

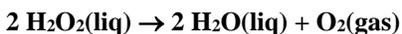
Name: \_\_\_\_\_

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) Consider the decomposition of  $\text{H}_2\text{O}_2$  (hydrogen peroxide) at 298 K and 1 atm pressure according to:



Please find the

a) standard enthalpy of reaction

b) standard entropy of reaction.

- 2) For the reaction in the previous question, please find the

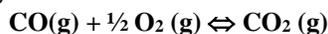
a) standard (Gibbs) free energy of reaction

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

- 3) Using standard enthalpies of formation given in kJ/mol, please calculate the standard enthalpy of reaction for:



- 4) Carbon monoxide in the atmosphere slowly converts to carbon dioxide at normal atmospheric temperatures



The standard enthalpy of reaction is -284 kJ and the standard entropy of reaction is -87 J/K. Estimate the temperature at which the equilibrium begins to favor the decomposition of  $\text{CO}_2$ . Assume that the enthalpy and the entropy of reaction are not affected by temperature

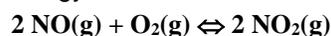
**Dougherty Valley HS Chemistry - AP**  
**Thermodynamics – Practice  $\Delta H^\circ$ ,  $\Delta S^\circ$ ,  $\Delta G^\circ$**

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- 5) Using standard entropies given in J/K, please calculate the standard entropy of reaction for:



- 6) Please calculate the standard (Gibbs) free energy of reaction for:



- 7) Calculate the entropy of vaporization of propane given that its enthalpy of vaporization is 16.9 kJ/mol at its normal boiling point of  $-42.1^\circ\text{C}$ .

- 8) Obtain the numerical value of the equilibrium constant (at 298K) for the following reaction:



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

	The entropy of a gas increases with increasing temperature
	The energy of a perfect crystal is zero at 0 K.
	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

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

**a)** Find  $\Delta G^\circ$  for the reaction:  $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightleftharpoons 2 \text{NH}_3(\text{g})$

**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  $\text{NH}_3$  and 0.50 atm  $\text{N}_2$  if one does not want the amounts of  $\text{NH}_3$  and  $\text{N}_2$  to change?

ANSWERS:

- |                       |   |
|-----------------------|---|
| 1. -196.4 kJ; 125 J/K | 2. -233.6 kJ; $9.18 \times 10^{40}$   |
| 3. 175.9 kJ           | 4. $T > 3264 \text{ K}$   |
| 5. -133.2 J/K         | 6. -69.7 kJ   |
| 7. 73.1 J/K           | 8. $4.0 \times 10^{-2}$ (using $\Delta G_f^\circ$ data); $3.1 \times 10^{-2}$ (using $\Delta H_f^\circ$ and $S^\circ$ data) |
| 9. T F F F T T        | 10. -32.734 kJ; proceed to the right; $5.3 \times 10^{-3} \text{ atm}$  |