

Hess' Law – Additional Practice Problems

- 1 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = 249.8 kJ
 $\text{PCl}_5(\text{g}) \rightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 $\text{P}_4(\text{s}) + 6\text{Cl}_2(\text{g}) \rightarrow 4\text{PCl}_3(\text{g}) \quad \Delta H = -2439 \text{ kJ}$
 $4\text{PCl}_5(\text{g}) \rightarrow \text{P}_4(\text{s}) + 10\text{Cl}_2(\text{g}) \quad \Delta H = 3438 \text{ kJ}$
- 2 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = 235 kJ
 $2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{C}_2\text{H}_2(\text{g}) + 5/2\text{O}_2(\text{g})$
 $\text{C}_2\text{H}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g}) \quad \Delta H = -94.5 \text{ kJ}$
 $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \quad \Delta H = 71.2 \text{ kJ}$
 $\text{C}_2\text{H}_6(\text{g}) + 7/2\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g}) \quad \Delta H = -283 \text{ kJ}$
- 3 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = -18 kJ
 $\text{N}_2\text{H}_4(\text{l}) + \text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
 $\text{N}_2\text{H}_4(\text{l}) + \text{CH}_4\text{O}(\text{l}) \rightarrow \text{CH}_2\text{O}(\text{g}) + \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \quad \Delta H = -37 \text{ kJ}$
 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) \quad \Delta H = -46 \text{ kJ}$
 $\text{CH}_4\text{O}(\text{l}) \rightarrow \text{CH}_2\text{O}(\text{g}) + \text{H}_2(\text{g}) \quad \Delta H = -65 \text{ kJ}$
- 4 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = 72 kJ
 $\text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{g})$
 $\text{H}_2\text{S}(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{SO}_4(\text{l}) \quad \Delta H = -235.5 \text{ kJ}$
 $\text{H}_2\text{S}(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \quad \Delta H = -207 \text{ kJ}$
 $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g}) \quad \Delta H = 44 \text{ kJ}$
- 5 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = 204.0 kJ
 $2\text{C}_2\text{H}_4\text{O}(\text{l}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{C}_2\text{H}_6\text{O}(\text{l}) + \text{O}_2(\text{g})$
 $\text{C}_2\text{H}_6\text{O}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l}) \quad \Delta H = -685.5 \text{ kJ}$
 $\text{C}_2\text{H}_4\text{O}(\text{l}) + 5/2\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \quad \Delta H = -583.5 \text{ kJ}$
- 6 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = -83 kJ
 $\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) \quad \Delta H = -115 \text{ kJ}$
 $2\text{NH}_3(\text{g}) + 4\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NO}_2(\text{g}) + 7\text{H}_2(\text{g}) \quad \Delta H = -142.5 \text{ kJ}$
 $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \quad \Delta H = -43.7 \text{ kJ}$
- 7 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = 886 kJ
 $\text{CO}_2(\text{g}) \rightarrow \text{C}(\text{s}) + \text{O}_2(\text{g})$
 $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \quad \Delta H = 643 \text{ kJ}$
 $\text{C}_2\text{H}_6(\text{g}) \rightarrow 2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) \quad \Delta H = 190.6 \text{ kJ}$
 $2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_2\text{H}_6(\text{g}) + 7/2\text{O}_2(\text{g}) \quad \Delta H = 3511.1 \text{ kJ}$
- 8 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = -46.2 kJ
 $\text{N}_2\text{H}_4(\text{l}) + \text{CH}_4\text{O}(\text{l}) \rightarrow \text{CH}_2\text{O}(\text{g}) + \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$
 $2\text{NH}_3(\text{g}) \rightarrow \text{N}_2\text{H}_4(\text{l}) + \text{H}_2(\text{g}) \quad \Delta H = 22.5 \text{ kJ}$
 $2\text{NH}_3(\text{g}) \rightarrow \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \quad \Delta H = 57.5 \text{ kJ}$
 $\text{CH}_2\text{O}(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{CH}_4\text{O}(\text{l}) \quad \Delta H = 81.2 \text{ kJ}$
- 9 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = -230 kJ
 $1/2\text{H}_2(\text{g}) + 1/2\text{Cl}_2(\text{g}) \rightarrow \text{HCl}(\text{g})$
 $\text{COCl}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_2\text{Cl}_2(\text{l}) + \text{O}_2(\text{g}) \quad \Delta H = 47.5 \text{ kJ}$
 $2\text{HCl}(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Cl}_2(\text{g}) \quad \Delta H = 105 \text{ kJ}$
 $\text{CH}_2\text{Cl}_2(\text{l}) + \text{H}_2(\text{g}) + 3/2\text{O}_2(\text{g}) \rightarrow \text{COCl}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \quad \Delta H = -402.5 \text{ kJ}$
- 10 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: answer = -705 kJ
 $\text{C}_2\text{H}_2(\text{g}) + 5/2\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
 $\text{C}_2\text{H}_6(\text{g}) \rightarrow \text{C}_2\text{H}_2(\text{g}) + 2\text{H}_2(\text{g}) \quad \Delta H = 283.5 \text{ kJ}$
 $\text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g}) \quad \Delta H = -213.7 \text{ kJ}$
 $2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g}) + 7/2\text{O}_2(\text{g}) \quad \Delta H = 849 \text{ kJ}$
- 11 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: Answer = -78 kJ
 $\text{HCl}(\text{g}) + \text{NaNO}_2(\text{s}) \rightarrow \text{HNO}_2(\text{l}) + \text{NaCl}(\text{s})$
 $2\text{NaCl}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HCl}(\text{g}) + \text{Na}_2\text{O}(\text{s}) \quad \Delta H = 507 \text{ kJ}$
 $\text{NO}(\text{g}) + \text{NO}_2(\text{g}) + \text{Na}_2\text{O}(\text{s}) \rightarrow 2\text{NaNO}_2(\text{s}) \quad \Delta H = -427 \text{ kJ}$
 $\text{NO}(\text{g}) + \text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}(\text{g}) + \text{O}_2(\text{g}) \quad \Delta H = -43 \text{ kJ}$
 $2\text{HNO}_2(\text{l}) \rightarrow \text{N}_2\text{O}(\text{g}) + \text{O}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \quad \Delta H = 34 \text{ kJ}$
- 12 Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values: Answer = -976.03 kJ
 $\text{Zn}(\text{s}) + 1/8\text{S}_8(\text{s}) + 2\text{O}_2(\text{g}) \rightarrow \text{ZnSO}_4(\text{s})$
 $\text{Zn}(\text{s}) + 1/8\text{S}_8(\text{s}) \rightarrow \text{ZnS}(\text{s}) \quad \Delta H = -183.92 \text{ kJ}$
 $2\text{ZnS}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{ZnO}(\text{s}) + 2\text{SO}_2(\text{g}) \quad \Delta H = -927.54 \text{ kJ}$
 $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g}) \quad \Delta H = -196.04 \text{ kJ}$
 $\text{ZnO}(\text{s}) + \text{SO}_3(\text{g}) \rightarrow \text{ZnSO}_4(\text{s}) \quad \Delta H = -230.32 \text{ kJ}$