Worksheet #1

Name: **Period:**   **Seat#:**

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1) For each system below, indicate whether ΔS and ΔH is a positive or negative value. Then indicate if the reaction is entropy driven, enthalpy driven, both or neither. Qualitative, you do not need to do calculations for this part.
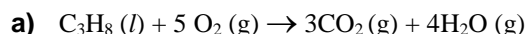
a) $NaCl_{(s)} + H_2O_{(l)} + heat \rightarrow NaCl_{(aq)}$	**b)** $O_{2(g)} + H_2O_{(l)} \rightarrow O_{2(aq)} + heat$	**c)** $CO_{2(s)} + heat \rightarrow CO_{2(g)}$
ΔS =	ΔS =	ΔS =
ΔH =	ΔH =	ΔH =
Driven?	Driven?	Driven?

2) Quantitative, do calculations for this part. Calculate the ΔH°rxn, ΔS°rxn, ΔG°rxn, Then, indicate whether ΔH°, ΔS°, ΔG° are positive or negative values. Then indicate if the reaction is spontaneous or not. Then indicate if the reaction is entropy driven, enthalpy driven, both, or neither. Then calculate ΔSuniverse to further show if the reaction is spontaneous or not, remember the entropy of the universe should be increasing for spontaneous reactions!
   Hint must solve for temperature first before you can find ΔSuniv!

Substance	**ΔH°formation (kJ/mole)**	**ΔS°formation (J/mole°K)**	**ΔG°formation (kJ/mole)**
C_3H_8 (*l*)	-103.8	269.9	-23.5
O_2 (g)	0	205.1	0
CO_2 (g)	-393.5	213.7	-394.4
H_2O (g)	-241.8	188.8	-228.6
TiO_2 (s)	-939.7	49.9	-884.5
$TiCl_4$ (*l*)	-804.2	252.3	-737.2
C (s)	0	5.7	0
Cl_2 (g)	0	223.1	0

$\Delta H° = \Sigma \Delta H_f° \ prod. - \Sigma \Delta H_f° \ react.$	$\Delta S° = \Sigma \Delta S° \ prod. - \Sigma \Delta S° \ react.$	$\Delta G° = \Delta H° - T\Delta S°$	$\Delta S_{universe} = \dfrac{-\Delta H}{T}$

a) C_3H_8 (*l*) + 5 O_2 (g) $\rightarrow$ 3CO_2 (g) + 4H_2O (g)
After calculations circle/highlight:
ΔH°   +   or -
ΔS°   +   or -
ΔG°   +   or -
Spontaneous /
"thermodynamically favorable":
        Yes   No
Driven:
        Enthalpy   Entropy
        Both   Neither
ΔS_univ   +   or -

6840 J/molK

b) TiO_2 (s) + C (s) + 2Cl_2 (g) $\rightarrow$ $TiCl_4$ (*l*) + CO_2 (g)
After calculations circle/highlight:
ΔH°   +   or -
ΔS°   +   or -
ΔG°   +   or -
Spontaneous /
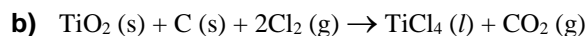*"thermodynamically favorable":*
        Yes   No
Driven:
        Enthalpy   Entropy
        Both   Neither
ΔS_univ   +   or

847 J/molK