

### 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  $25 \text{ cm}^3$ . 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.