Name: ______________________________

### MODELING WITH LINEAR FUNCTIONS

When we use equations to **model** real-world phenomena we often look to **linear models** first because they are the easiest to use and understand. We can now use our skills from the last few lessons to model real-world linear phenomena.

Don't ever forget these two facts about linear models:

**CRITICAL LINEAR MODEL FACTS**

All linear models in the form $y = mx + b$ have two **parameters**, the slope, $m$, and the $y$-intercept, $b$:

1. The slope, $m$, always tells us how fast the **output** is changing relative to the **input**.
2. The $y$-intercept, $b$, always tells us "how much" we start with, or the **output's starting value** (at $x = 0$).

***Exercise #1:*** Jannine has \$450 in her savings account at the beginning of the year. She places money in the account at the rate of \$5 per week. We want to model the amount of money she has in savings, $s$, as a function of the number of weeks she has been saving, $w$.

(a) Fill out the table below for some of the number of weeks. Show the calculations that result in your answer.

| Number of weeks, $w$ | Calculation | Amount in Savings, $s$ |
|---|---|---|
| 0 | | \$450 |
| 1 | 1(5)+450 | \$455 |
| 5 | 5(5) +450 | \$475 |
| 10 | 10(5)+450 | \$500 |

(b) Use information in the givens or in the table to write an equation for the savings, $s$, as a linear function of the weeks she has been saving, $w$.

$y = mx + b$

$y = 5x + 450$

$\boxed{S = 5W + 450}$

(c) If Jannine saves for exactly one year, what is the **range** in her savings over the year? Show how you arrived at your answer.

$S = 5w + 450$

$S = 5(52) + 450 = \$710$

started at \$450, now has

(d) Why would it not make sense to evaluate $s(6.5)$? In other words, what types of numbers belong in the **domain** of this linear function?

Whole numbers belong in the domain.

6.5 weeks??

(e) Use two points from the table to verify that the rate of change of the function is 5. How do the units show up in the calculation?

*Exercise* #2: Amanda is walking away from a light pole at a rate of 4 feet per second. If she starts at a distance of 6 feet from the light pole, which of the following gives her distance, $d$, from the light pole after walking for $t$-seconds?

(1) $d = 4t + 6$ (3) $d = 6t + 4$

(2) $d = \frac{3}{2}t$ (4) $d = -6t + 4$

$y = mx + b$

$y = 4x + 6$

**Independent Practice – Then Turn And Talk!**

1. A company that manufactures radios first pays a start-up cost, and then spends a certain amount of money to manufacture each radio. If the cost of manufacturing $r$ radios is given by the function $c(r) = 5.25r + 125$, then the value 5.25 best represents

$mx + b$

1) the start-up cost
2) the profit earned from the sale of one radio
3) the amount spent to manufacture each radio
4) the average number of radios manufactured

2. Which chart could represent the function $f(x) = -2x + 6$?

1)

| x | f(x) |
|---|---|
| 0 | 6 |
| 2 | 10 |
| 4 | 14 |
| 6 | 18 |

2)

| x | f(x) |
|---|---|
| 0 | 4 |
| 2 | 6 |
| 4 | 8 |
| 6 | 10 |

3)

| x | f(x) |
|---|---|
| 0 | 8 |
| 2 | 10 |
| 4 | 12 |
| 6 | 14 |

4)

| x | f(x) |
|---|---|
| 0 | 6 |
| 2 | 2 |
| 4 | –2 |
| 6 | –6 |

3. The owner of a small computer repair business has one employee, who is paid an hourly rate of \$22. The owner estimates his weekly profit using the function $P(x) = 8600 - 22x$. In this function, $x$ represents the number of

1) computers repaired per week
2) hours worked per week
3) customers served per week
4) days worked per week

Name: ___________________________________

## Modeling with Linear Functions
## Homework

1. Water is building up in a bathtub. After 2 minutes there are 12 gallons of water and after 4 minutes, there are 20 gallons of water. What is the average rate at which water is entering the bathtub from $t = 2$ to $t = 4$ minutes? Show how you calculated the rate.

   (1) 8 gallons per minute (3) 10 gallons per minute

   (2) 6 gallons per minute (4) 4 gallons per minute

2. Francisco is saving money in an account. At the beginning of the year, he has $56 in savings and puts in another $4 per week. Which of the following equations models the amount of savings, $s$, as a function of the number of weeks, $w$, Francisco has been saving?

   (1) $s = 4w + 56$ (3) $s = 56w + 4$

   (2) $s = \frac{w}{4} + 56$ (4) $s = \frac{w}{56} + 4$

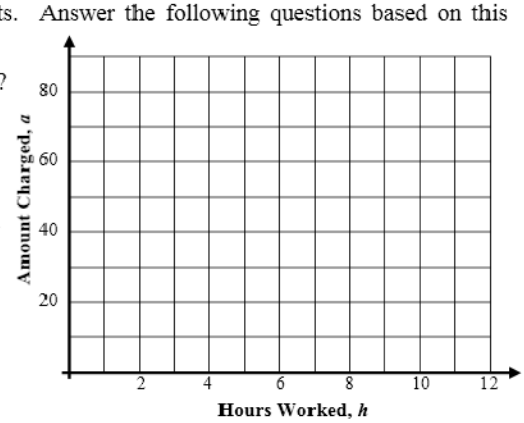
### Applications

3. Maria charges $15 for every 2 hours that she babysits. Answer the following questions based on this information.

(a) How much would Maria charge for working for 5 hours?

(b) Fill out the table below for the amount that Maria makes as she babysits and graph the relationship on the grid provided.

| Hours Worked, $h$ | 2 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|
| Amount, $a$, in $ | 15 | | | | | |




(c) Write an equation for the amount, $a$, that Maria makes as a function of the number of hours, $h$, that she babysits. Keep in mind that Maria will make $0 for babysitting for 0 hours.

4. The temperature is falling outside at a steady rate of 4 degrees Fahrenheit every hour. If the temperature starts at 68 Fahrenheit do the following.

(a) Fill out the table below for the outside temperature during the time it is cooling down.

| Time Cooling, $t$, (hours) | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Temperature, $F$, (Fahrenheit) | | | | |

(b) Write a linear equation that relates the Fahrenheit temperature, $F$, to the time in hours, $t$, that it has been falling.

5. The population of deer in a park is growing over the years. The table below gives the population found in a survey by local wildlife officials.

| Year | 2000 | 2003 | 2006 | 2009 |
|---|---|---|---|---|
| Deer Population | 168 | 216 | 264 | 312 |

(a) Find the average rate that the deer population is changing over each time interval below:

From 2000 to 2003 From 2003 to 2006 From 2006 to 2009

(b) Why does this calculation indicate a linear relationship?