

**GENERAL CHEMISTRY 2
THIRD HOUR EXAM
APRIL 15, 2022**

Name _____

Panthersoft ID _____

Signature _____

Part 1 _____ (20 points)

Part 2 _____ (44 points)

Part 3 _____ (36 points)

TOTAL _____ (100 points)

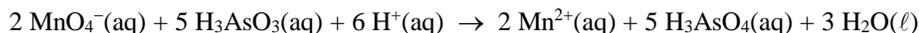
Do all of the following problems. Show your work.

Unless otherwise stated, you may assume $T = 25. \text{ }^\circ\text{C}$ in all problems.

Part 1. Multiple choice. Circle the letter corresponding to the correct answer. There is one and only one correct answer per problem. [4 points each]

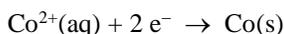
- 1) Which of the following reactions is expected to go to completion?
- The reaction of a weak acid with a weak base
 - The reaction of a strong acid with a weak base
 - The reaction of a strong acid with a strong base
 - Both a and b
 - Both b and c
- 2) Which of the following methods can be used to prepare a buffer solution?
- Adding a monoprotic weak acid and the sodium salt of the conjugate base of the weak acid to water
 - Partially neutralizing a solution containing a monoprotic weak acid by the addition of sodium hydroxide (NaOH), a strong soluble base
 - Partially neutralizing a solution containing the sodium salt of the conjugate base of a weak monoprotic acid by the addition of hydrochloric acid (HCl), a strong monoprotic acid
 - Both a and b
 - Both a and b and c
- 3) Oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) is a diprotic acid. Consider a solution of oxalic acid titrated with a solution of potassium hydroxide (KOH), a strong soluble base. How many equivalence points will be observed in the titration?
- 0
 - 1
 - 2
 - 3
 - More than 3

- 4) Permanganate ion (MnO_4^-) can be used to titrate solutions of arsenous acid (H_3AsO_3). The reaction that occurs is



A solution contains 3.628×10^{-3} moles of H_3AsO_3 . To reach the equivalence point for the titration, how many moles of MnO_4^- ion must be added to the solution?

- 0.726×10^{-3} moles of MnO_4^- ion
 - 1.451×10^{-3} moles of MnO_4^- ion
 - 3.628×10^{-3} moles of MnO_4^- ion
 - 9.070×10^{-3} moles of MnO_4^- ion
 - 18.14×10^{-3} moles of MnO_4^- ion
- 5) Cobalt metal can be produced by the electrolysis of a solution containing Co^{2+} ion. The half reaction that occurs is



Electrolysis of a solution containing Co^{2+} ion is carried out for a period of 5.00 hours, using a current $i = 2.30$ amps ($1 \text{ amp} = 1 \text{ C/s}$). How many moles of cobalt metal will be produced?

- 0.215 moles Co
- 0.429 moles Co
- 0.644 moles Co
- 0.858 moles Co
- 1.000 moles Co

Part 2. Short answer.

1) A buffer solution contains 0.0480 M nitrous acid (HNO_2 , $K_a = 7.1 \times 10^{-4}$) and 0.0340 M nitrite ion (NO_2^-).

a) What is the pH of the buffer solution? [8 points]

b) Give the balanced chemical reaction that takes place when a small amount of HBr (a strong acid) is added to the buffer solution. [4 points]

2) Scandium (III) fluoride (ScF_3 , MW = 102.0 g/mol) is a slightly soluble ionic compound, with $K_{sp} = 5.8 \times 10^{-24}$. How many grams of scandium (III) fluoride will dissolve in 1.000 L of pure water? [10 points]

3) What is the difference (if any) between a galvanic cell and an electrolytic cell? [4 points]

4) For each of the following substances given the oxidation number for the indicated atom [2 points each]

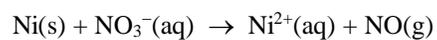
a) ClF_3 Cl _____

b) C_2H_6 C _____

c) NaH H _____

d) $\text{K}_2\text{Cr}_2\text{O}_7$ Cr _____

5) Balance the following oxidation-reduction reaction for acid conditions. [10 points]



Part 3. Problems.

1) A 0.4147 g sample of a weak monoprotic acid was titrated with a 0.1273 M solution of potassium hydroxide (KOH), a strong soluble base.

a) The pH at the equivalence point for the titration will be (circle the correct answer) [4 points]

less than 7.0

equal to 7.0

greater than 7.0

b) After the addition of 24.86 mL of the potassium hydroxide solution, the equivalence point for the titration is reached. Based on this information, find the molecular weight of the weak monoprotic acid. [12 points]

2) Consider the following galvanic cell



Relevant half-cell reduction reactions are given below and may be of use in doing this problem.



a) What is the oxidizing agent in the above galvanic cell? [4 points]

oxidizing agent = _____

b) Give the half-cell oxidation reaction, the half-cell reduction reaction, the net cell reaction, the cell potential for standard state conditions (E°_{cell}), and the cell potential for the actual conditions (E_{cell}) for the above galvanic cell. [16 points]