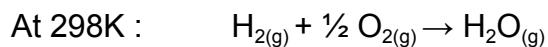


Chemistry 3**Set of exercises-1****General informations: Gibbs free energy and chemical equilibrium****Exercise 1**

Based on the values of absolute entropy given in the table below, calculate the entropy of the reaction at 298K. Comment.

State	Body	S°_{298} (cal/K.mol)
Solid	Ag	10.2
Solid	C	1.37
Liquid	H_2O	16.73
Liquid	Hg	18.17
Gas	He	30.13
Gas	H_2O	45.1
Gas	H_2	31.21
Gas	O_2	49
Gas	CO_2	51.5

Exercise 2

Consider the decomposition of yellow mercury(II) oxide.



- Calculate the standard free energy change at room temperature, ΔG°_{298} using (a) standard free energies of formation and

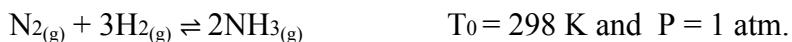
(b) standard enthalpies of formation and standard entropies.

- Do the results indicate the reaction to be spontaneous or nonspontaneous under standard conditions?

Compound	ΔG°_f (kJ/mol)	ΔH°_f (kJ/mol)	S°_{298} (J/K·mol)
$HgO_{(s)}$	-58.43	-90.46	71.13
$Hg_{(l)}$	0	0	75.9
$O_{2(g)}$	0	0	205.2

Exercise 3

Consider the following equilibrium :



$T_0 = 298$ K and $P = 1$ atm.

Is the reaction spontaneous at $T_0 = 298$ K and at $T_1 = 500$ K ? Conclude.

Compound	$N_{2(g)}$	$H_{2(g)}$	$NH_{3(g)}$
ΔH_f° (kJ/mol)	0	0	-46

S_f° (JK ⁻¹ mol ⁻¹)	191.61	130.68	192.45
C_p (JK ⁻¹ mol ⁻¹)	29.13	28.82	35.06

Exercise 4 (home work to be returned next week)

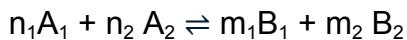
The formation and the decomposition of water molecule is governed by the following data.

Compound	H ₂ O	H ₂	O ₂
Enthalpy	-285.83 kJ/mol	0	0
Entropy	69.91 J/K mol	130.68 J/K mol	205.14 J/K mol

1. Say if the formation and the decomposition reactions are exergonic or endergonic.
2. Discuss the spontaneity in case of electrolysis and fuel cell applications.

Exercise 5

Consider the following reaction for an ideal gas:



1. Give the expressions of the following equilibrium constants K_p , K_c , and K_x .
2. Deduce the relationship between these constants.

Exercise 6

Find out the value of equilibrium constant for the following reaction at 298 K.



Standard energy change, ΔG° at the given temperature is -13.6 kJ/mol.