MULTIPLE CHOICE (3pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1.) Which of the following compounds would have the highest water solubility? 1.) B
a.) $PbCO_3$ (b.) CH_3OH c.) C_6H_8 d.) CH_3Br

2.) What type of hybridized orbitals would be present in $SeBr_6$? 2.) D
a.) sp^2 b.) sp^3 c.) sp^3d (d.) sp^3d^2

3.) You are making a new pharmaceutical ingredient, and combine enough materials to make 50.00g of product, but when you weigh out what you made, you only have 38.64g. What is your percent yield? 3.) A
(a.) 77.28% b.) 22.72% c.) 29.40% d.) 129.4%
$(38.64g / 50.00g)100$

4.) What is the oxidation number on W in the compound $W_2O_4^{2-}$? 4.) C
a.) +4 b.) +8 (c.) +3 d.) +6
$-8 + 2W = -2 \quad 2W = +6 \quad W = +3$

5.) How many oxygen molecules would be needed in the correctly balanced equation for $C_4H_7OH + O_2 \rightarrow CO_2 + H_2O$? 5.) C
a.) 9 b.) 10 (c.) 11 d.) 12
$\frac{11}{2}$ 4 4 $\times 2$

6.) What would be the total ion concentration in a 2.4M solution of $Mg_3(SO_4)_2$? 6.) A
(a.) 12.0M b.) 7.2M c.) 4.8M d.) 26.4M
$7.2 + 4.8 = 12.0$

7.) What volume of a 0.856M solution of NaCl (58.4428g/mol) would contain 1.500g of NaCl? 7.) D
a.) 1750mL b.) 22.0mL c.) 1280mL (d.) 30.0mL
$1.500g \left(\frac{1mol}{58.4428g}\right) = 0.025666 mol \left(\frac{1L}{0.856mol}\right) = 0.029984L \times 1000 \frac{mL}{1L}$

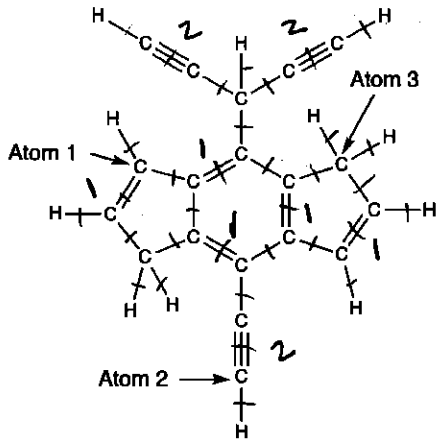
8.) What volume of 2.50M stock solution would be needed to make 125.0mL of a 0.500M solution? 8.) B
a.) 625mL (b.) 25.0mL c.) 0.0100mL d.) 156mL
$(2.50M)(mL) = (0.500M)(125.0mL)$

9.) What is the oxidizing agent in the reaction $CuCl_2 + 2Na \rightarrow 2NaCl + Cu$? 9.) A
(a.) Cu^{2+} b.) Na c.) Na^+ d.) Cu
+2 0 +1 0

10.) What would be the solid product when NaOH reacts with $Ca(NO_3)_2$? 10.) C
a.) $NaNO_3$ b.) $Na(NO_3)_2$ (c.) $Ca(OH)_2$ d.) CaOH

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! SHOW ALL WORK. If your work is in a different location, you must make a note of this in the given work area for the problem in order for the work to be considered for partial credit. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

1.) a.) Indicate the hybridization around each of the atoms labeled in the structure below:



Atom 1: sp^2

Atom 2: sp

Atom 3: sp^3

b.) How many sigma orbitals are present in the molecule? Answer: 33

c.) How many pi orbitals are present in the molecule? Answer: 11

2.) If 12.86 mL of 0.550M NaOH is needed to fully titrate a 25.00 sample of sulfuric acid, what was the concentration of the sulfuric acid?

$$2\ NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow 2H_2O\ (l) + Na_2SO_4\ (aq)$$

Answer: 0.141 M

$$0.01286\,L \left(\frac{0.550\,mol}{L}\right)$$

$$= 0.007073\,mol\ NaOH \left(\frac{1\,mol\ H_2SO_4}{2\,mol\ NaOH}\right)$$

$$= \frac{0.0035365\,mol\ H_2SO_4}{0.02500}$$

$$= 0.14146\ \frac{mol}{L}$$

3.) Given the reaction: $3\ Cu(s) + 8\ HNO_3(aq) \rightarrow 3\ Cu(NO_3)_2(aq) + 2\ NO\ (g) + 4\ H_2O(l)$

a.) If 28.2g Cu (63.546g/mol) reacts with 33.6g HNO_3 (63.01284g/mol), what is the limiting reagent?

