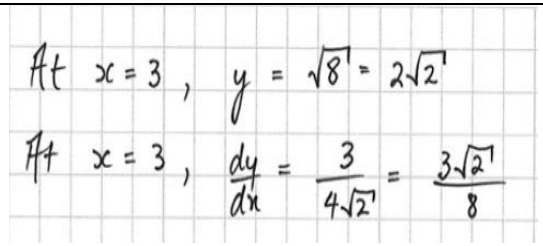
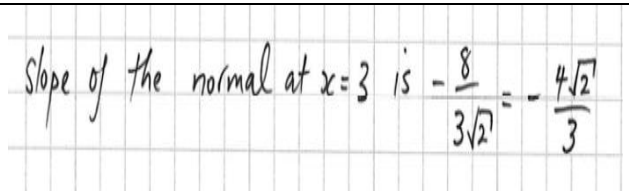
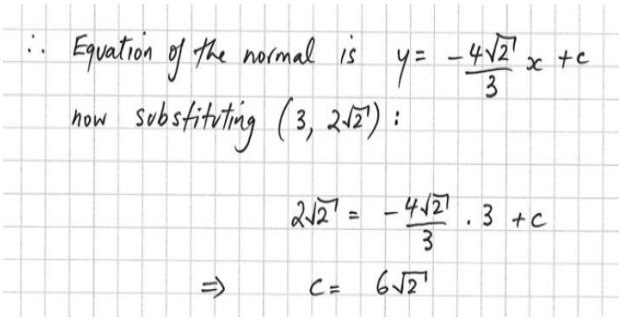
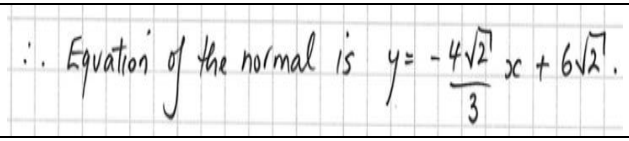
Differentiation

Question:

Find the equation of the normal to $y = \sqrt{3x-1}$ at $x = 3$. All values in the equation found should be in exact form.

Step	Method/ Hint	Answer	Marks allocation (where applicable)
Step 1	Identify the key components of the question;	- Normal means perpendicular (at right angle) to the graph at the given point - The normal gradient is given by $\frac{-1}{\text{gradient function}}$ - The gradient is found by finding the derivative of the function - What the question is asking for as a final answer	
Step 2	Find the derivative, 'using the derivative rule', by firstly rearranging the original equation to contain a fractional power Y= $(3x-1)^{\frac{-1}{2}}$ Then use the chain rule to find the derivative (the derivative of the whole expression multiplied by the derivative of the function in the bracket) $\frac{dy}{dx} = 3.\frac{1}{2}(3x-1)^{-\frac{1}{2}}$ Simplify this so there is no negative or fractional power $\frac{dy}{dx} = \frac{3}{2.(3x-1)^{1/2}}$ $\frac{dy}{dx} = \frac{3}{2\sqrt{3x-1}}$	RHside: $\frac{dy}{dx} = 3.\frac{1}{2}(3x-1)^{\frac{1}{2}}$ $= \frac{3}{2\sqrt{3x-1}}$	1 mark

Step 3	Substitute x=3 into both equations Y= $\sqrt{3.(3)-1}$ (finding the y value at x=3) and $\frac{dy}{dx} = \frac{3}{2\sqrt{3.(3)-1}}$ (finding the gradient value at x=3)		1 mark
Step 4	Find the gradient of the normal by finding $\frac{-1}{gradient\ function}$ Grad norm = $\frac{-1}{\frac{3\sqrt{2}}{8}}$ This is simplified to Grad norm = $\frac{-8}{3\sqrt{2}}$ or $\frac{-4\sqrt{2}}{3}$		1 mark
Step 5	Using all of the components you have calculated, find the y intercept (c), using **y = mx+c** Knowing; m= $\frac{-4\sqrt{2}}{3}$ x = 3 y = $2\sqrt{2}$		1 mark
Step 6	Finally answer the question, identifying the equation of the normal.		1 mark