

Objective 2 - Construct Correct Model

Note: There are no textbook or videos directly to this section. If you want to review a certain type of model, you will need to go back to that Module.

General tips to constructing a model:

- Identify the appropriate function to model the situation.
- Try introducing small numbers to check your model. *For example, if you need to model population growth, try using a small population like 10 to make sure you are seeing the growth you expect.*
- Check your units and variables.

Question 1 Chemists commonly create a solution by mixing two products of differing concentrations together. For example, a chemist could have large amounts of a 10% acid solution and a 30% acid solution, but need a 11 liter 23% solution. Construct a model that describes the amount of acid in a 23% acid solution, A_{23} , in terms of the volume of the 10% acid solution, v .

$$A_{23} = \boxed{-0.2000000000000000 v + 3.3000000000000000}$$

Question 2 There is initially 855 grams of element X . The half-life of element X is 321711 years. Describe the amount of element X remaining as a function of time, t , in years.

$$X(t) = \boxed{855} e^{\boxed{-\frac{1}{321711} \log(2)} t}$$

Question 3 A company sells doughnuts. They incur a fixed cost of \$10000 for rent, insurance, and other expenses. It costs \$0.15 to produce each doughnut. The company sells each doughnut for \$0.15. Construct a model that describes their total revenue, R , as a function of the number of doughnuts, x , they produce.

$$R(x) = \boxed{-10000}$$

Learning outcomes:
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Question 4 *Kepler's Third Law: The square of the time, T , required for a planet to orbit the Sun is directly proportional to the cube of the mean distance, a , that the planet is from the Sun. Assume that Mars' mean distance from the Sun is 4 AUs and it takes Mars about 386.69 months to orbit the Sun. Write the equation that describes time T (years) in terms of the mean distance, a (AUs).*

$$T(a) = \boxed{4.028} a^{\boxed{3/2}}$$

Question 5 *The half-life of carbon-14 is 5,730 years. Describe the age in years of an object in terms of the ratio of carbon-14, $r = \frac{C}{C_0}$, remaining.*

$$t(r) = \boxed{-8266.64258429376} \ln(\boxed{r})$$

Question 6 *Two UFPD are patrolling the campus on foot. To cover more ground, they split up and begin walking in different directions. Office A is walking at 5 mph while Office B is walking at 3 mph. Construct a model that describes their total distance from each other, T_2 , as a function of minutes, m , that have passed if they were walking in exactly 90 degrees from each other (e.g., North/East).*

$$T_2(m) = \boxed{\frac{1}{30} \sqrt{\frac{17}{2}} m}$$

Question 7 *A population of bacteria doubles every hours. If the culture started with 200, write the equation that models the bacteria population after t hours.*

$$P(t) = \boxed{200} \boxed{2}^{\boxed{t}}$$