$$y = (3x+1)^{20}$$

$$\frac{dy}{dx} = 20(3x+1)^{19} \cdot 3$$

$$= \boxed{60(3x+1)^{19}}$$

CHAIN RULE:

$$\frac{d}{dx} f(g(x)) = f'(g(x)) \cdot g'(x)$$

OUTSIDE

INSIDE

DERIV. OF INSIDE

Ex: $y = \cos(x^3)$

OUTSIDE: $\cos$

INSIDE: x^3

$$y' = -\sin(x^3) \cdot 3x^2$$

DERIV OF INSIDE: $3x^2$

$$\boxed{y' = -3x^2 \sin(x^3)}$$

Ex: $f(x) = \sin^5 x$

$= (\sin x)^5$

$f' = 5(\sin x)^4 \cdot \cos x$

DERIV. OF INSIDE

$= \boxed{5\cos x \sin^4 x}$

CHAIN RULE – MORE SPECIFICALLY

① $\frac{d}{dx}\left[f(x)\right]^n = n\left[f(x)\right]^{n-1} \cdot f'(x)$ POWER RULE REMIX

② $\frac{d}{dx}\left[\text{TRIG}(f(x))\right] = \text{TRIG}'(f(x)) \cdot f'(x)$ TRIG REMIX

Ex: $y = \sqrt{2x^2+1}$

$$y = (2x^2+1)^{1/2}$$

$$y' = \frac{1}{2}(2x^2+1)^{-1/2}(4x)$$

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

Ex: $y = \left(\frac{x}{x+1}\right)^2$

DERIV OF $\frac{x}{x+1}$

QUOTIENT RULE

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

$$= \frac{2}{1}\left(\frac{x}{x+1}\right)\left(\frac{1}{(x+1)^2}\right) = \boxed{\frac{2x}{(x+1)^3}}$$

Ex: $y = (3x-1)^4 \cdot (7x+1)^5$ PRODUCT RULE FIRST

$$y' = 4(3x-1)^3 \cdot 3 \cdot (7x+1)^5 + 5(7x+1)^4 \cdot 7 \cdot (3x-1)^4$$

$$= \boxed{12(3x-1)^3(7x+1)^5 + 35(7x+1)^4(3x-1)^4}$$