Name: ____________________________________ Date: ___________________

DISCRETE FUNCTIONS
COMMON CORE ALGEBRA I

We have done a lot of modeling this year. Each time we used a function to describe the relationship between two quantities the input variable (typically x or t) was either **continuous** or **discrete**. A non-rigorous set of definitions for continuous and discrete is given below:

CONTINUOUS VERSUS DISCRETE VARIABLES

A **continuous variable/function** takes on all real number values between its extremes.

A **discrete variable/function** takes on isolated or unconnected values between its extremes.

In this lesson we will concentrate on **discrete functions** because most of the graphing we have done has been of **continuous functions**.

***Exercise* #1:** Miranda has a lemonade stand where she is selling cups of lemonade for $0.50 per cup.

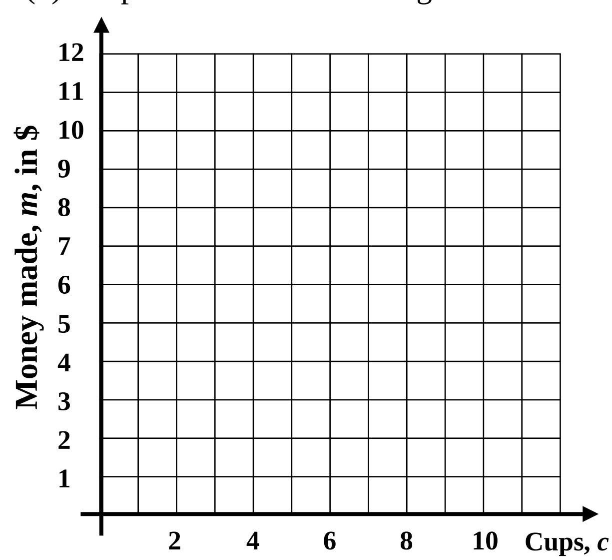
(a) Fill out the table below for the amount of money, m, that Miranda makes as a function of the number of cups, c, that she sells.

Cups, c	0	1	2	3	4
Money, m					

(b) Create an equation that finds the money made, m, as a function of the number of cups, c, sold.

(c) Explain why this is an example of a **discrete function**.

(d) Graph this function on the grid below.



(e) How many cups of lemonade would Miranda need to sell in order to make exactly $30?

(f) Explain why Miranda cannot make exactly $28.75.

So, **discrete functions** are **characterized** by **domains** (inputs) that **realistically** contain only certain types of numbers, typically **whole numbers**.

***Exercise* #2:** In each of the following cases, two variables are related by a function. In each situation, determine whether the function is **continuous** or **discrete**. Explain your thinking.

(a) A person who is driving at a constant speed of 62 miles per hour has a distance traveled, *d*, given as a function of time, *t*, in hours as $d = 62t$.

(b) Franklin is selling candy bars to raise money for the Drama Club. Each candy bar costs \$2.50. The money he raises, *m*, as a function of the number of candy bars, *b*, he sells is given by $m = 2.50b$.

(c) A teacher imposes a one-half multiplicative penalty each day that an assignment is turned in late. The total credit, *c*, that a student can earn based on the number of days it is late is given by $c = 100 \cdot \left(\frac{1}{2}\right)^d$.

(d) A bathtub is draining at a rate of 3.2 gallons per minute from an initial volume of 164 gallons. The volume, *V*, of water left in the bathtub after *m* minutes is given by $V = 164 - 3.2m$.

Phenomena that are discrete often have ramifications when it comes to realistic solutions to modeling problems. Consider an example that compares texting plans.

***Exercise* #3:** Malik is trying to compare texting plans for two cell phone companies. His options are given below.

Option A: A monthly charge of \$12.50 and each text costs \$0.02.

Option B: No monthly charge, but a charge of \$0.05 per text.

(a) Write equations that give the total monthly cost, *c*, based on the number of text's made, *n*, for both options.

Option A:

Option B:

(b) Why will Malik not be able to find a number of texts where the two plans charge an equal monthly amount?

(c) Even though the solution to (b) is not **viable**, it still might be helpful in thinking about the two cell phone plans. What information does it provide?

Name: ____________________________________ Date: __________________

DISCRETE FUNCTIONS
COMMON CORE ALGEBRA I HOMEWORK

APPLICATIONS

1. In each of the following cases, two variables are related by a function. In each situation, determine whether the function is **continuous** or **discrete**. Explain your thinking.

   (a) The height, *h*, of an object above the ground can be modeled as a function of time, *t*, by the equation $h = 200 - 16t^2$.

