Task: Water Tank **8th Grade**

A tank is filled with water. A drain is opened and begins draining water from the tank at a constant rate. The amount of water in the tank at various times is given in the table below.

Number of gallons in the tank	Minutes since drain has been opened
141	11
113	18
77	27

a) Tim makes the statement that the tank contained 190 gallons at the moment the drain was opened. Find a way to show Tim if he is correct or incorrect.

b) When the tank has 50 gallons of water remaining, the drain is set to automatically shut off. How long will it take for the drain to shut off? Show how you decided.

Teacher Notes: This task is a great example of the importance of the initial amount in a situation. Students may use these different solution pathways to solve these problems. This would open up great discussion during class. It would be important to show that this situation can be represented multiple ways (graph, table, equation).
It is important to note that the table is reversed from what we typically see. Time is the y axis if students keep the table as is. This would lead to fruitful discussion of independent and dependent variables.

Common Core State Standards for Mathematical Content	Common Core State Standards for Mathematical Practice
8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. **8.EE.B.6** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** 5. Use appropriate tools strategically. **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

Essential Understandings

- Functions provide a tool for describing how variables change together. Using a function in this way is called *modeling*, and the function is called a *model*.
- Functions can be represented in multiple ways—in algebraic symbols, situations, graphs, verbal descriptions, tables, and so on—and

these representations, and the links among them, are useful in analyzing patterns of change.

- Some representations of a function may be more useful than others, depending on how they are used.
- Linear functions have constant rates of change.

Explore Phase

Possible Solution Paths	**Assessing and Advancing Questions**
a) Students could determine the rate at which water is removed from the tank as 4 gallons/minute. They could then work their way back up the table to determine that there are 185 gallons in the tank when the drain is opened.	Assessing – How did you determine that water is draining from the tank at 4 gallons per minute? Advancing – If you use the typical slope formula what do you get for the slope? What is the units for the rate we find using the slope formula?
b) Students may use the table to continue the pattern until they get 50 gallons Or They could set up the equation $50 = -4x + 185$ $-135 = -4x$ $33.75 = x$	Assessing – How did you know to continue the pattern in the table? Advancing – What if the drain shut off after 25 gallons. How many minutes would it be until the drain shut off? Assessing – How did you know to set up this equation? Advancing – If Tim had been correct in part a, how many minutes would it take for the drain to cut off?
Possible Student Misconceptions	
a) Students may say that the tank contained 141 gallons initially because it is the first value given in the table.	Assessing – How many minutes have elapsed when the tank contains 141 gallons? Advancing - Can we figure out how many gallons the tank contained after 10 minutes? 9 minutes?

b) Students may struggle to determine how long it takes to get down to 50 gallons.	Assessing - How many minutes did it take for the tank to be drained down to 77 gallons? Advancing – Can we determine how many gallons are in the tank after 28 minutes? 30 minutes?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	Assessing – What is happening to the tank as time goes on? Advancing – Can we determine how "fast" water is draining from the tank?
If students finish early….	Assessing – How long would it take the tank to drain completely if there was no automatic shut off? Advancing – What if water was also pumped in at a rate of 2.5 gallons per minute for the entire time. Would the tank ever get down to 50 gallons? If so, how many minutes would it take to shut off.
Discuss/Analyze	
Whole Group Questions	
a) What was different about this table than usual? Could we reverse the table? Did anyone make a graph to help answer? Did anyone write an equation? Did anyone use the table? Did we come up with a consensus answer about the number of gallons originally in the pool? Was Tim correct? How did you show him whether he was right or wrong? Do you think he would understand your reasoning?	
b) How did everyone set up this part? Is there a way to use an equation? Is there a way to use the table? Is there a way to use a graph? Do we see that both of these parts to this question can be represented multiple ways? Why is this important? What does the .75 mean in our answer? Since this time, can we make this answer make more sense?	