

1. How does the entropy of the following system change in the following cases (increases or decreases and also write the ΔS with the appropriate sign)

- a) Solid lead melts *increase* $+\Delta S$
- b) A vapor converts to solid *decrease* $-\Delta S$
- c) A liquid boils *increase* $+\Delta S$
- d) A solid is dissolved in water *increase* $+\Delta S$
- e) Water freezes to form ice *decrease* $-\Delta S$
- f) Sugar crystallizes from a supersaturated solution *decrease* $-\Delta S$

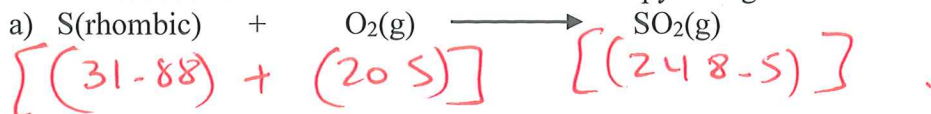
2. Predict whether the entropy change is positive or negative in the following reactions.

- a) $2\text{KClO}_4(\text{s}) \longrightarrow 2\text{KClO}_3(\text{s}) + \text{O}_2(\text{g})$ $+\Delta S$
- b) $\text{H}_2\text{O}(\text{g}) \longrightarrow \text{H}_2\text{O}(\text{l})$ $-\Delta S$
- c) $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \longrightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$ $+\Delta S$
- d) $\text{PCl}_3(\text{l}) + \text{Cl}_2(\text{g}) \longrightarrow \text{PCl}_5(\text{s})$ $-\Delta S$
- e) $\text{H}_2(\text{g}) \longrightarrow 2\text{H}(\text{g})$ $+\Delta S$
- f) $\text{U}(\text{s}) + 3\text{F}_2(\text{g}) \longrightarrow \text{UF}_6(\text{s})$ $-\Delta S$

3. Which of the following has a larger standard entropy.

- a) $\text{Li}(\text{s})$ or $\text{Li}(\text{l})$
- b) $\text{C}_2\text{H}_5\text{OH}(\text{l})$ or $\text{CH}_3\text{OCH}_3(\text{l})$
- c) $\text{O}_2(\text{g})$ or $\text{O}_3(\text{g})$
- d) $\text{NO}_2(\text{g})$ or $\text{N}_2\text{O}_4(\text{g})$

4. Use the data tables to calculate the standard entropy changes of the following reactions

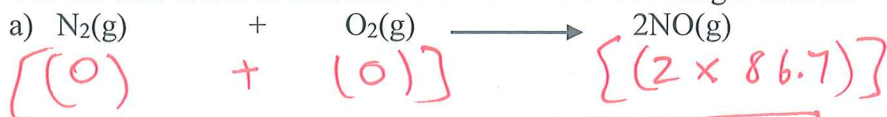


prod - react = $\boxed{11.6 \text{ J/kmol}}$



prod. - react = $\boxed{174.7 \text{ J/kmol}}$

5. Use the data tables to calculate the ΔG for the following reactions.



prod - react = $\boxed{173.4 \text{ kJ/mol}}$



prod - react = $\boxed{-2470 \text{ kJ/mol}}$

6. From the ΔH and ΔS , predict which of the following reactions would be spontaneous at 25°C.

a) Reaction A: $\Delta H = 10.5 \text{ KJ/mol}$; $\Delta S = 30 \text{ J/K}$

$\Delta G = \Delta H - T\Delta S$
 $= 10,500 \text{ J/mol} - (298 \text{ K} \times 30 \text{ J/kmol}) = \boxed{1560 \text{ J/mol}} \quad \text{NON-SPONT.}$

b) Reaction B: $\Delta H = 1.8 \text{ KJ/mol}$; $\Delta S = -113 \text{ J/K}$

$\Delta G = \Delta H - T\Delta S$
 $= \boxed{1800 \text{ J/mol}}$

7. Find the temperature at which both the following reactions will be spontaneous.

a) Reaction A: $\Delta H = -126 \text{ KJ/mol}$; $\Delta S = 84 \text{ J/K}$

$\Delta G = \Delta H - T\Delta S$
 $= -126 \times 10^3 \text{ J/mol} - (298 \text{ K} \times 84 \text{ J/K}) = \boxed{-151,000 \text{ J/mol}} \quad \text{SPONT. AT ALL TEMP.}$

b) Reaction B: $\Delta H = -11.7 \text{ KJ/mol}$; $\Delta S = -105 \text{ J/K}$

$\Delta G = -11.7 \times 10^3 - (298 \times (-105)) = +19,600 \text{ J}$
 ΔG is -ve because ΔS is -ve \therefore at lower temp. ΔG should be +ve

When $\Delta G = 0$ $\Delta H = T\Delta S$ $T = \frac{\Delta H}{\Delta S} = \frac{-11700}{-105} = \boxed{111 \text{ K}} \rightarrow \text{max. temp when } \Delta G \text{ is spont.}$