

Algebra 1-2: 2.1a Modeling Quantities (textbook section 1.2)

DOK 2: Model

You will: Define appropriate quantities for the purpose of descriptive modeling.

A _____ compares two quantities with different units. Example: A car gets 25 miles per gallon

A **Conversion factor** is a _____ (a comparison of two numbers by division) with equal quantities each measured in different units. Some common ones are:

$$\frac{1 \text{ ft}}{12 \text{ in}} \quad \frac{1 \text{ yd}}{3 \text{ ft}} \quad \frac{1 \text{ hr}}{60 \text{ min}} \quad \frac{4 \text{ qts}}{1 \text{ gal}} \quad \frac{16 \text{ oz}}{1 \text{ lb}}$$

_____ is a method of manipulating unit measures algebraically to determine the proper units for a quantity computed algebraically.

- 1) A large adult male human has about 12 pints of blood. Use dimensional analysis to convert this quantity to gallons.

Step A: Convert pints to quarts.

Step B: Convert quarts to gallons

$$\underline{\hspace{2cm}} \cdot \frac{1 \text{ quart}}{2 \text{ pints}} = \underline{\hspace{2cm}}$$

$$\underline{\hspace{2cm}} \cdot \frac{1 \text{ gallon}}{4 \text{ quarts}} = \underline{\hspace{2cm}}$$

In words: A large adult male has approximately _____ gallons of blood.

- 2) The length of a building is 720 in. Use dimensional analysis to convert this quantity to yards.

Step A: Convert inches to feet.

Step B: Convert feet to yards

$$\underline{\hspace{2cm}} \cdot \frac{\text{foot}}{\text{inches}} = \underline{\hspace{2cm}}$$

$$\underline{\hspace{2cm}} \cdot \frac{\text{yard}}{\text{feet}} = \underline{\hspace{2cm}}$$

In words: A _____ inch building is _____ yards.

Use dimensional analysis to convert the measures. Round to the nearest tenth.

- 3) 7500 seconds to hours

- 4) 88 inches to meters (1 meter = 3.28 ft)

- 5) 4 inches to yards

- 6) 1 day to seconds

?

When setting up a conversion factor, do you put the given units in the numerator or in the denominator? Why?

How do you ensure that the result of your calculation is in the desired unit?

- 7) During a cycling event for charity, Amanda traveled 105 kilometers in 4.2 hours and Brenda traveled at a rate of 0.2 mile per minute. Which girl traveled at a greater rate? Use $1 \text{ mi} = 1.61 \text{ km}$.
- 8) A box of books has a mass of 4.10 kilograms for every meter of its height. A box of magazines has a mass of 3 pounds for every foot of its height. Which box has a greater mass per unit of height? Use $1 \text{ lb} = 0.45 \text{ kg}$ and $1 \text{ m} = 3.28 \text{ ft}$. Round your answer to the nearest tenth.
- 9) Alan's go-kart travels 1750 feet per minute, and Barry's go-kart travels 21 miles per hour. Whose go-kart travels faster? Round your answer to the nearest tenth.

Algebra 1-2: 2.1b Solving Problems with Rates and Ratios (textbook section 1.2)

DOK 3: Model

You will use units and quantities to understand and solve a real-world problem.



Congratulations!

You have just won the state lottery, and now you must choose your prize—either \$250,000 after taxes in cash or free gas for life for you and your registered vehicle only.

1. Individually complete parts (a) and (b) without making any calculations, then answer the question in part (c):
 - a. Describe the lifestyle of a person for whom the \$250,000 prize is likely to be the best option.
 - b. Describe the lifestyle of a person for whom free gas for life is likely to be the best option.
 - c. Which prize do you think would be likely to be best for you? Explain why.

2. The variables in this problem include gallons of gas, cost of gas, miles driven, time in a lifetime. Brainstorm in your group to create a list of **RATES** that would be helpful in solving this problem.

Example:
$$\frac{\text{\# of miles}}{1 \text{ gallon of gas}}$$

3. You'll need to make some assumptions to complete these calculations:
 - The type of car you will drive (for gas mileage purposes)
 - How many miles you'll drive in a week
 - How long is a "lifetime"

Discuss these with your group and agree on the assumptions you will use.

To solve this problem, you'll need a string of ratios, something like this...

$$\frac{\$}{1 \text{ gallon}} \cdot \frac{1 \text{ gallon}}{\text{miles}} \cdot \frac{\text{miles}}{\text{time period}} \cdot \frac{\text{time period}}{1 \text{ lifetime}}$$

4. Work with your group to translate your assumptions to ratios and use unit conversions to calculate which prize would be likely to have the greatest monetary value for you. Support your answer mathematically.

5. Select one of your assumptions in question 3 to change. _____
Recalculate the prize based on this change.

6. How important do you think assumptions are in a real-world problem?

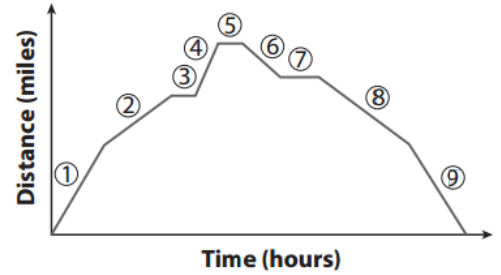
7. Revisit your answer in part 1c. Would you change which prize you would pick? Explain.

