Sec 3.4 Exponential Growth and Decay

A. Population Growth

$$P(t) = P(0) \cdot e^{kt}$$

Where:

- P(t) = Population after t years
- P(0) = Initial Population
- K = Growth constant
- T = Time

A bacteria culture initially contains 600 cells and grows at a rate proportional to its size. After 5 hours the population has increased to 620.

a.) Find an expression for the number of bacteria after t hours.

b.) Find the number of bacteria after 7 hours.

c.) Find the rate of growth after 7 hours. (Remember: Rate = Derivative)

d.) When will the population reach 4000?

B. Half Life

$$P(t) = P(0) \cdot e^{kt}$$

Where:

P(t) = Population after t years
P(0) = Initial Population
K = Growth constant
T = Time

The half-life of cesium-137 is 30 years. Suppose we have a 900-mg sample.

a.) Find the mass that remains after t years. (Find an expression for the mass that remains after t years.)

b.) How much of the sample remains after 150 years?

c.) After how long will only 4 mg remain?

C. Newton's Law of Cooling

$$T(t) = (T_0 - T_s) \cdot e^{kt} + T_s$$

Where:

- T(t) = Temperature after time t
- T_s = Temperature of surrounding area
- T_0 = Initial temperature of object
- K = Growth constant
- T = Time

Alternatively

$$T(t) = C \cdot e^{kt} + T_s$$

Where:

- T(t) = Temperature after time t
- T_s = Temperature of surrounding area
- C = Initial temp - surrounding temp
- K = Growth constant
- T = Time

A roast turkey is taken from an oven when its temperature has reached 175 Fahrenheit and is placed on a table in a room where the temperature is 65 Fahrenheit.

a.) If the temperature of the turkey is 155 Fahrenheit after half an hour, what is its temperature after 45 minutes?

b.) When will the turkey have cooled to 110 Fahrenheit?

D. Interest

Compound Interest	Compound Interest
$A = P\left(1 + \frac{r}{n}\right)^{nt}$	$A = P \cdot e^{rt}$
Where: A = Future Value P = Initial Value r = Interest rate n = Number of times per year compounded t = Time in years	Where: A = Future Value P = Initial Value r = Interest rate t = Time in years

If 8000 dollars is invested at 9% interest, find the value of the investment at the end of 5 years if interest is compounded

a.) annually

b.) quarterly

c.) monthly

d.) continuously