

b. Calculate the solubility in mol/L and g/L for iron(II) hydroxide (MM = 89 g/mol).

c. Will iron(III) hydroxide precipitate if the pH of 0.0050 M $\text{Fe}(\text{NO}_3)_3$ solution is 5.0?

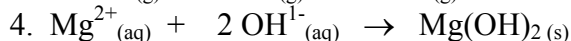
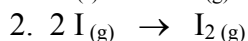
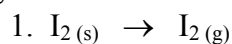
3. (6 points) Show by equations and words how the solubility of

a. AgCl changes in NH_3

b. MgCO_3 changes in HCl

4. (6 points)

_____ 1. Which response includes all the following processes that are accompanied by an increase in entropy?



a. 1, 2

b. 1, 3

c. 3, 4

d. 3

e. 2, 4

_____ 2. When 1 mole of gray tin changes to white tin at 13°C , the change in entropy is $+7.5 \text{ J/K}$. This means that

a. white tin is more ordered than gray tin

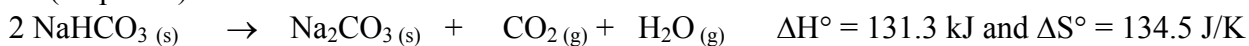
b. gray tin has a higher molar entropy than white tin

c. white tin has a higher molar entropy than gray tin

d. the change from gray to white tin is predicted to be nonspontaneous on the basis of the entropy change

e. the change from gray to white tin will occur very slowly

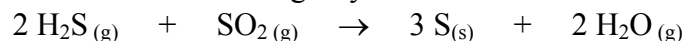
5. (10 points) Sodium carbonate can be made from sodium bicarbonate:



Is this reaction spontaneous at room temperature (25°C)? Show your work.

Will raising the temperature affect the spontaneity of this reaction? If so calculate the temperature at which this reaction will become spontaneous.

6. (10 points) The following reaction was described as the cause of sulfur deposits formed at volcanic sites. It may also be used to remove SO₂ from power-plant stack gases. Calculate the ΔG° for the reaction and comment on the meaning of your answer.



Substance	ΔG° _f (kJ/ mol)
H ₂ S _(g)	-33.0
SO _{2(g)}	-300.4
S _(s)	0
H ₂ O _(g)	-228.6

Would this be a feasible method for sulfur dioxide removal? Why or why not?

Would the procedure become more or less effective at a higher temperature?

7. (17 points) Using the table of reduction potentials below, answer the following questions.

a. Will NO₃¹⁻ ions oxidize Mn²⁺ ions to MnO₄¹⁻? _____

b. Will gold be oxidized by hydrogen ion? _____

c. Will chromium reduce Cd²⁺? _____

d. Which species in each pair is the better oxidizing agent?

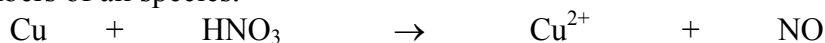


e. Which species in each pair is the better reducing agent?

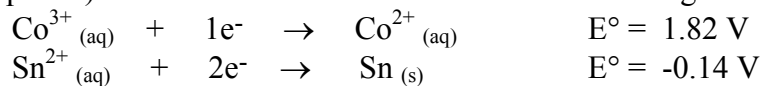




8. (10 points) Balance the following oxidation reduction reaction using the half-reaction method in acidic solution. Specify which half reaction is oxidation and which is reduction. Indicate the oxidation numbers of all species.



9. (17 points) Sketch the voltaic cell based on the following half-reactions.



Label the anode and cathode. Specify the half reaction occurring at each electrode. Show the direction of ion and electron movements. Write the overall cell reaction, calculate the cell emf and free energy of the reaction. $F = 96485 \text{ J/V mol e}^-$

BONUS: Describe in detail one of the batteries we discussed in lecture. Be sure to include the cell reactions. Or describe the process of oxidation. Use as much detail as possible.