Algebra 1-2: 2.2a Interpreting Graphs (textbook section 3.1)

DOK 3: Analyze

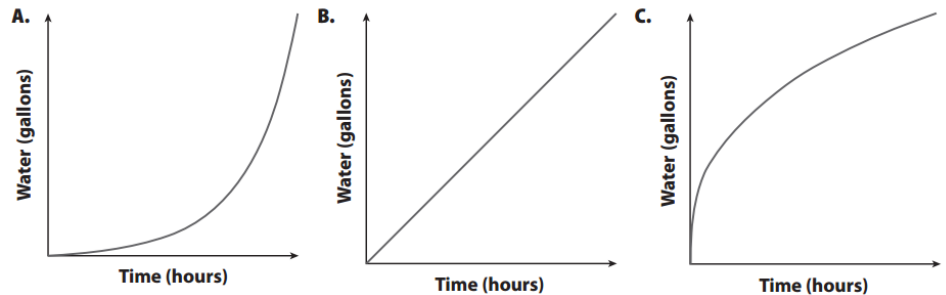
You will use rates to interpret key features of graphs

The distance a delivery van is from the warehouse varies throughout the day. The graph shows the distance from the warehouse for a day from 8:00 am to 5:00 pm.



- 1) Segment 1 shows that the delivery van moved away from the warehouse. What does segment 2 show?
- 2) Based on the time frame, what change in the distance from the warehouse is represented by segment 6?
- 3) Which line segments show intervals where the distance did not change? _____
- 4) What is a possible explanation for these segments?
- 5) Explain how the slope of each segment of the graph relates to the movement of the delivery truck:
 - a. Positive Slope:
 - b. Negative Slope:
 - c. Zero Slope:

Three hoses fill three different water barrels. A green hose fills a water barrel at a constant rate. A black hose is slowly opened when filling the barrel. A blue hose is completely open at the beginning and then slowly closed. The three graphs of the situations are shown.

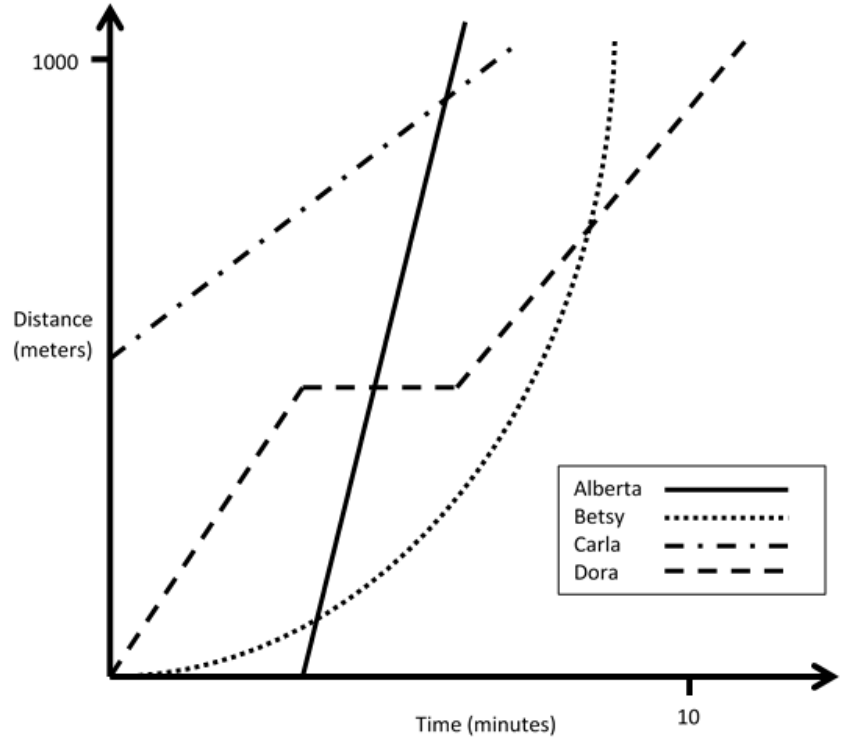


- 6) Which graph best represents the amount of water in the barrel filled by the green hose? _____
- 7) Describe the water level represented by the remaining graphs. Which graph represents each situation?
 - a. Describe the water level for graph A.
 - b. Describe the water level for graph C.
 - c. Graph A represents the _____ hose and graph C represents the _____ hose.

