Exam 2 Chm 203 (Dr Mattson) 30 September 2013

Name:

Circle your Folder group:

H He Li Be B C N O F Ne Na Mg Al Si

Instructions: Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. You will receive credit for **how** you worked each problem as well as for the correct answer. If you need more space, you may use the back of the periodic table provided — Write: "See PT" in the answer box and then hand the periodic table in with your exam. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be closed and stored on the floor under the table. Cell phones must be OFF and placed in your backpack/purse – not in your pocket.

1. (3 pts) Write the balanced equation for the combustion of propane, C_3H_8.

2. (3 pts) Balance the following reaction with the smallest whole-number coefficients.

$$\_\_ N_2O + \_\_ C_2H_6 \rightarrow \_\_ N_2 + \_\_ CO_2 + \_\_ H_2O$$

Questions 3 – 10 refer to the following balanced equation (which we discussed in class along with a demo):

$3 P_4S_3 + 16 KClO_3 \rightarrow 6 P_2O_5 + 9 SO_2 + 16 KCl$

3. (3 pts) How many moles of $KClO_3$ would be required to react stoichiometrically with 7.10 mol P_4S_3?

Answer with units:_____

4. (4 pts) Suppose 0.538 g P_4S_3 (MM = 220.1 g/mol) and 0.821 g $KClO_3$ (MM = 122.6 g/mol) were reacted together. What is the limiting reagent, and how many moles of the limiting reagent were initially present?

$3 P_4S_3$ + $16 KClO_3 \rightarrow 6 P_2O_5$ + $9 SO_2$ + $16 KCl$
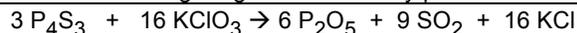
Limiting reagent_____ Moles of LR:_____

5. (3 pts) Suppose 30.0 g P_4S_3 were reacted with excess $KClO_3$ and 34.3 g P_2O_5 (MM = 141.9 g/mol) were obtained. What is the percent yield in this reaction?

Answer with units:_____

6. (3 pts) What is the percent by mass of phosphorus in P_4S_3?

Answer with units:_____

7. (4 pts) The formula P_2O_5 is an empirical formula. Suppose we found out that the actual MM was about 284 g/mol. What is the actual molecular formula?
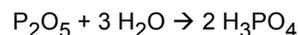
Answer with:_____

8. (4 pts) Another sulfide of phosphorus is known to exist that consists of 27.87 % P. What is the empirical formula for this compound?

Answer:_____

9. (1 pt) The formula you obtained in Question 8 and the formula P_4S_3 are examples of which law?

    A. Law of conservation of mass

    B. Law of definite proportions

    C. Law of multiple proportions

    D. Law of combining volumes

10. (3 pts) One of the products obtained, P_2O_5, reacts readily with water as shown here:

$$P_2O_5 + 3 H_2O \rightarrow 2 H_3PO_4$$

Suppose 0.442 mol of P_2O_5 were reacted with excess water and diluted to 1.000 L. What is the molar concentration of H_3PO_4?

Answer with units:_____

11. (5 pts) True/False about the solubility rules:

T F All nitrates are soluble.

T F All carbonates are soluble, except for Ag^+, Pb^{2+}, and Hg_2^{2+}.

T F All Group I salts are soluble.

T F Sulfides are generally insoluble except for Group I and NH_4^+.

T F All chlorides are soluble.

12. (5 pts) What sort of solution results when each of the following compounds is placed in a beaker of water? Will the solution be a strong, weak or non-electrolyte?

A. $Ba(NO_3)_2$ strong   weak   non-electrolyte

B. $FeCO_3$ strong   weak   non-electrolyte

C. $HC_2H_3O_2$ strong   weak   non-electrolyte

D. HBr   strong   weak   non-electrolyte

E. $C_{12}H_{22}O_{11}$ strong   weak   non-electrolyte

13. (6 pts) Which of these compounds are considered soluble in water? There is more than one!

A. NH_4Br B. $PbCl_2$ C. $CuSO_4$

D. $BaSO_4$ E. $KC_2H_3O_2$ F. MgS

14. (4 pts) Match these reactions (all aqueous) with their type

___ Acid-base   A. $HF + KOH \rightarrow H_2O + KF$

___ Precipitation   B. $2 Mg + O_2 \rightarrow 2 MgO$

___ Redox   C. $2 NaBr + CuSO_4 \rightarrow CuBr_2 + Na_2 SO_4$

___ No reaction   D. $Na_2CO_3 + CaCl_2 \rightarrow CaCO_3 + 2 NaCl$

15. (4 pts) Will a precipitate form if these two solutions are mixed? If so, identify the precipitate in the box at right.

