Question	Scheme	Marks	AOs
6(a)	Attempts $\cos^2(2x) \approx \left(1-\frac{(2x)^2}{2}\right)^2 = ...\left(1-4x^2+4x^4\right)$	M1	1.1b
	$1-\cos^2(2x) \approx 1-\left(1-4x^2+4x^4\right) = 4x^2-4x^4$ *	A1*	1.1b
		(2)	
(b)	$\frac{1-\cos^2(2x)}{\sin\left(\frac{x}{3}\right)\tan\left(\frac{x}{2}\right)} \approx \frac{4x^2-4x^4}{\left(\frac{x}{3}\right)\left(\frac{x}{2}\right)}$	M1	1.1b
	$= \frac{6}{x^2}\left(4x^2-4x^4\right) = 24-24x^2$	A1	2.1
		(2)	
(c)	24	B1ft	2.2a
	If x is (very) small, then any terms in x^2 are negligible.	dB1ft	2.4
		(2)	
			(6 marks)

Notes

(a)

M1: Attempts to use $\cos\theta \approx 1-\frac{\theta^2}{2}$ with θ, 2θ, x or $2x$ and squares the resulting expression.

Condone poor squaring, e.g., $\left(1-2x^2\right)^2 = 1-4x^4$ or missing brackets $\left(1-\frac{2x^2}{2}\right)^2 = \left(1-x^2\right)^2 = ...$

but not e.g. $\cos 2x \approx 2\left(1-\frac{x^2}{2}\right)$

May be implied by e.g. $1-\left(1-2x^2\right)^2 = 2x^2\left(2-2x^2\right)$ from difference of two squares.

A1*: Correct proof with an intermediate line such as $1-\left(1-4x^2+4x^4\right)$

Do not be concerned if the LHS does not appear and ignore any spurious = 0 in their work.
There should be no obvious incorrect statements in the proof e.g. $1-\left(1+4x^2-4x^4\right)$

Do not condone incorrect work including invisible brackets such as $1-1-4x^2+4x^4$ or $\left(1-\frac{2x^2}{2}\right)$ but condone a missing trailing bracket e.g. $1-(1-4x^2+4x^4$

Condone an attempt that starts in stages, which may not deal with the full expression e.g., $1-\left(1-\frac{4x^2}{2}\right) \to 1-\left(1-2x^2\right)^2 = ...$ has a missing square on the first bracket but is recovered in the next stage/step.

The final line should be in terms of x but condone a slip to e.g. θ in the workings of the proof.
If they complete the proof using θ they must revert to x to score this mark.

Special Cases: In each of these cases below, please send to review.
You may see attempts that use e.g.

- $\cos 2x = \pm 2\cos^2 x \pm 1$ or $\cos^2 2x = \pm\frac{1}{2} \pm \frac{1}{2}\cos 4x$
- $\cos 2x = \pm 1 \pm 2\sin^2 x$ followed by the small angle approximation for $\sin x$
- Maclaurin expansions

(b)

M1: Uses the **given answer** to part (a) and writes $\sin\left(\frac{x}{3}\right)$ **and** $\tan\left(\frac{x}{2}\right)$ using correct small angle approximations. Only allow misreads that are clearly misreads e.g. they cannot replace $\tan\left(\frac{x}{2}\right)$ with $\frac{x}{3}$ unless $\tan\left(\frac{x}{3}\right)$ is seen first. In such cases they will lose the A mark in (b) but both of the marks in (c) are available. Condone mixed variables for this mark.

A1: $24-24x^2$ but condone e.g. $24+-24x^2$ or e.g. $a = 24$ and $b = -24$
Condone recovery of missing/invisible brackets but the work must otherwise be correct.
Do not condone mixed variables being recovered unless explicitly replaced with x before cancelling x^2.

No marks are scored in (b) for using the Maclaurin expansions for $\sin\left(\frac{x}{3}\right)$ and/or $\tan\left(\frac{x}{2}\right)$

(c)

B1ft: 24 but this must follow from the non-zero constant term in their answer to (b).
Do not allow e.g. $x = 24$
Allow follow through on their non-zero constant term from a polynomial in x.

dB1ft: Suitable reason given but it should refer to their x^2 term in some way (and any additional terms if they have any). Ignore spurious remarks e.g. "if $x < 1$" unless contradictory.
Dependent on the previous B1ft mark.
Some acceptable examples:

- $"24"x^2 \to 0$ or $x^2 \to 0$
- "We can ignore the x^2 term"
- "x^2 is much smaller than 24"
- As $x \to 0$ their $a + bx^2 \to a$ (condone as $x \to 0$, bx^2 "becomes" 0)
- $\lim_{x\to 0} a+bx^2 = \left(a+b(0)^2\right) = a$
- Since x is very small, $24 - 24(0)^2 = 24$ (and condone if the squared is missing).

They cannot *just* substitute in 0 or a very small value for x to score the mark for the reason.
A reason such as "the answer rounds to 24" is not acceptable.
There must be some justification, either "as $x \to 0$" or "since x is very small"
so e.g. "$24 - 24(0)^2 = 24$ on its own scores B1ft dB0ft
This mark may be scored from any polynomial in x that includes at least a constant term and an x^2 term.

They cannot go back to e.g. $4x^4$ or $\dfrac{4x^4}{\frac{1}{6}x^2}$ and say this is negligible or $\to 0$ as they haven't dealt with the x in the denominator.