8) Could a graph of the amount of water in a water barrel slant downward from left to right? Explain

The Four Sister Race

One day four sisters, Alberta, Betsy, Carla, and Dora had a 1000 meter race. At right is a graph that is a sketch describing what happened that day. Use it to answer the questions below:



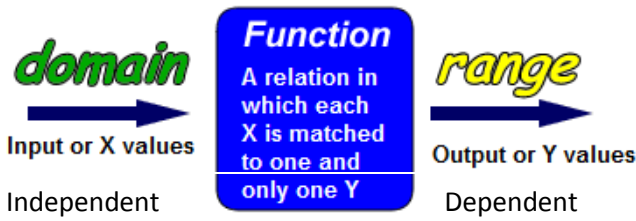
1. Who won the race?
2. Who had a head start at the beginning of the race?
3. Who started the race late?
4. How would you describe Carla's speed?
5. How would you describe Betsy's speed?
6. What happened to Dora in the middle of the race?
7. What order did the sisters finish? First Place: _____

2) _____, 3) _____, 4) _____

Algebra 1-2: 2.2b Graphing Relationships (textbook section 3.1)

DOK 3: Model

You will Use rates to model relationships with graphs



Continuous Graphs:
A graph made up of connected lines or curves; Domain (x) values include all real numbers
Discrete Graphs:
A graph made up of distinct, unconnected points; Domain (x) values are limited to distinct numbers

- 1) Simon sold candles to raise money for the school dance. He raised a total of \$25.00 for selling 10 candles. Find the unit rate (amount earned per candle). Then graph the relationship.
 - a. Will the graph be discrete or continuous?
 - b. The x-axis will represent _____, since this is the independent variable. Based on the problem, the x-axis will need to go from ____ to ____.
 - c. The y-axis will represent the _____, since this is the dependent variable. Based on the problem, the x-axis will need to go from ____ to ____.
 - d. The unit rate is _____ per candle. Using this information, create scales on the x- and y-axes.
 - e. Plot points on the graph to represent the amount of money the school earns for the different numbers of candles sold.



- 2) Find domain and range intervals, use unit rates to create scales on the x- and y-axes, and graph the function.
 - a. Alex drove 135 miles in 3 hours at a constant speed.
 - b. Max makes \$20 for every bracelet she sells. She has 10 bracelets to sell.

Discrete or Continuous

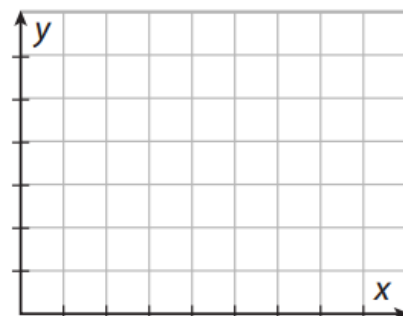
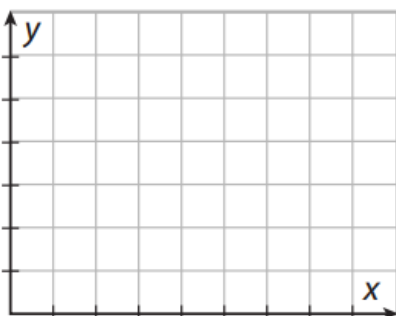
Discrete or Continuous

Domain:

Domain:

Range:

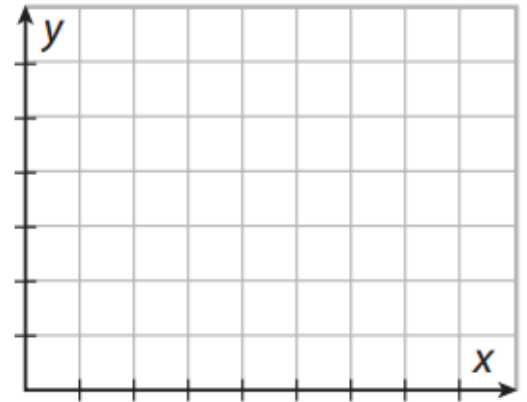
Range:



3) Ann walks at a rate of 5 miles per hour for 30 minutes to get to the bus stop. She waits 10 minutes for the bus to arrive. The bus drives directly (non-stop) to school at a rate of 40 miles per hour for 10 minutes

- b. Will the graph be discrete or continuous?
- c. The domain is _____
- d. The range is _____
- e. Use unit rates to sketch each section.

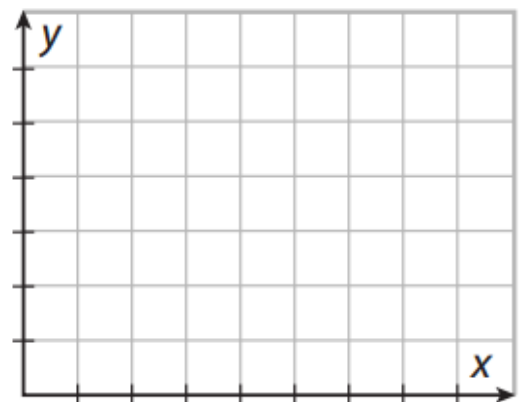
Section	Time (x)	Distance (y)



4) A bathtub is being filled with water. After 10 minutes, there are 75 quarts of water in the tub. Then someone accidentally pulls the drain plug while the water is still running, and the tub begins to empty. The tub loses 15 quarts in 5 minutes, and then someone plugs the drain and the tub fills for 6 more minutes, gaining another 45 quarts of water. After a 15-minute bath, the person gets out and pulls the drain plug. It takes 11 minutes for the tub to drain.

