Name …………………………………….. AP Chemistry

Unit 11: Thermodynamics Practice 1

1. Propane, C_3H_8, is a hydrocarbon that is commonly used as fuel for cooking.
   (a) Write a balanced equation for the complete combustion of propane gas, which yields $CO_2(g)$ and $H_2O(l)$.
   (b) Calculate the volume of air at 30°C and 1.00 atmosphere that is needed to burn completely 10.0 grams of propane. Assume that air is 21.0 percent O_2 by volume.
   (c) The heat of combustion of propane is -2,220.1 kJ/mol. Calculate the heat of formation, $\Delta H_f°$, of propane given that $\Delta H_f°$ of $H_2O(l)$ = -285.3 kJ/mol and $\Delta H_f°$ of $CO_2(g)$ = -393.5 kJ/mol.
   (d) Assuming that all of the heat evolved in burning 30.0 grams of propane is transferred to 8.00 kilograms of water (specific heat = 4.18 J/g·K), calculate the increase in temperature of water.

*1. Pentane, C_5H_{12}, is a hydrocarbon used in the production of Styrofoam and is present in certain fuels.
   (a) Write a balanced equation for the complete combustion of pentane gas, which yields $CO_2(g)$ and $H_2O(l)$.
   (b) Calculate the volume of air at 25°C and 1.00 atmosphere that is needed to burn completely 50.5 grams of pentane. Assume that air is 21.0 percent O_2 by volume.
   (c) The heat of combustion of pentane is -3,285.3 kJ/mol. Calculate the heat of formation, $\Delta H_f°$, of pentane given that $\Delta H_f°$ of $H_2O(l)$ = -285.3 kJ/mol and $\Delta H_f°$ of $CO_2(g)$ = -393.5 kJ/mol.
   (d) Assuming that all of the heat evolved in burning 50.5 grams of pentane is transferred to 10.0 kilograms of water (specific heat = 4.18 J/g·K), calculate the increase in temperature of water.

2. (a) The specific heat of fluorine gas is 0.037 J/g•K. Calculate the molar heat capacity (in J/mol•K) of fluorine gas. *(See Example 2a in notes)*

   (b) The molar heat capacity of a compound with the formula $C_4H_{10}SO$ is 43.6 J/mol•K. Calculate the specific heat, c, of this substance. *(See Example 2b in notes)*

3. Given the following data:

   $S(s) + 3/2\ O_2(g) \rightarrow SO_3(g)$ $\quad \Delta H = -395.2$ kJ

   $2\ SO_2(g) + O_2 \rightarrow 2\ SO_3(g)$ $\quad \Delta H = -198.2$ kJ

   Calculate ΔH for the reaction: $S(s) + O_2(g) \rightarrow SO_2(g)$

   (See Examples 5 and 6 in notes)

4. Given:

   $\Delta H_f^o\ NH_3(g) = -45.88$ kJ $\quad \Delta H_f^o\ H_2O(g) = -241.85$ kJ

   $\Delta H_f^o\ CH_4(g) = -74.92$ kJ $\quad \Delta H_f^o\ HCN(g) = +135.13$ kJ

   Calculate ΔH^o_{rxn} for: $2\ NH_3(g) + 3\ O_2(g) + 2\ CH_4(g) \rightarrow 2\ HCN(g) + 6\ H_2O(g)$

   (See Examples 7 and 8 in notes)

Answers:

1.	**(a)**	$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$	**(b)**	135 L of air
	(c)	-101.6 kJ/mol	**(d)**	ΔT = 45.2°
***1.**	**(a)**	$C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$	**(b)**	654 L of air
	(c)	-394.0 kJ/mol	**(d)**	55.1 K
2.	**(a)**	1.41 J/mol•K	**(b)**	0.411 J/g•K
3.	-296.1 kJ		**4.**	-939.24 kJ