Question Number	Scheme	Marks
2. (a)	$f(1)=4\times1^3+2\times1^2-12=-6$ AND $f(2)=4\times2^3+2\times2^2-12=28$	M1
	States change of sign, continuous and hence root	A1
		(2)
(b)	$4x^3+2x^2-12=0\Rightarrow x^2(4x+2)=12$	M1
	$\Rightarrow x^2=\dfrac{12}{4x+2}=\dfrac{6}{2x+1}\Rightarrow x=\sqrt{\dfrac{6}{2x+1}}$	A1
		(2)
(c) (i)	$\left(x_2=\sqrt{\dfrac{'6'}{2+1}}=1.4...\right),\qquad x_3=1.2519$	M1, A1
(ii)	$\alpha=1.2934$	B1
		(3)
		(7 marks)

(a)

M1: Attempts the value of $f(x)$ at 1 and 2 with at least one correct.

Candidates who state $f(1)<0$, $f(2)>0$ without finding the values will score M0, A0

A smaller interval could be chosen but unlikely. The root must lie within the interval

A1: Both values correct with reason and minimal conclusion (root)

For the reason accept, for example,

- 'Sign change and continuous function'
- '$f(1)=-6<0$, $f(2)=28>0$ and cts'

For the minimal conclusion accept, for example

- Root
- ✓
- QED
- Hence α in the range 1 to 2

(b)

M1: Either writes $4x^3+2x^2-12=0$ OR states $f(x)=0$ with $4x^3+2x^2=12$ o.e.

a**nd** 'correctly' reaches one of the following factorised forms

- $x^2(4x\pm2)=\pm12$
- $x^2(2x\pm1)=\pm6$
- $2x^2(2x\pm1)=\pm12$

Alternatively, they reach $4x^3+2x^2=12$ with evidence as stated above in line 1.

- and then divide each term by $2x^2$ giving $2x+1=\dfrac{12}{2x^2}$ o.e

The key step in the above is an attempt that isolates the $2x+1$ or $4x+2$ term

A1: Shows **each** of the following steps in correctly showing $x=\sqrt{\dfrac{6}{2x+1}}$

- States or sets $f(x)=0$
- $x^2(4x+2)=12$ o.e. for instance $2x+1=\dfrac{12}{2x^2}$
- $x^2=\dfrac{6}{2x+1}$ or $x^2=\dfrac{12}{4x+2}$ o.e
- $x=\sqrt{\dfrac{6}{2x+1}}$

……
…

Alt (b)

It is possible to do this backwards

M1: States $x=\sqrt{\dfrac{k}{2x+1}}$ squares and cross multiplies to $x^2(2x+1)=k$

A1: Compares $4x^3+2x^2-12=0$ with $2x^3+x^2-k=0$ o.e and states that $f(x)=0$ when $k=6$

…….

(c)

M1: Attempts to use the iteration formula at least once with $x_1=1$. Follow through on their *k*

It cannot be scored form a made-up value for *k.*

Look for $x_2=\sqrt{\dfrac{6}{2\times1+1}}$ but it is implied by $x_2=\sqrt{2}$ or awrt 1.4... for correct *k*

Also implied by $x_3=$ awrt 1.25 for correct *k*

A1: $x_3=$ awrt 1.2519

B1: $\alpha=1.2934$ CAO following evidence of some iteration (and must follow *k* = 6)

Accept as sight of iteration any decimal answer in the range $(1,2)$ for an intermediate value x_n

Question Number	Scheme	Marks
3. (a)	$\dfrac{\mathrm{d}x}{\mathrm{d}y}=\dfrac{8y(2y+1)-2\left(4y^2-3\right)}{(2y+1)^2}$	M1 A1
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{(2y+1)^2}{8y^2+8y+6}$	dM1, A1
		(4)
(b)	Sets $\dfrac{(2y+1)^2}{8y^2+8y+6}=\dfrac{1}{3}\Rightarrow 4y^2+4y-3=0$	M1, A1
	$\Rightarrow (2y-1)(2y+3)=0\Rightarrow y=\dfrac{1}{2}, x=\ldots$	dM1
	$P=\left(-1,\ \dfrac{1}{2}\right)$ only	A1
		(4) **(8 marks)**

(a)

M1: Attempts the quotient rule to achieve $\dfrac{Ay(2y+1)-B\left(4y^2-3\right)}{(2y+1)^2}$ $A>0, B>0$.

Product rule attempts may be seen

Condone missing brackets and ignore the LHS, so $\dfrac{\mathrm{d}x}{\mathrm{d}y}$ may be $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

A1: $\dfrac{\mathrm{d}x}{\mathrm{d}y}=\dfrac{8y(2y+1)-2\left(4y^2-3\right)}{(2y+1)^2}$ with both left-hand and right-hand sides correct (unsimplified)

Via the product rule you should see $\dfrac{\mathrm{d}x}{\mathrm{d}y}=8y(2y+1)^{-1}-2\left(4y^2-3\right)(2y+1)^{-2}$

dM1: Uses $\dfrac{\mathrm{d}y}{\mathrm{d}x}=1\div\dfrac{\mathrm{d}x}{\mathrm{d}y}$. It is dependent upon the previous M1

A1: $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{(2y+1)^2}{8y^2+8y+6}$ o.e such as $\dfrac{4y^2+4y+1}{8y^2+8y+6}$ ISW after a correct answer.

Allow partially factorised forms such as $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{(2y+1)^2}{2(2y+1)^2+4}$ but $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{-4y^2-4y-1}{-8y^2-8y-6}$ is A0

……
…….

Alt via division

M1: Divides $\left(4y^2-3\right)$ by $(2y+1)$ to achieve $2y+\alpha+\dfrac{\beta}{2y+1}$ and then differentiates to

$2+\dfrac{\delta}{(2y+1)^2}$