- f. Will the graph be discrete or continuous?
- g. The domain is _____
- h. The range is _____
- i. Use unit rates to sketch each section.

Section	Time (x)	Water (y)



Algebra 1-2: 2.3a Representing Relations and Functions (textbook section 3.2)

DOK 2: Model

You will identify relations, functions, domain, and range.

A **relation** is a set of ordered pairs (x, y) where x is the input value and y is the output value.

The **domain** is all possible inputs of a relation, and the **range** is all possible outputs of a relation.*

**When stating the domain and range, numbers are listed in order from least to greatest and values are not repeated.*

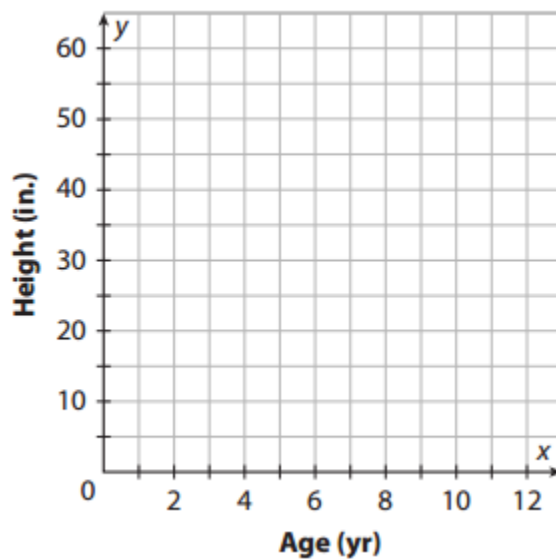
1) For the following relation, the input, x , is the ages of boys and the output, y , is their height (in.).

$$\{(7, 41), (8, 45), (9, 49), (10, 52), (10, 53), (11, 55), (12, 59)\}$$

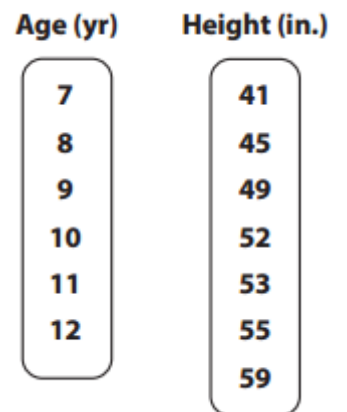
a. Fill in the values in the table.

x	y

b. Graph the Relation.



c. Map the Relation.



d. State the domain of the relation:

e. State the range of the relation.

A **function** is a special relation that assigns each element of the domain to exactly one element of the range.

domain

Input or X values

Function

A relation in which each X is matched to one and only one Y

range

Output or Y values

What does it mean to be a function?

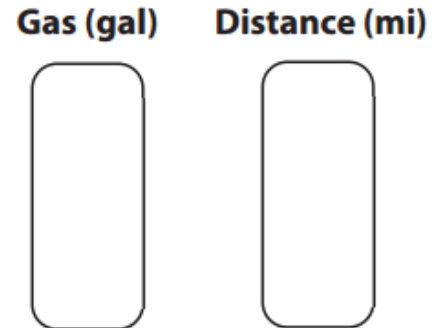
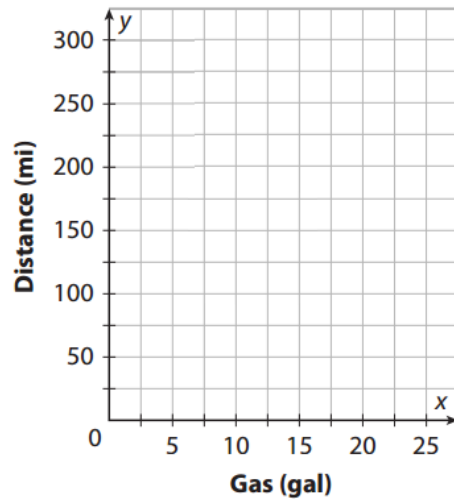
Think of x as a person and y as a place.

A person cannot be in more than one place at a time.

An x -value in a function cannot have more than one y -value.

2) The given relation represents the amount of gas in gallons and the distance traveled in miles from that amount of gas. Graph the relation and complete the mapping.

Gas (gallons)	Distance (miles)
10	150
16	240
17	240
20	300



- a. Domain: _____ The domain represents _____
- b. Range: _____ The range represents _____
- c. For an input of _____, there is an output of _____.
 For an input of _____, there is an output of _____.
 For an input of _____, there is an output of _____.
 For an input of _____, there is an output of _____.
- d. This relation _____ a function. Each domain value is paired with _____ range value.

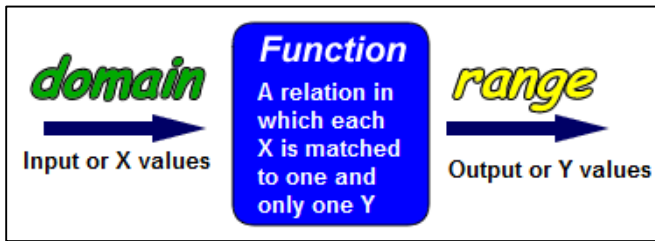
3) What would be true about a relation that is not a function? Give an example of a relation that is not a function.

