**True or False?**

**10th & 12th graders do this one:**

$$\text{If } y = \sqrt[3]{x^3 + 8}$$

$$\text{then } \frac{dy}{dx} = \frac{x^2}{y^2}$$

$$\frac{dy}{dx} = \frac{x^2}{\left(\sqrt[3]{x^3+8}\right)^2}$$

$$= \frac{x^2}{y^2}$$

**Juniors do this one:**

$$\text{If } y = \sqrt[3]{x^3 - e^3}$$

$$\text{then } \frac{dy}{dx} = \frac{x^2}{y^2}$$

$$y = (x^3 - e^3)^{1/3}$$

$$\cancel{\tfrac{1}{3}}(x^3 - e^3)^{-2/3} \cdot \cancel{3}x^2$$

$$\frac{x^2}{(x^3-e^3)^{2/3}} \quad \frac{x^2}{\left(\sqrt[3]{x^3-e^3}\right)^2} \quad \frac{x^2}{y^2}$$

$$X^{2/3} = \sqrt[3]{X^2} = \sqrt[3]{X}^{\,2}$$

Some terms:

Differential equation - an equation representing the relationship between a derivative and its independent variable.

Ex: $\frac{dy}{dx} = 3x^2$

Separable differential equation - A differential equation that can be re-written in the form $N(y)\,dy = M(x)\,dx$

Solutions to separable differential equations are simply the original function *y* from which the differential equation is derived.
We find the solution by integrating both sides of a differential equation, once its separated.

$$\cancel{dx} \cdot \frac{dy}{\cancel{dx}} = y^2 x \, dx$$

$$y^{-2} dy = x \, dx$$

$$\int y^{-2} dy = \int x \, dx$$

$$-y^{-1} = \frac{x^2}{2} + c$$

$$-y^{-1} = \frac{x^2}{2} + c$$

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

$$y^{-1} = -\frac{x^2}{2} + c$$

$$\frac{1}{y} = y^{-1} = -\frac{x^2 + 2c}{2}$$

$$y = -\frac{2}{x^2 + a} + 5$$

$+5$

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

$$y^{-1} dy = x^2 dx$$

$$\int \frac{1}{y}\, dy = \int x^2 dx$$

$$\ln|y| = \frac{x^3}{3} + c$$

$$\ln|y| = \frac{x^3}{3} + c$$

$$e^{\ln|y|} = e^{\frac{x^3}{3} + c}$$

$$y = \pm e^{\frac{x^3}{3} + c}$$

$$x^{2+3} = x^2 x^3$$

$$y = \pm e^{\frac{x^3}{3}} e^{c}$$

$$y = \pm c e^{\frac{x^3}{3}}$$

$$y = c e^{\frac{x^3}{3}}$$