Question Number	Scheme	Marks
9(a)	$\left(2\tan\theta = 3\cos\theta \Rightarrow\right)\dfrac{2\sin\theta}{\cos\theta} = 3\cos\theta$	M1
	$\dfrac{2\sin\theta}{\cos\theta} = 3\cos\theta \Rightarrow 2\sin\theta = 3\cos^2\theta = 3\left(1-\sin^2\theta\right)$	M1
	$2\sin\theta = 3\left(1-\sin^2\theta\right) \Rightarrow 3\sin^2\theta + 2\sin\theta - 3 = 0$*	A1*
		(3)
(b)	$\left(\sin\left(2x+\dfrac{\pi}{3}\right)=\right)\dfrac{-1\pm\sqrt{10}}{3}$ (May only see positive root) NB decimal roots are: −1.387…, 0.7207…	M1
	$2x+\dfrac{\pi}{3} = \sin^{-1}(0.7207...) \Rightarrow x = ...$	M1
	$-0.121,\ -2.50,\ 0.645,\ 3.02$	A1A1
		(4)
		Total 7

Question Number	Scheme	Marks
4 (a)	$(3+2x)^6$	
	First term 3^6 or 729	B1
	Term in x, x^2 or x^3: Award for one of ${}^6C_5(3)^5(2x)^1$, ${}^6C_4(3)^4(2x)^2$ or ${}^6C_3(3)^3(2x)^3$	M1
	Two of $...+2916x+4860x^2+4320x^3+...$	A1
	$(3+2x)^6 = 729+2916x+4860x^2+4320x^3+...$	A1
		(4)
(b)	Attempts one correct term $2x^2\times"729"$ **or** $\pm\dfrac{1}{6x}\times"4320"x^3$	M1
	Attempts to combine the correct two terms $2x^2\times"729"\pm\dfrac{1}{6x}\times"4320"x^3 = ...x^2$	dM1
	738 but condone $738x^2$	A1
		(3)
		Total 7

Question Number	Scheme	Marks
1.(a)	States/uses either $16k=-4$ or $\frac{16\times15}{2}k^2=p$	M1
	(i) $k=-\frac{1}{4}$	A1
	(ii) $p=\frac{15}{2}$	A1
		(3)
(b)	$g(x)=\left(2+\frac{16}{x}\right)(1+kx)^{16}$	
	Attempts either $2"p"$ or $16\times\frac{16\times15\times14}{3!}\times k^3$	M1
	Attempts sum of $2"p"$ and $16\times\frac{16\times15\times14}{3!}\times k^3$	dM1
	Term in x^2 $=(15-140)x^2=-125x^2$	A1
		(3)
		(6 marks)

Question Number	Scheme	Marks
4 (a)	$\frac{a\left(1-r^3\right)}{1-r}=70.2\ ,\quad \frac{a}{1-r}=75$	B1, B1
	Sub (2) in (1) $\quad 75\left(1-r^3\right)=70.2\Rightarrow r^3=(0.064)$	M1
	$r=0.4$	A1
		(4)
(b)	Substitutes $r=0.4$ into $\frac{a}{1-r}=75$ and finds a	M1
	$a=45$	A1
		(2)
		(6 marks)

Question Number	Scheme	Marks
4(i)	E.g. $2=\log_3 9$ Eg $\log_3(4x)-\log_3(5x+7)=\log_3\dfrac{4x}{5x+7}$	M1
	E.g. $36x=5x+7$ $\dfrac{4x}{5x+7}=\dfrac{1}{9}$	A1
	$x=\dfrac{7}{31}$	A1
		(3)
(ii)	$\left(\sum_{r=1}^{2}\log_a y^r=\right)\log_a y+\log_a y^2$ or $\left(\sum_{r=1}^{2}(\log_a y)^r=\right)\log_a y+(\log_a y)^2$	B1
	$\log_a y+\log_a y^2=\log_a y+(\log_a y)^2 \Rightarrow 2\log_a y-(\log_a y)^2=0$ $\Rightarrow \log_a y(2-\log_a y)=0 \Rightarrow \log_a y=2$	M1
	$y=a^2$	A1
		(3)
		Total 6

Question	Answer	Marks	Guidance
1	Differentiate using quotient rule (or product rule)	**M1**	
	Obtain $\dfrac{x-2x\ln x}{x^4}$	**A1**	OE
	Substitute $x=\mathrm{e}$ to obtain $-\dfrac{1}{\mathrm{e}^3}$ or exact equivalent	**A1**	
		3	

Question Number	Scheme	Marks
2.(a)	Attempts to substitute $u_2=6k+3$ in $u_3(=ku_2+3)$ $u_3=k(6k+3)+3$	M1 A1 **(2)**
(b)	Uses $\sum_{n=1}^{3}u_n=117 \Rightarrow 6+6k+3+k(6k+3)+3=117$ $6k^2+9k-105=0 \Rightarrow k=\ldots$ $k=\dfrac{7}{2}$	M1 dM1 A1 **(3)**
		(5 marks)

Question Number	Scheme	Marks
7(a)	$(u_{100} =) 20 + 99(0.5) = (£) 69.50$ *	B1*
		(1)
(b)	$S_{300} = \frac{1}{2}(300)\{2 \times 20 + 299(0.5)\} = ...$ **or** $S_{300} = \frac{1}{2}(300)\{20 + 169.50\} = ...$	M1
	$= (£) 28425$	A1
		(2)
(c)	$20 \times r^{299} = 250 \Rightarrow r = \sqrt[299]{\frac{250}{20}} (= 1.008483032...)$	M1
	$S_{300} = \frac{20(1 - r^{300})}{1 - r} = (27362.948...)$ $28425 - 27362.948...$	M1
	(£)1060	A1
		(3)
		Total 6

Question Number	Scheme	Marks
8 (i)	$S_n = a + ar + ar^2 + ...ar^{n-1}$	B1
	$S_n = a + ar + ar^2 + ...ar^{n-1}$ **and** $rS = ar + ar^2 + ar^3 + ...ar^n$ Finds S_n and rS_n and subtracts. E.g. $S - rS = ...$	M1
	Completes proof $\Rightarrow S_n(1-r) = a(1-r^n) \Rightarrow S_n = \frac{a(1-r^n)}{(1-r)}$ *	A1*
		(3)
(ii) (a)	Attempts $U = 150 \times 0.92^n$ with $n = 5$ or 6	M1
	$\Rightarrow (U_6) = 150 \times (0.92)^6 = 90.95$ (≈ 91 litres) *	A1*
		(2)
(b)	Attempts $S_n = \frac{a(1-r^n)}{(1-r)}$ with $n = 39/40/41$ $a = 150/138$ and $r = 0.92$	M1
	$S = \frac{138(1-0.92^{40})}{(1-0.92)}$, $S = 150 \times \frac{0.92(1-0.92^{40})}{(1-0.92)}$ OR $S = \frac{150(1-0.92^{41})}{(1-0.92)} - 150$	A1
	1664 litres	A1
		(3) **(8 marks)**