Exam3

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.) A chemist has synthesized some TNT ($C_7H_5N_3O_6$). Based on their stoichiometry calculations, they could have made 5.00g. Their product had a mass of 3.58g. What was their percent yield? 1.) B

a.) 140% b.) 71.6% c.) 28.4% d.) 39.7%

$\left(\frac{3.58g}{5.00g}\right)100 = 71.6\%$

2.) What is the oxidation number on chlorine in $HClO_2$? 2.) A

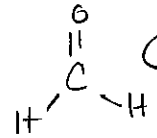
a.) +3 b.) +2 c.) +1 d.) −3 e.) −2 f.) −1

O = −2 H = +1 $-2(2) = -4 + 1 = -3$ $-3 + Cl = 0$ Cl = +3

3.) What is the strongest type of intermolecular force that can be used by formaldehyde (CH_2O)? 3.) B

a.) hydrogen bonding b.) dipole–dipole interactions

c.) dispersion forces d.) covalent bonds



4.) In the reaction to form water $2H_2 + O_2 \rightarrow 2H_2O$, how many moles of water could be made from 8 moles of hydrogen gas and 6 moles of oxygen gas? 4.) D

a.) 4 b.) 12 c.) 3 d.) 8 e.) 16 f.) 6

$8\,mol\ H_2\left(\frac{2\,mol\,H_2O}{2\,mol\,H_2}\right) = 8\,mol\ H_2O$ limiting

$6\,mol\ O_2\left(\frac{2\,mol\,H_2O}{1\,mol\,O_2}\right) = 12\,mol\ H_2O$

5.) Which of the following would be soluble in water? 5.) C

a.) Ag_2SO_4 b.) $CuCO_3$ c.) Li_3PO_4 d.) C_6H_{14}

6.) Which of the following is most likely to be water soluble? 6.) A

a.) $CH_3CH_2–O–H$ b.) C_7H_{14} c.) $C_3H_7–O–C_3H_7$ d.) C_3H_7Br

H bonding

7.) If placed in water, which of the following would give the highest ion concentration? 7.) C

a.) 3 mol $Ca_3(PO_4)_2$ b.) 1 mol NaCl c.) 2 mol $Ba(NO_3)_2$ d.) 4 mol Ag_2SO_4

insoluble 2 mol ions 6 mol ions insoluble

8.) What would be the molarity of a solution made from 0.578g lithium oxide dissolved in 250mL water? 8.) D

Li_2O $2(6.941\,g/mol) + 15.9994\,g/mol = 29.8814\,g/mol$

a.) 2.31x10^−3 M b.) 7.74x10^−5 M c.) 2.31M d.) 0.0774M

$0.578g\left(\frac{1\,mol}{29.8814g}\right) = 0.019343\,mol / 0.250L = 0.07737M$

9.) If 12.5mL of a 1.36M stock solution is diluted to 500.0mL, what is the concentration of the diluted solution? 9.) A

a.) 0.0340M b.) 54.4M c.) 0.0277M d.) 40.1M

$(1.36M)(12.5mL) = (X)(500.0mL)$ $X = 0.0340M$

10.) In the reaction Ni (s) + $Pb(NO_3)_2$ (aq) → Pb (s) + $Ni(NO_3)_2$ (aq), what is the oxidizing agent? 10.) C

+2 −1 0 +2 −1

a.) Ni b.) Pb^2+ c.) Pb d.) Ni^2+

11.) What is the strongest type of intermolecular attractive force that can be used by hexane (C_6H_{14})? 11.) C

a.) hydrogen bonding b.) dipole–dipole interactions

c.) dispersion forces d.) covalent bonds

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! SHOW ALL WORK. 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. For the reaction: $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$, if you combine 50.0g C_3H_8 (44.09652g/mol) and 75.0g O_2 (31.9988g/mol):

   a. What is your limiting reagent? Answer: O_2

   b. What is the theoretical yield of CO_2 (44.0098g/mol) in grams? Answer: 61.9g

C_3H_8: $50.0\text{g}\left(\frac{1\text{mol}}{44.09652\text{g}}\right) = 1.133876\text{ mol } C_3H_8\left(\frac{3\text{mol } CO_2}{1\text{mol } C_3H_8}\right) = 3.4016\text{ mol } CO_2$

O_2: $75.0\text{g}\left(\frac{1\text{mol}}{31.9988\text{g}}\right) = 2.34384\text{ mol } O_2\left(\frac{3\text{mol } CO_2}{5\text{mol } O_2}\right) = 1.4063\text{ mol } CO_2$

O_2 C_3H_8

$1.4063\text{ mol } CO_2 < 3.4016\text{ mol } CO_2$ so O_2 is the L.R.

