Worksheet – *Die Hard*   Name_____

Directions: Please show all work for partial credit.

In the movie *Die Hard with a Vengeance,* John McClain (Bruce Willis) and Zeus (Samuel L. Jackson) battle against a villain playing a game of "Simon Says." During a mad chase across the city solving riddles, our heroes find themselves in a park attempting to defuse a bomb. Within 5 minutes, exactly 4 gallons of water must be placed on a scale to defuse the bomb using only a 5 gallon bottle and a 3 gallon bottle for measuring.

1. TASK: Explain how to measure exactly four gallons of water using a five gallon bottle and a three gallon bottle.

2. When filled with water, how much does the water in each of these bottles weigh? Express your answer in pounds.

A **gallon** is a US liquid unit equal to 4 quarts or 3.785 liters.
One **liter** of water weighs one kilogram.
One **kilogram** equals 1,000 grams or 2.2 pounds.

3. Assume that water flows out of an Elephant's trunk in the park's fountain at the rate of 7.57 liters per minute.

a.) At this rate, how long does it take to fill the 5 gallon bottle from this spout?

b.) At this rate, how long does it take to fill the 3 gallon bottle from this spout?

c.) Considering the number of times each bottle is filled from the fountain in your answer to question #1, how long does it take to fill the bottles to create the needed 4 gallons of water?

4. In order to accomplish a task such as the one seen in this movie, the bottles must be of **relatively prime** capacity. Two numbers are called **relatively prime** if their greatest common divisor is one.

According to Professor G. Donald Allen from Texas A&M University, a theorem from number theory can actually be used to relate the situation in this problem by showing how many times each bottle is filled or emptied.

According to the theorem, the two solutions shown below are possible. Describe how each of these solutions will be accomplished in terms of when to empty and fill the bottles. If one of these solutions is your answer to question 1, write "solution used to question 1".

> $ax + by = k.$
> $x < y$ gallons of water
> x, y relatively prime
> $k < y$
> a, b integers
> a or b negative, the bottle is being emptied
> a or b positive, the bottle is being filled

One solution: $(3)(3) + (-1)(5) = 4.$
  3 gallon bottle is filled three times.
  5 gallon bottle is emptied once.

Another solution: $(-2)(3) + (2)(5) = 4$
  3 gallon bottle is emptied twice.
  5 gallon bottle is filled twice.