Heat Equations

\[ q = \text{heat (J or kJ)} \quad \Delta H = \text{enthalpy (J/mole or kJ/mole)} \]

\[ q = C_{cal} \Delta T \quad \text{(measure heat w calorimeter)} \]

\[ q = n \Delta H \quad \text{(reaction or phase change)} \]

\[ q = \text{mass } C_p \Delta T \quad \text{(heat a single substance)} \]

heat system + heat surroundings = 0

1) A calorimeter has a heat capacity of 3150 J/°C. If the temperature of the calorimeter changes from 23.0°C to 34.3 °C, how much heat was transferred?

2) A reaction (\( \Delta H^o_{\text{rxn}} = -46.46 \text{ kJ/mol} \)) is run in a calorimeter. How much heat is transferred to the calorimeter for 0.105 moles of reaction?

3) A reaction is run in a calorimeter with \( C_{cal} = 4234 \text{ J/°C} \). What will be the temperature change of the calorimeter if 36.39 kJ of heat is transferred to the calorimeter?

4) A calorimeter consists of a 100.0 g glass beaker, 1000.0 g of liquid water and a 1000.0 g copper pail. What is the heat capacity of this calorimeter in J/°C?
   The specific heat capacity of liquid water is 4.184 J/g.°C.
   The specific heat capacity of glass is 0.840 J/g.°C.
   The specific heat capacity of copper metal is 0.385 J/g.°C.

5) The specific heat capacity of liquid water is 4.184 J·g\(^{-1}\)·°C\(^{-1}\). Calculate the heat change for 355 mL of liquid water cooling from 30.0 °C to 0.0 °C. density = 1.00 g/mL for liquid water

6) The specific heat capacity of aluminum metal is 0.902 J·g\(^{-1}\)·°C\(^{-1}\). Calculate the heat required to raise the temperature of 10.0 grams of aluminum metal from 25.0°C to 225.0°C.

7) The air (density = 1.20 g/L) in a 4 ft\(^3\) (113 L) cooler has its temperature lowered from 22 °C to 0 °C by melting ice that removed 3050 J of heat. Calculate the specific heat capacity of air.

8) \( \Delta H^o = 43.5 \text{ kJ/mol} \) for the vaporization of ethanol. How much heat is required to evaporate 20.0 grams of ethanol (MW = 46.07 g/mole)?

9) \( \Delta H^o = 6.01 \text{ kJ/mol} \) for the fusion reaction of water. How much heat must be removed to make a tray of ice cubes? (12 cubes/tray ; 60.0 g water/cube)

10) The refrigerant F-21 (dichloromonofluoromethane MW = 101.9 g/mol) has \( \Delta H^o_{\text{vap}}=24.4 \text{ kJ/mol} \). How many grams of F-21 would condense to release 100.0 kJ of heat at the back of a refrigerator?

11) A 25.00 g cylinder of stainless steel at 200.0 °C is added to 100.0 mL of water at 22.0 °C in an insulated cup. The final temperature is 27.3 °C. What is the specific heat capacity of stainless steel?
12) 295 ml of liquid water at 23.0 °C is poured into an insulated 130. g plastic cup at 0.0 °C. The final temperature of the cup and water is 20.5 °C. Calculate the specific heat capacity of the plastic assuming no heat loss.

13) A calorimeter has a heat capacity of 5618 J/°C. 4.30 x 10⁻³ moles of reaction changes the temperature of the calorimeter from 22.2°C to 29.7 °C. What is the enthalpy of the reaction?

14) A calorimeter has a heat capacity of 618 J/°C. 1.05 mmoles of reaction changes the temperature of the calorimeter from 22.2°C to 27.3 °C. What is the enthalpy of the reaction?

15) A reaction (ΔH°= 105 kJ/mol) is run in a calorimeter. 25.0 millimoles of reaction resulted in a temperature change of the calorimeter of 4.08 °C. Did the calorimeter temperature go up or down? What is the heat capacity of the calorimeter?

**Answers**

1) 35600 J  
2) 4.88 kJ  
3) 8.595 °C  
4) 4653 J/°C

5) -44600 J  
6) 1.80 X 10³ J  
7) 1.0 J/g•°C  
8) 18.9 kJ

9) 240. kJ  
10) 418 g  
11) 0.51 J/g•°C  
12) 1.16 J/g•°C

13) -9800 kJ/mole  
14) -3.0 X 10³ kJ/mole  
15) down; 643 J/°C