

## HESS'S LAW CALCULATIONS

- Calculate the  $\Delta H$  for the following reaction:  $2 \text{N}_2(\text{g}) + 5 \text{O}_2(\text{g}) \rightarrow 2 \text{N}_2\text{O}_5(\text{g})$   
Use the following reactions:  

$$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta H^\circ = -285.8 \text{ kJ}$$

$$\text{N}_2\text{O}_5(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2 \text{HNO}_3(\text{l}) \quad \Delta H^\circ = -76.6 \text{ kJ}$$

$$1/2 \text{N}_2(\text{g}) + 3/2 \text{O}_2(\text{g}) + 1/2 \text{H}_2(\text{g}) \rightarrow \text{HNO}_3(\text{l}) \quad \Delta H^\circ = -174.1 \text{ kJ}$$
- Use the information below to calculate  $\Delta H$  for the following reaction.  $2\text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$   

$$\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g}) \quad \Delta H^\circ = 67.7 \text{ kJ}$$

$$\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g}) \quad \Delta H^\circ = 9.7 \text{ kJ}$$
- Carbon and CO can be combusted in  $\text{O}_2$  to form  $\text{CO}_2$ .  

$$\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -393.5 \text{ kJ}$$

$$\text{CO}(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -283.0 \text{ kJ}$$
 Use Hess's Law to calculate  $\Delta H$  of:  $\text{C}(\text{s}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$
- Carbon exists in two natural forms: graphite and diamond.  
Each form can be combusted:  

$$\text{C}(\text{graphite}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -393.5 \text{ kJ}$$

$$\text{C}(\text{diamond}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -395.4 \text{ kJ}$$
 Calculate  $\Delta H$  of the conversion of graphite to diamond:  $\text{C}(\text{graphite}) \rightarrow \text{C}(\text{diamond})$
- Calculate  $\Delta H$  for this reaction:  $2\text{C}(\text{s}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_2(\text{gas})$   
Given the following thermochemical reactions:  

$$\text{C}_2\text{H}_2(\text{g}) + 5/2 \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \quad \Delta H = -1229.6 \text{ kJ}$$

$$\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -393.5 \text{ kJ}$$

$$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta H = -285.8 \text{ kJ}$$
- Calculate  $\Delta H$  for this reaction:  $\text{NO}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{NO}_2(\text{g})$   
Given the following thermochemical reactions:  

$$\text{NO}(\text{g}) + \text{O}_3(\text{g}) \rightarrow \text{NO}_2 + \text{O}_2(\text{g}) \quad \Delta H = -198.9 \text{ kJ}$$

$$\text{O}_3(\text{g}) \rightarrow 3/2 \text{O}_2(\text{g}) \quad \Delta H = -142.3 \text{ kJ}$$

$$\text{O}_2(\text{g}) \rightarrow 2 \text{O}(\text{g}) \quad \Delta H = +495.0 \text{ kJ}$$
- Calculate  $\Delta H$  for the reaction  $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$ , from the following data.  

$$\text{C}_2\text{H}_4(\text{g}) + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}) \quad \Delta H = -1411. \text{ kJ}$$

$$\text{C}_2\text{H}_6(\text{g}) + 7/2 \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{l}) \quad \Delta H = -1560. \text{ kJ}$$

$$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta H = -285.8 \text{ kJ}$$
- Calculate  $\Delta H$  for the reaction  $2 \text{Al}(\text{s}) + 3 \text{Cl}_2(\text{g}) \rightarrow 2 \text{AlCl}_3(\text{s})$  from the following data.  

$$2 \text{Al}(\text{s}) + 6 \text{HCl}(\text{aq}) \rightarrow 2 \text{AlCl}_3(\text{aq}) + 3 \text{H}_2(\text{g}) \quad \Delta H = -1049. \text{ kJ}$$

$$\text{HCl}(\text{g}) \rightarrow \text{HCl}(\text{aq}) \quad \Delta H = -74.8 \text{ kJ}$$

$$\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2 \text{HCl}(\text{g}) \quad \Delta H = -1845. \text{ kJ}$$

$$\text{AlCl}_3(\text{s}) \rightarrow \text{AlCl}_3(\text{aq}) \quad \Delta H = -323. \text{ KJ}$$
- From the following enthalpy changes,  

$$\text{H}_2\text{O}_2(\text{l}) \rightarrow \text{H}_2\text{O}(\text{l}) + 1/2 \text{O}_2(\text{g}) \quad \Delta H = -94.6 \text{ kJ}$$

$$\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta H = -286.0 \text{ kJ}$$
 Calculate the value of  $\Delta H$  for the reaction:  $\text{H}_2(\text{g}) + \text{H}_2\text{O}_2(\text{l}) \rightarrow 2 \text{H}_2\text{O}(\text{l})$
- From the following enthalpy changes,  

$$2\text{P}(\text{s}) + 3\text{Cl}_2(\text{g}) \rightarrow 2 \text{PCl}_3(\text{l}) \quad \Delta H = -640 \text{ kJ}$$

$$2\text{P}(\text{s}) + 5\text{Cl}_2(\text{g}) \rightarrow 2 \text{PCl}_5(\text{s}) \quad \Delta H = -886 \text{ kJ}$$
 Calculate the value of  $\Delta H$  for the reaction:  $\text{PCl}_3(\text{l}) + \text{Cl}_2(\text{g}) \rightarrow \text{PCl}_5(\text{s})$

Answers:

1) 28.4kJ 2) -58kJ 3) -110.5kJ 4) 1.9kJ 5) 156.8kJ 6) -304.1kJ 7) -137kJ 8) -6387kJ 9) -380.6 10) -123kJ