

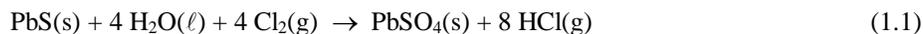
* While I prefer you turn in a hard copy of the worksheet, I will accept scanned copies sent to my email address, joensj@fiu.edu

Section: (circle one) M,W,F Tu,Tr

Exam 1 is Friday, September 23 (for the M,W,F class) and Thursday, September 22 (for the T,R class) in class. It will cover material from Chapters 13 and 14 of Burdge.

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

1) Consider the following chemical reaction.



Thermochemical data relevant to the reaction are given below (for $T = 298. \text{ K}$).

Substance	$\Delta H^\circ_f(\text{kJ/mole})$	$\Delta G^\circ_f(\text{kJ/mole})$	$S^\circ(\text{J/mole}\cdot\text{K})$
$\text{Cl}_2(g)$	0.0	0.0	223.0
$\text{HCl}(g)$	- 92.3	- 95.3	187.0
$\text{H}_2\text{O}(\ell)$	- 285.8	- 237.2	69.9
$\text{PbS}(s)$	- 94.3	- 92.7	91.2
$\text{PbSO}_4(s)$	- 918.4	- 811.2	147.3

a) Using the values for ΔG°_f in the above table, find $\Delta G^\circ_{\text{rxn}}$ for reaction 1.1 at $T = 298. \text{ K}$?

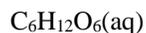
b) As found in Worksheet 3, the change in enthalpy and entropy for reaction 1.1 at $T = 298. \text{ K}$ are $\Delta H^\circ_{\text{rxn}} = - 419.3 \text{ kJ/mol}$ and $\Delta S^\circ_{\text{rxn}} = 380.5 \text{ J/mol}\cdot\text{K}$. Using those results and eq 1.2

$$\Delta G^\circ_{\text{rxn}} = \Delta H^\circ_{\text{rxn}} - T \Delta S^\circ_{\text{rxn}} \quad (1.2)$$

find $\Delta G^\circ_{\text{rxn}}$. Show that you get the same value for $\Delta G^\circ_{\text{rxn}}$ using eq 1.2 as found in part a of the problem.

c) Based on your answer in part a, is reaction 1.1 spontaneous for standard conditions? Justify your answer.

2) For each of the following pairs of substances indicate the one with the larger value for S° (absolute entropy).



3) State the Third Law of thermodynamics.

4) For a particular chemical reaction $\Delta H^\circ_{\text{rxn}} > 0$ and $\Delta S^\circ_{\text{rxn}} > 0$. Based on this, which of the following statements concerning the reaction (for standard conditions) is correct?

- a) The reaction is always spontaneous
- b) The reaction is never spontaneous
- c) The reaction is spontaneous at low temperatures, but not at high temperatures
- d) The reaction is spontaneous at high temperatures, but not at low temperatures
- e) Cannot tell from the information given

5) Using the data given below, estimate the value for T_b° , the normal boiling point, for $\text{GeCl}_4(\ell)$

Substance	ΔH°_f (kJ/mole)	ΔG°_f (kJ/mole)	S° (J/mole·K)
$\text{GeCl}_4(\ell)$	- 531.8	- 462.7	245.6
$\text{GeCl}_4(\text{g})$	- 495.8	- 457.3	347.7