4) Is the relation of ages of boys and their height from problem 1 a function? Explain.

Algebra 1-2: 2.3b Representing Relations and Functions in Graphs (textbook section 3.2)

DOK 2: Analyze

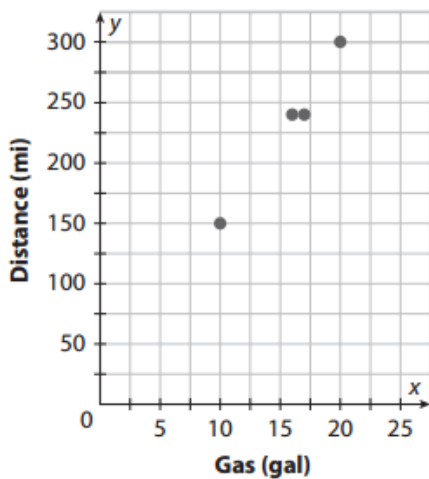
You will identify and represent functions and their domain, and range from graphs.



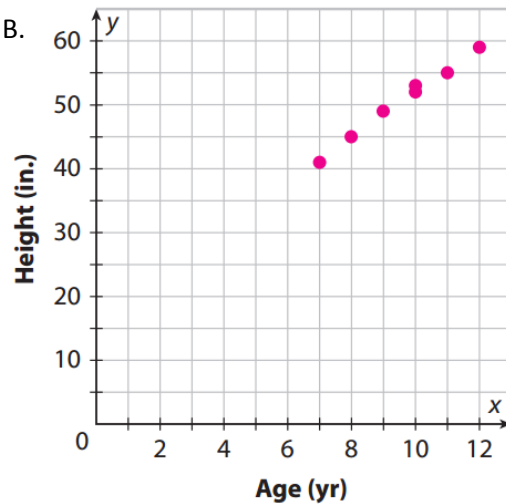
The **VERTICAL LINE TEST**, can be used to determine if a relation is a function. The vertical line test states that a relation is a function if and only if a vertical line does not pass through more than one point on the graph of the relation.

1) Here are two graphs from our previous lesson. Use the **vertical line test** to determine if they are functions.

A.



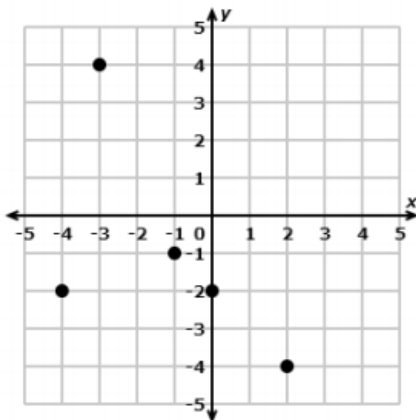
B.



Domain and Range in Discrete Graphs	Domain: List of the individual x values of the coordinates graphed	Range: List of the individual y values of the coordinates graphed
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2) Determine if the following graphs are functions and list their domain and range.

A.

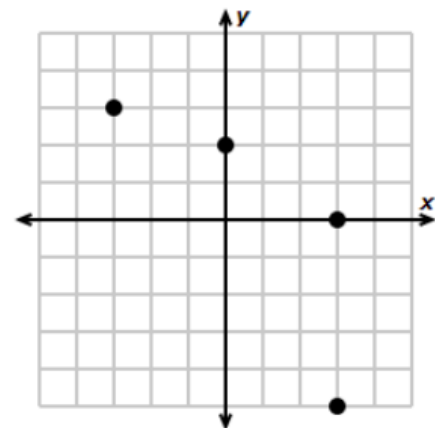


Function: Yes No

Domain: _____

Range: _____

B.



