CHM1025 Exam 2 Review Solutions 8/2/20 Summer 2020

(1.) convert 200mg → g

4

$$200mg \times \frac{1g}{10^3 mg} = 0.200g$$

$$(x_g \text{ of } AgCl)(0.7527) = 0.200g$$

$$(x_g \text{ of } AgCl) = 0.200g\,(0.7527)$$

$$\boxed{x_g \text{ of } AgCl = 0.266g}$$

(2.) sodium bicarbonate

3

$NaHCO_3$

find total mass:

Na + H + C + 3O

$$(22.99g/mol) + (1.008g/mol) + (12.01g/mol) + 3(16.00g/mol) = 84.01g/mol$$

$$\% \text{ mass of O} = \frac{\text{mass of O in compound}}{\text{total mass of compound}} \times 100 =$$

$$= \frac{48g/mol}{84.01g/mol} \times 100 = \boxed{57.14\%}$$

(3.) Use mass of CO_2 and H_2O to find how many grams of C and H were in the unknown compound sample to find O. (We can't easily tell O from CO_2 and H_2O because combustion involves reacting with O_2 which could end up in our products)

5

$$26.76g\ H_2O \times \frac{1\ mol\ H_2O}{18g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} = 2.9733mol\ H \times \frac{1g\ H}{1mol\ H} = 2.9733g$$

$$196.26g\ CO_2 \times \frac{1mol\ CO_2}{44.01g\ CO_2} \times \frac{1mol\ C}{1mol\ CO_2} = 4.459441036\ mol\ C \times \frac{12.01g\ C}{1mol\ C} = 53.56g$$

68.42g sample = (mass H + mass C + mass O)

68.42g − 2.9733g H − 53.56g C = x g O → 11.89g O in sample

now find moles of C, H, O and divide by the smallest of the 3.

$$11.89g\ O \times \frac{1mol\ O}{16g\ O} = 0.743245612mol$$

H: 2.9733mol / 0.743245612mol ≈ 4

C: 4.459441036 mol / 0.743245612 mol ≈ 6

O: 0.743245612mol / 0.743245612mol = 1

empirical formula: C_6H_4O to get molecular formula, divide the known molar mass by the empirical formula's molar mass to get the factor

$$184.12 g/mol \,/\, 92.06 g/mol\ C_6H_4O = 2$$ so double the subscripts to get $\boxed{C_{12}H_8O_2}$;

So there's $\boxed{12 \text{ carbons}}$

④ [1] $5.2 g\ Al \times \frac{1 mol\ Al}{26.98 g\ Al} \times \frac{3 mol\ H_2}{2 mol\ Al} = 0.2891$ mol H_2

$6.1 g\ NaOH \times \frac{1 mol\ NaOH}{39.99 g\ NaOH} \times \frac{3 mol\ H_2}{2 mol\ NaOH} = 0.22881$ mol H_2

less H_2 produced so NaOH was the limiting reactant

$0.22881 mol\ H_2 \times \frac{2 g\ H_2}{1 mol\ H_2} = 0.4576$ g H_2

$\% \text{ yield} = \frac{\text{g collected (actual)}}{\text{theoretical yield}} \times 100$

$= 0.35g / 0.4576g \times 100 = \boxed{76.6\%}$

⑤ [3] chlorous acid : $HClO_2$ → 68.45g/mol

→ chlorite ion ClO_2^-

-ous → -ite

-ic → -ate

$40.3g\ HClO_2 \times \frac{1 mol\ HClO_2}{68.45g\ HClO_2} \times \frac{2 mol\ O}{1 mol\ HClO_2} \times \frac{6.022 \times 10^{23} \text{ atoms of O}}{1 mol\ O}$

$= \boxed{7.09 \times 10^{23} \text{ atoms of O}}$

⑥ [3] (1) combination involves taking two or more elements/compounds and forming a single substance, in this case H_2O.

(2) combustion always involves reacting an organic substance with O_2 to yield H_2O and CO_2. Also if there's ever a reactant or product that's by itself (like just a metal solid like Na(s) or a diatomic like $O_2(g)$) it's always gonna be a redox!

(3) It's a combination rxn but a true ppt. reaction must form an insoluble salt; $MgCl_2(s)$ is actually soluble when you look at your solubility rules so nothing will precipitate

(4) Brønsted-Lowry Acid Base reactions simply involve transferring hydrogens from one reactant (acid) to the other (base) so HCl is the acid, NH_3 is the base

(5) This is both, since $CaSO_4(s)$ is actually insoluble, this counts as a ppt. rxn.

7. (1) the prefixes like di- or mono- or tri- aren't

5 used for ionic compounds like $Ni(OH)_2$, only for covalent compounds

↳ should be nickel (II) hydroxide

(2) Ca is not a transition metal so it never needs a (II) indication

↳ should be calcium carbonate

(3) though it is covalent, if the first atom is just one, you don't need to put mono- in front of it.

