CHM1020 – Practice Test 3 - Answers Name_____
Fall 2014

Part 1. Multiple Choice. Circle the one alternative that best completes the statement or answers the question.

1. Which of the following is soluble in water? (2 pts.)

   a) $BaSO_4$ b) AgCl *c) KOH d) $Fe(OH)_3$ e) $PbSO_4$ f) $PbBr_2$

2. Which of the following is insoluble in water? (2 pts.)

   a) $Fe(NO_3)_3$ b) $BaCl_2$ c) $Ba(OH)_2$ *d) $CaCO_3$ e) Li_2S f) NaBr

3. Reduction is defined as: (2 pts.)

   a) loss of electrons *b) gain of electrons c) loss of H d) gain of H e) loss of O

4. Is the following an Oxidation-Reduction reaction, and if so, what element is oxidized? (2 pts.)

   $2\ KBr\ (s) \rightarrow 2\ K\ (s) + Br_2\ (g)$

   a) K *b) Br c) Br_2 d) KBr e) This is not an oxidation-reduction reaction.

   $K^{+1} \rightarrow K^0$ (gained $1e^-$ = reduction), $B^{-1} \rightarrow Br^0$ (lost $1e^-$ = oxidation)

PART 2. FILL IN THE BLANK or Short Answer or Calculations (MUST SHOW ALL WORK with units and correct significant figures).

5. What is the mass of 0.348 moles of calcium? (3 pts.)

$$0.348\,\text{mol Ca}\left(\frac{40.078\,\text{g}}{1\,\text{mole Ca}}\right) = 13.9\,\text{g}$$

6. How many moles of zinc are in 43.0 g of zinc? (3 pts.)

$$43.0\,\text{g Zn}\left(\frac{1\,\text{mole Zn}}{65.39\,\text{g}}\right) = 0.658\,\text{mol Zn}$$

7. How many copper atoms are in 8.79 moles of copper? (2 pts.)

$$8.79\ \text{mole Cu}\left(\frac{6.022\ \text{x}\ 10^{23}\ \text{Cu atoms}}{1\ \text{mole Cu}}\right)=5.29\ \text{x}\ 10^{24}\ \text{Cu atoms}$$

8. How many copper atoms are in 34.9 g of copper? (4 pts.)

$$3.49\ \text{g Cu}\left(\frac{1\ \text{mol Cu}}{63.546\ \text{g}}\right)\left(\frac{6.022\ \text{x}\ 10^{23}\ \text{atoms}}{1\ \text{mole Cu}}\right)=3.31\ \text{x}\ 10^{23}\ \text{Cu atoms}$$

9. What is the molar mass of magnesium nitrate, $Mg(NO_3)_2$? Report answer to 5 significant figures. (4 pts.)

= 1(Mg atom) + 2 (N atoms) + 6 (O atoms) = 24.3050 g/mol + 2(14.0067 g/mol) + 6(15.9994 g/mol) =

148.3148 = 148.31 g/mole

10. What is the mass of 0.477 moles of magnesium nitrate? (4 pts.)

$$0.477\ \text{mol}\left(\frac{148.3148\ \text{g}}{1\ \text{mol}}\right)=70.7\ \text{g}$$ molar mass from problem #9 above

11. What is the percent by mass composition of oxygen in magnesium nitrate? Report answer to 4 significant figures. (4 pts.)

$$\frac{6\left(\text{molar mass of O}\right)}{\text{molar mass of Mg}(NO_3)_2}x100=\frac{6\left(15.9994\ \text{g/mol}\right)}{148.3148\ \text{g/mol}}x100=64.72\%$$

Molar mass of magnesium nitrate from problem #9 above.

12. How many moles of iron (III) chlorate, $Fe(ClO_3)_3$, are in 273 g of iron (III) chlorate? (4 pts.)

Molar mass of compound = 1(Fe atom) + 3(Cl atoms) + 9(O atoms) =

= 55.845g/mol + 3(35.453g/mol) + 9(15.9994g/mol) = 306.1986 g/mole

$$273\,\text{g}\left(\frac{1\,\text{mole Fe(ClO}_3)_3}{306.1986\,\text{g}}\right) = 0.892\,\text{mole}$$

13. How many moles of carbon are in 3.28 moles of C_3H_8? (2 pts.)

$$3.28\,\text{mol C}_3\text{H}_8\left(\frac{3\,\text{mol C}}{1\,\text{mole C}_3\text{H}_8}\right) = 9.84\,\text{mol C}$$

