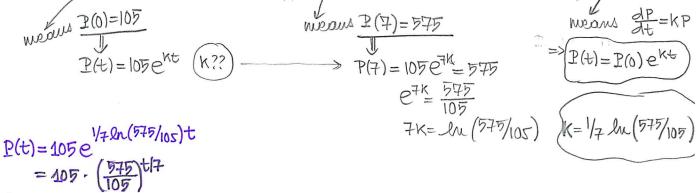
M133-S60: 9/15/2017

A(t)=d p 7/100t

## 6.5 Exponential Growth and Decay

1. A population P of insects increases at a rate proportional to the current population. Suppose there are 105 insects at time t=0 and 575 insects seven days later.

a). Find an expression for the number P(t) of insects at time t > 0, where t is in days.



b). How many insects will there be in 51 days?

$$P(51) = 105. \left(\frac{575}{105}\right)^{51/2}$$

2. Suppose that a particular carbon isotope which is found in living trees has a half-life of 5700 years.) Scientists have discovered that the charcoal from a tree burned in a volcanic eruption contains 36 percent of the isotope level that is normally found in living trees. How many years ago did the volcanic eruption occur?

$$m(t) = m_0 e^{kt}$$
  
 $(7401) - lle = 5700) \Rightarrow m(5700) = \frac{m_0}{2}$   
 $= m_0 e^{k.5700}$   
 $= m_0 e^{k.5700}$   
 $= m_0 e^{k.5700}$ 

Charcoal discovered @ trow: 36 Mo

$$M(t_{now}) = \frac{36}{100} M_0$$
 =>  $e^{Kt_{now}} = \frac{36}{100} => Kt_{now} = ln(\frac{36}{100}) => t_{now} = \frac{1}{K} ln(\frac{36}{100})$ 

$$= M_0 e^{Kt_{now}} = \frac{36}{100} ln(\frac{36}{100}) => t_{now} = \frac{1}{K} ln(\frac{36}{100})$$

$$= \frac{1}{100} ln(\frac{36}{100}) => t_{now} = \frac{1}{100} ln(\frac{36}{100})$$

3. Suppose you have just placed d dollars in a bank account that pays 5 percent (annual) interest, compounded continuously. A(t) = A0ert; A0=d; r= 5/10

a). How much do you have in the account after 7 years?

b). How long (in years) will it take your money to double?

$$A(t)=2d$$
 $A(t)=2d$ 
 $A(t)$ 

4. Suppose that the temperature of a cup of soup obeys Newton's law of cooling. If the soup has a temperature of 175°F when served to a customer, and 5 minutes later has cooled to 145°F in a room at 64°F, how much longer must it take the soup to reach a temperature of 110°F? (how many additional minutes)

$$T(t) = T_{S} + (T(0) - T_{S})e^{Kt}$$

$$T(t) = T_{S} + (T(0) - T_{S})e^{Kt}$$

$$T(t) = (14)e^{Kt}$$

$$T(t) = (10)e^{Kt}$$

$$= (10)e^$$

If the same cup of 175°F soup is instead placed into a freezer set at 10°F, what is the time required for the soup to cool from 175°F to 110°F in this situation?

What changes? 
$$Ts=10$$
 =>  $T(t)=10+(175-10)e^{kt}$   
=  $10+165e^{kt}$ 

Does K change? No, that constant belongs to the same soup.

$$T(t)=110$$
 (Solve Int)  
 $10+165e^{kt}=110$ ;  $e^{kt}=100/165$ ;  $kt=ln(100/165)$ ;  $t=1/k ln(100/165)$   
 $t=5 \frac{ln(100/165)}{ln(100/81)}$ 

- 5. Suppose that the temperature of a loaf of baked bread satisfies Newton's law of cooling. Right now the temperature of the bread is 65°C above room temperature but twenty-five minutes ago, it was 70°C above room temperature.
- a). How far above room temperature will the bread be thirty-five minutes from now?

In this problem: easier to work w/ 
$$y(t) = T(t) - T_s \Rightarrow y(t) = y(0)e^{kt}$$

J In this problem: easier to work w/ 
$$y(t) = T(t) - T_5$$
 ⇒  $y(t) = y(0)e^{kt}$  ⇒ Know:  $y(0) = 70 \rightarrow y(t) = 70e^{kt}$   $y(25) = 65 \rightarrow y(25) = 70e^{25k} = 65$ ;  $25k = \ln(65/70)$  (a). Find  $y(60) = ?$  [Why?  $35$  wins from now means  $y(25 + 35)$ ]  $y(60) = 70e^{60.725} \ln(65/70) = \sqrt{70.\left(\frac{65}{70}\right)^{12/5}}$ 

Find 
$$y(25+240)=y(265)=?$$
  
 $y(265)=70.e^{265.\frac{1}{25}ln(65/70)}=70.(\frac{65}{70})^{53/5}$ 

c). In how many minutes (from now) will the temperature of the bread measure 32°C above room temperature?

Solve 
$$y(t) = 32$$
:  $70e^{Kt} = 32$ ;  $Kt = lu(32/70)$ ;  $t = 25 \frac{lu(32/70)}{lu(65/70)}$ 

Thou now": This (-25) answer? not yet

answer: 
$$25 \frac{\ln(32/40)}{\ln(65/40)} - 25$$