Quiz 2.3 – Thermochemistry

Name: ~~Key~~

Kirchoff's Law

$4R \quad \frac{7}{2}R \quad 4R \quad \frac{7}{2}R$

Consider the reaction: $CH_4(g) + 2\,O_2(g) \longrightarrow 2\,H_2O(g) + CO_2(g)$

○ Find $\Delta_{rxn}H^{\ominus}$ for this reaction at 298 K using the following data:

298 K	$CH_4(g)$	$O_2(g)$	$H_2O(g)$	$CO_2(g)$
$\Delta_f H^{\ominus}$	$-74.81\frac{kJ}{mol}$	$0\frac{kJ}{mol}$	$-241.82\frac{kJ}{mol}$	$-393.51\frac{kJ}{mol}$

$$\Delta_{rxn}H^{\circ} = 2\cdot\left(-241.82\,\tfrac{kJ}{mol}\right) + 1\cdot\left(-393.51\,\tfrac{kJ}{mol}\right) - \left(-74.81\,\tfrac{kJ}{mol}\right) - 2\cdot\emptyset$$

$$\Delta_{rxn}H^{\circ} = -802.34\,\frac{kJ}{mol}$$

○ Assuming that these gases have perfect gas heat capacities in the low temperature limit, find $\Delta_{rxn}C_p$

$$\Delta_{rxn}C_p = 2\cdot(4R) + \left(\tfrac{7}{2}R\right) - (4R) - 2\cdot\left(\tfrac{7}{2}R\right) = \tfrac{1}{2}R = 4.157\,\frac{J}{mol\cdot K}$$

○ Find $\Delta_{rxn}H^{\ominus}$ at 265 K

$$\Delta_{rxn}H^{\ominus}(265) = \Delta_{rxn}H^{\ominus}(298) + \int_{298}^{265} \Delta_{rxn}C_p\,dT$$

$$= -802.34\,\frac{kJ}{mol} + 4.157\,\frac{J}{mol\cdot K}\left(\frac{1\,kJ}{1000\,J}\right)\cdot -33\,K$$

$$= -802.48\,\frac{kJ}{mol}$$