CHM 1046 - JOENS WORKSHEET #3 Due date: Monday, September 10th
WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME _____ Panther ID _____

For problems involving calculations you must show your work for credit.

1) HCFC-123 is a partially halogenated hydrocarbon that is currently used in refrigeration and air conditioning systems. It has the chemical formula $CHCl_2CF_3$, and is a gas at room temperature.

Give the formation reaction for $CHCl_2CF_3(g)$.

$2\ C(s) + ½\ H_2(g) + Cl_2(g) + {}^3/_2\ F_2(g) \rightarrow CHCl_2CF_3(g)$

Formation is production of one mole of a single product from elements in their most stable state.

2) For each of the following processes, indicate whether the process is or is not spontaneous. If there is not sufficient information to tell whether the process is or is not spontaneous, say "cannot tell".

ΔS_{syst}	ΔS_{surr}	Process is spontaneous? (yes / no / cannot tell)
positive	positive	yes
negative	positive	cannot tell
negative	negative	no
positive	zero	yes

Recall $\Delta S_{univ} = \Delta S_{syst} + \Delta S_{surr}$. For the first and fourth process, ΔS_{univ} has to be positive, and so those processes must be spontaneous. For the third process ΔS_{univ} has to be negative, and so that process is not spontaneous. For the second process ΔS_{univ} could be positive, negative or zero, and so no prediction can be made.

3) Which of the following is a state function?

a) heat (q)
b) enthalpy (H)
c) entropy (S)
d) both b and c
e) both a and b and c

____D_____

Enthalpy (H) and entropy (S) are state functions; heat (q) is not.

4) Using the data given below, find $\Delta H°_{rxn}$ and $\Delta S°_{rxn}$ for the following reaction (which is the combustion reaction for ethanol), taking place at T = 298. K. Data are also given at T = 298. K.

$CH_3CH_2OH(\ell) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(\ell)$

substance	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)	$S°$ (J/mol•K)
$CH_3CH_2OH(\ell)$	- 276.98	- 174.18	161.0
$CO_2(g)$	- 393.5	- 394.4	213.6
$H_2O(\ell)$	- 285.8	- 237.2	69.9
$O_2(g)$	0.0	0.0	205.0

$\Delta H°_{rxn} = [\ 2\ \Delta H°_f(CO_2(g)) + 3\ \Delta H°_f(H_2O(\ell))\ ] - [\ \Delta H°_f(CH_3CH_2OH(\ell)) + 3\ \Delta H°_f(O_2(g))\ ]$

$= [\ 2(-393.5) + 3\ (-285.8)\ ] - [\ (-276.98) = 3\ (0.0)\ ] = -1367.4$ kJ/mol

$\Delta S°_{rxn} = [\ 2\ S°(CO_2(g)) + 3\ S°(H_2O(\ell))\ ] - [\ S°(CH_3CH_2OH(\ell)) + 3\ S°(O_2(g))\ ]$

$= [\ 2(213.6) + 3\ (69.9)\ ] - [\ (161.0) + 3\ (205.0)\ ] = -139.1$ J/mol•K

Note that $\Delta H°_{rxn}$ and $\Delta S°_{rxn}$ have different units. Also note that we would expect $\Delta H°_{rxn} < 0$, because combustion reactions are exothermic (release heat). We would also expect $\Delta S°_{rxn} < 0$, because for this reaction Δn_g is negative ($\Delta n_g = -1$). This is one way to check on whether your answers are reasonable or not (though it will not catch all errors you might make).