14. How many carbon atoms are in 3.28 moles of C_3H_8? (4 pts.)

$$3.28\,\text{mol C}_3\text{H}_3\left(\frac{3\,\text{mol C}}{1\,\text{mol C}_3\text{H}_8}\right)\left(\frac{6.022\,\text{x}\,10^{23}\,\text{atoms}}{1\,\text{mol C}}\right) = 5.93\,\text{x}\,10^{24}\,\text{C atoms}$$

15. How many carbon atoms are in 47.2 g of C_3H_8? (5 pts.)

$$47.2\,\text{g C}_3\text{H}_8\left(\frac{1\,\text{mol C}_3\text{H}_8}{44.09652\,\text{g}}\right)\left(\frac{3\,\text{mol C}}{1\,\text{mol C}_3\text{H}_8}\right)\left(\frac{6.022\,\text{x}\,10^{23}\,\text{atoms}}{1\,\text{mol C}}\right) = 1.93\,\text{x}\,10^{24}\,\text{C atoms}$$

16. How many moles of O_2 react with 6.21 moles of iron? (2 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

$$6.21\,\text{mol Fe}\left(\frac{3\,\text{mol O}_2}{4\,\text{mol Fe}}\right) = 4.66\,\text{mol O}_2$$

17. How many moles of Fe_2O_3 are produced when 6.21 moles of iron react? (2 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

$$6.21\,\text{mol Fe}\left(\frac{2\,\text{mol Fe}_2\text{O}_3}{4\,\text{mol Fe}}\right) = 3.11\,\text{mol Fe}_2\text{O}_3$$

18. How many moles of Fe_2O_3 are produced when 39.7 g of iron react? (4 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

$$39.7\,\text{g Fe}\left(\frac{1\,\text{mol Fe}}{55.845\,\text{g}}\right)\left(\frac{2\,\text{mol Fe}_2\text{O}_3}{4\,\text{mol Fe}}\right) = 0.355\,\text{mol Fe}_2\text{O}_3$$

19. A compound with the empirical formula CH_2 was found to have a molar mass of approximately 84 g/mole. What is the molecular formula of the compound? (5 pts.)

one method:

$$\frac{\text{actual molar mass}}{\text{molar mass of empirical formula}} = X$$

$$\frac{84\ \text{g/mole}}{14.02688\ \text{g/mole}} = 5.9885 \cong 6 = X$$

actual chemical formula = X (empirical formula)

= 6 * (CH_2) = C_6H_{12}

another method:

possible chemical formulas	molar mass
CH_2	14.1 g/mol
emp.for.*2 = C_2H_4	28.2 "
" *3 = C_3H_6	42.3 "
"*4 = C_4H_8	56.4 "
"*5 = C_5H_{10}	70.5 "
"*6 = C_6H_{12}	84.6 "

last one matches molar mass, 84.6 ≈ 84,
so actual chemical formula is C_6H_{12}

Please circle answers. (I can't do that in Word.)

20. If we want to produce 73.0 g of iron (III) oxide, (a) how many moles of iron do we need to react, and (b) how many grams of iron do we need to react? (6 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

(a) $$73.0\ g\ Fe_2O_3\left(\frac{1\ mol\ Fe_2O_3}{159.6882\ g}\right)\left(\frac{4\ mol\ Fe}{2\ mole\ Fe_2O_3}\right) = 0.914\ mol\ Fe$$

(b) $$73.0\ g\ Fe_2O_3\left(\frac{1\ mol\ Fe_2O_3}{159.6882\ g}\right)\left(\frac{4\ mol\ Fe}{2\ mole\ Fe_2O_3}\right)\left(\frac{55.845\ g}{1\ mole\ Fe}\right) = 51.1\ g\ Fe$$

For Part (b), you can just show the answer from Part (a) times the 3rd step above = answer. Just remember to not round the answer from part (a) when you are calculating part (b). When you give the answer to part (a) be sure to give it in the correct number of significant figures.

