Name: ______________________ Date: ______________ Period: ______

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

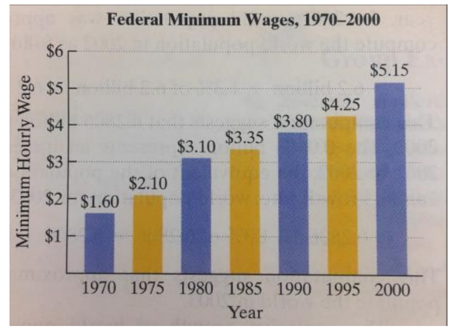
Exponential Growth & Decay Model $A = P(e)^{rt}$

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.

Consider x-values for the years - what is the principal (starting) value?
Use any known point to solve for r



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

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

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?

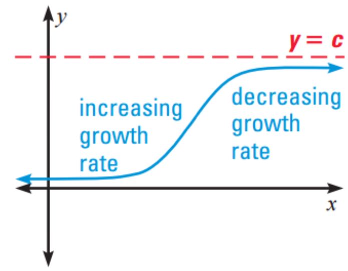
- Begin with the exponential decay model.
- In terms of P, what will the output (A) be?
- Divide both sides by P
- Log to solve for k

Logistic Growth Model

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

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 4th 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 from 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	$T = C + (T_0 - C)e^{kt}$