CONCEPT: CONSTANT-PRESSURE CALORIMETRY

● **Calorimeter**: A container, usually insulated against heat loss that contains a liquid with a given heat capacity.

- □ Usually when a heated object is placed in a liquid, both the liquid and the calorimeter absorb the released heat.
- □ **Standard Heat Capacity** (___): For a calorimeter, the amount of heat required to change its temperature.
  - The weight of a calorimeter is usually unknown so exclude units associated with mass in its formula.

Standard Heat Capacity

$$\_\_ = \frac{q}{\triangle T}$$

- □ ____ = Standard heat capacity in $\frac{J}{°C}$
- □ q = heat
- □ T = Temperature in °C

EXAMPLE: What is the standard heat capacity (in kJ/°C) of a calorimeter that absorbs 87.0 J as its temperature goes from 33 °C to 38.1 °C?

CONCEPT: CONSTANT-PRESSURE CALORIMETRY

Coffee Cup Calorimeter

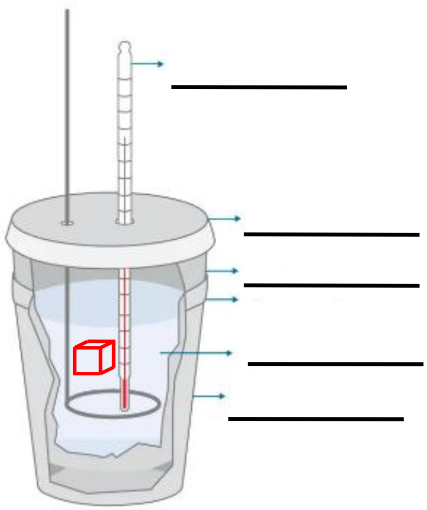
● **Constant Pressure Calorimetry** uses a coffee cup calorimeter to determine heat transfers occurring in a liquid solution.

□ A coffee cup calorimeter is basically an insulated styrofoam cup with a lid.

□ **Constant Pressure**: The calorimeter measuring heat is open to the atmosphere where pressure is fixed.

Constant–Pressure Calorimetry

Coffee-Cup Calorimeter



Constant–Pressure Formula

□ When both the liquid and calorimeter absorb heat from the hot object we get:

$$\_\_\_\_ q_{lost} = \_\_\_\_ q_{gained} + \_\_\_\_\_\_\_\_\_\_\_\_$$

□ Expanding them to their heat capacity formulas gives:

$$\_\_\, m \cdot c \cdot \Delta T = \_\_\, m \cdot c \cdot \Delta T + \_\_\_\_ \cdot \_\_\_\_$$

EXAMPLE: When 60.0 g of lead at 68.3 ºC is poured into 90.0 g H_2O at 30.0 ºC within a coffee-cup calorimeter, the temperature increases to 48.0 ºC. Based on this information, what is the heat capacity of the calorimeter? The specific heat of lead and water are 0.128 J/g ∙ ºC and 4.184 J/g ∙ ºC respectively.

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PRACTICE: A 115.6 g piece of copper metal at 182.5 ºC is placed into 120.0 mL of methylene chloride at 31.0 ºC within a coffee-cup calorimeter. If the final temperature of the solution is 50.3 ºC, what is the specific heat of methylene chloride? Assume the calorimeter absorbs a negligible amount of heat. The specific heat of copper is 0.385 J/g · ºC and the density of methylene chloride is 1.33 g/cm^3.

PRACTICE: You place 75.0 mL of 0.100 M NaOH in a calorimeter at 25.00 ºC and carefully add 55.0 mL of 0.200 M HNO_3, also at 25.00 ºC. After stirring, the final temperature is 53.35 ºC. Calculate the enthalpy ΔH_{rxn} (in J/mol) for the formation of water. (Specific heat capacity, C_s, and density of the solution: 4.184 J/g·K and 1.00 g/mL).