

1. Print your name. What is your year in school and your major ?
You must print legibly. Do not use a ultrafine pencil that is difficult to read.
2. Why are you taking this class ? What other math classes will you be taking ?
3. What was the last math class you took ? From whom and where ?
4. How familiar are you with techniques of integration ?
5. Do you have a computer with mathematical software ? Which software ?
6. What are differential equations ? Why do we study them ?
7. What grade do you honestly expect to get from this class ? Why ?

0. Print your name: _____

1. What is meant by the term “equilibrium solution” ? Draw a direction field that has two equilibrium solutions. Include several solution curves to illustrate what is going on.

2. Solve $y' = 4 - y$ with $y(1) = 2$.

3. Find the general solution to $y' + 2y = te^{-t} + 1$

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1. A tank contains 100 gal of water with 10 lb of salt dissolved in it. Water containing 3 lb of salt per gallon flows into the top of the tank at a rate of 4 gal/min. A well-stirred solution flows out of the bottom of the tank at a rate of 4 gal/min. Give an IVP that describes the amount of salt after t minutes. Do not solve it.

2. A pizza is at room temperature. It is placed in a 400° F oven. Five minutes later the pizza has reached a temperature of 95° F; five minutes after that it's reached 120° F. Newton's law states that the rate of temperature change is proportional to the difference in temperature of the object and the environment. Using that, find the room temperature.

3. Solve the initial value problem $y' = \frac{1}{2y + 2yx^2}$ where $y(1) = -1$.

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1. Solve each of the following. Your answer may be an implicit equation.

(a).
$$\frac{dy}{dx} = \frac{ye^{xy} \tan(x) + e^{xy} \sec^2(x) - 2x}{3y^2 - xe^{xy} \tan(x)}$$

(b).
$$y' = \frac{y - x}{y + x}$$

2. An island contains a population of 500 mice that normally doubles in size every five weeks. Plans are made to bring in cats to kill off the mice. Assume that each week the cats eat a constant number of mice. How many mice per week do the cats need to eat in order to guarantee that eventually all the mice are killed off ?

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Solve each of the following, using only the techniques about constant coefficient linear 2nd order homogeneous equations from our last class and from the handout. Do not attempt to solve the equations with any other method.

1. $y'' + 2y' + 2y = 0$

2. $4y'' - 4y' + y = 0$

3. $2y'' + 5y' - y = 0$

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1. Find a homogeneous linear constant coefficient 2nd order DE for which $y = 3 + 2e^t$ is a solution. State initial conditions at $t = 0$.

2. Solve $3y'' + y' + 2y = 2 \cos(t)$

3. Suppose a mass weighing 4lb stretches a spring 6 in. Assume the damping constant is 2 lb-sec/ft and that there is an external force of te^{-t} lb. The mass is pushed upward one foot and then let go with no initial velocity. Set up an initial value problem describing the motion of the spring. Do not solve it.

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1. Use the method of undetermined coefficients to solve $y'' + y' - 2y = 5e^{-2t}$.

2. Find a second order linear differential equation with constant coefficients for which $y_1 = 4t^2 + 7t + \pi e^{3t}$ and $y_2 = 4t^2 + 7t - 9te^{3t}$ are solutions.

3. Suppose $f(t) \geq \frac{e}{\sqrt{\pi}}$ for all t . What can you say about solutions to $x'' + f(t) \cdot x = 0$?

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1. Describe the nature of the critical point $(0, 0)$ of the system $x' = y$ and $y' = -5x - 4y$.

2. Suppose an almost linear system has corresponding linear system having $(0, 0)$ as a stable center. What can you say about the type of critical point that $(0, 0)$ is for the almost linear system? Why can't you say more?

3. Set up the system of equations that is known as the predator-prey model. Describe the meaning of each of the terms.

0. Print your name: _____

1. Without using a table of transforms, find the Laplace transform of t^2 .

2. Find the inverse Laplace transform of $\frac{2s - 3}{(s - 3)(s - 5)}$

3. Using the Laplace transform, change the IVP $y'' - 3y' + 2y = 4e^{-2t}$ with $y(0) = 5$ and $y'(0) = -3$ into an algebraic equation of the form $L(y) =$ "some expression in s ".