7	**(a)**		$2x\ln x+\dfrac{x^2-2}{x}$ $2x\ln x+\dfrac{x^2-2}{x}=0$ $2x^2\ln x+x^2-2=0$ **A.G.**	**M1** **A1** **[2]**	**3.1a** **1.1**	Attempt differentiation using product rule Equate to 0 and obtain given answer	May expand first to give $2x\ln x+\dfrac{x^2}{x}-\dfrac{2}{x}$ (allow middle term as just x) Must be equated to 0 **before** clearing the fractions Must be equation ie … = 0
	(b)		$f'(x)=4x\ln x+2x^2.\frac{1}{x}+2x$ $x_{n+1}=x_n-\dfrac{2x_n^2\ln x_n+x_n^2-2}{4x_n\ln x_n+2x_n^2.\frac{1}{x_n}+2x_n}$ $x_{n+1}=\dfrac{x_n\left(4x_n\ln x_n+4x_n\right)-\left(2x_n^2\ln x_n+x_n^2-2\right)}{4x_n\ln x_n+4x_n}$ $x_{n+1}=\dfrac{4x_n^2\ln x_n+4x_n^2-2x_n^2\ln x_n-x_n^2+2}{4x_n\ln x_n+4x_n}$ $x_{n+1}=\dfrac{2x_n^2\ln x_n+3x_n^2+2}{4x_n\left(\ln x_n+1\right)}$ **A.G.**	**B1** **M1** **M1** **A1** **[4]**	**1.1** **1.1** **1.1** **2.1**	Correct derivative seen Use correct Newton-Raphson formula, with numerator correct and their derivative in the denominator Attempt rearrangement into single fraction with brackets expanded Obtain given answer, with no errors seen	Allow simplified middle term of $2x$ Allow fractional term without subscripts **SC** Condone use of N-R on $(x^2-2)\ln x$ Allow without subscripts N-R not necessarily correct, but must be recognisable attempt **SC** Rearrange their N-R on $(x^2-2)\ln x$ Subscripts needed on RHS at least one step before AG LHS needs x_{n+1} seen
	(c)		$x_2=1.25, x_3=1.2075$	**B1** **[1]**	**1.1**	Condone 1.21, or better, for x_3	x_3 = 1.207515437…

Question			Answer	Marks	AO	Guidance	
	(d)		(1.206, – 0.102)	**B1** **B1** **[2]**	**2.2a** **2.2a**	Correct x-coordinate Correct y-coordinate	Must be 3dp or better Could be given as single coordinate or $x = 1.206$, $y = -0.102$ Allow BOD if 1.206 given but not identified as x-value