Chapter 8 & 9 − Review Set

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1. The ΔH for the combustion of $C_6H_{12}O_6$ is 2820[kJ]. Determine ΔH if you start with 35.8 g of oxygen.

$$\begin{aligned} C_6H_{12}O_6 + 6\,O_2 &\longrightarrow 6\,CO_2 + 6\,H_2O \\ \frac{35.8}{32} \cdot \frac{-2820}{6} &= -525.81[\text{kJ}] \end{aligned} \tag{1}$$

2. The enthalpy change for the combustion of CH_4 is -891[kJ]. Calculate the enthalpy change if you end with 52[g] of water.

$$\begin{aligned} CH_4 + 2\,O_2 &\longrightarrow CO_2 + 2\,H_2O \\ \frac{52}{18} &= 2.\bar{8}[\text{mol}] \\ 2.\bar{8} \cdot \frac{-891}{2} &= -1287[\text{kJ}] \end{aligned} \tag{2}$$

3. Calculate the heat of formation of $AlCl_3$ when the enthalpy change of the reaction is -2677[kJ], given $3\,Al + 3\,NH_4ClO_4(\Delta H = -295[\text{kJ}]) \longrightarrow Al_2O_3(\Delta H = -1676[\text{kJ}]) + AlCl_3 + 3\,NO(\Delta H = 90[\text{kJ}]) + 6\,H_2O(\Delta H = -242[\text{kJ}])$

$$\begin{aligned} (-1676) + x + 3(90) + 6(-242) - 3(-295) &= -2677[\text{kJ}] \\ x &= -704[\text{kJ}] \end{aligned} \tag{3}$$

4. What are the strongest attractive forces that must be overcome to:

   (a) Melt Ice − Hydrogen Bonding

   (b) Vaporize $CaCl_2$ − Ionic

   (c) Melt KNO_3 − Ionic

(d) Dissolve Br_2 in CCl_4 − London

(e) Sublime CO_2 − London

(f) Boil CH_4 − London

(g) Melt Iodine − London

(h) Melt SiO_2 − Network Covalent

(i) Boil C_2H_5OH − Hydrogen Bonding

(j) Melt NH_3 − Hydrogen Bonding

5. C_8H_{18} has a vapor pressure of 45.2mmHg] at 25[° C]. If 10[mL] ($\rho = 0.692\left[\frac{\text{g}}{\text{mL}}\right]$) is added to a 15[L] container, how many molecules will be left in the liquid phase after equilibrium is established?

$$\begin{aligned} 10 \cdot .692 &= 6.92[\text{g}] \\ \frac{6.92}{130} &= .0532[\text{mol}] \\ P = \frac{nRT}{V} &= \frac{.0532 \cdot .0821 \cdot 298}{15} \\ &= .0868[\text{ATM}] \rightarrow 65.947[\text{mmHg}] \\ 65.947 - 45.2 &= 20.747[\text{mmHg}_{\text{liquid}}] \\ \frac{20.747}{45.2} \cdot .0532 &= .0244[\text{mol}] \\ .0244 \cdot 6.22 \cdot 10^{23} &= 1.51 \cdot 10^{22}[\text{molecules}] \end{aligned} \tag{4}$$

6. Playing tennis for half an hour consumes 225[kcal] of energy. How long would you have to play tennis to lose one pound of body fat? (one gram of body fat = 32[kJ] of energy)

$$\begin{aligned} 225[\text{kcal}] &= 941.4[\text{kJ}] \\ 2 \cdot \frac{941.4}{32} &= 58.84\left[\frac{\text{g}}{\text{h}}\right] \\ 58.84\left[\frac{\text{g}}{\text{h}}\right] &= .13\left[\frac{\text{lb}}{\text{h}}\right] \\ .13 \cdot x &= 1 \\ x &= 7.7[\text{h}] \end{aligned} \tag{5}$$

7. Calculate the ΔH using bond energies when C_2H_4 is combusted.

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\begin{aligned}
&\mathrm{C_2H_4 + 3\,O_2 \longrightarrow 2\,CO_2 + 2\,H_2O} \\
&\text{Broken:} \\
&3(\mathrm{O{=\!=}O}) = 3(498) \\
&\mathrm{C{=\!=}C} = 612 \\
&4(\mathrm{C{-\!-}H}) = 4(414) \\
&\text{Made:} \\
&4(\mathrm{C{=\!=}O}) = 4(715) \\
&4(\mathrm{O{-\!-}H}) = 4(464) \\
&-4(715) - 4(464) + 3(498) + 612 + 4(414) = -954[\mathrm{kJ}]
\end{aligned}
\tag{6}
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