Name: ____________________________________ Date: __________________

MODELING WITH LINEAR FUNCTIONS
COMMON CORE ALGEBRA I

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		
1		
5		
10		

(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*.

(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.

(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?

(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?

Sometimes the information we have about the linear relationship does not include the starting value. Let's take a look at that type of situation.

***Exercise* #2:** Kirk is driving along a long-road at a constant speed. He is driving directly towards Denver. He knows that after 2-hours of driving he is 272 miles from Denver. After 3 and a half hours he is 176 miles from Denver.

(a) Summarize the information given in the problem as two ordered pairs, where the number of hours, *h*, is the input and the distance from Denver, *D*, is the output.

(b) Calculate $\frac{\Delta D}{\Delta h}=\frac{D(3.5)-D(2)}{3.5-2}$. Include proper units in your answer.

(c) You should have found that the rate of change was negative. Why is it? Explain what is physically happening to result in this negative rate of change.

(d) Assuming the relationship is linear (which it would be at a constant speed), write an equation for the distance *D* as a linear function of the number of hours, *h*.

(e) How far did Kirk start from Denver? Show the work that leads to your answer.

(f) After how many hours will Kirk arrive in Denver? Show the work that leads to your answer.

***Exercise* #3:** 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) $d=4t+6$

(2) $d=\frac{3}{2}t$

(3) $d=6t+4$

(4) $d=-6t+4$

Name: ______________________________ Date: ______________

MODELING WITH LINEAR FUNCTIONS
COMMON CORE ALGEBRA I HOMEWORK

FLUENCY

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

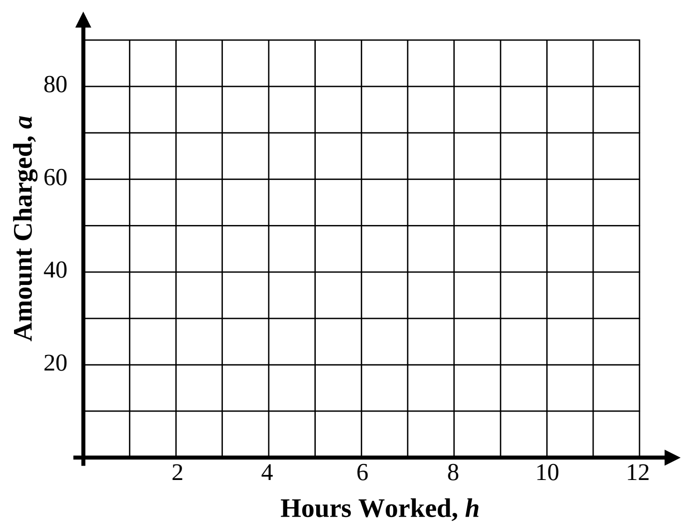
APPLICATIONS

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.

(c) According to your equation, what is the temperature when $t = 2.75$ hours?

(d) If this cooling continues at this constant rate, how many hours will it take for the temperature to reach the freezing point of water? Show your work.

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?

(c) If *t* stands for the number of years since 2000, write an equation for the deer population, *p*, as a function of *t*.

(d) What does your model predict the deer population to be in the year 2014?

(e) How many years will it take for the deer population to reach 500? Round to the nearest year.