Question	Answer	Marks	Partial Marks
1(a)	$w-1=\log_5 12$ or $w-1=\dfrac{\log 12}{\log 5}$	**M1**	
	$w=2.54$ cao	**A1**	
1(b)	Rewrites in quadratic form e.g.: $y=x^{\frac{1}{3}}$ $y^2-5y+6=0$ or $\left(x^{\frac{1}{3}}\right)^2-5x^{\frac{1}{3}}+6=0$	**M1**	
	and factorises or solves e.g. : $(y-2)(y-3)=0$	**M1**	Factorising *their* 3 term quadratic
	$x = 8$ and $x = 27$	**A1**	
2(a)	$\lg\dfrac{x^2}{3(x+6)}$ oe, nfww	**B2**	**B1** for any two log laws applied correctly e.g. $\lg\dfrac{x^2}{x+6}-\lg 3$
2(b)	$\lg\dfrac{x^2}{3(x+6)}=\lg 1$ or $10^0=\dfrac{x^2}{3(x+6)}$	**B1**	FT *their* $\lg\dfrac{x^2}{3(x+6)}$ providing a single logarithm
	$x^2-3x-18=0$	**B1**	**dep** on **B2** in **part (a)**
	Factorises or solves their 3-term quadratic	**M1**	
	$x = 6$ indicated as only solution	**A1**	**dep** on **B2** in **part (a)**
3	Valid method to find m $m=\dfrac{8-1}{9-16}$ [$=-1$]	**M1**	
	Valid method to find c e.g. $1=their(-1)\times 16+c$	**M1**	**FT** *their m*
	$\sqrt[3]{y}=their(-1)x^2+their17$	**A1**	Equation with correct variables and $\sqrt[3]{y}=$
	$y=\left(-x^2+17\right)^3$ oe, isw	**A1**	

Question	Answer	Marks	Partial Marks
4	$27m - 153 + 3n + 6 = 0$ or better	**B1**	
	$-m - 17 - n + 6 = -12$ or better	**B1**	
	Eliminates one unknown for a pair of linear equations in *m* and *n* and solves for one unknown	**M1**	
	$m = 6$, $n = -5$	**A2**	**A1** for either
	–24 cao	**A1**	
5(a)(i)	$1 + 4nx + 8n(n-1)x^2$	**B2**	**B1** for any two correct terms or all 3 correct but listed not summed
5(a)(ii)	$8n(n-1) - 16n$	**M1**	**FT** from (i) identifying correct terms and combining *their* coefficient of $x^2 - 4 \times$ *their* coefficient of x
	Solves or factorises *their* 3-term quadratic in *n* only	**M1**	Forms a 3-term quadratic = 0 and solves except allow '= a constant' if they go on to complete to square
	$n = 29$ only	**A1**	
5(b)	${}^{10}C_2 \times \left(\frac{x}{2}\right)^8 \times \left(-\frac{8}{x^4}\right)^2$ soi	**M1**	Must be clearly identified not in expansion
	11.25 or $\frac{45}{4}$	**A1**	
6(a)(i)	$6 \times 6 \times 5 \times 4 \times 3$ oe	**M1**	
	2160	**A1**	
6(a)(ii)	Full correct calculation (360 + 900) 'how many end with 0'+ 'how many end with 2, 4, 6' oe	**M2**	**M1** for any correct product soi Eg $(6 \times 5 \times 4 \times 3 \times 1)$ or 360 $(5 \times 5 \times 4 \times 3 \times 1)$ or 300 $(5 \times 5 \times 4 \times 3 \times 3)$ or 900
	1260 cao	**A1**	
6(b)	${}^{15}C_7 - {}^{9}C_7$	**M1**	
	6399	**A1**	

Question	Answer	Marks	Partial Marks
6(c)(i)	$\frac{n!}{(n-3)!3!}+\frac{n!}{(n-2)!2!}$	**B2**	**B1** for either expression correct
	$\frac{n(n-1)(n-2)}{6}+\frac{n(n-1)}{2}$	**M2**	**M1** for either expression correct
	$\frac{n(n-1)(n-2+3)}{6}$ or $\frac{n^3-3n^2+2n}{6}+\frac{3n^2-3n}{6}$ leading to $\frac{1}{6}(n^3-n)$	**A1**	
6(c)(ii)	$n(n^2-25)=0$ oe	**M1**	
	$n = 5$ as the only solution	**A1**	
7	$\frac{d}{dx}(\sin 3x)=3\cos 3x$ soi	**B1**	
	$u=(1+\sin 3x)^4$ $\frac{du}{dx}=4(1+\sin 3x)^3(3\cos 3x)$ soi	**M1**	**FT** *their* 3cos3*x*
	$\frac{dy}{dx}=\frac{\sqrt{x}\left(4(1+\sin 3x)^3(3\cos 3x)\right)-(1+\sin 3x)^4\times\frac{1}{2}x^{-\frac{1}{2}}}{\left(\sqrt{x}\right)^2}$	**M1**	FT *their* $\frac{du}{dx}$ *or their* $\frac{dv}{dx}$ but not both
	Correct derivative	**A1**	
	Evaluates *their* derivative at $x = 1.9$ and multiplies by h	**M1**	
	$0.651h$	**A1**	
8(a)	$x=6\sqrt{3}\sin 60$ $y=-6\sqrt{3}\cos 60$ oe and completion to $9\mathbf{i}-3\sqrt{3}\mathbf{j}$	**B2**	**B1** for either x or y correct Allow **SC1** for verification that $9\mathbf{i}-3\sqrt{3}\mathbf{j}$ has a bearing of 120° and that $9\mathbf{i}-3\sqrt{3}\mathbf{j}$ has a magnitude of $6\sqrt{3}$
8(b)	$(5\mathbf{i}+16\mathbf{j})+3\left(9\mathbf{i}-3\sqrt{3}\mathbf{j}\right)$ oe, isw	**B1**	
8(c)	$29\mathbf{i}+16\mathbf{j}+t(-12\sqrt{3}\mathbf{j})$ oe, isw	**B1**	

