

Differentiation of Exponential and Logarithmic Functions.

→ Exponential Function:

1)

$$y = e^x$$

$$\frac{dy}{dx} = \frac{d}{dx} e^x$$

$$= e^x \cdot \frac{d}{dx} (x)$$

$$= e^x (1)$$

$$= e^x$$

2)

$$y = e^{x^2}$$

$$\frac{dy}{dx} = \frac{d}{dx} e^{x^2}$$

$$= e^{x^2} \cdot \frac{d}{dx} (x^2)$$

$$= e^{x^2} \cdot 2x$$

$$= 2x \cdot e^{x^2}$$

$$e^{\sqrt{x}+1}$$

$$\frac{dy}{dx} = \frac{d}{dx} e^{\sqrt{x}+1}$$

$$= e^{\sqrt{x}+1} \cdot \frac{d}{dx} \sqrt{x}+1$$

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

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

$$= e^{\sqrt{x}+1} \cdot \left(\frac{1}{2x}\right)^{\frac{1}{2}}$$

$$\therefore x^{-n}$$

$$\frac{1}{x^n}$$

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

$$x \cdot e^x$$

product rule

$$\frac{dy}{dx} = \frac{d}{dx} x \cdot e^x$$

$$\therefore u'v + uv'$$

$$= x \cdot \frac{d}{dx} (e^x)$$

$$= \frac{d}{dx} (x) \cdot e^x + x \frac{d}{dx} e^x$$

$$= 1 \cdot e^x + x \cdot e^x$$

$$= xe^x + e^x$$

Differentiation of logarithmic function.

1) $\ln x$

$$\frac{d}{dx} \ln x = \frac{1}{x} \cdot (1) = \frac{1}{x}$$

2) $\ln x^2$

$$\frac{d}{dx} \ln x^2 = \frac{2x}{x^2} \cdot \frac{1}{x^2} \cdot 2x = \frac{2x}{x \cdot x} = \frac{2}{x}$$

3) $\ln x^3$

$$\frac{d}{dx} \ln x^3 = \frac{1}{x^3} \cdot 3x^2 = \frac{3x^2}{x^3} = \frac{3}{x}$$

4) $\ln(x+5)$

$$\frac{d}{dx} \ln(x+5) = \frac{1}{x+5} \cdot (1) = \frac{1}{x+5}$$

5) $\ln(x^2+4)$

$$\frac{d}{dx} (x^2+4) = \frac{1}{x^2+4} \cdot 2x = \frac{2x}{x^2+4}$$

6) $\ln(7x+5-x^3)$

$$\frac{d}{dx} (7x+5-x^3) = \frac{1}{7x+5-x^3} \cdot 7(1)-3x^2 = \frac{7-3x^2}{7x+5-x^3}$$

9) Some constant power variable
is present but constant is
not more 'e' but a number.

e.g., a^x

$$\frac{dy}{dx} = \frac{d}{dx} a^x$$

$$= a^x \cdot (1) \cdot \ln a$$

1) $\frac{d}{dx} (3^x)$

$$= 3^x \cdot (1) \ln 3$$

2) 7^{2x-5}

$$\frac{dy}{dx} = \frac{d}{dx} 7^{2x-5}$$

$$= (7^{2x-5}) (2) (\ln 7)$$

3) 9^{x^3}

$$\frac{dy}{dx} = \frac{d}{dx} 9^{x^3}$$

$$= (9^{x^3}) (3x^2) (\ln 9)$$

Representation: "f"

Mathematically:

Integral $\int f(x) \cdot \frac{d}{dx} dx$ variable integration
Integral of 'f' with respect to 'x'

Power Rule:

$$\int x^n dx = \frac{x^{n+1}}{n+1} \quad n \neq -1$$

eg.,

$$\int x^2 dx = \frac{x^{2+1}}{2+1} = \frac{x^3}{3}$$

Function involving constant number.
or Constant rule.

$$\int 2x^2 dx$$

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

$$\star \int 5 \cdot dx$$
$$= 5x$$

→ Some other Rules/Formulas:

$$\int e^x dx = e^x$$

$$\int \frac{1}{x} \cdot dx = \ln x.$$

\star Sum and Difference Rule:

$$\int (e^x - 3) \cdot dx$$

$$= \int e^x \cdot dx - \int 3 dx.$$

$$= e^x - 3x$$

Differentiate following questions:

1) e^{x^2+5}

2) $5^{\sqrt{x}}$

3) $\ln(4x^2-3x-5)$

4) xe^{2x}

5) $\frac{3^x}{3^x+2} \rightarrow$ Apply quotient Rule

6) $2e^x - 8^x$

7) 4^{3x^2}

8) e^{-x^3}

9) 2^{-x^2}

10) $4^x \cdot 3^{2x}$

11) $\ln(x^2-2x)$

Integration

1) $\int 8x^3 dx$

2) $\int \frac{1}{3\sqrt{x}} dx$

2) ~~$\int e^x + e^x + e^x$~~

3) ~~$\int \int x^4 dx$~~ $\int 5x^4 dx$

4) $\int (6x^6 + 4x^{\frac{2}{3}} + 8) dx$