Answer: HNO_3

$$28.2g\ Cu\left(\frac{1mol}{63.546g}\right) = 0.443773\ mol\ Cu\left(\frac{2mol\ NO}{3mol\ Cu}\right)$$

$$= 0.29585\ mol\ NO$$

$$33.6g\ HNO_3\left(\frac{1mol}{63.01284g}\right) = 0.533225\ mol\ HNO_3\left(\frac{2mol\ NO}{8mol\ HNO_3}\right)$$

$$= 0.1333\ mol\ NO$$

b.) What is the theoretical yield, in grams, of NO (30.0061g/mol)?

Answer: 4.00 g

$$0.1333mol\ NO\left(\frac{30.0061g}{mol}\right)$$

$$= 3.999998g$$

4.) Given the following reaction, if 58.7mL of $Fe(NO_3)_3$ was needed to make 15.8g of $Fe_2(CO_3)_3$ (291.7176g/mol), what was the concentration of the $Fe(NO_3)_3$ solution?

$$2Fe(NO_3)_3\ (aq) + 3Na_2CO_3\ (aq) \rightarrow Fe_2(CO_3)_3\ (s) + 6NaNO_3\ (aq)$$

Answer: 1.85 M

$$15.8g\left(\frac{1mol}{291.7176g}\right)$$

$$= 0.054162\ mol\ Fe_2(CO_3)_3\left(\frac{2mol\ Fe(NO_3)_3}{1mol\ Fe_2(CO_3)_3}\right)$$

$$= \frac{0.108324\ mol\ Fe(NO_3)_3}{0.0587\ L}$$

$$= 1.8454\ \frac{mol}{L}$$

5.) Complete and balance the following reactions. If no reaction will occur, write "No Rxn".

a.) $2Al + 3CuBr_2 \rightarrow 3Cu + 2AlBr_3$

b.) $Fe + H_2O\ (l) \rightarrow$ no rxn

c.) $Mg + 2HNO_3 \rightarrow H_2 + Mg(NO_3)_2$

d.) $Ba + 2H_2O\ (g) \rightarrow H_2 + Ba(OH)_2$

e.) $Pb + ZnCl_2 \rightarrow$ no rxn

6.) A compound made of only hydrogen and carbon is burned to form 11.0g CO_2 (44.0098g/mol) and 2.25g H_2O (18.01528g/mol). What is the empirical formula of the compound?

Answer: C H

$$C: 11.0g\ CO_2\left(\frac{1mol}{44.0098g}\right) = 0.24994mol\ CO_2\left(\frac{1mol\ C}{1mol\ CO_2}\right)$$
$$= 0.24994\ mol\ C$$

$$H: 2.25g\ H_2O\left(\frac{1mol}{18.01528g}\right) = 0.12489mol\ H_2O\left(\frac{2\ mol\ H}{1mol\ H_2O}\right)$$
$$= 0.249788\ mol\ H$$

$$C: \frac{0.24994}{0.249788} = 1.0006 \qquad H: \frac{0.249788}{0.249788} = 1$$

7.) For the reaction $\overset{0}{K} + \overset{+3}{FeCl_3} \rightarrow \overset{0}{Fe} + \overset{+1}{3KCl}$

a.) Write the oxidation half reaction: $K \rightarrow K^+ + 1e^-$

b.) Write the reduction half reaction: $Fe^{3+} + 3e^- \rightarrow Fe$

If a solution of Na_2SO_4 is reacted with a solution of $Ba(NO_3)_2$:

c.) Write the balanced chemical equation, including the phases of matter for each compound.

$$Na_2SO_4(aq) + Ba(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + BaSO_4(s)$$

d.) Write the **net** ionic equation, including the phases of matter for each species.

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