \frac{1-\sqrt{2}}{3+2\sqrt{2}}\right]$	M1	
	$\frac{1-\sqrt{2}}{3+2\sqrt{2}} \times \frac{3-2\sqrt{2}}{3-2\sqrt{2}}$	M1	**FT** *their* $3 + 2\sqrt{2}$ if of equivalent difficulty
	Correctly expands $\frac{3-2\sqrt{2}-3\sqrt{2}+4}{9-8}$	DM1	**FT** *their* $3 + 2\sqrt{2}$ if of equivalent difficulty
	$7 - 5\sqrt{2}$	A1	
	Alternative method $\frac{1-\sqrt{2}}{(1+\sqrt{2})(1+\sqrt{2})} \times \frac{(1-\sqrt{2})(1-\sqrt{2})}{(1-\sqrt{2})(1-\sqrt{2})}$	(M1)	
	$\frac{(3-2\sqrt{2})(1-\sqrt{2})}{(1-2)^2}$	(M1)	
	Correctly expands $\frac{3-3\sqrt{2}-2\sqrt{2}+4}{[(-1)^2]}$	(DM1)	**FT** *their* $3 - 2\sqrt{2}$ if of equivalent difficulty
	$7 - 5\sqrt{2}$	(A1)	

Question	Answer	Marks	Partial Marks
3	$C(10, -4)$	**B1**	
	$\left[m_{AC} =\right]\frac{6-1}{2-6}$ oe or $\frac{-5}{4}$ oe	**M1**	
	$m_{\perp} = \frac{4}{5}$	**M1**	**FT** $\frac{-1}{their\frac{-5}{4}}$
	$y - (-4) = \frac{4}{5}(x-10)$ oe	**A1**	**FT** *their* coordinates of *C* providing that one coordinate is correct and *their* perpendicular gradient
	$4x - 5y = 60$ oe	**A1**	
4(a)	CVs $\frac{1}{5}$, 6	**M1**	
	$x < \frac{1}{5}$, $x > 6$	**A1**	mark final answer
4(b)	$(-4k)^2 - 4(2k+1)(2k-1)$	**M1**	
	$16k^2 - 4(4k^2 - 1)$ or $16k^2 - 16k^2 - 8k + 8k + 4$ or better	**A1**	
	$4 > 0$	**A1**	
5(a)	8π	**B1**	
5(b)	$c = 3$	**B1**	
	$\left[\frac{\pi}{b} = 8\pi\right]$ $b = \frac{1}{8}$	**B1**	
	$7 = a\tan\left(\frac{\pi}{4}\right) + 3$ oe	**M1**	
	$a = 4$	**A1**	

Question	Answer	Marks	Partial Marks
6(a)	$\mathrm{p}'(x):\ 18x^2+2ax-52$	**B1**	
	$18 + 2a - 52 = 4$	**M1**	**FT** if at least 2 terms correct in derivative and has a term in a
	$a=19$	**A1**	
	Correct method to find b $\frac{6\times27}{8}+\frac{9(19)}{4}-\frac{52\times3}{2}+b=0$ or $\frac{81}{4}+\frac{171}{4}-78+b=0$ oe or correct elimination of a using $9a+4b=231$ oe and $2a-34=4$ oe	**M1**	**FT** *their* integer value of a if used $9(19)+4b=231$
	$b=15$	**A1**	If 0 scored, **SC1** for $9a+4b=231$ or $\frac{81}{4}+\frac{9a}{4}-78+b=0$ or $\frac{9}{4}a+b=\frac{231}{4}$ oe
6(b)	$\mathrm{p}(x)=(2x-3)(3x^2+14x-5)$	**M2**	**M1** for two terms correct in quadratic factor
	$(2x-3)(3x-1)(x+5)$	**A1**	
7(a)(i)	$x>0.6$	**B1**	
7(a)(ii)	$[x=]\frac{13}{5}$ or 2.6	**B1**	nfww
7(b)	$\frac{1}{2}\log_y 64=\log_y 8$ soi or $4=\log_y y^4$ soi	**B1**	
	Combines log terms e.g. $\log_y \frac{x}{1296}=4$ or $\log_y x=\log_y 1296y^4$ or $\log_y \frac{1296}{x}=-4$	**B2**	**B1** for one further correct application of a relevant log law e.g. $\log_y x=4+\log_y 1296$ or $\log_y x=\log_y y^4+\log_y 8+\log_y 162$
	$y^4=\frac{x}{1296}$ or $1296y^4=x$ oe	**M1**	
	$y=\frac{\sqrt[4]{x}}{6}$ or $y=\frac{x^{\frac{1}{4}}}{6}$	**A1**	mark final answer

