

Example-1

A 75 g piece of Ag metal is heated to 80°C and dropped into 50 g of water at 23.2°C. The final temperature of the Ag-H₂O mixture is 27.6°C. What is the specific heat of silver?

(specific heat of water 4.18 J/g°C)

<u>Ag</u>	<u>H₂O</u>
$m = 75 \text{ g}$	$m = 50 \text{ g}$
$T_i = 80^\circ\text{C}$	$T_i = 23.2^\circ\text{C}$
$T_f = 27.6^\circ\text{C}$	$T_f = 27.6^\circ\text{C}$
$C_p = ?$	$C_p = 4.18$

$$q_{\text{Ag}} = -q_{\text{H}_2\text{O}}$$

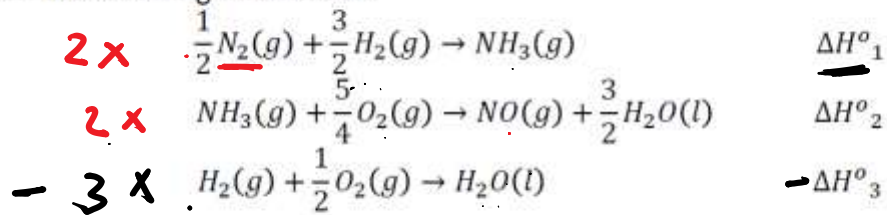
$$\frac{m \cdot c \cdot \Delta T}{\text{Ag}} = - \frac{m \cdot c \cdot \Delta T}{\text{H}_2\text{O}}$$

$$75 \times c \times (27.6 - 80) = -50 \times 4.18 \times (27.6 - 23.2)$$

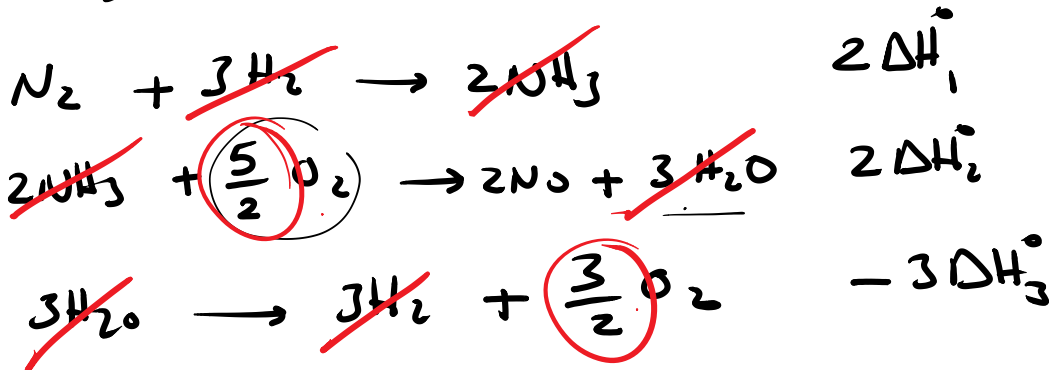
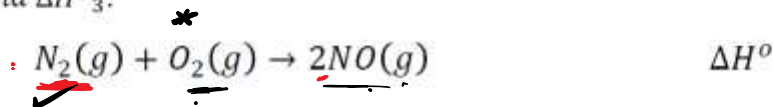
$$c_{\text{Ag}} = \frac{-50 \times 4.18 \times (27.6 - 23.2)}{75 \times (27.6 - 80)} = 0.234 \text{ J/g}^\circ\text{C}$$

* Example-2

Given the following information:



Determine the ΔH° for the following reaction, expressed in terms of $\Delta H^\circ_1, \Delta H^\circ_2$ and ΔH°_3 .



$$\Delta H = 2\Delta H^\circ_1 + 2\Delta H^\circ_2 - 3\Delta H^\circ_3$$

Example-3

A bomb calorimetry experiment is performed with xylose, $C_5H_{10}O_5(s)$, as the combustible substance. The data obtained are

Mass of xylose burned:

1.183 g

Heat capacity of calorimeter:

4.728 kJ/°C

Initial calorimeter temperature:

23.39°C

Final calorimeter temperature:

27.19°C

Combustion

exo

-ve

What is the heat of combustion of xylose, in kilojoules per mole?

