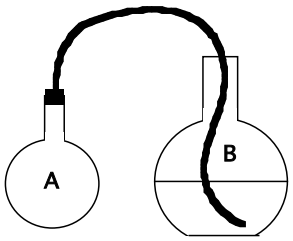
Exam Three **CHM 203 (Dr. Mattson)** **8 October 2004**	***Academic Integrity Pledge:*** *In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.* *Signature:*

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. BOX YOUR ANSWERS!

1. A 1-L flask (Flask A) was equipped with a 1-hole stopper connected to a gas delivery tube. The other end of the gas delivery tube was placed in 4-L flask (Flask B) containing 2 L water. Approximately 25 mL nitric acid was added to Flask A followed by two copper pennies. The flask was immediately fitted with the stopper/delivery tube. Flask A filled with red nitrogen dioxide gas and bubbles were observed coming form the delivery tube in Flask B. After some time, the bubbling subsided, then stopped. Eventually water from Flask B was drawn into Flask A. The new solution in Flask A was blue in color due to copper(II). At the bottom of Flask A, two very small copper discs remained.



(a) (1 pt) What kind of a reaction was observed?
(A) Acid-base (B) Precipitation
(C) Redox (D) None of these

(b) (1 pt) Which statement is true?
(A) Nitric acid is the acid and copper is the base in this acid-base reaction.
(B) Copper nitrate was precipitated in this precipitation reaction.
(C) Copper was reduced in this redox reaction.
(D) Copper was the reducing reagent in this redox reaction.

(c) (1 pts) Why was the water drawn from Flask B to Flask A?
(A) Nitrogen dioxide present in Flask A is extremely soluble in water, thus reducing the pressure in Flask A and causing water to transfer from Flask B to Flask A.
(B) The copper ions in Flask A must combine with the nitrate ions in Flask B so the solution transfers from Flask B to Flask A.
(C) Nitric acid attracts water in order to form a dilute solution, thus causing water to transfer from Flask B to Flask A.
(D) The reaction pushed all of the air out of Flask A, thus creating a vacuum. This resulted in water moving from Flask B to Flask A.

(d) (1 pts) What was the limiting reagent?
(A) nitric acid
(B) copper
(C) water
(D) no limiting reagent

(e) (2 pts) Write an unbalanced equation that shows the reactants and products of the reaction.

2. (5 pts) Classify each of these as an strong electrolyte, weak electrolyte or non-electrolyte in aqueous solution. Circle your answer.

(a) $HC_2H_3O_2$	**strong**	**weak**	**non**
(b) HNO_3	**strong**	**weak**	**non**
(c) CH_3OH	**strong**	**weak**	**non**
(d) PbI_2	**strong**	**weak**	**non**
(e) K_2CO_3	**strong**	**weak**	**non**

3. (5 pts) Classify each of the following salts as either soluble or insoluble in water.

(a) NaOH	**soluble**	**insoluble**
(b) $CaCl_2$	**soluble**	**insoluble**
(c) $CaCO_3$	**soluble**	**insoluble**
(d) $BaSO_4$	**soluble**	**insoluble**
(e) $(NH_4)_2CO_3$	**soluble**	**insoluble**

4. (4 pts) Will a precipitate occur? If no reaction occurs, write "No reaction" after the arrow. If a reaction does occur, complete the reaction and draw a box around the precipitate.

(a) $Na_2SO_4 + Hg_2(NO_3)_2 \longrightarrow$

(b) $BaCl_2 + K_2SO_4 \longrightarrow$

(c) $NH_4Br + Ca(NO_3)_2 \longrightarrow$

(d) $MgCl_2 + KOH \longrightarrow$

5. (2 pts) Aqueous ammonium phosphate and aqueous cobalt(II) bromide are mixed and a precipitate is formed. Write the net ionic equation for this reaction.

6. (5 pts) Identify each of these ***unbalanced*** reactions in aqueous solution as (**P**) Precipitation, (**AB**) Acid-Base, (**OR**) oxidation-reduction or (**NR**) for no reaction (Warning! In the case where no reaction takes place, the equation is erroneously written as if a reaction has taken place).