21. If 15.7 g of iron reacts and 18.3 g of iron (III) oxide are produced in lab, what is the percent yield? (7 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

$$15.7\ g\ Fe\left(\frac{1\ mole\ Fe}{55.845\ g}\right)\left(\frac{2\ mole\ Fe_2O_3}{4\ mol\ Fe}\right)\left(\frac{159.6882\ g}{1\ mol\ Fe_2O_3}\right) = 22.\bar{4}4699\ g\ Fe_2O_3 = theoretical\ \ yield$$

$$\%\ yield = \frac{actual\ yield}{theoretical\ yield}\ x\ 100 = \frac{18.3\ g}{22.\bar{4}4699\ g} = 81.5\%$$

22. What is the empirical formula of a compound that contains 82.66% carbon and 17.34% hydrogen by mass? (6 pts.)

1) Assume a 100.0 g sample, so you have 82.66 g and 17.34 g.
2) Convert grams to moles.

$$82.66\text{ g C}\left(\frac{1\text{ mole C}}{12.011\text{ g}}\right) = 6.882\text{ mol C}$$

$$17.34\text{ g H}\left(\frac{1\text{ mole H}}{1.00794\text{ g}}\right) = 17.2\overline{0}3\text{ mol H}$$

3) Divide by the smallest number of moles to get a ratio of moles (and to get larger numbers versus fractions).

$$\frac{17.20\text{ mol H}}{6.882\text{ mol C}} = \frac{2.499\text{ mol H}}{1\text{ mol C}}$$

4) Find a whole number ratio (we can't have 2.5 H atoms). Guideline is that you can round to a whole number only if it is within 0.1 of a whole number.

$$\frac{2.499\text{ mol H}}{1\text{ mol C}}\text{ x }\frac{2}{2} = \frac{4.9985}{2} \approx \frac{5\text{ mol H}}{2\text{ mol C}}$$

5) Write the empirical formula in proper format.

empirical formula = C_2H_5

23. For the following reaction, (a) write the balanced, complete ionic equation (5pts.), (b) write the balanced net ionic equation (3 pts.), and (c) list or circle the spectator ions (2 pts.).

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

(a) $Ba^{+2}\ (aq) + \underline{2\ Cl^{-1}\ (aq)} + \underline{2\ K^{+1}\ (aq)} + SO_4^{-2}\ (aq) \rightarrow BaSO_4\ (s) + \underline{2\ K^{+1}\ (aq)} + \underline{2\ Cl^{-1}\ (aq)}$

or underline spectator ions

(b) $Ba^{+2}\ (aq) + SO_4^{-2}\ (aq) \rightarrow BaSO_4\ (s)$

PART 3. Do the following reactions occur, and if so, what are the products? (If you say No Reaction, cross off any products.) [You do NOT need to balance the reactions.] (2-3 pts. each)
I can't circle in Word so I will underline.

24.) $Ba(OH)_2\ (aq) + HBr\ (aq) \rightarrow$ yes or no (circle one) $\rightarrow$ $H_2O\ (l) + BaBr_2\ (aq)$
This is an acid-base reaction.

25.) $KCl\ (aq) + Pb(NO_3)_2\ (aq) \rightarrow$ yes or no (circle one) $\rightarrow$ $PbCl_2\ (s) + KNO_3\ (aq)$
This is a precipitation reaction.

26.) $C_3H_8\ (g) + O_2\ (g) \rightarrow$ yes $\rightarrow$ $CO_2\ (g) + H_2O\ (l)$
This is a combustion reaction.

27.) $NH_4Br\ (aq) + LiNO_3\ (aq) \rightarrow$ yes or no (circle one) $\rightarrow$ _____No Reaction_____
When you check the solubility of all the possible products, they are all (aq), so No Reaction.

28. If 0.322 moles of iron reacts with 0.260 moles of oxygen gas, (a) what is the limiting reactant? Must show work and explain. (b) How many moles of iron (III) oxide are produced? MUST show work. (9 pts.)

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$
0.322 mol 0.260 mol

(a) To find the Limiting Reactant, answer the question: If we use all of Reactant #1, how much of Reactant #2 do we need?

$0.322\ mol\ Fe\left(\frac{3\ mol\ O_2}{4\ mol\ Fe}\right) = 0.24\overline{1}5\ mol\ O_2$, we only need 0.2415 mol of O_2 to react with all of the Fe. We have more than this, we have 0.260 mol O_2. So, if we reacted all of the Fe, we would only use 0.2415 mol of O_2 and then we would have some O_2 leftover. There, the O_2 is the excess reactant and Fe is the limiting reactant. I then go back and write L.R. and excess over the appropriate reactant:

L.R. excess
$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$
0.322 mol 0.260 mol

(b) Always start a calculation with a number you know. We know that we used all of the Limiting Reactant (by definition).

L.R.
$$0.322\ mol\ Fe\left(\frac{2\ mole\ Fe_2O_3}{4\ mol\ Fe}\right) = \underline{0.161\ mol\ Fe_2O_3\ are\ produced}$$