PRODUCT RULE

$$\frac{d}{dx}\left[PQ\right] = P'Q + PQ'$$

QUOTIENT RULE

$$\frac{d}{dx}\left[\frac{P}{Q}\right] = \frac{P'Q - PQ'}{Q^2}$$

1. $f(x) = \underbrace{(7x-2)}_{P}\underbrace{(x^5+3)}_{Q}$

$$P' = 7 \qquad Q' = 5x^4$$

$$P'Q + PQ'$$

$$f'(x) = 7(x^5+3) + (7x-2)(5x^4)$$

$$= 7x^5 + 21 + 35x^5 - 10x^4$$

$$= 42x^5 - 10x^4 + 21$$

2. $f(x) = \sqrt[3]{x}\,(\cos x)$

$$= \underbrace{x^{\frac{1}{3}}}_{P}\ \underbrace{\cos x}_{Q}$$

$$P' = \frac{1}{3}x^{\frac{1}{3}-1} \qquad Q' = -\sin x$$

$$= \frac{1}{3}x^{-\frac{2}{3}}$$

$$= \frac{1}{3x^{2/3}}$$

$$P'Q + PQ'$$

$$f'(x) = \frac{1}{3x^{2/3}}\cos x + x^{\frac{1}{3}}(-\sin x)$$

$$= \frac{\cos x}{3x^{2/3}} - \frac{(\sin x)x^{\frac{1}{3}}}{1}$$

$$= \frac{\cos x}{3x^{2/3}} - \frac{(\sin x)x^{\frac{1}{3}} \cdot 3x^{2/3}}{1 \cdot 3x^{2/3}}$$

$$= \frac{\cos x}{3x^{2/3}} - \frac{3x\sin x}{3x^{2/3}}$$

$$= \frac{\cos x - 3x\sin x}{3x^{2/3}}$$

3. $g(x) = \dfrac{x^2+3}{8x-1}\ \begin{matrix})\ P \\ )\ Q \end{matrix}$

$$P' = 2x \quad Q' = 8$$

$$\frac{P'Q - PQ'}{Q^2}$$

$$g'(x) = \frac{2x(8x-1) - (x^2+3)8}{(8x-1)^2}$$

$$= \frac{2\left[x(8x-1) - 4(x^2+3)\right]}{(8x-1)^2}$$

$$= \frac{2\left[8x^2 - x - 4x^2 - 12\right]}{(8x-1)^2}$$

$$= \frac{2(4x^2 - x - 12)}{(8x-1)^2}$$