Question	Answer	Marks	Partial Marks
8(d)	Forms $\overrightarrow{AB}$ or $\overrightarrow{BA}$ when $t = 1$ e.g. $\overrightarrow{BA} = (32\mathbf{i} + (16 - 9\sqrt{3})\mathbf{j}) - (29\mathbf{i} + (16 - 12\sqrt{3})\mathbf{j})$ oe	**B1**	**FT** *their* (b) and (c) with $t = 1$
	$\sqrt{3^2 + (3\sqrt{3})^2}$	**M1**	**FT** *their* $\overrightarrow{AB}$ or $\overrightarrow{BA}$
	6 (km)	**A1**	cao
9(a)	$h = \sqrt{x^2 - \left(\frac{x}{2}\right)^2}$ oe or $\cos 30 = \frac{h}{x}$ oe or $\frac{1}{2}xh = \frac{1}{2}x^2 \sin 60$	**M1**	Correct expression connecting x and h
	$x = \frac{2h}{\sqrt{3}}$ oe	**A1**	Must be $x =$
	$V = \frac{1}{2} \times \left(their \frac{2h}{\sqrt{3}}\right)^2 \times \sin 60° \times 5$ or $\frac{1}{2} \times h \times their \frac{2h}{\sqrt{3}} \times 5$	**M1**	
	Correct completion to given answer $V = \frac{5\sqrt{3}h^2}{3}$	**A1**	
9(b)	Correct derivative of V e.g. $\frac{10\sqrt{3}}{3}h$	**B1**	
	$\frac{dh}{dt} = \frac{dV}{dt} \times \frac{dh}{dV}$ soi	**B1**	Not $\frac{\partial V}{\partial h}$
	$0.5 \div \left(\frac{10\sqrt{3}}{3} \times 0.1\right)$ oe	**M1**	
	0.866 (metres per minute) or 0.8660[25…] rot to 4 or more sf	**A1**	Allow $\frac{\sqrt{3}}{2}$ isw
10(a)	$\ln x - 1$	**B2**	**B1** for $[1\times]\ln x + x \times \frac{1}{x}[-2]$ oe

Question	Answer	Marks	Partial Marks
10(b)	$x+\frac{1}{x}+2$	B1	
	$\frac{dy}{dx}=\frac{x^2}{2}+\ln x+2x(+c)$	M2	**M1** for $\frac{dy}{dx}=...+\ln x+...$ or for $\frac{dy}{dx}=\frac{x^2}{2}+...+2x$
	Substitution to find c: $\frac{e^2}{2}+2e=\frac{e^2}{2}+\ln e+2e+c$ $[c=-1]$	M1	**FT** *their* attempt to integrate dependent on at least **M1**
	$y=\int\left(\frac{x^2}{2}+2x+\ln x-1\right)dx$	A1	
	Integrates and uses (a) $y=\frac{x^3}{6}+\frac{2x^2}{2}+x\ln x-2x+C$	M1	Dependent on **M2M1** **FT** error in c only
	$\frac{e^3}{6}+e^2=\frac{e^3}{6}+e^2+e\ln e-2e+C$	M1	Substitution to find C Dependent on previous **M1**
	$y=\frac{x^3}{6}+x^2+x\ln x-2x+e$	A1	
11	$B\left(\frac{\pi}{10},0\right)$ soi	B1	
	$\int_0^{\frac{\pi}{4}}e^{\frac{x}{2}}\,dx-\int_0^{\frac{\pi}{10}}\cos 5x\,dx$	M2	**M1** Integrates $e^{\frac{x}{2}}$ to $ke^{\frac{x}{2}}$, $k\neq 0$ **M1** Integrates $\cos 5x$ to $k\sin 5x$, $k>0$ or $k=-\frac{1}{5}$
	$\left[2e^{\frac{x}{2}}\right]_0^{\frac{\pi}{4}}-\left[\frac{\sin 5x}{5}\right]_0^{\frac{\pi}{10}}$	A2	**A1** for each part correct
	$\left[2e^{\frac{\pi}{8}}-2e^0\right]-\left[\frac{1}{5}\sin\frac{5\pi}{10}-\frac{1}{5}\sin 0\right]$	M1	**M1** for correct attempt at subtraction and for one correct use of limits dependent on at least **M1**for integration and **B1**
	$2e^{\frac{\pi}{8}}-\frac{11}{5}$ isw	A1	