Question Number	Scheme	Notes	Marks
2(a)	$f(0.3) = ... \ \{3.4563...\}$ $f(0.4) = -... \ \{4.0615...\}$	Attempts both f(0.3) and f(0.4) and achieves a positive **value** for f (0.3) and a a negative **value** for f (0.4)	M1
	Sign change oe **and** {f(x) is} continuous $\Rightarrow$ root {between $x = 0.3$ and $x = 0.4$}	Both f(0.3)= awrt 3.5 or 3.4 (truncated) & f(0.4) = awrt –4.1 or –4.0 or –4 (truncated), sign change oe, continuity and a minimal conclusion e.g., "root" or "shown". A graph alone is insufficient. Allow "positive, negative" or f(0.3) > 0, f (0.4) < 0 or f(0.3)f(0.4) < 0 for "sign change".	A1
			(2)
(b)	$f(x) = x^2 - \dfrac{7x-4\sqrt{x}}{x^3} = x^2 - 7x^{-2} + 4x^{-2.5}$ $f'(x) = 2x + 14x^{-3} - 10x^{-3.5}$	Indices must be processed for any marks M1: For $...x^n \rightarrow ...x^{n-1}$ at least once A1: 2 correct terms simplified or unsimplified A1: All correct simplified or unsimplified	M1A1A1
	If quotient/product rule used award M1 for any evidence of $...x^n \rightarrow ...x^{n-1}$ $\left(\text{e.g., } x^2 \rightarrow 2x\right)$. Their **final** expression in these cases must imply 2 correct terms for the first A mark. Quotient rule leads to $2x - \dfrac{x^3\left(7-2x^{-\frac{1}{2}}\right) - 3x^2\left(7x-4x^{\frac{1}{2}}\right)}{\left(x^3\right)^2} = 2x - \dfrac{7x^3 - 2x^{\frac{5}{2}} - 21x^3 + 12x^{\frac{5}{2}}}{x^6} = 2x - \dfrac{-14x^3 + 10x^{\frac{5}{2}}}{x^6}$ Product rule on $x^{-3}\left(7x-4\sqrt{x}\right)$ leads to $2x - \left[x^{-3}\left(7-2x^{-\frac{1}{2}}\right) + \left(-3x^{-4}\right)\left(7x-4x^{\frac{1}{2}}\right)\right] = 2x - \left[7x^{-3} - 2x^{-\frac{7}{2}} - 21x^{-3} + 12x^{-\frac{7}{2}}\right]$		
			(3)
(c)	$x_1 = 0.3 - \dfrac{f(0.3)}{f'(0.3)} = ...$ $\left\{= 0.3 - \dfrac{0.3^2 - \dfrac{7(0.3) - 4\sqrt{0.3}}{0.3^3}}{"2(0.3) + 14(0.3)^{-3} - 10(0.3)^{-3.5}"}\right\}$ $\left\{= 0.3 - \dfrac{3.456304816...}{-157.0821698...} = 0.3 + 0.02200316... = ...\right\}$	Obtains a **value** from an attempt to apply the correct Newton-Raphson formula. Allow slips with substitution/miscopying and may be using an incorrectly simplified $f(x)$. Implied by awrt 0.32 (0.322003...) even if f ' (x) is incorrect. Not implied by real root which is 0.33 or 0.328 (0.3276079...) If not implied and no substitution is seen accept as minimum $"0.3 - \dfrac{f(0.3)}{f'(0.3)} = ..."$ but $"x_0 - \dfrac{f(x_0)}{f'(x_0)} = ..."$ is only acceptable if $x_0 = 0.3$ is seen. If only a value is seen it must round to 0.32	M1
	0.322	For awrt 0.322. Must be decimal Ignore further iterations $"\alpha ="$ is not required - just look for awrt 0.322 regardless of how it is labelled	A1
			(2)

Question Number	Scheme	Notes	Marks
2(d)	$f(1.3) = -0.37613...$ $f(1.5) = 0.590438...$ Examples: $\frac{"0.590438.."}{1.5-\beta} = \frac{-("-0.37613...")}{\beta-1.3}$ $\frac{1.5-\beta}{\beta-1.3} = \frac{"0.590438.."}{-("-0.37613...")}$ $\frac{1.5-\beta}{1.5-1.3} = \frac{"0.590438..."}{"0.590438..."-("-0.37613...")}$ $\beta = \frac{1.3("0.590438...")-1.5("-0.37613...")}{"0.590438..."-"-0.37613..."}$ $\Rightarrow \beta = ...$	Obtains a negative value for f (1.3) and a positive value for f (1.5), forms a correct equation for these values **and** solves to obtain a value. Apply BOD if only $\lvert f(1.3)\rvert$ and $\lvert f(1.5)\rvert$ seen. Note f(1.5) may be seen as $\frac{64\sqrt{6}-93}{108}$. Accept "f (1.3)" & "f (1.5)" in equation if values for these seen. May use $\frac{af(b)-bf(a)}{f(b)-f(a)}$ oe. Allow e.g., x for β. If their variable denotes e.g., the distance between (1.3, 0) and $(\beta, 0)$ then 1.3 must be added later. Implied by awrt 1.378 (1.3778285...). Not by real root of 1.377 (1.376561...) **Must be using the correct interval.**	M1
	$= 1.378$	For awrt 1.378. Must be decimal. Ignore further iterations "$\beta =$" is not required - just look for awrt 1.378 regardless of how it is labelled	A1
	Alternative via line equation: $y-("-0.37613...") = \frac{"0.590438..."-("-0.37613...")}{1.5-1.3}(x-1.3)$ then $y=0 \Rightarrow x = ...$ M1 for a correct equation with their f (1.3) and f (1.5), setting y = 0 and solving for x. May use $(1.5, "0.590438...")$ as the point. Could also see equivalent attempts using $y = mx + c$ (finds c from a correct equation, puts y = 0 and solves)		
			(2)
			Total 9