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.

$$\Delta G^{\circ} = \Sigma \Delta G_f^{\circ} \ products - \Sigma \Delta G_f^{\circ} \ reactants$$

	1)	Calculate G° in kJ for the following	a reactions, using t	thermodynamic data from a	an appendix or	vour reference sheet
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a) $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(l)$

-81.99

b) $2 \text{ NH}_4\text{Cl}(s) + \text{CaO}(s) \rightarrow \text{CaCl}_2(s) + \text{H}_2\text{O}(l) + 2 \text{ NH}_3(g)$

<u>-10.68</u>

c) $CaSO_4(s) + 2 HCl(g) \rightarrow CaCl_2(s) + H_2SO_4(l)$

72 2

d) $C_2H_4(g) + H_2O(l) \rightarrow C_2H_5OH(l)$

-5 42

e) $Ca(s) + 2 H_2SO_4(l) \rightarrow CaSO_4(s) + SO_2(g) + 2 H_2O(l)$

-715.9

2) When solid KI is dissolved in water, a cooling of the mixture occurs because the solution process is endothermic. Explain, in terms of what happens to the molecules and ions, why this mixing occurs spontaneously?

3) Predict the algebraic sign of the entropy change for the following reactions?

a) $PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$	b) $SO_2(g) + CaO(s) \rightarrow CaSO_3(s)$
c) $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$	d) $\operatorname{Ni}(s) + 2 \operatorname{HCl}(aq) \rightarrow \operatorname{H}_2(g) + \operatorname{NiCl}(aq)$
$\mathbf{e)} I_2(s) \to I_2(g)$	f) $\operatorname{Cl}_2(g) + \operatorname{Br}_2(g) \to 2 \operatorname{BrCl}(g)$
g) $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$	h) $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$

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4)	Show that ΔS for	the melting	of ice is	positive
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Conceptually	Quantitatively

5) Calculate the entropy change in J/mol·K for each of the following reactions. $\Delta S^{\circ} = \Sigma \Delta S^{\circ} products - \Sigma \Delta S^{\circ} reactants$

a) $CaO(s) + 2 HCl(g) \rightarrow CaCl_2(s) + H_2O(l)$

b) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$

-120.78 -228.34

6) Predict the probability of the following reactions by calculating the sign of ΔG . Then classify each reaction as exothermic or endothermic, and if there is increase or decrease to entropy. Then, if spontaneous, identify if it is

entropy driven, enthalpy driven, both, or neither.

ΔG Calculation	Endo or Exo?	Spont. or Non-spont.
a) $H_2O(l) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$		
$\Delta H = +285 \text{ kJ}$		
$T\Delta S = +245 \text{ kJ}$		
120 1210 10	Increase or Decrease Entropy?	What drives the Rxn (if spont)
b) $C_6H_{14}(g) \rightarrow 6 C(s) + 7 H_2(g)$	Endo or Exo?	Spont. or Non-spont.
$\Delta H = +167 \text{ kJ}$		
$T\Delta S = +168 \text{ kJ}$		
125 100 K		
	Increase or Decrease Entropy?	What drives the Rxn (if spont)
c) $2 \text{ Fe(s)} + \frac{1}{2} N_2(g) \rightarrow \text{Fe}_2 N(s)$	Endo or Exo?	Spont. or Non-spont.
$\Delta H = -3.8 \text{ kJ}$		
$T\Delta S = -14.6 \text{ kJ}$		
	Increase or Decrease Entropy?	What drives the Rxn (if spont)
d) $HCl(g) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$	Endo or Exo?	Spont. or Non-spont.
$\Delta H = -75.3 \text{ kJ}$		
$T\Delta S = -39.3 \text{ kJ}$		
	Increase or Decrease Entropy?	What drives the Rxn (if spont)
		1

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<u>7)</u>	Calculate ΔG° in kJ/mole for the following reactions, using the appropriate data tables from your textbook appearance ΔG°	ndix.
a)	$2 \text{ NH}_4\text{Cl}(s) + \text{CaO}(s) \rightarrow \text{CaCl}_2(s) + \text{H}_2\text{O}(l) + 2 \text{ NH}_3(g)$	
		10.68
b)	$CaSO_4(s) + 2 HCl(g) \rightarrow CaCl(s) + H_2SO_4(l)$	
		<u>72.2</u>
<u> </u>		
8)	Use the following reaction at 298.2 K $2 \text{ NO}_2(g) \rightarrow \text{N}_2\text{O}_4(g)$	
a)	The values of ΔH° and ΔS° are -58.03 kJ mol ⁻¹ and -176.61 J K ⁻¹ mol ⁻¹ respectively. What is the value of ΔG° at 298.2 K?	
		<u>5.40</u>
b	At what temperature is $\Delta G^{\circ} = 0$?	
		<u>328.6</u>
c)	Is ΔG negative above, or below, this temperature?	320.0
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