Question Number	Scheme	Marks
1	$\mathrm{f}(x)=3\sqrt{x}-\frac{1}{x}-5 \qquad [3,\ 3.8]$	
(a)	$\mathrm{f}(3)=-0.1371809...$(awrt -0.14 or -0.13). [$\mathrm{f}(3.8)=0.5849187...$(awrt 0.58)] $\mathrm{f}(3.4)=0.2376090...$ (awrt 0.24 or 0.23 or just 0.2)	M1 A1
	$\mathrm{f}(3.2)=0.0540631...$ (awrt 0.05) $\mathrm{f}(3.1)=-0.0405355...$ (awrt -0.04)	**d**M1
	$\mathrm{f}(3.15)=0.007011487...$ (awrt 0.007) $\Rightarrow \alpha \approx 3.1$	A1
		(4)
(b)(i)	$\mathrm{f}'(x)=\frac{3}{2}x^{-\frac{1}{2}}+x^{-2}$ or e.g., $\frac{3}{2\sqrt{x}}+\frac{1}{x^2}$	M1 A1
		(2)
(b)(ii)	$\left\{x_0="3.1",\quad \alpha=\right\} \quad "3.1"-\frac{\mathrm{f}("3.1")}{\mathrm{f}'("3.1")}=3.1-\frac{3\sqrt{3.1}-\frac{1}{3.1}-5}{\frac{3}{2\sqrt{3.1}}+\frac{1}{3.1^2}}=\ldots$	M1
	$\left\{=3.1-\frac{-0.0405...}{0.95600...}\right\} \quad =3.1424(01196)$	A1
		(2)
		Total 8

Notes

(a) NB Use of linear interpolation will score no marks for part (a).

M1: Attempts a value for f(3.4) **and** either f(3) or f(3.8) with one correct to 2dp (rounded or truncated)

A1: Correct value for f(3.4) to at least 1s.f. which may be rounded or truncated if full figure not seen.

dM1: **Requires previous M mark.** Proceeds to calculate values for f(3.2) and then f(3.1), or appropriate evaluations for their results to narrow to within a 0.1 range, with at least one correct evaluation.

Useful values: f(3.3) = 01464… f(3.5) = 0.3267…, f(3.6) = 0.4143… , f(3.7) = 0.5003…

A1: 3.1 following calculation of f(3.15) and all correct values. May use x or "root" = There is no requirement for "f(x) continuous" or "sign change" or any reasoning. Ignore if they proceed with further evaluations (e.g. f(3.125)).

SC: 3.1 following signs of values only (e.g., "f(3) = –ve...") is max 1010

(b)(i)

M1: For either $3x^{\frac{1}{2}} \rightarrow px^{-\frac{1}{2}}$ or $x^{-1} \rightarrow qx^{-2}$ oe

A1: Fully correct differentiation (any equivalent form)

(ii)

M1: Applies correct Newton-Raphson formula with their 3.1 or other appropriate value and their $\mathrm{f}'(x)$ and obtains a value. Accept for method seen a correct statement of the formula followed by a value (no need to see the substitution but the formula must be shown).

This mark can be implied by awrt 3.1424 as long as the answer to (a) was 3.1 and (b)(i) was correct, otherwise working must be seen.

If there was no answer to part (a) allow for a correct application with their chosen starting value, but method must be seen. Allow if they use an unrounded value from (a) etc.

A1: awrt 3.1424 following a correct derivative and 3.1 used and ignore further iterations (isw).

Note the exact root is 3.1426 [3.142593527]