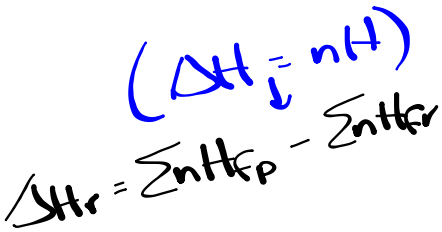
Energy Changes / Reaction Enthalpies

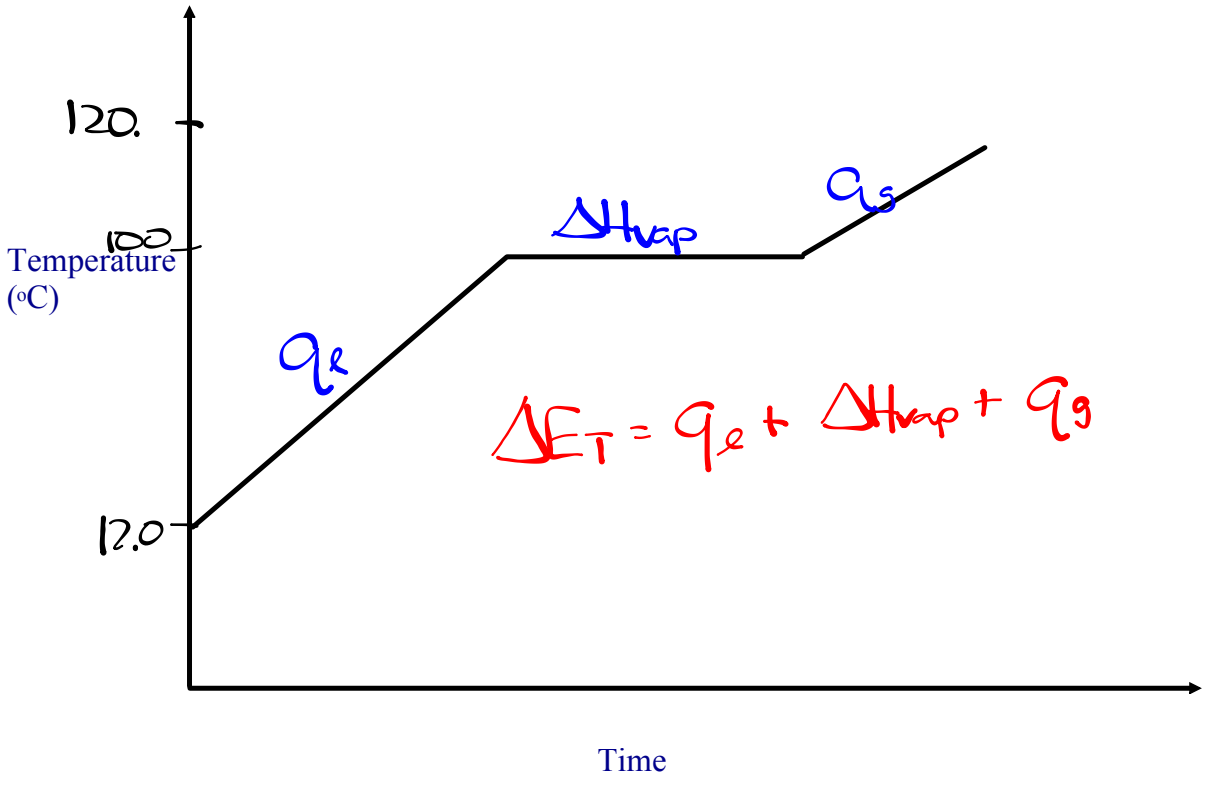
Major Topics

- Total Energy
- Calorimetry
- Hess' Law
- Heats of Formation
- Multi-Step Problems



Total Energy

Calculate the total energy change if 25.0g of water at 12.0°C is completely converted to steam at 120.°C.



Calorimetry

7.37 g of sodium nitrate is dissolved in 100. mL of water at an initial temperature of 16.3°C. The final temperature of the solution is 25.1°C. Calculate the molar enthalpy of solution, H_s, for sodium nitrate.

$\Delta H = -q$

$vC\Delta T$

$q = -q$

$mC\Delta T = -mC\Delta T$

* T_f is same

Hess's Law

$$2NO_{2(g)} \longrightarrow N_{2(g)} + 2O_{2(g)} \qquad \Delta H_r = ?$$

Calculate the standard enthalpy change for this reaction using the following information:

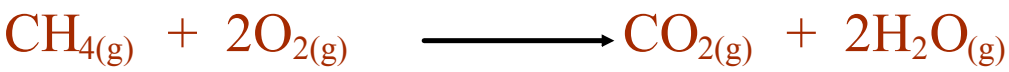
$N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$ $\Delta H_r = -91.8$ kJ

$NO_{2(g)} + H_{2(g)} \longrightarrow NH_{3(g)} + 2H_2O_{(l)}$ $\Delta H_r = 85.5$ kJ

$H_2O_{(l)} \longrightarrow H_{2(g)} + O_{2(g)}$ $\Delta H_r = 285.8$ kJ

Heats of Formation

Ex. What is the standard molar enthalpy of combustion of methane fuel?



Multi-Step Problems

Ex. $2NaHCO_{3(s)} + 129.2kJ \longrightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$

What quantity of energy ΔH_r, is required to decompose 100. kg of $NaHCO_{3(s)}$?

Step 1: Hr (general)

$\Delta Hr = \Sigma nHr_p - \Sigma nHr_r$

$\Delta Hr = nHr$

$Hr = \frac{\Delta Hr}{n} = \frac{129.2\,kJ}{2\,mol} = 64.6\,kJ/mol$

Step 2 : n (specific)

$100\,000\,g\,NaHCO_3 \times \frac{1\,mol\,NaHCO_3}{84.01\,g\,NaHCO_3} = 1190.33\,mol$

Step 3: ΔHr (specific)

$\Delta Hr = nHr$

$\Delta Hr = (1190.33\,mol)(64.6\,kJ/mol)$

$\Delta Hr = 76\,900\,kJ$