SECTION 1 WORKSHEET

Name: _____ Class: _____

Date: _____

CONCENTRATE THIS! SUGAR OR SALT INTRODUCTION

1. **Solutions:**

EXAMPLE:
Coffee crystal = solute
Water = solvent
Liquid Coffee = solution

→ So a solute is dissolved in solvent to make a solution

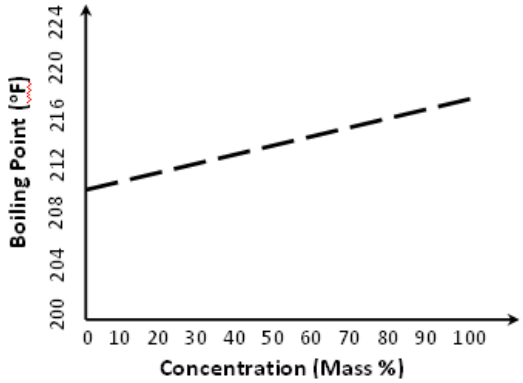
2. **Solution Concentration = how much solute dissolved in solvent**

Express concentration by a mass (%) = $\frac{\text{Mass Solute}}{\text{Mass Solution}} \times 100$

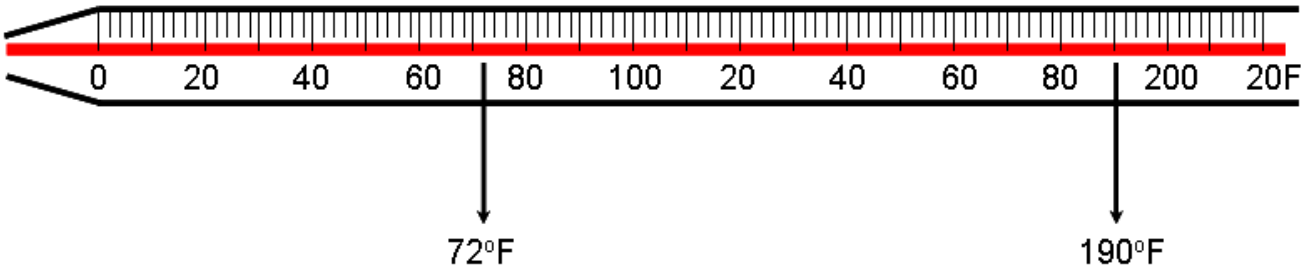
3. **Boiling Point Changes with Concentration**

The boiling point of a solvent is elevated by adding a non-volatile solute.

This can be shown by performing experiments and plotting with a graph.



4. **Reading Thermometer**



Creating a Solution:

Step 1. Choose either SALT or SUGAR as your solute for Activity 1 (circle one)

Step 2. Weigh solute and Record in **Table 1**= **Mass Solute**

Step 3: Weight Empty beaker and Record in **Table 1**

Step 4: Add 200ml water to empty beaker , Weigh and Record in **Table 1**

Step 5: Calculate… Step 4 - Step 3 = **Mass Solvent** Record in **Table 1**

Step 6: Calculate… Step 2 + Step 5 = **Mass Solute** + **Mass Solvent** = **Mass Solution** Record in **Table 1**

Step 7: Calculate… $\frac{\text{Mass Solute}}{\text{Mass Solution}} \times 100 =$ **Concentration** Record in **Table 1**

Boiling Point Testing:

Step 8: Make a foil lid for beaker (use a rubber band to secure over beaker)

Step 9: Make a small hole in lid for the thermometer to be inserted.

Step 10: Place beaker solution on burner and wait for it to boil. Boiling is described by a rapid and continuous boiling.

Step 11: Record the boiling temperature in **TABLE 1**; make sure thermometer is not touching sides of beaker.

Step 12: Drain, rinse, and dry beaker.

