

**Problem 1:**

If an arrow is shot upward on the moon with a velocity of 58 m/s, its height (in meters) after  $t$  seconds is given by

$$H = 58t - 0.83t^2.$$

1. Find the velocity of the arrow after one second.
2. Find the velocity of the arrow when  $t = a$ .
3. When will the arrow hit the moon?
4. With what velocity will the arrow hit the moon?

**Problem 2:**

The number of bacteria after  $t$  hours in a controlled laboratory experiment is  $n = f(t)$ .

1. What is the meaning of the derivative  $f'(5)$ ? What are its units?
2. Suppose there is an unlimited amount of space and nutrients for the bacteria. Which do you think is larger,  $f'(5)$  or  $f'(10)$ ? If the supply of nutrients is limited, would that affect your conclusion?

**Problem 3:**

The weight,  $W$ , in lbs. of a child is a function of its age,  $a$ , in years, so  $W = f(a)$ .

- (a) Do you expect  $f'(a)$  to be positive or negative? Why?
- (b) What does  $f(8) = 45$  tell you? Give units for the numbers 8 and 45.
- (c) What are the units of  $f'(a)$ ? Explain what  $f'(a)$  tells you in terms of age and weight.
- (d) What does  $f'(8) = 4$  tell you in terms of age and weight.
- (e) If  $a$  increases, do you expect  $f'(a)$  to increase or decrease? Explain.

**Answers:**

- (a) Positive, since weight increases as the child gets older.
- (b)  $f(8) = 45$  tells us that when the child is 8 years old, the child weighs 45 pounds.
- (c) The units of  $f'(a)$  are lbs/year (pounds per year)?  $f'(a)$  tells the rate of growth (in lbs/year) of the child at age  $a$ .
- (d)  $f'(8) = 4$  tells us that the 8-year-old child is growing at about 4 lbs/year.
- (e) As  $a$  increases,  $f'(a)$  will decrease, since the rate of growth slows down as the child grows up.