   (b) The cost *C* of a charter bus trip depends on the number of people, *n*, who go on the trip. This dependence can be shown in the equation $C = 22.50n$.

2. Which of the following would be an example of two variables related with a discrete function.

   (1) The volume of water in a swimming pool and the amount of time it has been filling.

   (2) The cost of buying pens and the number of pens purchased.

   (3) The area of a square garden and the length of the side of the garden.

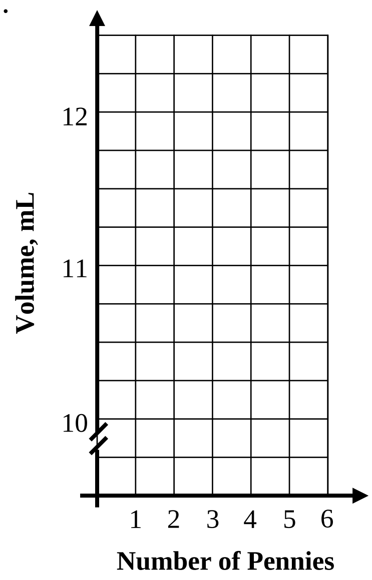
   (4) The mean temperature of a planet and its distance from the sun.

3. Maxwell is attempting to determine the volume of a penny in cubic centimeters. He does an experiment where he drops pennies into water and records the volume, in milliliters. The data is shown below.

Number of Pennies	0	1	2	3	4	5	6
Volume (mL)	10.5	10.8	11.1	11.4	11.7	12.0	12.3

   (a) Explain why the volume is a discrete function.

   (b) Graph the data from the chart on the grid below.



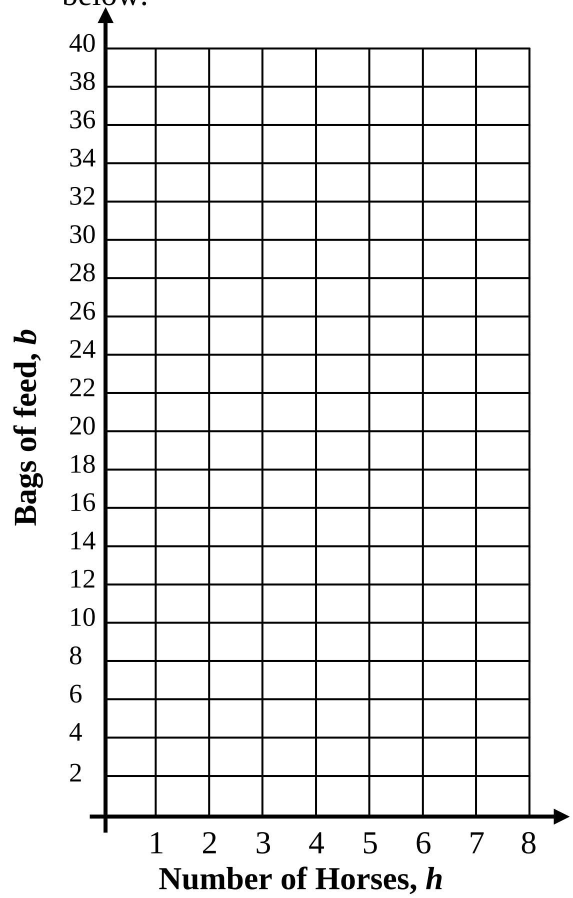
   (c) Write an equation for the volume, *v*, as a function of the number of pennies, *p*, placed in the water. This is a discrete linear function.

   (d) One milliliter is equivalent to one cubic centimeter. What is the volume of one penny in cubic centimeters?

4. Shana is trying to make sure that a local farm has enough bags of horse feed to last the week. She knows the she wants to have 3 bags of feed per horse and a reserve of 8 bags as well.

(a) Determine an equation for the number of bags, *b*, that Shana should plan on as a function of the number of horses, *h*, present on the farm.

(b) Create a graph of your equation on the grid below.



(c) Using your equation from (a), how many bags of feed should Shana keep stocked if the farm has 15 horses?

(d) Using your equation from (a), how many horses can be on the farm if Shana has 62 bags of feed?

5. An amusement park models the amount of wait-time, *W*, in minutes for a ride based on the number of people, *n*, standing in line. The equation they determine is:

$$W(n) = 0.4n + 12$$

(a) Explain why this is an example of a discrete function.

(b) Interpret the fact that $W(10) = 16$. In other words, what does this mean in terms of the scenario being modeled.

(c) If the park estimates that the wait time is 45 minutes, then how many people must be standing in line for this exact wait time? Why is this not a viable solution?