

## 6.4

### 6.4 Initial Value and Exponential Growth and Decay

Find the solution to the initial value problem.

1.  $\frac{dy}{dx} = \frac{2x}{y}$  if  $y = 4$  when  $x = 3$

2.  $\frac{dy}{dx} = 4xy$  if  $y = e^4$  when  $x = 1$

3.  $\frac{dy}{dx} = e^{x+y}$  if  $y = 4$  when  $x = 0$

4.  $\frac{dy}{dx} = 3y$  if  $y = 10$  when  $x = 0$

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### 2005 Free Response #6

$$\frac{dy}{dx} = \frac{-xy^2}{2}, f(-1) = 2$$

Do you remember the law of exponential change?

What does “exponential change” really mean anyway?

The law of exponential change (from a calculus perspective):

Solve  $\frac{dy}{dt} = ky$  if  $y = y_0$  when  $t=0$

The law of exponential change

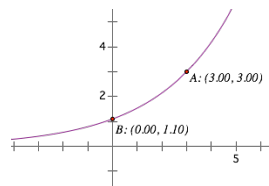
Calc Version:

Algebra Version:

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1. Solve  $\frac{dy}{dt} = -2.1y$  if  $y_0 = 100$

Find an equation in the form  $y = y_0 e^{kt}$  for the following graph



3. A certain bacteria grows at a rate proportional to the amount present. If after 3 hours there are 3000 bacteria and after 7 hours there are 5000 bacteria, what was the initial amount? How many will be present at 10 hours?

4. A radioactive substance decays according to the equation  $y = y_0 e^{-0.06t}$ . Find the half-life of the substance. How long before only 20% of the substance remains?

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5. The rate of change (in cubic inches per second) of the volume of water in a draining swimming pool is proportional to the amount present, according to the equation  $\frac{dy}{dt} = -1.5y$ .

The initial amount of water is 10,000 cubic inches. When will there be 100 cubic inches remaining?

**Newtons Law of Cooling**  $T - T_s = (T_0 - T_s)e^{-kt}$

6. A cinnamon eggo waffle is  $200^\circ$  when taken out of the toaster and set on your little sister's plate. After one minute, the eggo has cooled to  $170^\circ$ . If the eggo cools to  $100^\circ$  then the butter will no longer melt, and your little sister will throw a massive temper tantrum. You will then need make her new egos and eat the cold ones yourself. How much time do you have to butter the eggo? (Room temp is  $70^\circ$ )