(a) $HCl + KOH \longrightarrow H_2O + KCl$

P AB OR NR

(b) $Mg + AgNO_3 \longrightarrow Mg(NO_3)_2 + Ag$

P AB OR NR

(c) $BaCl_2 + Ag_2SO_4 \longrightarrow AgCl + BaSO_4$

P AB OR NR

(d) $KBr + (NH_4)_2S \longrightarrow K_2S + NH_4Br$

P AB OR NR

(e) $Ni(NO_3)_2 + KOH \longrightarrow Ni(OH)_2 + KNO_3$

P AB OR NR

7. (5 pts) Circle the member of each group that has different properties from the rest of the group. (For example: All soluble except for _____ ***or*** All ionic except for _____ ***or*** All acids except for _____, etc.)

(a) KCl NaCN LiBr $Fe(NO_3)_2$ SO_3

(b) H_2SO_4 H_3PO_4 HNO_3 $HClO_4$ HCl

(c) $Ca(NO_3)_2$ $PbBr_2$ MgS $Mg(OH)_2$ $Fe(OH)_3$

(d) HF HCN HNO_3 HNO_2 $HC_2H_3O_2$

(e) CH_3OH KNO_3 CO_2 NH_3 H_2O

8. Mr. Doyle disposes of the permanganate solution from the "purple lab" by reacting it with sulfite to produce $Mn^{+2}(aq)$ and sulfate.

$$2\ MnO_4^- + 5\ SO_3^{-2} + 4\ H_3O^+ \longrightarrow 2\ Mn^{+2} + 5\ SO_4^{-2} + 6\ H_2O$$

(a) (1 pt) The species that is oxidized is:

A. MnO_4^- B. Mn^{+2} C. SO_3^{-2} D. SO_4^{-2}

(b) (1 pt) The species that is reduced is:

A. MnO_4^- B. Mn^{+2} C. SO_3^{-2} D. SO_4^{-2}

(c) (1 pt) The oxidizing agent is:

A. MnO_4^- B. Mn^{+2} C. SO_3^{-2} D. SO_4^{-2}

(d) (1 pt) The reducing agent is:

A. MnO_4^- B. Mn^{+2} C. SO_3^{-2} D. SO_4^{-2}

9. (4 pts) Refer again to the equation in Question 7. What volume of 0.20 M sodium sulfite is required to react completely with 0.50 mol $KMnO_4$?

10. (4 pts) What is the concentration of each of the three ions in the solution that results when 250 mL 0.20 M $Na_2SO_4(aq)$ with 400 mL 0.40 M $NaNO_3(aq)$ are mixed together?

11. (5 pts) What is the concentration of each of the four ions in the solution that results when 400 mL 0.20 M $Na_2S(aq)$ with 350 mL 0.40 M $Ca(NO_3)_2(aq)$ are mixed together?

12. (1 point) Print your name here:

Your exam score (50 possible): _____

Determine your grade:
A $\geq$ 46.5; B+ $\geq$ 43.5; B $\geq$ 41.0;
C+ $\geq$ 37.5; C $\geq$ 34.00; D $\geq$ 30.00

Answers

1.

(a) C
(b) D
(c) A
(d) A
(e) $HNO_3(aq) + Cu(s) \longrightarrow Cu^{+2}(aq) + NO_2(g)$

2.

(a) weak
(b) strong
(c) non
(d) non
(e) strong

3.

(a) soluble
(b) soluble
(c) insoluble
(d) insoluble
(e) soluble

4.

(a) $Na_2SO_4 + Hg_2(NO_3)_2 \longrightarrow Hg_2SO_4(s) + 2\ NaNO_3(aq)$

(b) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4(s) + 2\ KCl(aq)$

(c) $NH_4Br + Ca(NO_3)_2 \longrightarrow$ No reaction

(d) $MgCl_2 + KOH \longrightarrow Mg(OH)_2(s) + 2\ KCl(aq)$

5. $3\ Co^{+2}(aq) + 2\ PO_4^{-3}(aq) \longrightarrow Co_3(PO_4)_2(s)$

6.

(a) AB
(b) OR
(c) P
(d) NR
(e) P

7.

(a) SO_3
(b) H_3PO_4
(c) $Ca(NO_3)_2$
(d) HNO_3
(e) KNO_3

8.

(a) C
(b) A
(c) A
(d) C

9. 12.5 L

10. $[Na^+] = 0.40$ M; $[SO_4^{-2}] = 0.077$ M; $[NO_3^-] = 0.246$ M

11. $[Na^+] = 0.213$ M; $[S^{-2}] = 0$ M; $[NO_3^-] = 0.37$ M; $[Ca^{+2}] = 0.080$ M