

1. Calculate the change in energy for a system undergoing an endothermic process in which 15.6 kJ of heat flows and where 1.4 kJ of work is done on the system.

$$\Delta E = q + w \quad \uparrow (+)$$

$$\Delta E = 15.6 \text{ kJ} + 1.4 \text{ kJ} = \boxed{17.0 \text{ kJ}}$$

2. A gas absorbs 45 kJ of heat and does -29 kJ of work. Calculate the change in internal energy.

$$\Delta E = 45 \text{ kJ} + (-29 \text{ kJ}) = \boxed{16 \text{ kJ}}$$

3. A system releases 125 kJ of heat and does 29 kJ of work. Calculate the change in internal energy.

$$\Delta E = -125 + (-29 \text{ kJ}) = \boxed{-154 \text{ kJ}}$$

4. A 0.150 g sample of octane (liquid) was burned in a bomb calorimeter causing the temperature to change from 25.246°C to 26.386°C. If the heat capacity of the calorimeter was 7.15 kJ/°C, calculate ΔH_{comb} for octane.

$$q_c = (7.15 \text{ kJ/}^\circ\text{C})(26.386^\circ\text{C} - 25.246^\circ\text{C})$$

$$q = 8.151 \text{ kJ per } 0.150 \text{ g octane (C}_8\text{H}_{18})$$

$$\Delta H = \frac{8.151 \text{ kJ}}{0.150 \text{ g octane}} \left(\frac{1 \text{ mol}}{114.23 \text{ g}} \right) = \boxed{6210 \text{ kJ/mol}}$$

5. Calcium oxide (lime) reacts with water to give calcium hydroxide. A 5.40 g sample of calcium oxide was added to 500. mL of water in a calorimeter of heat capacity 350. J/°C. The observed temperature increase was 2.60°C. What is the standard enthalpy change for the reaction of one mole of calcium oxide? (Surroundings = calorimeter & solution) Assume that the resulting solution has the same specific heat as water. 500 mL H₂O = 500 g H₂O (Density = 1 g/mL)

* Need to take into account the calorimeter and the solution *

$$q_c = (350 \text{ J/}^\circ\text{C})(2.60^\circ\text{C})$$

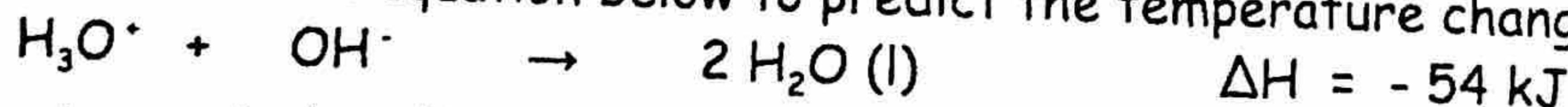
$$q_c = 910 \text{ J}$$

$$q_{\text{solution}} = (500 + 5.40)(4.184 \text{ J/g}^\circ\text{C})(2.6^\circ\text{C})$$

$$q_{\text{soln}} = 5498 \text{ J}$$

$$q_{\text{rxn}} = 910 \text{ J} + 5498 \text{ J} = 6408 \text{ J per } 5.40 \text{ g CaO}$$

6. A 50.0 mL sample of 0.20 M HCl was mixed with 50.0 mL of 0.20 M NaOH in a coffee cup calorimeter. Use the equation below to predict the temperature change that should be observed.



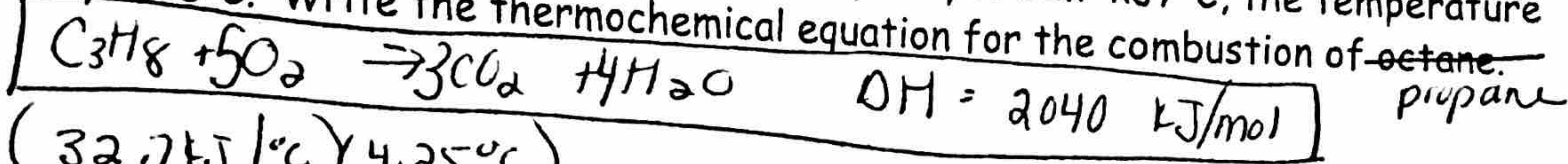
* assume density is 1 g/mL *

$$\text{mass} = 50 + 50 = 100.0 \text{ g}$$

$$-54000 \text{ J} = (100.0 \text{ g})(4.184 \text{ J/g}^\circ\text{C})(\Delta T)$$

$$\Delta T = \boxed{-129^\circ\text{C}}$$

7. Propane gas is often used as a home fuel in areas where natural gas is not available. When 3.00 g of propane is burned in a calorimeter whose heat capacity is 32.7 kJ/°C, the temperature increases by 4.25°C. Write the thermochemical equation for the combustion of ~~octane~~ propane.



$$q_c = (32.7 \text{ kJ/}^\circ\text{C}) \times (4.25^\circ\text{C})$$

$$q_c = 139 \text{ kJ}$$

$$\Delta H = 139 \text{ kJ} / \left(\frac{3.00 \text{ g}}{44.094 \text{ g/mol}} \right) = 2040 \text{ kJ/mol}$$

* thermochemical means balanced reaction and $\Delta H = -$ *

8. When 1.00 g of oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, is burned in a calorimeter, the temperature increases 0.312°C. If the ΔH_{comb} of oxalic acid is -246 kJ/mol, determine the heat capacity of the calorimeter.

$$\Delta H = \frac{-246 \text{ kJ}}{\text{mol}} = \frac{q_c}{1.00 \text{ g} / (90.036)}$$

$$q_c = -2.73 \text{ kJ}$$

$$-2.73 = (C) \times (0.312^\circ\text{C})$$

$$C = 8.75 \text{ kJ/}^\circ\text{C}$$

9. A sample of potassium chloride is dissolved in water in a coffee cup calorimeter. Use the data shown below to determine the enthalpy change for the dissolving process.

mass of KCl	2.80 g
volume of water	100.0 mL
initial temperature of water	22.6°C
final temperature of solution	19.9°C

) add together

$$\Delta H = (102.8 \text{ g}) \times (4.184 \text{ J/g}^\circ\text{C}) \times (19.9 - 22.6)$$

$$\Delta H = -1160 \text{ J}$$