$\boxed{\text{Diff Eq}}$ Find the general Solution: (in notes) $\rightarrow \boxed{y = ?}$

$$\cancel{dx}\left(\frac{dy}{\cancel{dx}} = 3xy\right)dx$$

$$\frac{dy}{y} = \frac{3x\cancel{y}\cdot dx}{\cancel{y}}$$

$$\int \frac{dy}{y} = \int 3x \cdot dx$$

$$\boxed{\frac{d}{dx}\ln x = \frac{1}{x}}$$

$$\int \frac{1}{y}\, dy = \frac{3}{2}x^2 + C$$

$$\ln y + C = \frac{3}{2}x^2 + C$$

3^2

$$\ln y = \frac{3}{2}x^2 + C$$

$$\log_e y = \frac{3}{2}x^2 + C$$

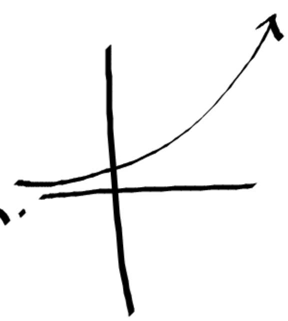
exponentiate

$$y = e^{\frac{3}{2}x^2 + C}$$

$$y = e^{3/2 x^2} \cdot e^C$$

$$\boxed{y = C \cdot e^{3/2 x^2}}$$

exponential growth.



$\frac{dy}{dx}$

$$\frac{dy}{dx} = \underbrace{C \cdot e^{3/2 x^2}}_{y} \cdot 3x$$

$y \cdot 3x$

ex

$$\int x \cdot \sqrt[3]{3x+1} \cdot dx$$

Let $u = (3x+1)$

$$\frac{du}{dx} = 3 \Rightarrow \frac{du}{3} = \frac{\cancel{3}dx}{\cancel{3}} \rightarrow dx = \frac{du}{3}$$

$$\frac{u-1}{3} = x$$

$$\int \frac{u-1}{3}(u)^{1/3} \cdot \frac{du}{3}$$

$$\int \frac{1}{9}(u-1) \cdot u^{1/3} \cdot du$$

$$\frac{1}{9}\int \left(u^{4/3} - u^{1/3}\right) \cdot du$$

$$\frac{1}{9}\left[\frac{3}{7}u^{7/3} - \frac{3}{4}u^{4/3} + C\right]$$

$$\frac{1}{21}u^{7/3} - \frac{1}{12}u^{4/3} + C$$

$$\frac{1}{21}(3x+1)^{7/3} - \frac{1}{12}(3x+1)^{4/3} + C$$

are they derivatives?

Reverse chain rule

Rule

$$\int c \cdot f(x) \cdot dx = c \cdot \int f(x)\, dx$$

8) $\int 2^{5x} \cdot dx$

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

$$\frac{d}{dx} e^x = e^x \cdot \cancel{\ln e} \to 1$$

$$\frac{1}{5}\int 5 \cdot 2^{5x} \cdot dx$$

$$\frac{1}{5}\,\frac{1}{\ln 2}\int 5 \cdot \ln 2 \cdot 2^{5x} \cdot dx$$

$$\frac{1}{5\ln 2}\left(2^{5x} + C\right) \to \boxed{\frac{1}{5\ln 2} \cdot 2^{5x} + C}$$

$$\cancel{\frac{1}{5\ln 2}}\, 2^{5x} \cdot \cancel{\ln 2 \cdot 5}$$

11. $-\int -\sin 2x \left(\cos 2x\right)^3 \cdot dx$

almost

$$= -\frac{1}{4}\left(\cos 2x\right)^4 + C$$