

3.5 Making Connections With Rational Functions and Equations

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- In order to create a saline solution, salt water with a concentration of 40 g/L is added at a rate of 500 L/min to a tank of water that initially contained 8000 L of pure water. The resulting concentration of the solution in the tank can be modelled by the function $C(t) = \frac{40t}{160+t}$, where C is the concentration, in grams per litre, and t is the time, in minutes.
 - In how many minutes the saline concentration be 20 g/L?
 - Is there an upper limit to the concentration in the tank? Explain.
 - What restrictions must be placed on the domain of C if the tank has a maximum capacity of 120 000 L?
- A company finds that its sales since the company started in 2000 can be modelled by the function $S(t) = \frac{20t^2 + 800t + 300}{8t^2 + 10t + 100}$, where S is the total sales, in millions of dollars, and t is the number of years since 2000.
 - What were the sales in 2000?
 - After many years, what does the model predict sales will be?
 - Calculate the years when the sales are \$9 million, algebraically.
 - Use Technology** Use technology to graph of the model. During what year were sales highest?
 - If you were working in the human resources department for the company, would you recommend that the company hire more people based on this model? Explain your reasoning.
- The weight (gravitational force) on a 100-kg object as a function of its height above mean sea level on Earth can be modelled by the formula $W(h) = \frac{4 \times 10^{16}}{(6.4 \times 10^6 + h)^2}$, where W is the weight, in Newtons (1 kg weighs about 10 N) and h is the height above mean sea level, in metres.
 - How much does the object weigh at sea level?
 - If you were to take the object to the top of Mt. Everest (height 9000 m), what would its weight be?
 - How high would the object have to be to weigh 800 N? Round your answer to the nearest kilometre.
- An integer n is squared, and the result doubled. Three is added to the same integer and the result squared. The ratio of the first answer to the second is then formed.
 - Write a function $R(n)$ that gives the ratio of the two answers.
 - Sketch the graph of R .
 - A student claims that the value of R will always be less than 2. Is she correct? Explain.
 - Solve algebraically to determine the values of n for which $R(n) \leq 0.5$. Illustrate your answer on a number line.
 - For which value(s) of n is $R(n) > 8$?

Name: _____

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5. A rectangular prism with a square base has a volume of 25 cm^3 . The surface area of the prism is given by the formula

$$S(b) = \frac{2b^3 + 100}{b}, \text{ where } S \text{ is the surface}$$

area, in square centimetres, and b is the length of each side of the base, in centimetres.

- a) What is the restriction on the length of the base?
- b) **Use Technology** Use technology to graph the function S over the domain $[0, 10]$.
- c) **Use Technology** Use technology to calculate the length of the base that would give the smallest surface area.
- d) This function has no asymptote, but does approach a curve that is a parabola. Determine the equation of that parabola.