↳ should be carbon monoxide

(4) remember your polyatomics! -<u>ous</u> endings are for polyatomic ions that end in -<u>ite</u>. ClO_4^- is perchlor<u>ate</u> so

↳ $HClO_4$ should be perchlor<u>ic</u> acid

(5) Correct! anions like S^{2-}, Cl^-, F^-, Br^-, I^-, or O^{2-} don't need any prefixes when in ionic compounds.

8. $$3FeCl_2(aq) + 2K_3PO_4(aq) \rightarrow Fe_3(PO_4)_2(s) + 6KCl(aq)$$

$$3Fe^{2+}(aq) + \cancel{6Cl^-}(aq) + \cancel{6K^+}(aq) + 2PO_4^{3-}(aq) \rightarrow Fe_3(PO_4)_2(s) + \cancel{6K^+}(aq) + \cancel{6Cl^-}(aq)$$

$$\boxed{3Fe^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Fe_3(PO_4)_2(s)}$$

9. Ground-State of Cu* [Ar] $4s^1\ 3d^{10}$

* for Cr, Mo, Cu, and Ag, their configurations take 1 s electrons and puts it in the d orbital.

Cu^+ loses 1 electron, remember when you remove electrons from transition metals, you remove from the s orbitals before the d orbitals.

so $\boxed{Cu^+: [Ar]\ 3d^{10}}$

(10) The neutral atom that fits the configuration is $\boxed{Ar}$ since its in the 3p orbital and has 6 electrons in it. So that's why it fits with the $3p^6$ description.

The cation with a single charge means its missing one electron. So $\boxed{Na^+}$ would also share the same configuration since its $4s^1$ electron is removed and then it's only left with electrons in the 3p orbital like Ar.

The anion with a single charge means it has gained an electron and so $\boxed{Cl^-}$ would also fit since it goes from $3p^5$ to $3p^6$ like Ar when it gains an electron.

(11) IE increases → and ↑ so each option looks like it won't work, except O has a lower IE than N since it doesn't follow the trend. B, Al, O, S all have lower IE's than the element before it.

$\boxed{3}$

(12.) % m/m is $\frac{\text{mass of solute}}{\text{mass of solution}} \times 100$

3 Molarity is $\frac{\text{moles of solute}}{\text{volume of solution (in L)}}$

so just convert % into grams 47% → 47g

47% m/m isopropanol in acetone

↓

$\frac{\text{47g iso.}}{\text{47g iso. + 53g acetone}}$ } remember is mass of solution
also we know acetone because 47+53=100%
(needs to add to 100)

to get this into M,

1) we need to turn the top into moles then

2) turn the g of solution into L of solution.

3 divide

1) $47\text{g iso.} \times \frac{1\text{ mol iso.}}{60.1\text{g iso.}} = 0.7821\text{ mol isopropanol}$

2) use densities to find volumes

$47\text{g iso.} \times \frac{1\text{ mL}}{0.785\text{g iso.}} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.05987\text{ L iso.}$

$53\text{g acetone} \times \frac{1\text{ mL}}{0.791\text{g acetone}} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.067\text{ L acetone}$

3) $\frac{0.7821\text{ mol iso.}}{(0.05987\text{L iso.} + 0.067\text{L acetone})} = \boxed{6.16\text{ M}}$

(13.) $H_2O(l) + NH_4^+(aq) \rightleftharpoons \underbrace{H_3O^+(aq)}_{\text{conjugate acid}} + \underbrace{NH_3(aq)}_{\text{conjugate base}}$

(14.) molar mass of lactic acid

5 $(3 \times 12.01\text{g} + 3 \times 16.00\text{g} + 6 \times 1.008\text{g}) = 90.08\text{g/mol}$

$42\text{g} \times \frac{1\text{ mol}}{90.08\text{g}} \times \frac{6.022 \times 10^{23}\text{ molecules of lactic acid}}{1\text{ mol}} = \boxed{2.81 \times 10^{23}\text{ molecules}}$

(15.) $C_3H_8 + 5O_2 \longrightarrow 4H_2O + 3CO_2$

12 $27g \text{ propane} \times \frac{1 \text{ mol propane}}{44.09g \text{ propane}} \times \frac{4 \text{ mol } H_2O}{1 \text{ mol propane}} = 2.45 \text{ mol } H_2O$

$1.3 \text{ moles } O_2 \times \frac{4 \text{ mol } H_2O}{5 \text{ mol } O_2} = 1.04 \text{ mol } H_2O$ ← O_2 is limiting

$1.04 \text{ mol } H_2O \times \frac{18g\ H_2O}{1 \text{ mol } H_2O} = 18.72g\ H_2O$

$\% \text{ yield} = 14.2g / 18.72g \times 100 = \boxed{75.85\%}$

(16.) $M_1V_1 = M_2V_2$

1) $(5.0M)(30mL) = (0.150M)(V_2)$

$V_2 = \boxed{1{,}000 ml \text{ or } 1L}$

2) $(0.150M)(10mL) = (M_2)(100mL)$

$\boxed{M_2 = 0.015M}$