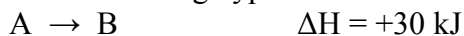


**CH1020 Exercises (worksheet 18)****(Hess's law; Standard enthalpy of reactions)**

1. State Hess's law. Why is it important to thermochemistry?
2. What is the connection between Hess's law and the fact that H is a state function?
3. Consider the following hypothetical reactions:



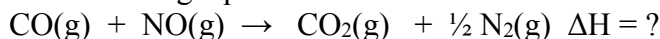
Use Hess's law to calculate the enthalpy change for the reaction  $A \rightarrow C$ .

4. Suppose you are given the following hypothetical reactions:

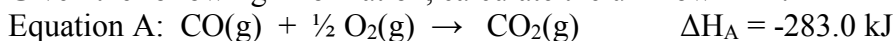


Use Hess's law to calculate the enthalpy change for the reaction  $Y \rightarrow Z$

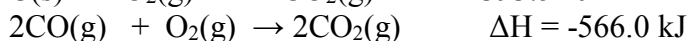
5. Two gaseous pollutants that form in auto exhaust are CO and NO. An environmental chemist is studying ways to convert them to less harmful gases through the following equation:



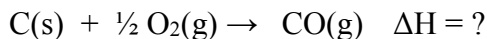
Given the following information, calculate the unknown  $\Delta H$ :



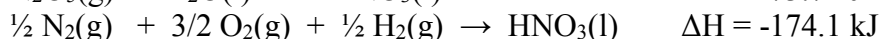
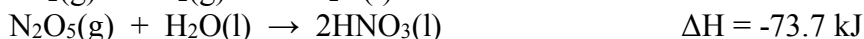
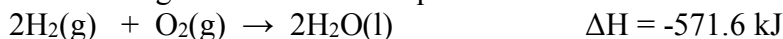
6. Given:



calculate  $\Delta H$  for the reaction:

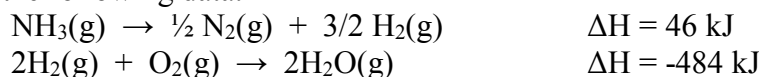


7. Given the following thermochemical equations

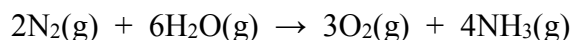


calculate  $\Delta H$  for the formation of one mole of dinitrogen pentoxide from its elements.

8. Given the following data:

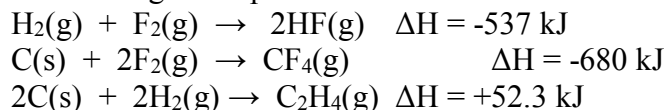


calculate  $\Delta H$  for the reaction

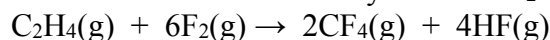


On the basis of the enthalpy change, is this a useful reaction for the synthesis of ammonia?

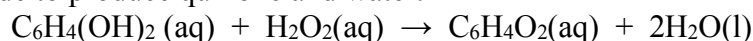
9. From the following enthalpies of reaction:



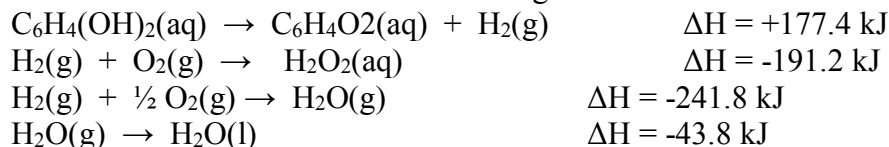
calculate  $\Delta H$  for the reaction of ethylene with  $\text{F}_2$ :



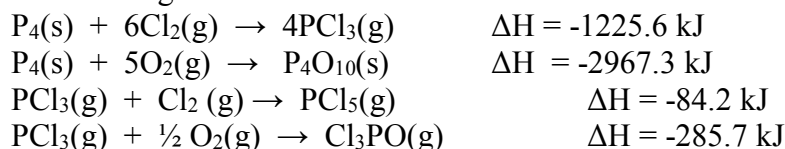
10. The bombardier beetle uses an explosive discharge as a defensive measure. The chemical reaction involved is the oxidation of hydroquinone by hydrogen peroxide to produce quinone and water:



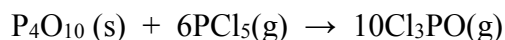
Calculate  $\Delta H$  for this reaction from the following data:



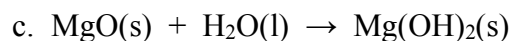
11. Given the following data:



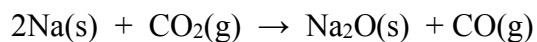
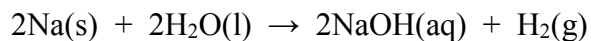
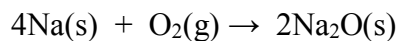
Calculate  $\Delta H$  for the reaction



12. Why are tables of standard enthalpies of formation so useful?
13. What is the value of the standard enthalpy of formation of an element in its most stable form?
14. Calculate  $\Delta H^\circ$  for the following reactions:
- $\text{C}_2\text{H}_5\text{OH}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g})$
  - $\text{SiCl}_4(\text{l}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{SiO}_2(\text{s}) + 4\text{HCl}(\text{aq})$

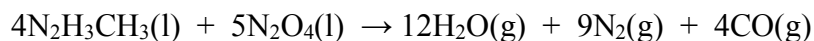


15. Calculate  $\Delta H^\circ$  for each of the following reactions:



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

16. The space shuttle orbiter utilizes the oxidation of methyl hydrazine by dinitrogen tetroxide for propulsion:



Calculate  $\Delta H^\circ$  for the reaction.

17. The standard enthalpy of combustion of ethane gas,  $\text{C}_2\text{H}_4\text{(g)}$ , is  $-1411.1 \text{ kJ/mol}$  at 298 K. Given the following enthalpies of formation, calculate the enthalpy of formation for  $\text{C}_2\text{H}_4\text{(g)}$

