Choose Wisely!

Understanding Non-Linear Graphs and Inequalities

2.6

LEARNING GOALS

In this lesson, you will:

- Identify the appropriate function to represent a problem situation.
- Determine solutions to linear functions using intersection points.
- Determine solutions to non-linear functions using intersection points.
- Describe advantages and disadvantages of using technology different methods to solve functions with and without technology.

We make decisions constantly: what time to wake up, what clothes to wear to school, whether or not to eat a big or small breakfast. And those decisions all happen a few hours after you wake up! So how do we decide what we do? There are actually a few different techniques for making decisions. One technique, which you have most likely heard about from a teacher, is weighing the pros and cons of your options then choosing the one that will result in the best outcome. Another technique is called satisficing—which means just using the first acceptable option, which probably isn't the best technique. Have you ever flipped a coin to make a decision? That is called flipism. Finally, some people may follow a person they deem an "expert" while others do the most opposite action recommended by "experts." While the technique you use isn't really important for some decisions (flipping a coin to decide whether or not to watch a TV show), there are plenty of decisions where there is a definite better choice (do you really want to flip a coin to decide whether to wear your pajamas to school?). The best advice for making decisions is to know your goal, gather all the information you can, determine pros and cons of each alternative decision, and make the decision.

What technique do you use when making decisions? Do you think some people are better decision makers than others? What makes them so?

PROBLEM 1 Grill 'Em Up!

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Your family is holding their annual cookout and you are in charge of buying food. On the menu are hamburgers and hot dogs. You have a budget determining how much you can spend. You have already purchased 3 packs of hot dogs at $2.29 a pack. You also need to buy the ground meat for the hamburgers. Ground meat sells for $2.99 per pound, but you are unsure of how many pounds to buy. You must determine the total cost of your shopping trip to know if you stayed within your budget.

This problem situation is represented by one of the following functions:

$f(p) = 2.99p + 6.87$

$f(p) = 2.29p^3 + 2.99p$

$f(p) = |2.99p| + 6.87$

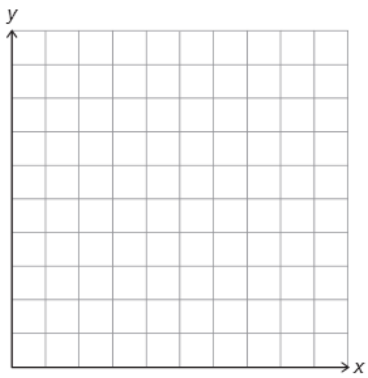
$f(p) = 3p^2 + 2.29p + 2.99$

1. Choose a function to represent this problem situation. Explain your reasoning.

2. Complete the table to represent the total amount paid as a function of the amount of ground meat purchased. Don't forget to determine the units of measure.

	Independent Quantity	Dependent Quantity
Quantity		
Units		
Expression	p	
	0.5	
	1.75	
		13.60
		17.34
	4.25	

3. Use the data from the table to create a graph of the problem situation on the coordinate plane.



4. Consider a total bill of $13.45.
   a. Estimate the amount of ground beef purchased.

   b. Determine the exact amount of ground meat purchased.

5. Based on the number of people coming to the cookout, you decide to buy 6 pounds of ground meat for the hamburgers.
   a. If your budget for the food is $25.00, do you have enough money? Why or why not?

   b. If you have enough money, how much money do you have left over? If you do not have enough money, how much more will you need?

PROBLEM 2 Ground Breaking Costs

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A construction company bought a new bulldozer for $125,000. The company estimates that its heavy equipment loses one-fifth of its value each year.

This problem situation is represented by one of the following functions:

$f(t) = 125{,}000t - \frac{1}{5}$

$f(t) = 125{,}000\left(\frac{4}{5}\right)^t$

$f(t) = \left|-\frac{1}{5}t \cdot 125{,}000\right|$

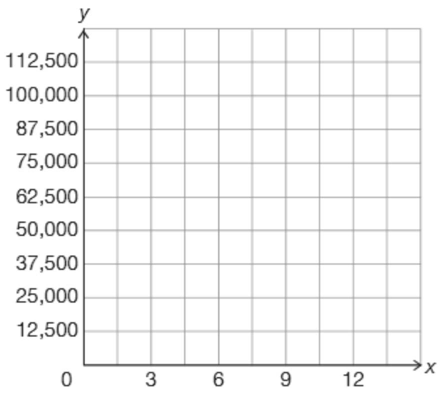
$f(t) = t^2 + 125{,}000t - \frac{1}{5}$

1. Choose a function to represent this problem situation. Explain your reasoning.

2. Complete the table to represent the cost of the bulldozer as a function of the number of years it is owned.

	Independent Quantity	Dependent Quantity
Quantity		
Units		
Expression	t	
	0	
	2.5	
	5	
	7	
	8.5	
	10	
	12.5	

3. Use the data and the function to graph the problem situation on the coordinate plane shown.



4. The owner wants to sell the bulldozer and make at least $25,000 in the sale.

a. Estimate the amount of time the owner has to achieve this goal.

b. Determine the exact amount of time the owner has to achieve this goal. Write your answer as an inequality.

5. When will the bulldozer be worth $0?

PROBLEM 3 Stick the Landing!

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In gymnastics, it is important to have a mat below the equipment to absorb the impact when landing or falling. The thickness of the mats used in the rings, parallel bars, and vault events must be between 7.5 and 8.25 inches thick, with a target thickness of 7.875 inches.

