Basic Differentiation:

$$y = ax^n$$

$$\boxed{\frac{dy}{dx} = anx^{n-1}}$$

e.g.:

① $y = 5x^2$

$$\frac{dy}{dx} = (5 \times 2)\, x^{2-1}$$

$$= 10x^1$$

$$= 10x.$$

Differentiate $\rightarrow x^1$,

$y = x$ | $\frac{dy}{dx} = 1$

$y = 2x$ | $\frac{dy}{dx} = 2$

$y = -3x$ | $\frac{dy}{dx} = -3$

$y = \frac{5}{3}x$ | $\frac{dy}{dx} = \frac{5}{3}$

Differentiate $\rightarrow$ constant

$y = 1$ | $\frac{dy}{dx} = 0$

$y = -1$ | $\frac{dy}{dx} = 0$

$y = 1/3$ | $\frac{dy}{dx} = 0$

Differentiate multiple:

① $y = 2x^2 + 5x + 2 + 3x^3$

$\frac{dy}{dx} = 4x + 5 + 0 + 9x^2$

$\frac{dy}{dx} = 4x + 5 + 9x^2$

Differentiate with chain rule:

method (i) :-

$y = (2x^2 + 5x + 2)^{10}$

Let,

$u = 2x^2 + 5x + 2$ —— (i)

$y = u^{10}$ —— (ii)

$\therefore \frac{dy}{dx} = \frac{d}{dx}(i) \times \frac{d}{du}(ii)$

$= \frac{d}{dx}(2x^2 + 5x + 2) \times \frac{d}{du}(u)^{10}$

$= (4x + 5) \times 10\, u^9$

Replace u with actual value:→

$$= (4x+5) \times 10\,(2x^2+5x+2)^9$$

$$= 10\,(4x+5)\,(2x^2+5x+2)^9$$

Differentiation with different alphabets:→

$y = 2x^2 + 5x$

$\frac{dy}{dx} = 4x + 5$

$y = 2u^2 + 5u$

$\frac{dy}{du} = 4u + 5$

u, y, x are all variables

$x = 2y^2 + 5y$

$\frac{dx}{dy} = 4y + 5$

$u = 2x^2 + 5x + 2$

$\frac{du}{dx} = 4x + 5$

Differentiation, where a, b and c are constant:

$y = 2ax^2 + bx + c$

$\frac{dy}{dx} = 4ax + b$

$(2ax2)x^{2-1}$

$t = 2ax^2 + bx + c$, here, t is not a constant as it is not mentioned. It is a variable here.

$\therefore \frac{dt}{dx} = 4ax + b$

method (ii): Chain rule

$$y = (2x^2 + 5x + 2)^{10}$$

Let, $u = 2x^2 + 5x + 2$.

Formula: $y = u^{10}$

$$\boxed{\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}}$$

for $\frac{dy}{du}$, we need to find an equation such as $y = u^5 + 2u^2 \ldots$

We have in our question,

$$y = u^{10}$$

$$\boxed{\frac{dy}{du} = 10u^9}$$

for $\frac{du}{dx}$, $u = 2x^2 + 5x \ldots$

We have, $u = 2x^2 + 5x + 2$

$$\boxed{\frac{du}{dx} = 4x + 5}$$

$\therefore y = (2x^2+5x+2)^{10}$

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

$$= 10u^9 \times (4x+5)$$

Replace u, with $u = 2x^2+5x+2$

$$\frac{dy}{dx} = 10(2x^2+5x+2)^9 (4x+5).$$

Answer.