Name: ____________________ Date: ____________ Period: ______

Chapter 3: Exponential & Logarithmic Functions
Topic 5: Modeling with Exponential & Log Functions

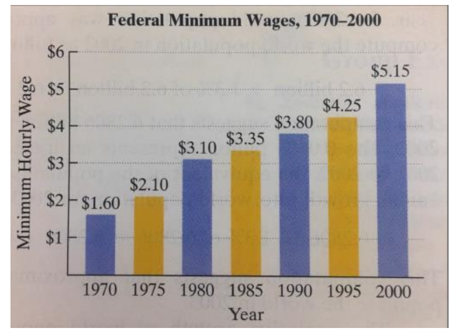
Exponential Growth & Decay Model $A = P(e)^{rt}$

In these questions, other pieces may be missing instead of just plugging in!

Example: The graph shows the growth of the minimum wage from 1970 through 2000.
a. Find the exponential growth function that models the data for 1970 through 2000.

- Plug in what you know

- Use any known point to solve for r



b. By which year will the minimum wage reach $7.50 per hour?

Example: The half life of Carbon-14 is 5715 years. That is, after 5715 years, a sample of Carbon-14 will have decayed to half of the amount. What is the exponential decay model for Carbon-14?

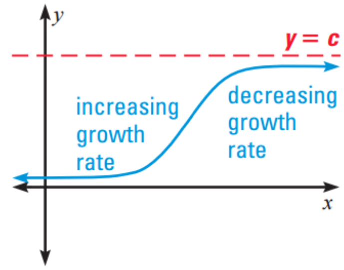
- Begin with the exponential decay model.
- In terms of P, what will the output (A) be?
- Divide both sides by P
- Log to solve for k

Logistic Growth Model

$$A = \frac{c}{1+a(e)^{-bt}}$$

Where a, b and c are constants with $c > 0$ and $b > 0$

Unlike exponential growth which has no upper bound (can increase infinitely), logistic growth does have an upeer bound. As time increases, the expression $a(e)^{-bt}$ approaches zero, making A approach c. Therefore, **c is the limit to the growth of A** and creates a horizontal asymptote for the graph of these functions



Example: The function $f(t) = \frac{30000}{1+20e^{-1.5t}}$ describes the number of people who have become ill with influenza t weeks after its initial outbreak in a town with 30,000 inhabitants.

How many people became ill with the flu when the epidemic began?

How many people were ill by the end of the 4^{th} week?

What is the limited size of the population that becomes ill?

Newton's Law of Cooling

The temperature, T, of a heated object at time t is given by $\boldsymbol{T = C + (T_0 - C)e^{kt}}$

Where: **C** is the constant temperature of the surrounding medium (often room temperature).

$\boldsymbol{T_0}$ is the initial temperature of the heated object.

$\boldsymbol{k}$ is a negative constant that is associated with cooling object.

Example: A cake removed fro the oven has a temperature of 210°F. It is left to cool in a room that has a temperature of 70°F. After 30 minutes, the temperature of the cake is 140°F.

a. Use Newton's Law of Cooling to find a model for the temperature of the cake, T, after t minutes.

b. What is the temperature of the cake after 40 minutes?

c. When will the temperatures of the cake be 90°F?

Formulas you need to know from this chapter:

Compound Interest	$A = P\left(1 + \frac{r}{n}\right)^{nt}$
Continuous Compounding Exponential Growth/Decay	$A = P(e)^{rt}$
Logistic Growth	$A = \frac{c}{1 + a(e)^{-bt}}$
Newton's Law of Cooling	$T = C + (T_0 - C)e^{kt}$