Thermochemistry Review

*1. $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(g)} + 2.25\ MJ$

$\Delta H_r = n H_r$

$\Delta H_r = (1\ mol)(-2.25\ MJ/mol)$

$\Delta H_r = -2.25\ MJ$

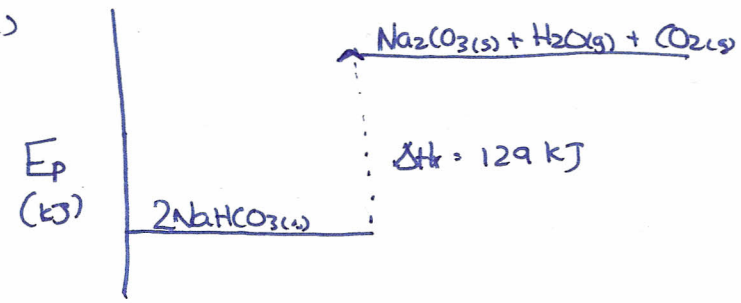
*2. $2NaHCO_{3(s)} + 129\ kJ \longrightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$

(a) $\Delta H_r = n H_r$

$H_r = \frac{\Delta H_r}{n} = \frac{129\ kJ}{1\ mol} = \boxed{\frac{129\ kJ}{mol}}$

(b) $2NaHCO_{3(s)} \longrightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$ $\quad \Delta H_r = 129\ kJ$

(c)



*3. $2CO_{(g)} + 2NO_{(g)} \longrightarrow N_{2(g)} + 2CO_{2(g)} + 746\ kJ$

Step 1: H_r

$\Delta H_r = n H_r$

$H_r = \frac{\Delta H_r}{n} = \frac{-746\ kJ}{2\ mol} = -373\ kJ/mol$

Step 2:

$500.g\ NO \times \frac{1\ mol\ NO}{30.01g\ NO} = 16.66\ mol$

Step 3: ΔH_r

$\Delta H_r = n H_r$

$\Delta H_r = (16.66\ mol)(-373\ kJ/mol)$

$\boxed{\Delta H_r = -6210\ kJ}$

4. $N_2H_{4(\ell)} + 3O_{2(g)} \longrightarrow 2NO_{2(g)} + 2H_2O_{(g)} + 400\ kJ$

(a) $\Delta H_c = n H_c$

$H_c = \frac{\Delta H_c}{n}$

$H_c = \frac{-400\ kJ}{1\ mol}$

$H_c = -400\ kJ/mol$

(b) $\Delta H_r = n H_r$

$H_r = \frac{\Delta H_r}{n}$

$H_r = \frac{-400\ kJ}{3\ mol}$

$H_r = -133.3\ kJ/mol$

(c) Step 1: $H_r = -133.3\ kJ/mol$ (from (b))

Step 2: n

$8.00\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} = 0.250\ mol\ O_2$

Step 3: ΔH_r

$\Delta H_r = n H_r$

$\Delta H_r = (-133.33\ kJ/mol)(0.250\ mol)$

$\Delta H_r = -33.3\ kJ$

5. $CuS_{(s)} + \frac{3}{2}O_{2(g)} \longrightarrow CuO_{(g)} + SO_{2(g)}$

(a) $\Delta H_r = \Sigma n H_{fp} - \Sigma n H_{fr}$

$\Delta H_r = \left[(1\ mol)(-157.3\ \frac{kJ}{mol}) + (1\ mol)(-296.8\ \frac{kJ}{mol})\right] - \left[(1\ mol)(-53.1\ \frac{kJ}{mol}) + (\frac{3}{2}\ mol)(0\ \frac{kJ}{mol})\right]$

$\Delta H_r = -401.0\ kJ$

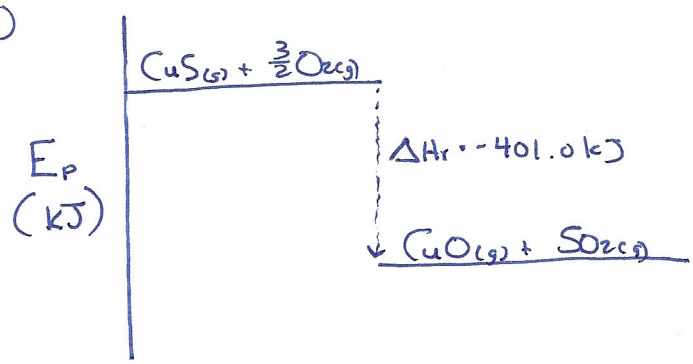
$\Delta H_r = n H_r$

$H_r = \frac{\Delta H_r}{n}$

$H_r = \frac{-401.0\ kJ}{1\ mol}$

$H_r = -401.0\ \frac{kJ}{mol}$

(b)



6. $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(g)}$

$\Delta H_r = \Sigma n H_{fp} - \Sigma n H_{fr}$

$\Delta H_r = \left[(3\,mol)(-393.5\,\frac{kJ}{mol}) + (4\,mol)(-241.8\,\frac{kJ}{mol})\right] - \left[(1\,mol)(-104.7\,\frac{kJ}{mol}) + (5\,mol)(0\,\frac{kJ}{mol})\right]$

$\Delta H_r = -2043\,kJ$

Step 1: H_r

$\Delta H_r = nH_r$

$H_r = \frac{\Delta H_r}{n} = \frac{-2043\,kJ}{1\,mol} = -2043\,\frac{kJ}{mol}$

Step 2: n

$\Delta H_r = -q$

$nH_r = -vC\Delta T$

$n = -\frac{(2.50L)(4.19\,\frac{kJ}{L\cdot°C})(70.0°C)}{-2043\,\frac{kJ}{mol}}$

$n = 0.359\,mol$

Step 3: m

$0.359\,mol \times \frac{44.11\,g}{1\,mol} = \boxed{15.8\,g\ C_3H_8}$

7. $2C_4H_{10(g)} + 13O_{2(g)} \longrightarrow 8CO_{2(g)} + 10H_2O_{(g)} + 5754.8\,kJ$

Step 1: H_r

$\Delta H_r = nH_r$

$H_r = \frac{-5754.8\,kJ}{10\,mol}$

$H_r = -575.48\,kJ/mol$

Step 2: n

$\Delta H_r = nH_r$

$n = \frac{\Delta H_r}{H_r}$

$n = \frac{-2400.kJ}{-575.48\,\frac{kJ}{mol}}$

$n = 4.170\,mol$

Step 3: m

$4.170\,mol \times \frac{18.02\,g}{1\,mol} = \boxed{75.15\,g\ H_2O}$