Question	Answer	Marks	Partial Marks
8(a)	$\frac{d}{dx}(e^{4x}) = 4e^{4x}$	**B1**	
	$8xe^{4x} + 2e^{4x}$ isw	**B1**	**FT** *their* ke^{4x}
8(b)	Use of part (a) $\int 8xe^{4x}\,dx = 2xe^{4x} - \int 2e^{4x}\,dx$ oe	**B1**	**FT** part **(a)** providing of form $kxe^{4x} + 2e^{4x}$
	$\int xe^{4x}\,dx = \frac{1}{4}xe^{4x} - \frac{1}{4}\int e^{4x}dx$ oe	**M1**	**FT** part **(a)** providing of form $kxe^{4x} + 2e^{4x}$
	$\frac{xe^{4x}}{4} - \frac{e^{4x}}{16} + c$ oe	**A2**	**A1** for any 2 terms correct
9(a)	$\sqrt{40^2 + (-9)^2}$ soi	**M1**	
	$\frac{40}{41}\mathbf{i} - \frac{9}{41}\mathbf{j}$ oe	**A1**	mark final answer
9(b)(i)	$0 < k < 1$	**B1**	
9(b)(ii)	$\overrightarrow{OR} = \mathbf{p} + k(\mathbf{q} - \mathbf{p})$ or $\overrightarrow{OR} = \mathbf{q} + (1-k)(\mathbf{p} - \mathbf{q})$	**M1**	
	$\overrightarrow{OR} = (1-k)\mathbf{p} + k\mathbf{q}$	**A1**	
	$\lambda + \mu = 1 - k + k = 1$	**A1**	

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Question	Answer	Marks	Partial Marks
10	*A*(1.5, 3.75) soi	**B1**	
	Factorises or solves $3+2x-x^2=0$	**M1**	
	C(3, 0) soi	**A1**	implies **M1**
	$\frac{\mathrm{d}y}{\mathrm{d}x}=2-2x$, when $x = 1.5$ $\frac{\mathrm{d}y}{\mathrm{d}x}=-1$	**B1**	
	$y – 3.75 = –(x – 1.5)$ oe leading to *B*(5.25, 0) soi	**B2**	**B1** for $y – 3.75 = –(x – 1.5)$ oe
	$\frac{1}{2}\times(5.25-1.5)\times3.75$ $5.25^2-\frac{5.25^2}{2}-\left(5.25(1.5)-\frac{1.5^2}{2}\right)$	**B1**	OR $\frac{1}{2}\times(5.25-3)\times2.25$ $5.25^2-\frac{5.25^2}{2}-\left(5.25(3)-\frac{3^2}{2}\right)$
	$\left[\int_{1.5}^{3}(3+2x-x^2)\,\mathrm{d}x=\left[\mathrm{F}(x)\right]_{1.5}^{3}=\right]$ $\left[3x+\frac{2x^2}{2}-\frac{x^3}{3}\right]_{1.5}^{3}$	**M1**	OR $\left[\int_{1.5}^{3}(2.25-3x+x^2)\,\mathrm{d}x=\left[\mathrm{G}(x)\right]_{1.5}^{3}=\right]$ $\left[2.25x-\frac{3x^2}{2}+\frac{x^3}{3}\right]_{1.5}^{3}$ oe
	$\left(their\,\frac{225}{32}\right)-\left(\mathrm{F}(3)-\mathrm{F}(1.5)\right)$	**M1**	**dep** on at least 2 correct terms in the integration OR $\left(\mathrm{G}(3)-\mathrm{G}(1.5)\right)+\left(their\,\frac{81}{32}\right)$
	$\frac{117}{32}$ or 3.65625	**A1**	
11(a)	$\left[S_{20}=\right]\frac{20}{2}\{2a+19d\}=1100$ oe	**B1**	
	$\left[S_{70}=\right]\frac{70}{2}\{2a+69d\}=14350$ oe	**B1**	
	Solves *their* linear equations in *a* and *d*	**M1**	**dep** on at least **B1** and an attempt to form the other equation using the sum formula
	$a = –2$, $d = 6$	**A2**	**A1** for each
	$\left[u_{12}=-2+11\times6=\right]64$	**B1**	

Question	Answer	Marks	Partial Marks
11(b)	$\frac{x-9}{x+6}=\frac{\frac{1}{2}(x+1)}{x-9}$ or $(x-9)\left(\frac{x-9}{x+6}\right)=\frac{1}{2}(x+1)$ $(x+6)\left(\frac{x-9}{x+6}\right)^2=\frac{1}{2}(x+1)$ oe	**M2**	**M1** for either $\frac{x-9}{x+6}$ or $\frac{\frac{1}{2}(x+1)}{x-9}$; may be embedded
	Correct simplification to given equation $x^2-43x+156=0$	**A1**	
	Factorises or solves: $(x-4)(x-39)=0$	**M1**	
	$x=4$, $x=39$	**A1**	
	$r=-\frac{1}{2}$ $r=\frac{2}{3}$ $\lvert r\rvert<1$ for each progression [and so the sum to infinity exists]	**A2**	**A1** for either value of r
12	$\frac{\pi x^2 y}{2}=25000$ oe	**M1**	
	$y=\frac{50000}{\pi x^2}$ or $\pi xy=\frac{50000}{x}$	**A1**	
	$S=\pi x\left(\frac{50000}{\pi x^2}\right)+\pi x^2$	**M1**	**FT** *their y* providing of the form $\frac{k}{\pi x^2}$
	$S=\frac{50000}{x}+\pi x^2$	**A1**	
	$\frac{\mathrm{d}S}{\mathrm{d}x}=-50000x^{-2}+2\pi x$ oe	**M1**	FT from expression of form $\frac{k}{x}+m\pi x^2$
	Equates to zero and solves for x: $x=\sqrt[3]{\frac{25000}{\pi}}$ or 19.9647....	**A1**	
	$S_{\min}=\frac{50000}{\sqrt[3]{\frac{25000}{\pi}}}+\pi\left(\sqrt[3]{\frac{25000}{\pi}}\right)^2$	**DM1**	**dep** on previous **M1;** **FT** *their* positive value of x used in a correct expression for S
	3760 or 3756 to 3757	**A1**	