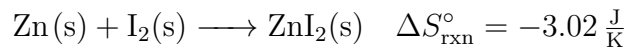


1. Consider the following reaction:



- (a) When solid zinc and solid iodine are mixed at room temperature, $\text{I}_2(\text{g})$ is observed. What can you infer about the sign of ΔH_f° of $\text{ZnI}_2(\text{s})$?

- (b) This reaction is spontaneous under what conditions?

All temps High temps Low temps No temps

2. Find the temperature at which $\text{NH}_3(\text{l})$ and $\text{NH}_3(\text{g})$ are equally favored.

Quantity	Value
$\Delta H_{\text{condensation of NH}_3}^{\circ}$	$-23.35 \frac{\text{kJ}}{\text{mol}}$
S_m° of $\text{NH}_3(\text{l})$	$95.36 \frac{\text{J}}{\text{mol}\cdot\text{K}}$
S_m° of $\text{NH}_3(\text{g})$	$192.77 \frac{\text{J}}{\text{mol}\cdot\text{K}}$

3. Consider the following reaction:



- (a) Rank the three reactants and products in order of increasing standard molar entropy.

- (b) This reaction is spontaneous under what conditions?

All temps High temps Low temps No temps

- (c) On the diagram, sketch relative energy levels for the reactants and products, clearly illustrating the ΔH and ΔS for the reaction.

4. If a reaction is exothermic and non-spontaneous at a given temperature, then it

- can never be spontaneous
- may be spontaneous at a higher temperature
- may be spontaneous at a lower temperature
- none of the above

5. Use the following data tables to answer the questions

Molecule	S_m° ($\frac{\text{J}}{\text{mol}\cdot\text{K}}$)	ΔH_f° ($\frac{\text{kJ}}{\text{mol}}$)		
N ₂ (g)	191.6	–	Bond	Bond Enthalpy
H ₂ (g)	130.7	–	N–N	945 $\frac{\text{kJ}}{\text{mol}}$
NH ₃ (g)	192.5	–	N–H	435 $\frac{\text{kJ}}{\text{mol}}$
H(g)	–	218.0		
N(g)	–	472.7		

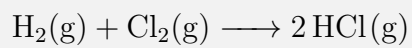
(a) Determine the bond enthalpy of H–H bond.

(b) Calculate ΔG_f° of NH₃(g), and determine the conditions where it is thermodynamically favored (Low T , High T , All T , or no T).

(c) Is ammonia a thermodynamically stable compound?

Homework Problem 19

1. Given the entropy change of the reaction is $\Delta S^\circ = -99 \frac{\text{J}}{\text{K}}$, determine the temperature range where this reaction is spontaneous.



Bond	Bond Enthalpy
H-H	$436 \frac{\text{kJ}}{\text{mol}}$
Cl-Cl	$243 \frac{\text{kJ}}{\text{mol}}$
H-Cl	$431 \frac{\text{kJ}}{\text{mol}}$