

1. Do WebAssign 11.4. Again, start with the WebAssign.

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2. Use separation of variables to find the solution to the differential equation

$$\frac{dz}{dy} = zy \quad z = 1 \text{ when } y = 0.$$

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3. Use separation of variables to find the solution to the differential equation

$$\frac{dw}{d\theta} = \theta w^2 \sin(\theta^2) \quad w(0) = 1.$$

4. Assume that  $a$  and  $b$  are nonzero constants to find the general solution to the differential equation

$$\frac{dR}{dt} = aR + b.$$

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5. Assume that  $x, y, t > 0$  to find the general solution to the differential equation

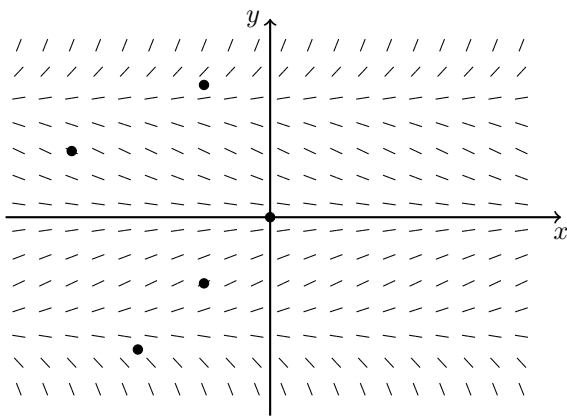
$$t \frac{dx}{dt} = (1 + 2 \ln(t)) \tan(x)$$

# Growth and Decay

Understand	Know the definitions of <i>relative and absolute growth rates</i> , and how to distinguish between them.
Understand	Know: the general solution to $\frac{dP}{dt} = kP$ is $P = P_0e^{kt}$ , which grows if $k > 0$ and decays if $k < 0$ .
Understand	Know the definitions of the terms <i>doubling time</i> and <i>half-life</i> .
Understand	Newton's Law of Cooling: for constant $\alpha$ , (rate of change of temp.) = $\alpha \cdot$ (temp. difference).
Apply	Be aware of the difference between continuous and annual growth rates, and watch for this in problem statements.
Apply	Set up a differential equation to model situations with exponential growth or decay, and solve it.
Apply	Identify equilibrium solutions of a differential equation, and classify them as <i>stable</i> or <i>unstable</i> .

We are going to begin exploring equilibrium solutions to a differential equation, both graphically and analytically.

1. The slope field for a differential equation is given below:



- Draw solution curves on the slope field through each of the five marked points. This can help you get an idea of how particular solutions behave.
- List all equilibrium solutions and classify each as *stable* or *unstable*. (Do solutions which start nearby to an equilibrium solution limit towards or away from the equilibrium solution as  $x \rightarrow \infty$ ?)

2. Find all equilibrium solutions for the differential equation

$$\frac{dy}{dx} = y(y - 2)(y + 2).$$

Step 1: Set the differential equation equal to 0 and solve for the dependent variable  $y$ . These values of  $y$  are the equilibrium solutions. Record them here:

$$y =$$

Step 2: Test each equilibrium solution to determine whether it is stable or unstable. We'll just do it for one of them here: take the largest of your three  $y$ -values and call it  $y_0 =$  \_\_\_\_\_.

Choose a value for  $y$  which is slightly bigger than  $y_0$ :  $y =$  \_\_\_\_\_. Calculate  $\frac{dy}{dx}$  using the differential equation. Is  $\frac{dy}{dx}$  positive or negative? (Circle which one!)

Now do the same for a value  $y =$  \_\_\_\_\_ slightly smaller than  $y_0$ . Is  $\frac{dy}{dx}$  positive or negative for that value of  $y$ ? (Circle which one!)

If the slopes point away from the equilibrium solution, then that solution is *unstable*. If the slopes point toward the equilibrium solution, then it is *stable*.

Classify the three equilibrium solutions using this method. Report your answers here:

Quiz (Leave this space blank)