Question Number	Scheme	Marks
2(a)	$\mathrm{f}(\frac{5}{4}) = (2-k\times\frac{5}{4})^5 = \frac{243}{32} \Rightarrow (2-k\times\frac{5}{4}) = \sqrt[5]{\frac{243}{32}} \Rightarrow k = ...$	M1
	$\frac{3}{2} \Rightarrow \frac{5k}{4} = \frac{1}{2} \Rightarrow k = \frac{2}{5}$ *	A1*
		(2)
(b)	$\pm {}^5C_1 \times 2^4 \times \left(\pm\frac{2}{5}x\right)$ or $\pm {}^5C_2 \times 2^3 \times \left(\pm\frac{2}{5}x\right)^2$	M1
	$32 - 32x + \frac{64}{5}x^2$	A1A1
		(3)
(c)	$\mathrm{f}'(x) = -32 + \frac{128}{5}x + ... \Rightarrow \mathrm{f}'(0) = ...$	M1
	$\mathrm{f}'(0) = -32$	A1ft
		(2)
		(7 marks)

(a)

M1: Substitutes $x = \frac{5}{4}$ into $\mathrm{f}(x)$, equates to $\frac{243}{32}$ and attempts to make *k* the subject by taking the 5th root of both sides.

A1*: $k = \frac{2}{5}$ with no errors and sufficient working shown.

Accept as a minimum $(2-k\times\frac{5}{4})^5 = \frac{243}{32} \Rightarrow (2-k\times\frac{5}{4}) = \frac{3}{2} \Rightarrow k = \frac{2}{5}$

Note that **<u>just</u>** $(2-k\times\frac{5}{4})^5 = \frac{243}{32} \Rightarrow k = \frac{2}{5}$ scores no marks as the minimum for the M mark requires taking the 5th root of both sides.

Alternative by verification:

M1: $k = \frac{2}{5},\ x = \frac{5}{4} \Rightarrow (2-\frac{2}{5}\times\frac{5}{4})^5 = \left(\frac{3}{2}\right)^5 = \frac{243}{32}$

Substitutes $k = \frac{2}{5}$ and $x = \frac{5}{4}$ and attempts to raise **an evaluated** $2 - kx$ to the power of 5

A1: Hence $k = \frac{2}{5}$

Fully correct work and makes a (minimal) conclusion e.g. Hence proven, QED, Therefore true, etc.

Note that **<u>just</u>** $(2-\frac{2}{5}\times\frac{5}{4})^5 = \frac{243}{32}$ or $(2-\frac{2}{5}\times\frac{5}{4})^5 = (2-\frac{1}{2})^5 = \frac{243}{32}$ scores no marks as the $2-\frac{2}{5}\times\frac{5}{4}$ or $2-\frac{1}{2}$ must be evaluated for the M mark.

(b)

M1: Attempts the binomial expansion to obtain the correct structure for the x or x^2 term i.e. the correct binomial coefficient with the correct power of 2 and the correct power of $\pm\frac{2}{5}x$.

The binomial coefficients do not have to be evaluated but must be correct if they are.

If awarding this mark for the x^2 term you can condone missing brackets e.g. $\pm{}^5C_2\times 2^3\times\pm\frac{2}{5}x^2$

A1: For the correct simplified x or x^2 term i.e. $-32x$ or $+\frac{64}{5}x^2$

A1: For $32-32x+\frac{64}{5}x^2$ which may be written as a list. Allow equivalents for $\frac{64}{5}$ e.g. 12.8

Condone $32+(-32x)+\frac{64}{5}x^2$

Ignore any extra terms but do not isw – mark their final answer.
If they don't simplify in (b) do not allow simplified terms in (c) as recovery.

(b) Alternative takes out a power of 2:

$$\left(2-\frac{2}{5}x\right)^5=2^5\left(1-\frac{1}{5}x\right)^5=2^5\left(1-5\times\frac{1}{5}x+\frac{5\times4}{2}\left(\frac{1}{5}x\right)^2+...\right)$$

Score **M1** for $2^5\left(...\pm5\times\pm\frac{1}{5}x+...\right)$ or $2^5\left(...\pm\frac{5\times4}{2}\left(\pm\frac{1}{5}x\right)^2+...\right)$ condoning $\left(\pm\frac{1}{5}x^2\right)$ as above

Then **A** marks as above.

(c)

M1: Attempts to differentiate their expansion **and** substitutes $x=0$ which may be implied.

For the differentiation, look for $x^n\rightarrow x^{n-1}$ at least once including $k\rightarrow 0$ or $kx\rightarrow k$

A1ft: -32 following correct differentiation

Or follow through on their q provided

- the expansion in (b) was of the form $p+qx+rx^2,\ \ p,q,r\neq 0$
- the differentiation is correct for their $p+qx+rx^2$ i.e. $q+2rx$

In part (c) you can also ignore any extra terms e.g. do not penalise if they have differentiated any of the extra terms incorrectly in an otherwise correct solution.

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.