

Practice for Proficiency
Calorimetry

Concept: Specific heat – This needs to be understood. There are a handful of variations here. Give them a try.

Can I do simple energy transfer to an object.

1. Two 500g blocks (copper 0.36J/g°C and aluminum 0.9J/g°C) starting at 25°C each absorb 500J of energy. What is the final temperature of each block?

$$q = m \cdot \Delta T \cdot C$$

$$500 \frac{J}{m \cdot C} = \Delta T$$

$$\frac{500}{500 \cdot 0.36} = \Delta T = 2.70$$

$$25 + 2.70 = 27.70^\circ C$$

$$\frac{500}{500 \cdot 0.9} = 1.10$$

$$25 + 1.1 = 26.1^\circ C$$

2. A 500g block of metal at 80°C is dropped into 1000g of water at 20°C. The final temperature is measured at 28°C. Calculate the specific heat of the block.

$$q = m \cdot \Delta T \cdot C$$

Water gains energy

$$1000 \cdot 4.18 \cdot 8^\circ C = 33440 J$$

$$33440 = 500 \cdot 8 \cdot C$$

$$C = 0.83 J/g^\circ C$$

3. A block of hot metal is dropped into a calorimeter cup (2J/°C) containing 200g of water (4.18J/g°C) at 20°C. The final temperature of the water and cup is 28°C. How much energy did the block lose?

$$q = m \cdot \Delta T \cdot C$$

$$200 \cdot 8 \cdot 4.18 = 6688 J \text{ to warm water}$$

$$\frac{q}{\Delta T \cdot C} = 16 J$$

$$6688 + 16 = 6704 J$$

Can I calculate the Enthalpy change of a chemical reaction?

4. Mercury has a normal melting point of -39°C, a $\Delta H_{\text{fusion}} = 11.78 J/\text{gram}$, and the specific heat of solid mercury is 0.14J/g°C. A 100g sample of mercury at -49°C is warmed and melted. The final temperature of the liquid is -39°C.

a. Write out the thermodynamic reaction taking place here.



b. How much energy is required for this process.

$$q = m \Delta T C$$

$$100 \cdot 10 \cdot 0.14 = 140 J$$

$$\frac{100g}{1g} \cdot 11.78 J = 1178 J$$

$$1178 J + 140 J = 1318 J$$

5. 4.0g of Solid NH_4Cl is dissolved in 100mL of water at 35°C. The temperature drops to 31°C. Calculate the Enthalpy of dissolution.

$$NH_4Cl \rightarrow NH_4^+ + Cl^-$$

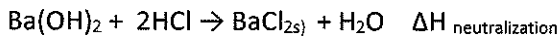
$$\Delta H = \frac{q}{\text{mol}}$$

$$\frac{4g}{53.49} = 0.0749 \text{ mol}$$

$$q = m \cdot \Delta T \cdot C$$

$$104 \cdot 4 \cdot 4.18 = 1738 J$$

6. Barium hydroxide (10g) is added to HCl (10g) in 100g of water. The water warms 3°. The specific heat of the solution is 4.18J/g°C.



a. Which substance is the limiting reactant?

b. How much energy is exchanged?

$$q = m \cdot \Delta T \cdot C$$

$$120 \cdot 3 \cdot 4.18 = 1504 J$$

c. Calculate the enthalpy of neutralization.

$$\frac{1504 J}{0.05 \text{ mol}} = 30080 J/mol$$

$$30.0 kJ/mol$$

$$\frac{1738 J}{0.074} = 23485 J$$

$$23.4 kJ/mol$$

Per 1 mol of $Ba(OH)_2$