Lesson #70/71

Differential Equations

- An equation involving one or more derivatives

- A first order DE has a first derivative in it.
- A second order DE has a second derivative in it.

We will use the "separation of variables" method:

Example #1: $\frac{dy}{dx} = x^3$

Step 1: Put x's with x's on one side.
Step 2: Put y's with y's on the other side.
Step 3: Integrate both sides.
Step 4: Solve for y, if possible.
** Don't forget the + C!**

Example #2:
Solve using separation of variables.

$$\frac{dy}{dx} = -4xy^2$$

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Example #3:

$$x(y-1)\frac{dy}{dx} = y$$

Example #4:

$$\frac{dy}{dx} = xe^{y}$$

But now, we want to find the solution that passes through the point (2,0).

Solving Separable DE with Initial Conditions

1- Separate the variables
2- Integrate both sides
3- Don't forget +C
4- Plug in initial condition to solve for C
5- Plug c into the equation you used to solve, then isolate y

Example #5: Find the equation of the solution curve that passes through the point (1, -1) for the DE.

$$\frac{dy}{dx} = \frac{y^2}{3\sqrt{x}}$$

Growth and Decay Formula:

The rate of change of y(t) is directly proportional to the amount present, y.

$$\frac{dy}{dt} = ky$$

Solve by separation of variables:

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Separable Differential Equations with Log

2004 Question 5c)

Consider the differential equation $\frac{dy}{dx} = x^4(y-2)$.
Find the particular solution of $y = f(x)$ to the given differential equation with the initial condition $f(0) = 0$.

*To figure out what to pull out of the absolute value, we plug in the ______________________________. If the number is positive, we ____. If the number is negative, we ____.

2006 Question 5b)

Consider the differential equation $\frac{dy}{dx} = \frac{1+y}{x}$, where $x \neq 0$. Find the particular solution $y = f(x)$ to the differential equation with the initial condition $f(-1) = 1$.