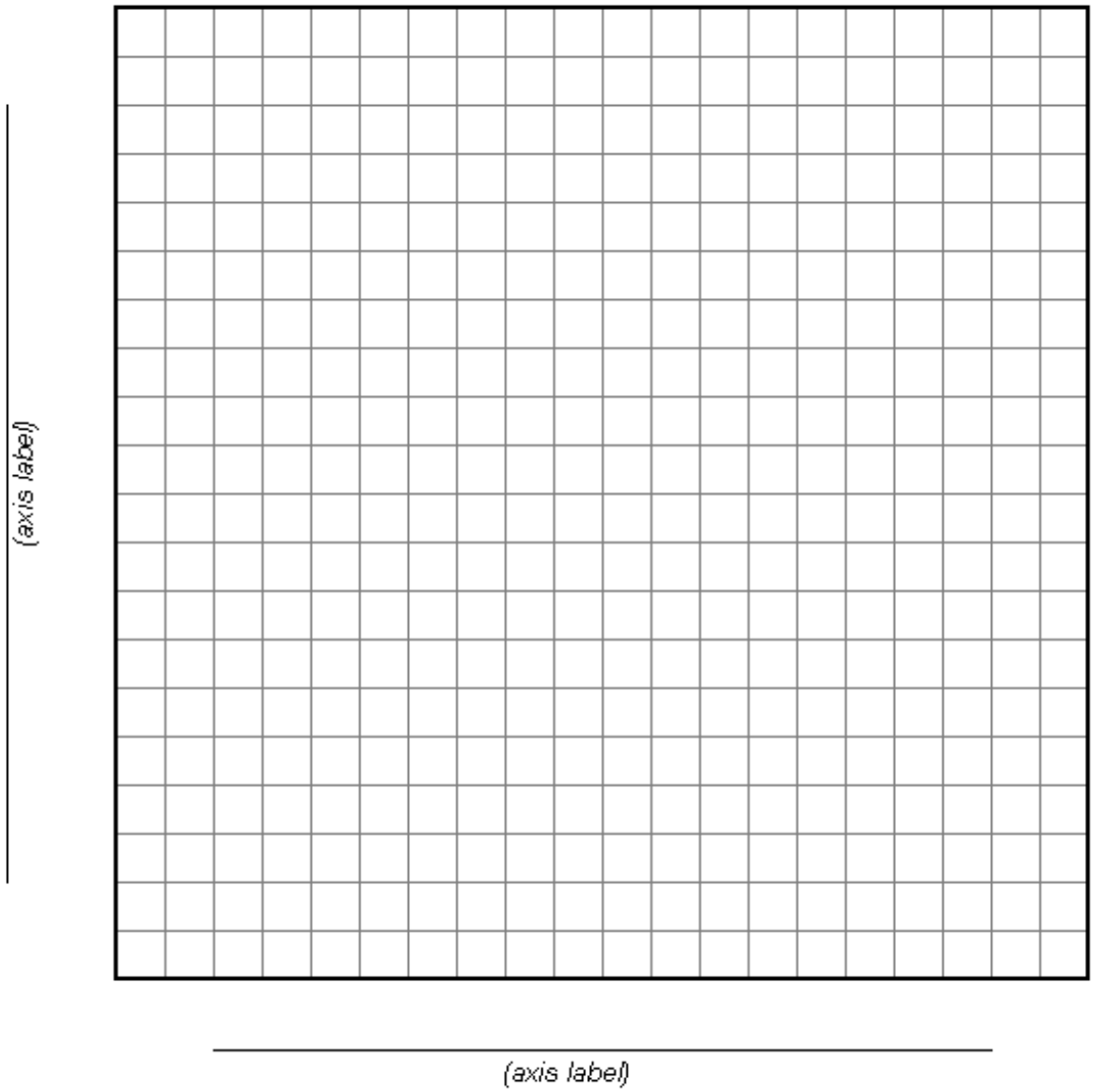
Step 13: Repeat from Step 1 (but now weigh a different amount of the same solute).

Step 14: Repeat from Step 1 again...should have three rows complete in **TABLE 1** once you finish testing.

