1. Predict the sign of ΔS_{sys} for each reaction:

   (a) $Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$

   (b) $2\,H_2S(g) + 3\,O_2(g) \longrightarrow 2\,H_2O(g) + 2\,SO_2(g)$

   (c) $N_2(g) + 3\,H_2(g) \longrightarrow 2\,NH_3(g)$

   (d) $2\,KClO_3(s) \longrightarrow 2\,KCl(s) + 3\,O_2(g)$

2. Predict the sign of ΔH_{sys} and ΔS_{sys} for each process.

   (a) Evaporation

   (b) Condensation

   (c) Melting

   (d) Freezing (fusion)

   (e) Sublimation (solid to gas)

3. Calculate ΔG_{rxn} at the indicated temperature for each reaction and determine if the reaction is spontaneous under those conditions.

   (a) $\Delta H_{rxn} = -385\ kJ/mol;\ \Delta S_{rxn} = +25\ J/(Kmol);\ 298\ K$

   (b) $\Delta H_{rxn} = +114\ kJ/mol;\ \Delta S_{rxn} = +21\ J/(Kmol);\ 225\ K$

Useful information:

$R = 8.314\ J/(mol \cdot K)$

Compound	$\Delta H_f^\circ\ (kJ/mol)$	$\Delta G_f^\circ\ (kJ/mol)$	$\Delta S_f^\circ\ (J/mol \cdot K)$
NO_2(g)	33.2	51.3	240.1
$H_2O(\ell)$	-285.8	-237.1	70
HNO_3(aq)	-207	-110.9	146
NO (g)	91.3	87.6	210.8

4. Calculate ΔH_{rxn}°, ΔS_{rxn}°, and ΔG_{rxn}° for the following reaction at 25°C.

$3\,NO_2(g) + H_2O(\ell) \longrightarrow 2\,HNO_3(aq) + NO(g)$