Differential Equations Sort & Solve

Student Directions:

1. Sort each of the 12 cards into three categories based on their differential equations:
   - Independent variable only
   - Dependent variable only
   - Both independent and dependent variable

2. Record your results here by arranging the card letters in each category in alphabetical order.

Independent only _____. _____, _____, _____ Dependent only _____. _____, _____, _____ Both independent and dependent _____. _____, _____, _____

3. Check your results.

4. Work each problem and record your answer in this grid. You should not need a calculator. Some of the answers will be irrational $\left(-3e^2 \text{ or } \frac{5}{\sqrt{2}}, \text{e.g.}\right)$. Check your answers periodically.

A	B	C	D	E	F	G	H	I	J	K	L

5. Turn in this page and all of your pages of work to your teacher. Scramble the cards for the next class.

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Teacher Directions:

Decide how you want to use this activity before you copy the three pages of cards onto brightly colored paper, cut them up and put them in zip lock bags. I would use this as a cooperative activity to generate a lot of discussion and practice so the number of sets I would want would be (largest class)/2.

I would probably have my students get out notebook paper, and then put them in groups of two or three by pulling names from a hat and then distribute one full set of 12 cards to each group once they have gotten themselves rearranged. I would not allow students to use a calculator for this activity.

Explain what the activity is for – they should classify (sort) first and then solve next. If you want, you can have them solve only a portion of the cards (not all 12). To make sure they solve at least one of each type, they could solve the first three (ABC), alternatively they could solve any six they want, or at least six, etc. You decide. Monitor their progress – have them come to you or walk around the room to make sure they are sorting properly. Then, as they begin solving, again, check their work. You could post the answers to the cards covered with lettered post-it-notes around the room so they can lift the letter and check their own work. The sorting might take about 10-15 minutes; the solving will take much longer.

Answers:
2. Record your results here by arranging the card letters in each category in alphabetical order.

Independent A, F, H, K **Dependent B, D, G, L** **Both independent & dependent C, E, I, J**

4. Work each problem and record your answer in this grid. You should not need a calculator.
Some of the answers will be irrational ($-3e^2$ or $\frac{5}{\sqrt{2}}$, e.g.). Check your answers periodically.

A	B	C	D	E	F	G	H	I	J	K	L
-3	4	e^{11}	$\frac{82}{3}$	$3-e^{-7/2}$	$2-\frac{\pi}{4}$	-91	$-4-\frac{\pi^2}{4}$	-14	$-\frac{3}{\sqrt{2}}$	$\frac{9}{2}$	69

The velocity of a particle traveling along the x −axis is given by $\frac{dx}{dt} = -2t + 3$ for $t \geq 0$. If the particle begins at $x = -5$ when $t = 0$, what is the particle's position when $t = 2$? A	The particular solution, $y = H(x)$, to the differential equation $\frac{dH}{dx} = (H + 7)^3$ which passes through the point $\left(-\frac{3}{2}, -6\right)$ has the form $H(x) = -7 + (2x + C)^{-\frac{1}{2}}$. Find the value of C. B
It is a truth universally acknowledged that acceleration is the derivative of velocity (i.e. $a = v'$). A particle's acceleration is given by the differential equation $v' = t^2 v$. Determine the velocity of the particle when $t = 3$ given that when $t = 0, v = e^2$. C	Let $y = f(x)$ be the particular solution to the differential equation $y' = 2\sqrt{3y - 1}$ with initial condition $f(0) = \frac{37}{3}$. Find the particular solution $y = f(x)$ and then evaluate $f(1)$. D

The point $(1, 2)$ is on the graph of the solution curve to the differential equation $\frac{dy}{dx} = (x+2)(3-y)$. Find the y −coordinate such that the point $(2, y)$ is also on the graph of the solution curve. E	Given $\frac{dy}{dx} = \frac{1}{1+x^2}$ and $y(0) = 2$. Find $y(-1)$. F
Given that $\frac{dy}{dx} = \frac{1}{1+y^2}$ and $y(-1) = 3$, determine the x −value when $y = -6$. G	The differential equation, $\frac{dx}{dy} = \cos y + 2y$, when solved will yield x as a function of y. Find the constant of integration, C, for the particular solution, $f(y) = x$ given that the point $(y, x) = \left(\frac{\pi}{2}, -3\right)$ is on the graph. H

Write the equation of the tangent line to $y = W(t)$ at $t = 0$ given that $W(0) = -7$ and $\frac{dW}{dt} = 2tW + W$. Then, use the tangent line to approximate $W(1)$.

I

Given that $\frac{dG}{d\theta} = \frac{\theta \sin(\theta^2)}{G}$ and that $G\left(\sqrt{\frac{\pi}{3}}\right) = -2$, determine $G\left(\sqrt{\frac{\pi}{2}}\right)$.

J

Given: $\frac{dH}{dt} = 3te^{t^2-1}$; $H(1) = \frac{3}{2}$
Write the equation of the tangent line to $y = H(t)$ at $t = 1$ and use it to approximate $H(2)$.

K

The rate, in degrees Celsius per minute, at which a hot pot of water cools is given by $\frac{dW}{dt} = -\frac{1}{3}W + 21$ where W is the temperature in degrees Celsius and t is the time in minutes. The pot of water is 81 degrees Celsius at time $t = 0$. Use the tangent line to $W(t)$ at $t = 0$ to estimate $W(2)$, the temperature of the pot of water at time $t = 2$ minutes.

L