# Worksheet #3

**Name:**                                           **Period:**                    **Seat#:**

## Conceptual Questions

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| **1)** Draw and label a diagram of a calorimeter with all of its necessary features. | **2)** Explain WHY we are able to set Q = -Q in calorimetry problems. |

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| **3)** Write a generic equation for calculating a change in temperature (Δ T). | **4)** Watch the video by following the QR code to the right. What is the difference between a bomb calorimeter and a coffee cup calorimeter? | |

**5)** A 500-mL bottle of water at room temperature and a 2-L bottle of water at the same temperature were placed in a refrigerator. After 30 minutes, the 500-mL bottle of water had cooled to the temperature of the refrigerator. An hour later, the 2-L of water had cooled to the same temperature. When asked which sample of water lost the most heat, the teacher received the answers below. Indicate which of these answers is correct *and* describe the error in each of the other answers.

Student #1
Both bottles lost the same amount of heat because they started at the same temperature and finished at the same temperature.

Student #2
The 2-L bottle of water lost more heat because there was more water.

Student #3
The 500-mL bottle of water lost more heat because it cooled more quickly.

Student #4
It is not possible to tell because we do not know the initial temperature and the final temperature of the water.

**Mathematical Questions**
- Identify the variables involved
- Show plugging in the variables to the correct places in the equation
- Get an actual answer, including units! Box your answer!
- Don't forget - you must show units and any conversions that might be involved.
- You can either rearrange your equation before you plug in your variables, or after. Do what works for you!
- Some answers are provided at the end. They are underlined.

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**6)** A piece of metal weighing 59.047 g was heated to 100.0 °C and then put it into 100.0 mL of water (initially at 23.7 °C). The metal and water were allowed to come to an equilibrium temperature, determined to be 27.8 °C. Calculate the specific heat of the metal. _0.402 J/g°C_

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**7)** When 1.0 g of fructose, $C_6H_{12}O_6(s)$, a sugar commonly found in fruits, is burned in oxygen in a bomb calorimeter, the temperature of the calorimeter increases by 1.58 °C. If the heat capacity of the calorimeter and its contents is 9.90 kJ/g°C, what is q for this combustion? _15.642 kJ_

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**8)** How much will the temperature of a cup (180 g) of coffee at 95 °C be reduced when a 45 g silver spoon (specific heat 0.24 J/g °C) at 25 °C is placed in the coffee and the two are allowed to reach the same temperature? Assume that the coffee has the same density and specific heat as water. _-0.99°C_

**9)** The amount of fat recommended for someone with a daily diet of 2000 Calories is 65 g. What percent of the calories in this diet would be supplied by this amount of fat if the average number of Calories for fat is 9.1 Calories/g?_29.58%_

**10)** A 45-g aluminum spoon (specific heat 0.88 J/g °C) at 24 °C is placed in 180 mL (180 g) of coffee at 85 °C and the temperature of the two become equal.

      **a)** What is the final temperature when the two become equal? Assume that coffee has the same specific heat as water. _81.95°C_

      **b)** The first time a student solved this problem she got an answer of 88 °C. Explain why this is clearly an incorrect answer.

**11)** In a coffee-cup calorimeter, 100.0 g of $H_2O$ and 100.0 mL of HCl are mixed. They both had an initial temperature of 24.6°C. After the reaction, the temperature of both substances is 31.3°C.

      **a)** Was the reaction exothermic or endothermic? Explain.

      **b)** Calculate how much heat the water lost or gained. _+2800.6 J_

**12)** Equal amounts of heat are used to heat a 25.0 g sample of water and a 25.0 g sample of alcohol. The temperature of the water rises from 23.1ºC to 27.9ºC, while the temperature of the alcohol rises from 21.6ºC to 29.9ºC. Calculate the specific heat of alcohol. *2.42 J/g°C*

**13)** A piece of glass is heated to 92.3ºC and then placed into a 41.3 g sample of water. The initial temperature of the water is 18.9ºC, and the final temperature of the water is 20.3ºC. Calculate the mass of the piece of the glass. (The specific heat of glass is 0.739 J/g·ºC.) *4.5 g*