

Question	Scheme	Marks	AOs
6(a)	$(f'(x) =) 4 \cos\left(\frac{1}{2}x\right) - 3$	M1 A1	1.1b 1.1b
	Sets $f'(x) = 4 \cos\left(\frac{1}{2}x\right) - 3 = 0 \Rightarrow x =$	dM1	3.1a
	$x = 14.0$ Cao	A1	3.2a
		(4)	
(b)	Explains that $f(4) > 0$, $f(5) < 0$ and the function is continuous	B1	2.4
		(1)	
(c)	Attempts $x_1 = 5 - \frac{8 \sin 2.5 - 15 + 9}{"4 \cos 2.5 - 3"}$ (NB $f(5) = -1.212\dots$ and $f'(5) = -6.204\dots$)	M1	1.1b
	$x_1 = \text{awrt } 4.80$	A1	1.1b
		(2)	
(7 marks)			
Notes:			

(a)

M1: Differentiates to obtain $k \cos\left(\frac{1}{2}x\right) \pm \alpha$ where α is a constant which may be zero and no other terms. The brackets are not required.

A1: Correct derivative $f'(x) = 4 \cos\left(\frac{1}{2}x\right) - 3$. Allow unsimplified e.g. $f'(x) = \frac{1}{2} \times 8 \cos\left(\frac{1}{2}x\right) - 3x^0$

There is no need for $f'(x) = \dots$ or $\frac{dy}{dx} = \dots$ just look for the expression and the brackets are not required.

dM1: For the complete strategy of proceeding to a value for x .

Look for

- $f'(x) = a \cos\left(\frac{1}{2}x\right) + b = 0$, $a, b \neq 0$
- Correct method of finding a valid solution to $a \cos\left(\frac{1}{2}x\right) + b = 0$

Allow for $a \cos\left(\frac{1}{2}x\right) + b = 0 \Rightarrow \cos\left(\frac{1}{2}x\right) = \pm k \Rightarrow x = 2 \cos^{-1}(\pm k)$ where $|k| < 1$

If this working is not shown then you may need to check their value(s).

For example $4 \cos\left(\frac{1}{2}x\right) - 3 = 0 \Rightarrow x = 1.4\dots$ or $11.1\dots$ (or $82.8\dots$ or $637\dots$ or 803 in degrees) would indicate this method.

A1: Selects the correct turning point $x = 14.0$ and not just 14 or unrounded e.g. $14.011\dots$

Must be this value only and no other values unless they are clearly rejected or 14.0 clearly selected. Ignore any attempts to find the y coordinate.

Correct answer with no working scores no marks.

(b)

B1: See scheme. Must be a full reason, (e.g. change of sign and continuous)

Accept equivalent statements for $f(4) > 0$, $f(5) < 0$ e.g. $f(4) \times f(5) < 0$, "there is a change of sign", "one negative one positive". A minimum is "change of sign and continuous" but do **not** allow this mark if the comment about continuity is clearly incorrect e.g. "because x is continuous" or "because the interval is continuous"

(c)

M1: Attempts $x_1 = 5 - \frac{f(5)}{f'(5)}$ to obtain a value following through on their $f'(x)$ as long as it is a “changed” function.

Must be a correct N-R formula used – may need to check their values.

Allow if attempted in degrees. For reference in degrees $f(5) = -5.65\dots$ and $f'(5) = 0.996\dots$ and gives $x_1 = 10.67\dots$

There must be clear evidence that $5 - \frac{f(5)}{f'(5)}$ is being attempted.

so e.g. $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \Rightarrow x_1 = 4.80$ scores M0 as does e.g. $x_1 = x - \frac{8 \sin\left(\frac{1}{2}x\right) - 3x + 9}{4 \cos\left(\frac{1}{2}x\right) - 3} = 4.80$

BUT evidence may be provided by the accuracy of their answer. Note that the full N-R accuracy is 4.804624337 so e.g. 4.805 or 4.804 (truncated) with no evidence of incorrect work may imply the method.

A1: $x_1 =$ awrt 4.80 not awrt 4.8 but isw if awrt 4.80 is seen. Ignore any subsequent iterations.

Note that work for part (a) cannot be recovered in part (c)

Note also:

$5 - \frac{f(5)}{f'(5)} =$ awrt 4.80 following a correct derivative scores M1A1

$5 - \frac{f(5)}{f'(5)} \neq$ awrt 4.80 with no evidence that $5 - \frac{f(5)}{f'(5)}$ was attempted scores M0