1. Suppose you define a function $D$ by

$$D(t) = \text{the temperature in Sewanee at time } t$$

Assume that $t = 0$ corresponds to midnight last night and that $t$ is measured in hours.

(a) Translate into English: $D(7) = 42$

(b) Translate into English: $D'(7) = 6$.

(c) For what values of $t$ (if any) do you think $D'(t)$ will be negative? Briefly explain.

2. Suppose there is a major concert at an arena that holds 20,000 people. Define a function $C$ by

$$C(t) = \text{the number of cars in the arenas parking lot at time } t.$$ 

Assume $t$ is measured in minutes and that $t = 0$ corresponds to the time the concert starts.

(a) what are the units on $C'(t)$?

(b) Translate into English: $C(-30) = 4000$.

(c) Translate into English: $C'(-30) = 15$.

(d) Approximately what is $C'(30)$?

(e) (Assuming the concert lasts about two hours) approximately what are $C'(150)$ and $C'(250)$?

3. As you know, the amount of time you have to wait in line to ride a particular ride at your favorite theme park depends on what time of day it is. If you show up early, you might have a short wait. If you get there in the middle of the day, though, the park is crowded and the youll have to wait in line for a long time. By night time, the kiddies have mostly gone home and wait times are shorter.

Define a function $W$ by $W(t) = \text{your wait time (in minutes) if you show up at the ride } t \text{ minutes after the park opens}$.

(a) Translate into English: $W(60) = 35$;

(b) Translate into English: $W'(60) = 2$;

(c) Suppose $W'(240) = 0$. What does that mean?
4. At the end of your four years at Sewanee, your class rank will be determined by your GPA. Let’s assume that if your GPA is 4.3, you will have a rank of 1 (the best rank you can have). If you have a GPA of 3.0, your rank will be 200 (right in the middle).

Define a function $R$ by

$$R(g) = \text{your class rank, given that your GPA is } g.$$ 

Note that $R(4.3) = 1$ and $R(3.0) = 200$.

(a) What can you say about the sign of $R'$? Is $R'$ positive? Negative? Sometimes positive and sometimes negative?

(b) Translate into English: $R'(3.0) = -400$.

(c) Approximately what is $R'(3.9)$?

5. Suppose you are standing $x$ feet away from a painting hanging on a wall at a museum. In order to get the best possible view of the painting, you want to maximize the viewing angle $\theta$ (see the sketch below). Obviously $\theta$ changes as $x$ changes, so $\theta$ is a function of $x$. Let’s say $\theta$ is measured in degrees.

(a) Translate the following statement into English: $\theta'(2) = 4$.

(b) Suppose you are standing 8 feet from the painting and somebody tells you that $\theta'(8) = -2$. Should you move forward or backward in order to get a better view of the painting? Explain.
6. Suppose you are hitting a baseball. Given a particular pitch speed and a particular bat, the speed of the ball leaving your bat will be a function of the speed of your bat. Let’s call that function $L$. So $L(b)$ denotes the speed (in mph) of the ball leaving your bat, given a bat speed of $b$ mph.

(a) What can you say about the sign of $L'$? Explain.

(b) Interpret the meaning of: $L'(80) = 1.3$.

7. For a particular plane, the amount of fuel needed to fly from Atlanta to Boston depends on the total weight of the stuff (i.e. passengers, luggage, etc.) in the plane. Define a function $G$ by $G(w) =$ the amount of fuel (in gallons) required to fly from Atlanta to Boston if the total weight of the passengers and cargo is $w$ pounds.

(a) Translate into English: $G(3000) = 800$.

(b) What are the units on $G'$?

(c) Is $G'$ always positive? Always negative? Sometimes positive and sometimes negative? Explain.

(d) Which is a more realistic estimate of $G'(3000)$: 1 or 1000? Explain.

8. Define a function $H$ by

$$H(a) = \text{your height at age } a.$$ 

Assume $a$ is measured in years and $H(a)$ in inches.

(a) What is $H(19)$?

(b) What is $H'(19)$?

(c) What can you say about the sign of $H'$?

(d) At what value of $a$ does $H'$ reach its maximum? Explain.
9. Suppose you are the advertising director for a company that sells woogets. Define a function $R$ by $R(b) =$ your revenue (in dollars) from the sale of woogets, assuming you spend $b$ dollars on advertising.


(b) Do you think $R''$ is positive, negative, or zero? Explain.

(c) Suppose you know that $R'(10000) = .85$. What should you, as ad director, do?

10. Define a function $F$ by $F(s) =$ the fuel efficiency (measured in mpg) of your car if you’re driving it at $s$ miles per hour.

(a) Translate into English: $F(40) = 32$.

(b) Translate into English: $F'(40) = .2$.

(c) For what value of $s$ do you think $F'(s) = 0$? What is the practical significance of that value?