Function: Yes No

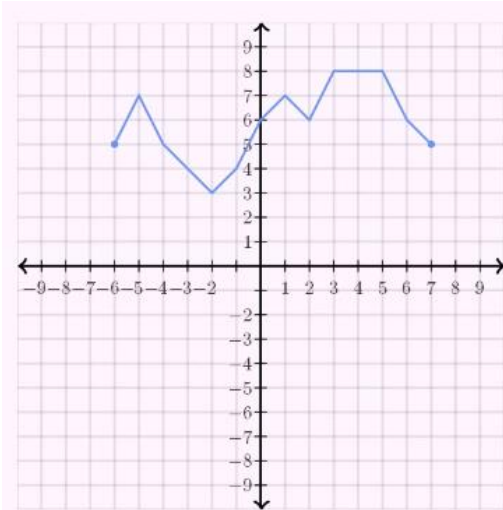
Domain: _____

Range: _____

Domain and Range in Continuous Graphs	Domain: The spread of all x values shown on the graph $start \leq x \leq end$	Range: The spread of all y values shown on the graph $start \leq y \leq end$
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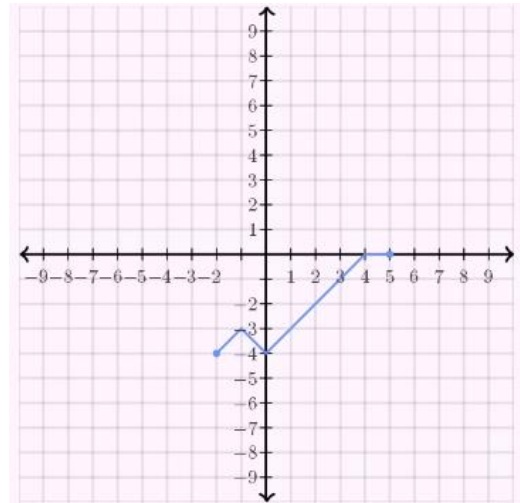
3) Determine if the following graphs are functions and list their domain and range.

A.



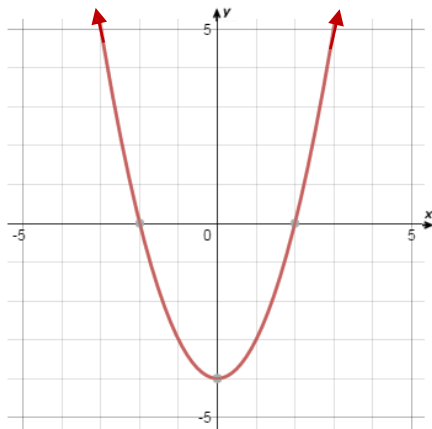
Function: Yes No
 Domain: _____
 Range: _____

B.



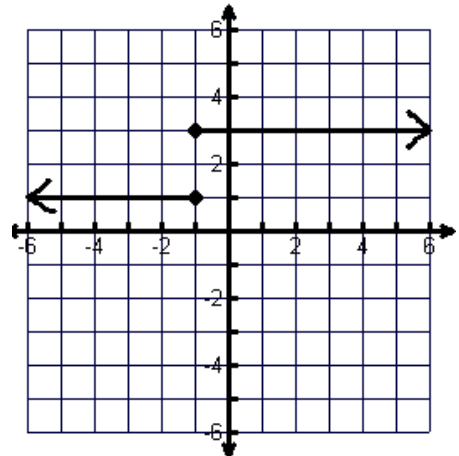
Function: Yes No
 Domain: _____
 Range: _____

C.



Function: Yes No
 Domain: _____
 Range: _____

D.



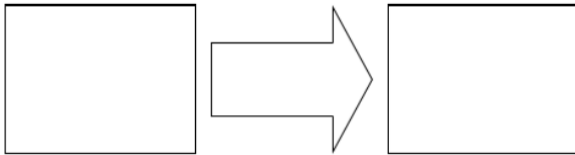
Function: Yes No
 Domain: _____
 Range: _____

Algebra 1-2: 2-4a Modeling with Functions – Function Notation (textbook section 3.3)

DOK 2: Model

You will use function notation to model real-world scenarios

Independent and Dependent Variables



_____ is always the independent variable

_____ is always the dependent variable

1) Identify dependent and independent variables in each situation

	Independent variable	Dependent variable
a) More electricity is used when the outside temperature goes up, and less is used when the outside temperature goes down.		
b) The cost of shipping a package is based on its weight		
c) The faster Tom walks, the quicker he gets home		
d) David measures how many inches his tomato plants grown each week		

If x is the independent variable and y is the dependent variable, then you can use **FUNCTION NOTATION** to write $y = f(x)$, which is read “y equals f of x,” where f names the function. When an equation in two variables describes a function, you always can use function notation to write it.

The dependent variable y is a function of the independent variable x .
 y is a function of x .
 $y = f(x)$

2) Write an equation in function notation: Amanda babysits and charges \$5 per hour.

Time Worked in Hours (x)	1	2	3	4
Amount Earned in Dollars (y)	5	10	15	20

a. The _____ is five times _____.

b. An algebraic expression that defines a function is a **FUNCTION RULE**. Write an equation using two variables to show this relationship.

c. Translate the equation to function notation.

Amount earned	is	\$5	times	the number of hours worked.
↓	↓	↓	↓	↓
_____	=	5	•	_____
_____	=	5	•	_____

For each example identify the independent and dependent variables. Write an equation in function notation for each situation, and then use the equation to solve the problem.

3) A lawyer’s fee is \$180 per hour for his services. How much does the lawyer charge for 5 hours?

- a. _____ depends upon _____,
therefore the independent variable is _____ and the dependent variable is _____.
- b. Pick a letter to represent the independent variable and write a function rule in function notation:
- c. Use the function rule to solve the problem. Write a sentence interpreting your answer.

4) The admission fee at a carnival is \$9. Each ride costs \$1.75. How much does it cost to go to the carnival and then go on 12 rides?

- a. _____ depends upon _____,
therefore the independent variable is _____ and the dependent variable is _____.
- b. Pick a letter to represent the independent variable and write a function rule in function notation:
- c. Use the function rule to solve the problem. Write a sentence interpreting your answer.

5) Kate earns \$7.50 per hour. How much money will she earn after working 8 hours?