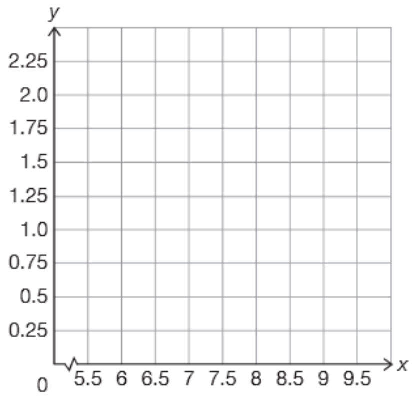
> This problem situation is represented by one of the following functions:
>
> $f(t) = 7.875t - 0.375$
>
> $f(t) = 7.875^t$
>
> $f(t) = |t - 7.875|$
>
> $f(t) = 7.875t^2 + 7.5t + 8.25$

1. Choose a function to represent this problem situation. Explain your reasoning.

2. Complete the table to represent the mat thickness in terms of the target thickness of the mat.

	Independent Variable	Dependent Variable
Quantity		
Units		
Expression	t	
	5.5	
	6.625	
		0.875
	7.5	
		0.25
		0.875
	9.25	
	9.875	

3. Use the data and the function to graph the problem situation on the coordinate plane shown.



4. The Olympics Committee announces that they will only use mats with a thickness of 7.875 inches and an acceptable difference of 0.375 inch.

   a. Write the absolute value inequality that represents this situation.

   b. Determine the thickest and thinnest mats that will be acceptable for competition. Write your solution as a compound inequality.

5. The All-Star Gymnastics Club has a practice mat with a thickness that is 1.625 inches off the Olympic recommendations. What are the possible thicknesses of the Gymnastics Club's practice mat?

PROBLEM 4 Fore!

In 1971, astronaut Alan Shepard hit a golf ball on the moon. He hit the ball at an angle of 45° with a speed of 100 feet per second. The acceleration of the ball due to the gravity on the moon is 5.3 feet per second squared. Then the ball landed.

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This problem situation is represented by one of the following functions:

$f(d) = 5.3d$

$f(d) = 100^d + 5.3$

$f(d) = |5.3d| + 100$

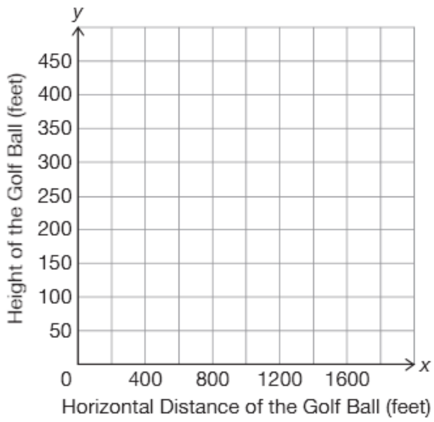
$f(d) = -\frac{5.3}{10,000}d^2 + d$

1. Choose a function to represent this problem situation.

2. Complete the table to represent the height of the golf ball in terms of the distance it was hit.

	Independent Quantity	Dependent Quantity
Quantity	Horizontal Distance of the Golf Ball	Height of the Golf Ball
Units		
Expression		
	405	
	745	
	945	
	1110	
	1335	
	1595	

3. Use the data and the function to graph the problem situation on the coordinate plane shown.

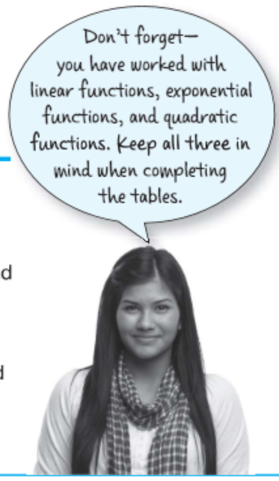


4. The Saturn V rocket that launched Alan Shepard into space was 363 feet tall. At what horizontal distance was the golf ball higher than the rocket was tall?

5. At what horizontal distance did the golf ball reach its maximum height? What was the greatest height the ball reached?

6. How far did the golf ball travel before it landed back on the moon?

Talk the Talk



In this chapter you used three different methods to determine values of various functions. You completed numeric tables of values, determined values from graphs, and solved equations algebraically. In addition, you used each of these methods by hand and with a
graphing calculator.

Think about each of the various methods for problem solving and complete the tables on the following pages. Pay attention to the unknown when describing each strategy.

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	Numerically	
	Without Technology	With Technology
Given an Independent Quantity (input value)	**Description of the method:** **Advantages:** **Disadvantages/Limitation:**	**Description of the method:** **Advantages:** **Disadvantages:**
Given a Dependent Quantity (output value)	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**

	Graphically	
	Without Technology	**With Technology**
Given an Independent Quantity (input value)	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**
Given a Dependent Quantity (output value)	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**	**Description of the method:** **Advantages:** **Disadvantages/Limitations:**

2

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	Algebraically	
	Without Technology	**With Technology**
Given an Independent Quantity (input value)	**Description of method:** **Advantages:** **Disadvantages/Limitations:**	**Description of method:** **Advantages:** **Disadvantages/Limitations:**
Given a Dependent Quantity (output value)	**Description of method:** **Advantages:** **Disadvantages/Limitations:**	**Description of method:** **Advantages:** **Disadvantages/Limitations:**

Be prepared to share your solutions and methods.