

## Chemistry 1210 Spring 2023 Test 2

Wednesday, March 1, 2023

Time: 1 hour 50 minutes

Name: \_\_\_\_\_

Student #: \_\_\_\_\_

*This test consists of **six** pages of questions, the formula sheet, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **37** marks available. Good luck!*

1) **[2 marks]** The molar solubility of  $\text{Ca}_3(\text{PO}_4)_2$  in water is  $1.14 \times 10^{-7}$ . The  $K_{\text{sp}}$  of  $\text{Ca}_3(\text{PO}_4)_2$  should therefore be:

- a)  $1.92 \times 10^{-35}$       c)  $2.07 \times 10^{-33}$       e)  $7.78 \times 10^{-14}$   
b)  $6.9 \times 10^{-34}$       d)  $1.3 \times 10^{-14}$

2) **[2 marks]** The  $K_{\text{sp}}$  of  $\text{Ag}_3\text{PO}_4$  is  $8.89 \times 10^{-17}$ , and the molar mass of  $\text{Ag}_3\text{PO}_4$  is 418.6 grams. The number of grams of  $\text{Ag}_3\text{PO}_4$  that will dissolve in 1 litre of 0.010 M  $\text{AgNO}_3$  is therefore:

- a)  $3.0 \times 10^{-15}$       c)  $3.3 \times 10^{-12}$       e)  $8.9 \times 10^{-11}$   
b)  $8.9 \times 10^{-15}$       d)  $3.7 \times 10^{-12}$       f)  $3.7 \times 10^{-8}$

3) **[4 marks]** A solution contains  $[S^{2-}] = 1.0 \times 10^{-10}$  M and  $[PO_4^{3-}] = 1.0 \times 10^{-2}$  M. Solid  $AgNO_3$  is added carefully to separate the two ions. The  $K_{sp}$ s of the two compounds formed are  $8.89 \times 10^{-17}$  ( $Ag_3PO_4$ ) and  $1.6 \times 10^{-49}$  ( $Ag_2S$ ).

a) Which ion will precipitate first?

b) At the point of maximum separation, what will be the percent remaining of the first ion to precipitate?

4) **[4 marks]** Give the oxidation number of the oxygen atom in each of the following compounds:

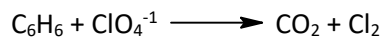
a)  $F_2O$  \_\_\_\_\_

b)  $Na_2O_2$  \_\_\_\_\_

c)  $NaOF$  \_\_\_\_\_

d)  $FOOF$  \_\_\_\_\_

5) **[7 marks total]** Given the following (unbalanced) redox reaction, occurring in **basic** solution:



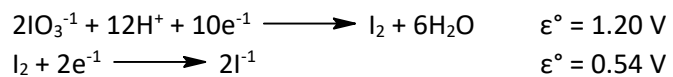
a) **[4 marks]** Balance the reaction.

b) **[1 mark]** Identify the reducing agent.

c) **[1 mark]** Identify the species which is oxidized.

d) **[1 mark]** How many electrons are transferred in the overall process?

6) **[5 marks total]** Given the following half-reactions:

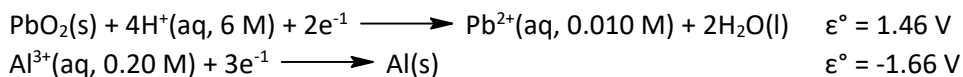


a) **[2 marks]** Write the reaction for the disproportionation of  $\text{I}_2$ .

b) **[1 mark]** Will  $\text{I}_2$  disproportionate under standard conditions? How do you know? (No marks for guessing. 😊)

c) **[2 marks]** Calculate  $K_c$  for the disproportionation. You may assume a temperature of  $25^\circ\text{C}$ .

7) **[9 marks total]** A battery was constructed using the following half-reactions:

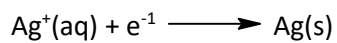


The battery was run at 25°C, and 2 litres of solution were used in each half-cell. Platinum electrodes were available for use as necessary.

- [1 mark]** Which electrode will be the anode?
- [1 mark]** Give the cell notation for the battery.
- [1 mark]** What is the overall reaction occurring in the battery?
- [1 mark]** What voltage will the battery produce under standard conditions?
- [2 marks]** What voltage will the battery produce under the conditions given?

- f) **[3 marks]** A current of 0.50 A was drawn from the battery for 3 hours and 13 minutes. What was the concentration of the  $\text{Al}^{3+}$  at the end of this time?

- 8) **[4 marks]** A concentration cell was assembled based on the following half-reaction:



One half cell contained a 0.10 M solution of  $\text{AgNO}_3$ , and the other held a saturated solution of  $\text{Ag}_2\text{CO}_3$ . The cell, when run at  $35.17^\circ\text{C}$ , produced 0.157 volts. What is the  $K_{\text{sp}}$  of  $\text{Ag}_2\text{CO}_3$  at  $35.17^\circ\text{C}$ ?