Unit 11 – Chapter 6: Thermochemistry	Name
Assignment #2	Period

- The enthalpy of combustion of solid carbon to form carbon dioxide is -393.7 kJ/mol carbon, and the enthalpy of combustion of carbon monoxide to form carbon dioxide is -283.3 kJ/mol CO. Use these data to calculate the ΔH for the reaction: 2 C_(s) + O_{2(g)} → 2 CO_(g)
- 2) Combustion reactions involve reacting a substance with oxygen. When compounds containing carbon and hydrogen are combusted, carbon dioxide and water are the products. Using the enthalpies of combustion for C₄H₄ (-2341 kJ/mol), C₄H₈ (-2755 kJ/mol), and H₂ (-286 kJ/mol), calculate ΔH for the reaction: C₄H_{4(g)} + 2 H_{2(g)} \rightarrow C₄H_{8(g)}
- 3) Given the following data:

$2 \operatorname{CIF}_{(g)} + \operatorname{O}_{2(g)} \operatorname{CI}_2 \operatorname{O}_{(g)} + \operatorname{F}_2 \operatorname{O}_{(g)}$	$\Delta H = +167.4 \text{ kJ}$
$2 \operatorname{CIF}_{3(g)} + 2 \operatorname{O}_{2(g)} \operatorname{CI}_2 \operatorname{O}_{(g)} + 3 \operatorname{F}_2 \operatorname{O}_{(g)}$	$\Delta H = +341.4 \text{ kJ}$
$2 \operatorname{F}_{2(g)} + \operatorname{O}_{2(g)} \xrightarrow{} 2 \operatorname{F}_2\operatorname{O}_{(g)}$	$\Delta H = =43.4 \text{ kJ}$
Calculate ΔH for the reaction: $ClF_{(g)} + F_{2(g)} \rightarrow ClF_{3(g)}$	

4) The bombardier beetle uses an explosive discharge as a defensive measure. The chemical reaction involved is the oxidation of hydroquinone by hydrogen peroxide to produce quinone and water:

 $C_{6}H_{4}(OH)_{2(aq)} + H_{2}O_{2(aq)} \rightarrow C_{6}H_{4}O_{2(aq)} + 2 H_{2}O_{(l)}$

Calculate ΔH for this reaction from the following data:

$C_6H_4(OH)_{2(aq)} \rightarrow C_6H_4O_{2(aq)} + H_{2(g)}$	∆ <i>H</i> = +177.4 kJ
$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(aq)}$	Δ <i>H</i> = -191.2 kJ
$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2 O_{(g)}$	∆ <i>H</i> = -241.8 kJ
$H_2O_{(g)} \rightarrow H_2O_{(l)}$	∆ <i>H</i> = -43.8 kJ

5) Given the following data:

$P_{4(s)}$ + 6 $Cl_{2(g)}$ \rightarrow 4 $PCl_{3(g)}$	Δ <i>H</i> = -1225.6 kJ
$P_{4(g)} + 5 O_{2(g)} P_4 O_{10(s)}$	Δ <i>H</i> = -2967.3 kJ
$PCI_{3(g)} + CI_{2(g)} \rightarrow PCI_{3(g)}$	Δ <i>H</i> = -84.2 kJ
$PCI_{3(g)} + \frac{1}{2} O_{2(g)} \rightarrow CI_2PO_{(g)}$	Δ <i>H</i> = -285.7 kJ
Calculate the ΔH for the reaction:	$P_4O_{10(s)}$ + 6 $PCI_{3(g)}$ \rightarrow 10 $CI_3PO_{4(g)}$

6) Calculate ΔH^0 for each of the following reactions using the data in Appendix 4:

 $4 \operatorname{Na}_{(s)} + \operatorname{O}_{2(g)} \rightarrow 2 \operatorname{Na}_{2}\operatorname{O}_{(s)}$ $2 \operatorname{Na}_{(s)} + 2 \operatorname{H}_{2}\operatorname{O}_{(l)} \rightarrow 2 \operatorname{Na}\operatorname{OH}_{(aq)} + \operatorname{H}_{2(g)}$ $2 \operatorname{Na}_{(s)} + \operatorname{CO}_{2(g)} \rightarrow \operatorname{Na}_{2}\operatorname{O}_{(s)} + \operatorname{CO}_{(g)}$

Explain why a water or carbon dioxide fire extinguisher might not be effective in putting out a sodium fire.

7) The space shuttle orbiter utilizes the oxidation of methylhydrazine by dinitrogen tetroxide for propulsion:

 $4 \text{ N}_2\text{H}_3\text{CH}_{3(l)} + 5 \text{ N}_2\text{O}_{4(l)} \rightarrow 12 \text{ H}_2\text{O}_{(g)} + 9 \text{ N}_{2(g)} + 4 \text{ CO}_{2(g)}$ Calculate ΔH^0 for this reaction.

8) Consider the reaction:

 $2 \operatorname{ClF}_{3(g)} + 2 \operatorname{NH}_{3(g)} \xrightarrow{} \operatorname{N}_{2(g)} + 6 \operatorname{HF}_{(g)} + \operatorname{Cl}_{2(g)} \quad \Delta H^0 = -1196 \text{ kJ}$ Calculate ΔH_f for $\operatorname{ClF}_{3(g)}$.

9) The standard enthalpy of combustion of ethene gas, $C_2H_{4(g)}$, is -1411.1 kJ/mol at 298 K. Given the following enthalpies of formation, calculate ΔH^{0}_{f} for $C_2H_{4(g)}$.

 $CO_{2(g)} = -393.5 \text{ kJ/mol}$ $H_2O_{(l)} = -285.8 \text{ kJ/mol}$