Question Number	Scheme	Notes	Marks
4	$f(x)=\frac{1}{10}x-\frac{(x-4)^2}{\sqrt{x}}=\frac{1}{10}x-\frac{x^2-8x+16}{\sqrt{x}}=\frac{1}{10}x-x^{\frac{3}{2}}+8x^{\frac{1}{2}}-16x^{-\frac{1}{2}}$ $x>0$		
(a)	$f(5)=0.05278...$ $f(5.1)=-0.02579...$ Obtains values for both f (5) and f (5.1) with one correct (1 sf as shown below) if just values are given. Accept $f(5)=\frac{5-2\sqrt{5}}{10}$ for the M mark but the A mark requires a convincing argument that this is > 0		**M1**
	Sign change (or > 0, < 0, or positive, negative or product negative) and f(x) is **continuous** therefore a **root** α is between $x = 5$ and $x = 5.1$	f (5) = awrt 0.05 and f (5.1) = awrt –0.03 (or truncated: -0.02), sign change, any reference to continuity (which could be poor e.g., "x/it/the graph is continual") and a minimal conclusion.	**A1**
			(2)
(b)	$f(5.05)=0.01439...$ $(\Rightarrow 5.05<\alpha<5.1)$	For f (5.05) = awrt 0.01	**B1**
	$f(5.075)=...$ $\{-0.00547...\}$	Obtains a value for f (5.075) following a positive value for f (5.05)	**M1**
	$[5.05,\ 5.075]$ or e.g., $5.05<\alpha<5.075$ Correct interval following no clearly incorrect values for f(5.05) and f(5.075). Allow any equivalent notation but must be a **mathematical** interval. May use x or a etc for α. Note real root is 5.068164... Ignore further bisections and additional work/comment		**A1**
			(3)
(c)	$f'(x)=\frac{1}{10}-\frac{3}{2}x^{\frac{1}{2}}+4x^{-\frac{1}{2}}+8x^{-\frac{3}{2}}$ M1: For $...x^n\to...x^{n-1}$ once, e.g., $\frac{1}{10}x\to\frac{1}{10}$ & allow unprocessed indices e.g., $\frac{1}{10}x^{1-1}$ A1: An expression of the correct form (sign and coefficient slips only). No unprocessed indices nor x^0 A1: All correct. Accept $...+\frac{8}{2}x^{-\frac{1}{2}}+\frac{16}{2}x^{-\frac{1}{2}}$		**M1** **A1** **A1**
	If quotient/product rule is used on the fraction you may see: $\frac{1}{10}-\frac{2x^{\frac{1}{2}}(x-4)-\frac{1}{2}x^{-\frac{1}{2}}(x-4)^2}{x}$ or $\frac{1}{10}-\frac{x^{\frac{1}{2}}(2x-8)-\frac{1}{2}x^{-\frac{1}{2}}(x^2-8x+16)}{x}$ or $\frac{1}{10}-\left(2x^{\frac{1}{2}}(x-4)-\frac{1}{2}x^{-\frac{1}{2}}(x-4)^2\right)$ or $\frac{1}{10}-\left(x^{\frac{1}{2}}(2x-8)-\frac{1}{2}x^{-\frac{1}{2}}(x^2-8x+16)\right)$ and remember to ISW once a correct answer is seen		
			(3)
(d)	$x_1=3.3-\frac{f(3.3)}{f'(3.3)}=3.3-\frac{0.0115437451...}{0.9115437451...}=...$ $\{3.23388811...\}$ Attempts to apply a correct Newton-Raphson formula with 3.3, obtaining a value. Implied by awrt 3.234 (i.e., correct to 3 dp) and could just give this value which scores both marks. Accept as minimal evidence e.g., "$\{x_1=\}\ x_0-\frac{f(x_0)}{f'(x_0)}=...$" and no need to check value. Note: real root is 3.2368768...		**M1**
	= awrt 3.234 Ignore how the value is labelled and it can follow an incorrect f '(x)		**A1**
			(2)
			(Total 10 marks)