- a. _____ depends upon _____,
therefore the independent variable is _____ and the dependent variable is _____.
- b. Pick a letter to represent the independent variable and write a function rule in function notation:
- c. Use the function rule to solve the problem. Write a sentence interpreting your answer.

Algebra 1-2: 2.4b Modeling with Functions – Function Notation Practice (textbook section 3.3)**DOK 2: Model**

You will use function notation to model real-world situations

1) Rewrite the following equations using function notation:

a. $y = 3x + 1$

b. $p = 45n - 2500$

c. $h = -16t^2 + 20t + 8$

2) Evaluate function for the:

Domain: $f(x) = 3x - 15$ for $x = 5$ or

Range: $f(x) = 3x - 15$ for $f(x) = 22$

Try it out!

3) Rocko needs to lose weight to wrestle in the 104 pound weight class. He currently weighs 135 pounds and estimates that he can lose an additional 2.5 pounds per week.

a. What are the independent and dependent variables in this problem?

b. Complete the table representing the function.

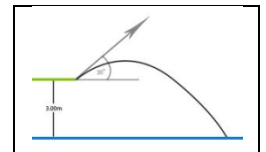
c. Represent the function using function notation.

- d. How could you express his goal of 104 pounds in function notation? _____
- e. When will he make weight? Use mathematics to justify your answer.

FLYING T-SHIRTS

- 4) Marcus is launching t-shirts into a crowd of people from the top of a 30ft tower. The height of the t-shirts above the tower as a function of time can be described by the function below.

$h(t) = -16t^2 + 50t + 30$. Use the function to determine the height of the t-shirt at each given time in seconds. Write a complete sentence to interpret your solution in terms of the problem situation.



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f. $h(3) =$

g. $h(0) =$

h. $h(5) =$

i. What is special about the value of $h(0)$?

j. Look at the height for $h(5)$. Since the tower is 30 feet tall, what does this tell you about what has happened to the t-shirt?

Algebra 1-2: 2.5a Modeling with Functions - Domain and Range of Discrete Data

(textbook section 3.3-3.4) DOK 2: Analyze

You will: Identify and describe the domain and range of a function

Discrete Data:	Continuous Data:
Domain (x) values are limited to certain values	Domain (x) values include any values in a given range
Examples:	Examples:

1) The temperature in a house drops 2°F for every hour the air conditioner is on between the hours of 6:00 am and 11:00 am. The following is a list of times and the temperature in the house: 6am, 82°F; 8 am, 78°F; 9 am, 76°F; 10 am, 74°F; and 11 am, 72°F. Find the domain and range of the time vs. temperature.

Domain: { _____ }. Range: { _____ }.

When a function describes a real-world situation, every real number is not always a **reasonable** choice for the domain and range. For example:

- Could the number representing the length of an object be negative?
- Could you have fractions that represent the number of people at an event?

Write a function in function notation for each situation. Find a reasonable domain and range for each function.

2) Manuel has already sold \$20 worth of tickets to the school play. He has 4 tickets left to sell at \$2.50 per ticket.

- a. Write a function for the total amount collected from ticket sales. Let t represent the number of tickets to sell.
- b. Manuel has only 4 tickets left to sell, so a reasonable domain is { _____ }.
- c. Substitute these values into the function rule to find the range values.

Range = { _____ }.

3) The temperature early in the morning is 17 °C. The temperature increases by 2 °C for every hour for the next 5 hours. Write a function for the temperature in degrees Celsius.

- a. Write a function for the temperatures after h hours.

- b. A reasonable domain is {_____}.

- c. Substitute these values into the function rule to find the range values.

Range = {_____}.

4) A cable company charges new customers \$40 for installation and \$60 per month for its service. You are going to sign a one year service agreement.

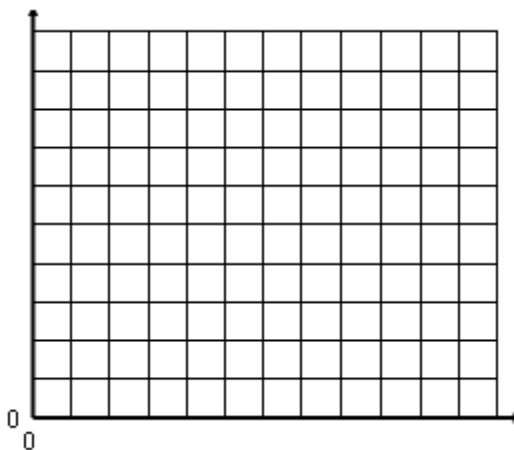
- a. Write a function for the cost of playing m months of service.

- b. A reasonable domain is {_____}.

- c. Substitute these values into the function rule to find the range values.

Range: {_____}.

d. Graph the function



- e. The company decided to offer a sale to attract new customers and reduced the installation fee to \$5. Write a function that models this new situation. Find $f(3)$ for the new function and explain what the solution means in the context of the problem.