$1.4063\text{mol } CO_2\left(\frac{44.0098\text{g}}{\text{mol}}\right) = 61.8911\text{g } CO_2$

2. If a titration required 25.78mL of 0.500M barium hydroxide to neutralize 54.78mL of phosphoric acid, what was the concentration (M) of the phosphoric acid?

$2\ H_3PO_4 + 3\ Ba(OH)_2 \rightarrow Ba_3(PO_4)_2 + 6H_2O$

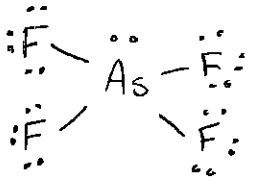
Answer: 0.159 M

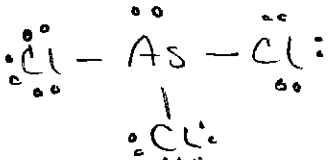
$0.02578\text{L}\left(\frac{0.500\text{mol } Ba(OH)_2}{\text{L}}\right) = 0.01289\text{ mol } Ba(OH)_2\left(\frac{2\text{mol } H_3PO_4}{3\text{mol } Ba(OH)_2}\right)$

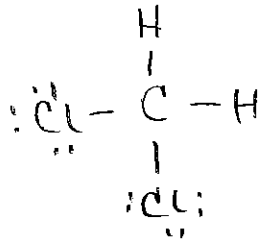
$= \frac{0.0085933\text{ mol } H_3PO_4}{0.05478\text{L}} = 0.15687\frac{\text{mol}}{\text{L}}$

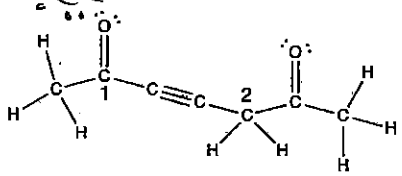
3. a.) For each of the following compounds, give the electron domain geometry, the molecular geometry, and state whether the compound is polar or nonpolar.

Compound	Electron Domain Geometry	Molecular Geometry	Polar or Nonpolar
AsF_4^{-1}	trigonal bipyramidal	seesaw	polar
$AsCl_3$	tetrahedral	trigonal pyramidal	polar
CH_2Cl_2	tetrahedral	tetrahedral	polar









b.) In the molecule above, what is the hybridization around atom 1? Answer: sp2

c.) In the molecule above, what is the hybridization around atom 2? Answer: sp^3

d.) How many sigma bonds are present in the molecule? Answer: 16

e.) How many pi bonds are present in the molecule? Answer: 4

4. What mass of lead (II) chloride (278.106g/mol) would be produced if 58.76mL of a 1.500M solution of sodium chloride was added to an excess of lead (II) nitrate?

$$2\ NaCl\ (aq) + Pb(NO_3)_2\ (aq) \rightarrow PbCl_2\ (s) + 2\ NaNO_3$$

Answer: 12.26g

$$0.05876\,L\left(\frac{1.500\,mol\ NaCl}{L}\right) = 0.08814\ mol\ NaCl\left(\frac{1\,mol\ PbCl_2}{2\,mol\ NaCl}\right)$$

$$= 0.04407\ mol\ PbCl_2\left(\frac{278.106\,g}{mol}\right) = 12.256\,g\ PbCl_2$$

5. a.) Complete and balance the following equation for a precipitation reaction. Include the phases of matter for the products.

$2KOH\,(aq) + Pb(NO_3)_2\,(aq) \rightarrow 2KNO_{3(aq)} + Pb(OH)_2\,(s)$

b.) Write the net ionic equation for the reaction in part a.

$2K^+_{(aq)} + 2OH^-_{(aq)} + Pb^{2+}(aq) + \cancel{2NO_3^-}\,(aq) \rightarrow \cancel{2K^+}(aq) + \cancel{2NO_3^-}(aq) + Pb(OH)_2\,(s)$

$2OH^-(aq) + Pb^{2+}(aq) \longrightarrow Pb(OH)_2\,(s)$

c.) For the reaction $2\,Na + SnCl_2 \rightarrow Sn + 2\,NaCl$

(0 +2 0 +1)

Write the reduction ½ reaction: $Sn^{2+} + 2e^- \rightarrow Sn$

Write the oxidation ½ reaction: $Na \rightarrow Na^+ + e^-$

Identify the reducing agent: Na

6. Complete and balance the following chemical equations. If there is no reaction, state NO RXN. You do not need to include the phases of matter. For cations with variable charges, use the charge shown on the activity series.

a.) $2K + MgCl_2 \rightarrow Mg + 2KCl$

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

Fe does not react w/ liquid (cold) water

c.) $Pb + AlCl_3 \rightarrow$ no rxn

Pb is below Al on activity series

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

e.) $2Cr + 6HNO_3 \rightarrow 3H_2\,(g) + 2Cr(NO_3)_3$

Cr^{3+} because that is the ion listed on the activity series