

Name: _____

Period: _____

Seat#: _____

Directions: Show all work in a way that would earn you credit on the AP Test! This is always the rule! Some answers are provided at the end in italics and underlined. If you need more space, use binder paper and staple to your worksheet.

- 1) Calculate the following things based on the decomposition of H_2O_2 (hydrogen peroxide) at 298 K and 1 atm pressure
 $2 \text{H}_2\text{O}_2(\text{liq}) \rightarrow 2 \text{H}_2\text{O}(\text{liq}) + \text{O}_2(\text{gas})$

a) standard enthalpy of reaction

-196.4 kJ

b) standard entropy of reaction.

125 J/K

c) standard (Gibbs) free energy of reaction

-233.6 kJ

d) the value of the (thermodynamic) equilibrium constant at 298 K, 1 atm

9.18×10^{40}

- 2) Using standard enthalpies of formation given in kJ/mol, please calculate the standard enthalpy of reaction for:
 $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$

175.9 kJ

- 3) CO in the atmosphere slowly converts to CO_2 at normal atmospheric temperatures $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g})$
The standard enthalpy of rxn is -284 kJ and the standard entropy of rxn is -87 J/K. Estimate the temperature at which equilibrium begins to favor the decomposition of CO_2 . Assume enthalpy and entropy of rxn are not affected by temp.

$T > 3264 \text{ K}$

- 4) Please calculate the standard entropy of reaction for: $2 \text{NH}_3(\text{g}) \rightarrow \text{N}_2\text{H}_4(\text{liq}) + \text{H}_2(\text{g})$
192.5 121.2 130.6

-133.2 J/K

- 5) Please calculate the standard (Gibbs) free energy of reaction for: $2 \text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{NO}_2(\text{g})$

-69.7 kJ

6) Calculate the entropy of vaporization of propane. Enthalpy of vaporization is 16.9 kJ/mol at its boiling point of -42.1°C .

73.1 J/K

7) Calculate the equilibrium constant (at 298K) for the following reaction: $\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{liq}) \leftrightarrow \text{H}_2\text{CO}_3(\text{aq})$

4.0×10^{-2} (using ΔG_f° data); 3.1×10^{-2} (using ΔH_f° and S° data)

8) Please indicate if TRUE or FALSE (Explain why as well):

	The entropy of a gas increases with increasing temperature
	Spontaneous processes always increase the entropy of the reacting system
	All spontaneous processes release heat to the surroundings
	An endothermic reaction is more likely to be spontaneous at high temperatures than at low temperatures
	The entropy of sugar decreases as it precipitates from an aqueous solution

9) Ammonia gas a standard (Gibbs) free energy of formation equal to -16.367 kJ/mol

a) Find ΔG° for the reaction: $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \leftrightarrow 2 \text{NH}_3(\text{g})$

-32.734 kJ

b) In which direction will this reaction proceed if a mixture of gases is made with:

$$P_{\text{NH}_3} = 1.00 \text{ atm} \quad P_{\text{H}_2} = 0.50 \text{ atm} \quad P_{\text{N}_2} = 0.50 \text{ atm}$$

c) What pressure of hydrogen gas should be added to a mixture already containing 0.20 atm NH_3 and 0.50 atm N_2 if one does not want the amounts of NH_3 and N_2 to change?

$5.3 \times 10^{-3} \text{ atm}$