Question Number	Scheme	Marks
3(a)(i)	$a_1 = \frac{1}{4}$	B1
(ii)	$a_2 = \frac{1}{4}$	B1
(iii)	$a_3 = 1$	B1
		(3)
(b)	$\frac{50}{2}[2+49]$ $(=1275)$ oe	M1A1
	$\sum_{n=1}^{50} \cos^2\left(\frac{n\pi}{3}\right) = 34\times\frac{1}{4}+16\times1$	M1
	$1275+\frac{49}{2}=\frac{2599}{2}$	A1
		(4)
		(7 marks)

(a)

B1: $\frac{1}{4}$ or 0.25

B1: $\frac{1}{4}$ or 0.25

B1: 1 (which has clearly not come from a rounded degrees decimal answer)

Note that use of degrees gives $a_1 = 0.9996659868...$, $a_2 = 0.9986643935...$, $a_3 = 0.9969965583...$ and scores no marks.

(b)

M1: Correct attempt to find the sum of $1+2+3+...+50$

A1: $\frac{50}{2}[2+49]$ or e.g. $\frac{50}{2}[1+50]$ or 1275

Award for any correct numerical expression or for 1275. May be implied or may be seen as part of a complete calculation. A correct answer only of 1275 implies both of the first 2 marks.

M1: Correct attempt to find $\sum_{n=1}^{50} \cos^2\left(\frac{n\pi}{3}\right)$ e.g. by $34\times\frac{1}{4}+16\times1$ or $17\times\frac{1}{4}+17\times\frac{1}{4}+16\times1$ or $16\times(\frac{1}{4}+\frac{1}{4}+1)+\frac{1}{4}+\frac{1}{4}$ or $17\times(\frac{1}{4}+\frac{1}{4}+1)-1$

Must be a **correct** method for the **correct** sequence, e.g. $\frac{1}{4}+\frac{1}{4}+1+\frac{1}{4}+\frac{1}{4}+1+\frac{1}{4}+\frac{1}{4}+1+...$

If they **just** write down 49/2 this scores M0

A1: $\frac{2599}{2}$ or exact equivalent e.g. 1299.5. Isw once a correct answer is seen.

Note that a method must be seen in part (b) as stated in the question. Correct answer only of 2599/2 scores no marks.

Question Number	Scheme	Marks
4(a)	$10=\log_a 8-\log_a 4\Rightarrow \log_a 2=10$	M1
	$a^{10}=2$	M1
	$a=2^{1/10}=1.07177...$ *	A1*
		(3)
(b)	$w=\log_{1.072}(t+5)-\log_{1.072}4\Rightarrow w=\log_{1.072}\left(\frac{t+5}{4}\right)$	M1
	$w=\log_{1.072}\left(\frac{t+5}{4}\right)\Rightarrow \frac{t+5}{4}=1.072^w\Rightarrow t=...$	M1
	$t=4\times 1.072^w-5$	A1
		(3)
(b) ALT	$w=\log_{1.072}(t+5)-\log_{1.072}4\Rightarrow w+\log_{1.072}4=\log_{1.072}(t+5)$	M1
	$\Rightarrow t+5=1.072^{w+\log_{1.072}4}$	M1
	$\Rightarrow t=1.072^{w+\log_{1.072}4}-5$	A1
(c)	$t=4\times 1.072^{15}-5=...$	M1
	awrt 6.35	A1
		(2)
		(8 marks)

(a)

M1: Substitutes $t=3$ and $w=10$ into the equation and achieves $\log_a 2=10$ or e.g. $\log_a \frac{8}{4}=10$ correctly

M1: Correctly removes the log to obtain $a^{10}="2"$

A1*: Fully correct proof showing $a=2^{1/10}$ or $a=\sqrt[10]{2}$ or $a=\sqrt[10]{\frac{8}{4}}$ and obtains awrt 1.072

Note that this may be implied by the accuracy of their *a* e.g. 1.071773463… so allow for 1.0718 (rounded) or 1.0717 (truncated).

May also see logarithm approach e.g. $a^{10}=2\Rightarrow \log a^{10}=\log 2\Rightarrow \log a=\frac{\log 2}{10}\Rightarrow a=10^{\frac{\log 2}{10}}=...$

or $a^{10}=2\Rightarrow \ln a^{10}=\ln 2\Rightarrow \ln a=\frac{\ln 2}{10}\Rightarrow a=e^{\frac{\ln 2}{10}}=...$

<u>False solutions in (a):</u>

$$10=\log_a 8-\log_a 4\Rightarrow \frac{\log_a 8}{\log_a 4}=10\Rightarrow \log_a 2=10\Rightarrow a^{10}=2\Rightarrow a=\sqrt[10]{2}=1.072$$

Scores **M0M1A0**

$$10=\log_a 8-\log_a 4\Rightarrow \frac{8\log a}{4\log a}=10\Rightarrow 2\log a=10\Rightarrow \log a^2=10\Rightarrow a^{10}=2\Rightarrow a=\sqrt[10]{2}=1.072$$

Scores no marks