Closing Today: HW_7B,7C (8.1)
Closing Next Wed: HW_9A,9B,9C
Final Exam, Saturday, March 11
1:30-4:20pm
Kane 130

Entry Task: Implicitly differentiate

$$x^2 + y^3 = 8$$

and solve for $\frac{dy}{dx}$.

9.3: Separable Diff. Equations

A **separable** differential equation is one that can be written as:

$$\frac{dy}{dx} = f(x)g(y).$$

(or $\frac{dy}{dx} = \frac{f(x)}{g(y)}$ or $\frac{dy}{dx} = \frac{g(y)}{f(x)}$.)

The idea is that we will separate and integrate.

(But truly we are reversing *implicit differentiation*).

Example: Find the general explicit solution for

$$\frac{dy}{dx} = \frac{x}{y^4}$$

Example: Find the general explicit solution to

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

Example: Find the general explicit solution to

$$\frac{dP}{dt} + 4 = P$$

Initial Conditions:

Example: Find the explicit solution to

$$\frac{dy}{dx} = \frac{\cos(x)}{y} \text{ with } y(0) = -5$$

Old Final Question:

Example: Find the explicit solution to

$$\frac{dy}{dx} = \frac{x\sqrt{1+x^2}}{e^y} \text{ with } y(0) = 0$$

Another Old Final

Example: Find the explicit solution to

$$\frac{dy}{dx} - x^2 = x^2 y \text{ with } y(0) = 1$$

Applications:

***1. Law of Natural Growth/Decay*:**
Assumption: "*The rate of growth/decay is proportional to the function value*."

Example:
A population has 500 bacteria at t = 0. After 3 hours there are 8000 bacteria. Assume the population grows at a rate proportional to its size.
Find B(t).

Example:
The *half-life* of cesium-137 is 30 years. Suppose we start with a 100-mg sample. The mass function m(t) decays at a rate proportional to its size. Find m(t).