Algebra 1-2: 2.5b Modeling with Functions: Domain and Range of Continuous Data

(textbook sections 3.3-3.4)

DOK2: Analyze

You will: Identify and describe the domain and range of a function

1) For a babysitting job, Cara charges \$2 for bus fare plus her hourly rate. Cara uses the function $C(h) = 2 + 8h$ to determine the total charge for a babysitting job that lasts h hours. Because of school and her curfew, Cara can only babysit between 4:00pm and 10:00pm. She has a minimum charge of 2 hours. Find the domain and range of the function.

a. List the terms in the function and interpret what they represent.

b. The domain represents _____ . The range represents _____
 What are the restrictions? Do they effect the domain or range?

c. Translate the restrictions into a reasonable domain _____ $\leq x \leq$ _____ .

d. Substitute these values into the function rule to find the range values.

_____ $\leq y \leq$ _____ .

2) An above-ground swimming pool is leaking. The function $h(d) = 48 - 1.5d$ gives the height of the water in the pool in inches d days after the leak began.

a. List the terms in the function and interpret what they represent.

b. The domain represents _____ . The range represents _____
 What are the restrictions? Do they effect the domain or range?

c. Translate the restrictions into a reasonable domain and range

Domain: _____ $\leq x \leq$ _____

Range: _____ $\leq y \leq$ _____

Algebra 1-2: 2.6 Multiple Representations of Functions (textbook sections 3.3-3.4)

DOK 2: Model

You will represent functions in four ways: verbally, algebraically, numerically, and visually.

The Four Representations of Functions	Verbally	By a description in words
	Algebraically	By an explicit rule/equation
	Numerically	By a table of values, list of ordered pair or mapping diagram
	Visually	By a graph

Verbally

- 1) A plumber charges a trip charge of \$50 plus \$65 for each hour worked (no partial, always rounded up). Your maximum budget is \$450.

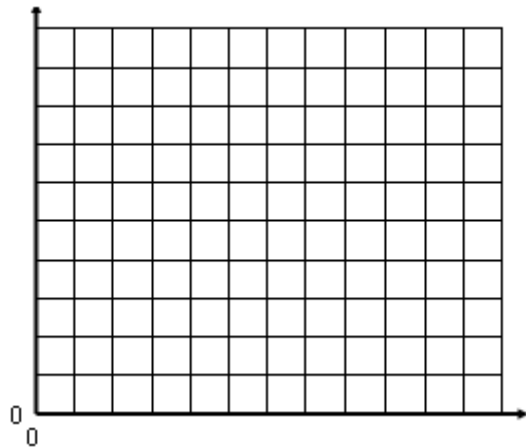
Algebraically (use function notation)

Domain

Range

Numerically

Visually



Verbally

- 2)

Algebraically (use function notation)

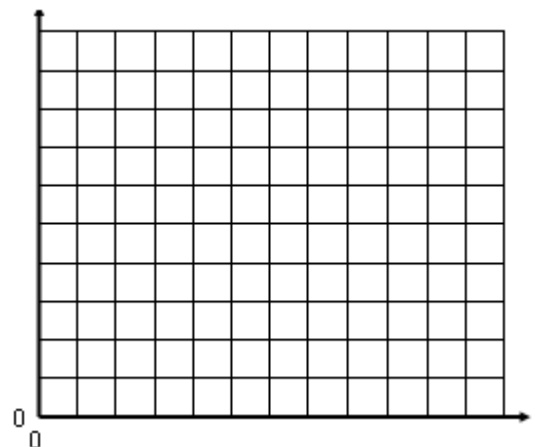
$h(t) = 200 - 16t^2$ where $h(t)$ represents the bungee jumper's height t seconds after leaving the jumping platform.

Domain: $0 \text{ seconds} \leq x \leq 3.5 \text{ seconds}$

Range: $0 \text{ feet} \leq y \leq 200 \text{ feet}$

Numerically

Visually



Verbally

3) Brian is riding his bicycle at a constant speed of _____ miles per hour from the school to the library which is _____ miles from the school.

Algebraically (use function notation)

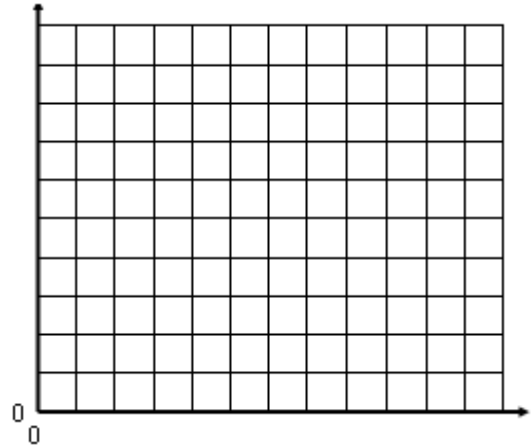
Domain

Range

Numerically

Time in hours	Miles to Library
0	24
0.5	18
1.0	12
1.5	6
2.0	0

Visually



Verbally

4) Tickets to a science museum cost \$20 each. There is a \$3 service charge for each order no matter how many tickets are purchased. Write an equation for the cost (in dollars) of ordering tickets.

Algebraically (use function notation)

Domain

Range

Numerically

Visually