$Ba(NO_3)_2(aq) + K_2SO_4(aq) \rightarrow$	Yes No	
$(NH_4)_2S(aq) + Na_2CO_3(aq) \rightarrow$	Yes No	

16. (4 pts) Sketch a representation of HCl(aq) in the beaker at on the left and HF(aq) in the beaker on the right. The sketches must correctly portray what ions, if any, are present. Show charges on ions (example, Na^+)
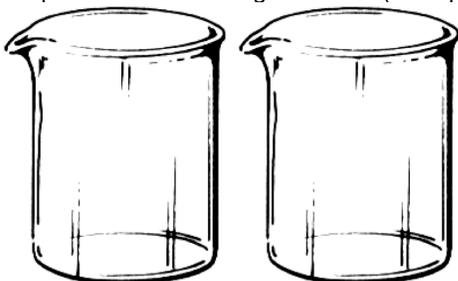
17. (2 pts) Write the net ionic reaction that takes place between any strong acid with any strong base?

18. In class we saw the reaction between metallic aluminum and aqueous copper(II) chloride. We saw that solid metallic copper was formed and the other product was colorless $Al^{+3}(aq)$.

18a. (3 pts) Write and balance the net ionic reaction that took place.

18b. (2 pt) Circle the oxidizing agent and draw a box around the reducing agent.

19. (4 pts) Assign oxidation numbers to the sulfur atom in each of these compounds.

S_8	H_2S
H_2SO_3	SO_3

Note: If you are Nomenclature Certified you may stop.

20. (5 pts) Name these substances.

HNO_3
$CoCO_3$
$HClO_2$
$KClO_3$
N_2O_4

21. (5 pts) Circle the correct formula for each of these.

A. vanadium(V) phosphate

     $V_3(PO_4)_5$ VPO_4 $V_3(PO_3)_5$

     V_5PO_4 VPO_3 $V_5(PO)_4$

B. potassium bromite

     $PBrO_3$ $KBrO_4$ K_2BrO_3

     K_2BrO_2 $KBrO_2$ KBrO

C. acetic acid

     $H_2C_2H_3O_2$ $HC_2H_2O_3$ $H_2C_2H_2O_3$

     $H_2C_2H_2O_2$ $HC_2H_3O_3$ $HC_2H_3O_2$

D. tetraphosphorus trisulfide

     $P_4(SO_3)_3$ $P_4(SO_4)_3$ P_5S_3

     P_4S_3 $(PO_4)_3S_3$ P_3S_4

E. nitrous acid

     HNO_2 HNO_3 HNO_4

     H_2NO_2 H_2NO_3 H_2NO_4

Subtotal from exam: _____

Folder work: (20 max)   _____

Total: _____

Answers

1. $C_3H_8. + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

2. $7\ N_2O + C_2H_6 \rightarrow 7\ N_2 + 2\ CO_2 + 3\ H_2O$

3. 37.9 mol $KClO_3$

4. 0.00670 mol $KClO_3$

5. 88.6%

6. 56.3 % P

7. P_4O_{10}

8. P_2S_5

9. C

10. 0.884 M H_3PO_4

11. T F T T F

12.
   A. $Ba(NO_3)_2$ strong electrolyte

   B. $FeCO_3$ non-electrolyte

   C. $HC_2H_3O_2$ weak electrolyte

   D. HBr   strong electrolyte
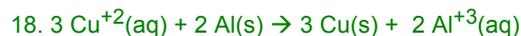
   E. $C_{12}H_{22}O_{11}$ non-electrolyte

13. A C E

14. A D B C

15.

$Ba(NO_3)_2(aq) + K_2SO_4(aq) \rightarrow$	Yes	$BaSO_4(aq)$
$(NH_4)_2S(aq) + Na_2CO_3(aq) \rightarrow$	No	

16. Your sketch of HCl(aq) should show 100% dissociated
   into H^+ (or H_3O^+) and Cl^-. HF(aq) is a weak acid and
   the drawing should show mostly associated HF
   molecules and one dissociated H^+ (or H_3O^+) and F^-.

17. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

18. $3\ Cu^{+2}(aq) + 2\ Al(s) \rightarrow 3\ Cu(s) + 2\ Al^{+3}(aq)$

18b. The oxidizing agent is $Cu^{+2}(aq)$; the reducing agent
   is Al(s).

19.

S_8 ox number = 0	H_2S ox number = -2
H_2SO_3 ox number = +4	SO_3 ox number = +6

20. (5 pts) Name these substances.

Nitric acid
Cobalt(II) carbonate
Chlorous acid
Potassium chlorate
Dinitrogen tetroxide

21. (5 pts) Circle the correct formula for each of these.

   A. $V_3(PO_4)_5$

   B. $KBrO_2$

   C. $HC_2H_3O_2$

   D. P_4S_3

   E. HNO_2