TABLE 1: SECTION 1 TESTING

Mass Solute (grams)	Mass Empty Beaker (grams)	Mass Beaker + H_20 (grams)	Mass Solvent (grams)	Mass Solution (grams)	Concentration (%)	Boiling Point (^oF)
STEP 2	*STEP 3*	*STEP 4*	*STEP 5*	*STEP 6*	*STEP 7*	*STEP 11*
0	**-**	**-**	**-**	**-**	**0**	**220**

12. Create a scatter plot of your test data & draw a single line to connect the points.
    - x-axis = Concentration
    - y-axis = Boiling Point



Goal: Lowest cost solution that will have a boiling point T_{boil} = 117°F

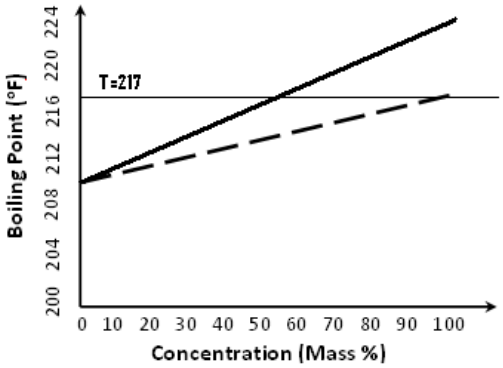
Engineering Design: Determine which solute will yield the cheapest solution. You will still use 200mL water as your solvent

Testing:

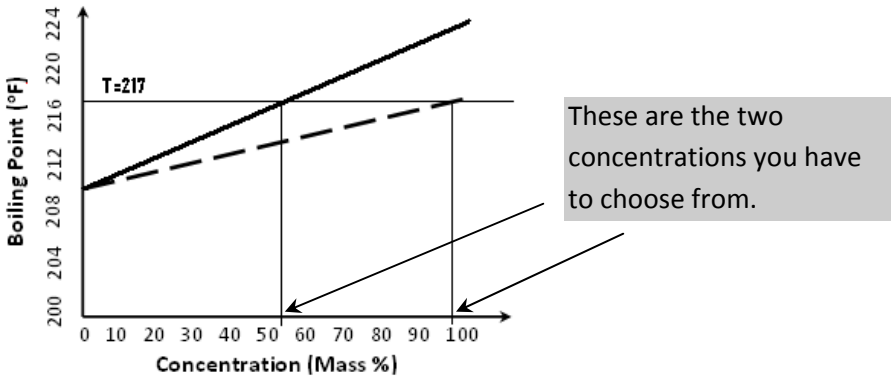
1. You have data for one solute already plotted on the graph on PAGE 3. Now plot the data for the 2nd solute (use the same graph).

2. Draw a single line connecting the 2nd set of points & label each line (so you know which line is which).

3. Draw a horizontal line across your graph at a boiling temperature = 117°F. (should cross both solute lines)



4. Draw a vertical line down from where your horizontal line crosses each solute line



5. Record the two concentrations from your graph that will yield a solution with a boiling point of 217°F

SALT Concentration = _____ %

SUGAR Concentration = _____ %

6. Determine mass required for making each solution. Use the following equation to calculate the solute mass required.

$$\text{Mass Solute} = \frac{\frac{\text{Concentration \%}}{100} \times \text{Mass Solvent}}{\left(1 - \frac{\text{Concentration \%}}{100}\right)}$$

Mass Salt =

Mass Sugar =

7. Determine cost of each solution: **Salt** = \$0.0006/gram salt & **Sugar** = \$0.002/gram sugar

Cost Salt Solution =

Cost of Sugar Solution =

8. Now test the best solution (test the same as yesterday) & record data in **TABLE 2**

TABLE 2: SECTION 2 TESTING

Mass Solute (grams)	**Mass Solution (grams)**	**Concentration** $\left(\frac{\text{Mass Solute}}{\text{Mass Solution}} \times 100\,\%\right)$	**Boiling Point (°F)**

9. Calculate your error in the boiling point

$$\% \text{ Error} = \frac{\text{Actual Boiling Temperature} - 217^{o}F}{217^{o}F} \times 100\%$$

% Error =

10. Record your **Concentration** and measured **Boiling Point** on the board.