Department of Chemistry
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Free Energy – Supplemental Worksheet

1. Calculate $\Delta S_{universe}$ after the completion of the following reaction:

$2NiS(s) + 3O_2(g) \rightarrow 2SO_2(g) + 2NiO(s)$ at 25 °C $\Delta H = -890$ kJ

Substance	S (J/Kmole)
SO_2	248
NiO	38
O_2	205
NiS	53

2. Determine the ΔG when:

$\Delta S_{universe} = 1303$ J/K
$\Delta S_{surr} = 1.300$ kJ/K
T = 25 °C

3. Determine the minimum temperature for a reaction with ΔH = 271 kJ and ΔS = 195 J/K to be spontaneous.

4. Consider the reaction: $CO(g) + Cl_2(g) \rightarrow COCl_2(g)$ Calculate ΔG_{rxn} at 25 °C.

Substance	ΔH_f (kJ/mol)	S (J/ mol K)
CO	-110.5	197.6
Cl_2	0.0	223.0
$COCl_2$	-223.0	289.2

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5. Determine ΔG_f for $SO_2(g)$. Assume 25 °C for all reactions.

$\Delta H_{f,SO2}$ (g) = -297 kJ/mol $S_{m,SO2}$ (g) = 248 J/(K mol)

Then determine ΔG_{rxn} of the following reaction: ΔG_f Cu_2S (s) = -86.2 kJ/mol

$Cu_2S(s) + O_2(g) \rightarrow SO_2(g) + 2Cu(s)$

6. Calculate ΔG° for the reactions below using the provided data. Assume 298 K is standard temperature for your calculations.

	$\Delta H°_f$ ($kJ \cdot mol^{-1}$)	$\Delta S°_m$ ($J \cdot mol^{-1} \cdot K^{-1}$)
$Ag^+(aq)$	105.6	72.68
AgCl(s)	-127.1	96.2
$C_{graphite}(s)$		5.740
CH3OH(l)	-238.7	126.8
$Cl^-(aq)$	-167.2	56.5
$H_2(g)$		130.6
$O_2(g)$		205.0

a. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

b. $C_{graphite}(s) + 1/2\ O_2(g) + 2\ H_2(g) \rightarrow CH3OH(l)$

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