ΔH

(Xylose: 150.13 g/mol)

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

$$= 1.183 \times 4.728 \times (27.19 - 23.39)$$

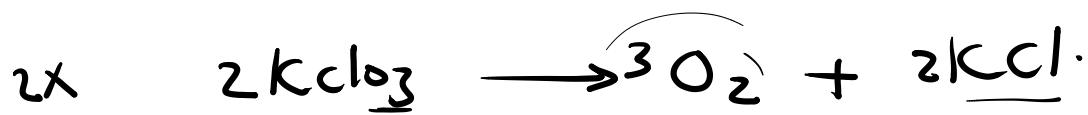
$$= -17.97 \text{ kJ}$$

$$\rightarrow \Delta H = \frac{q}{n} = \frac{-17.97}{0.007879} = -2280.7 \text{ kJ/mol}$$

$$n = \frac{m}{M_r} = \frac{1.183}{150.13} = 0.007879 \text{ mol}$$

Example-4

A 3.57 g sample of a KCl-KClO₃ mixture is decomposed by heating and produces 119 mL O₂ (g) measured at 22.4°C and 738 mmHg. What is the mass percent of KClO₃ in the mixture? (KClO₃: 122.6 g/mol)



$$V = \frac{119 \text{ ml}}{1000} = 0.119 \text{ L}$$

$$T = 22.4^\circ\text{C} + 273 = 295.4 \text{ K}$$

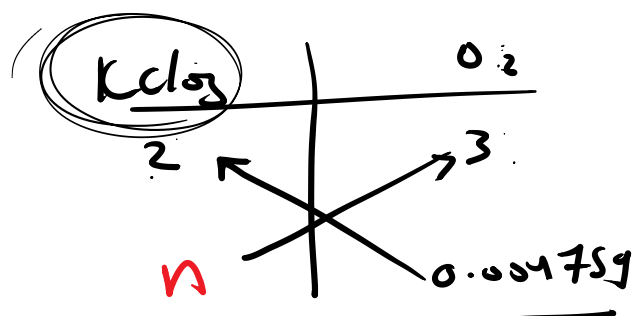
$$P = \frac{738 \text{ mmHg}}{760} = 0.97 \text{ atm}$$

$$R = 0.0821$$

$$PV = nRT$$

$$n_{\text{O}_2} = \frac{PV}{RT} = \frac{0.97 \times 0.119}{0.0821 \times 295.4} = 0.004759 \text{ mol}$$

$$n_{\text{KClO}_3} = \frac{0.004759 \times 2}{3} = 0.00317 \text{ mol}$$



$$n = \frac{2 \times 0.004759}{3}$$

$$m_{\text{KClO}_3} = n \times M_r = 0.00317 \times 122.6 = 0.389 \text{ g}$$

$$\begin{aligned} \% m_{\text{KClO}_3} &= \frac{m_{\text{KClO}_3}}{m_{\text{sample}}} \times 100 \\ &= \frac{0.389}{1.57} \times 100 = \underline{\underline{24.8\%}} \end{aligned}$$

Example 5

- How many joules of work is done when 0.225 mol of N_2 gas at 23°C is compressed to 1.5 L in volume at 0.75 atm pressure?

$$w = ? \text{ J}$$

$$n = 0.225 \text{ mol}$$

$$T = 23^\circ\text{C} + 273 = 296 \text{ K}$$

$$V_f = 1.5 \text{ L}$$

$$P_i = 0.75 \text{ atm}$$

$$V_i = ?$$

$$P_f \rightsquigarrow P_{\text{ext}}$$

$$w = -P_{\text{ext}} \Delta V$$

$$\rightarrow P_i V_i = nRT$$

$$? \rightarrow P_i V_i = P_f V_f$$

$$* P_i V_i = nRT$$

$$V_i = \frac{nRT}{P} = \frac{0.225 \times 0.0821 \times 300}{0.75} = \underline{\underline{7.28 \text{ L}}}$$

$$* P_i V_i = P_f V_f$$

$$P_f = \frac{P_i V_i}{V_f} = \frac{0.75 \times 7.28}{1.5} = \underline{\underline{3.64 \text{ atm}}}$$

$$* \underline{\underline{w}} = - P_{\text{ext}} \Delta V = - 3.64 \times (1.5 - 7.28) \times \frac{101}{100}$$
$$= \underline{\underline{2124.96 \text{ J}}}$$