

$$Q1) a) i) y = \frac{x^2}{2x+1} = \cancel{x^2(2x+1)^{-1}}$$

$$\begin{aligned} f &= x^2 & \frac{df}{dx} &= 2x \\ g &= 2x+1 & \frac{dg}{dx} &= 2 \end{aligned}$$

Quotient rule

$$\frac{d}{dx} \left(\frac{f}{g} \right) = \frac{\frac{df}{dx} g - f \frac{dg}{dx}}{g^2}$$

$$\frac{(2x)(2x+1) - (x^2)(2)}{(2x+1)^2}$$

$$= \frac{4x^2 + 2x - 2x^2}{4x^2 + 4x + 1}$$

$$= \frac{2x^2 + 2x}{(2x+1)^2}$$

$$= \frac{2x(x+1)}{2x+1}$$

$$\cancel{= (2x+1)^{-1}}$$

$$ii) y = \sqrt{x^2+1} = (x^2+1)^{\frac{1}{2}}$$

$$y' = \frac{1}{2} (x^2+1)^{-\frac{1}{2}} 2x$$

$$= \frac{x}{\sqrt{x^2+1}}$$

Chain rule

$$\frac{dy}{du} \frac{du}{dx}$$

$$iii) y = 3x^{\frac{3}{2}} + \frac{3}{x^2} - 6x = 3^{\frac{3}{2}} + 3x^{-2} - 6x$$

$$y' = \frac{9}{2} x^{\frac{1}{2}} - 6x^{-3} - 6$$