Matter and Chemical Bonding Review

MULTIPLE CHOICE

1.D 2.D 3..B 4.A 5.C 6.A 7.E 8.E

SHORT ANSWER

9.

Chemical Formula	**IUPAC Name**
(a) $NaClO_3$	Sodium chlorate
(b) $Mg(NO_2)_2$	Magnesium nitrite
(c) HI	Hydrogen iodide
(d) H_2O_2	Hydrogen peroxide
(e) CCl_4	Carbon tetrachloride

10.

oxygen sodium boron neon

11. To obtain a full valence shell, hydrogen atoms will form covalent bonds with one another. Nitrogen will do the same with itself, in order to give each atom a stable octet.

H—H :N ≡ N:

12. $2Na_{(s)} + 2HOH_{(l)} \rightarrow H_{2(g)} + 2NaOH_{(aq)}$

13. $Na_2SO_{4(aq)} + Pb(NO_3)_{2(aq)} \rightarrow PbSO_{4(s)} + 2NaNO_{3(aq)}$ Double Displacement Reaction

14. -Brittle: if lattice is shifted by an impact, like charges are forced next to each other and repel.
-Relatively strong attraction between ions: the ionic bonds must be overcome to a large degree to break down the crystal lattice and allow the substance to melt.
-Ions arrange themselves so that there is maximum proximity to ions of opposite charge, but maximum distance from ions of same charge. A crystal lattice is formed and ordered particles result in a solid.

16. a) CO_2, CH_4, CCl_4 b) HCl, HF, CH_3Cl, H_2O

17. London Dispersion Forces: CO_2, CH_4, CCl_4

Dipole-dipole Forces and London Dispersion Forces: HCl, CH_3Cl

Hydrogen Bonding and London Dispersion Forces: H_2O, HF

Quantities in Chemical Reactions Review

MULTIPLE CHOICE

1.D 2.B 3.D 4.A

PROBLEM

5. m_{Mg} = 24.30 u x 1 atoms = 24.30 u
m_O = 16.00 u x 2 atoms = 32.00 u
m_H = 1.01 u x 2 atoms = 2.02 u
m_{total} = 58.32 u

$$\%Mg = \frac{24.30 \text{ u}}{58.32 \text{ u}} \times 100\% = 41.67\%$$

$$\%O = \frac{32.00 \text{ u}}{58.32 \text{ u}} \times 100\% = 54.87\%$$

$$\%H = \frac{2.02 \text{ u}}{58.32 \text{ u}} \times 100\% = 3.46\%$$

The percentage composition, by mass, of $Mg(OH)_2$ is 41.67% magnesium, 54.87% oxygen, and 3.46% hydrogen.

6.

m_C = 10.06% □ 100.0 g C = 10.06 g $\quad$ M_C = 12.01 g/mol
m_{Cl} = 89.10% □ 100.0 g Cl = 89.10 g $\quad$ M_{Cl} = 35.50 g/mol
m_H = 0.84% □ 100.0 g H = 0.84 g $\quad$ M_H = 1.01 g/mol

$$n_C = 10.06 \text{ g} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = 0.84 \text{ mol}$$

$$n_{Cl} = 89.10 \text{ g} \times \frac{1 \text{ mol}}{35.50 \text{ g}} = 2.51 \text{ mol}$$

$$n_H = 0.84 \text{ g} \times \frac{1 \text{ mol}}{1.01 \text{ g}} = 0.83 \text{ mol}$$

The molar ratio for C:Cl:H is 0.84:2.51:0.83. Dividing by 0.83 to obtain the lowest ratio, we obtain the molar ratio of 1:3:1. The empirical formula of the compound is CCl_3H.

$$\text{empirical formula mass} = 12.01 \text{ u} + (3 \times 35.50 \text{ u}) + 1.01 \text{ u} = 119.52 \text{ u}$$

$$\frac{\text{molecular mass}}{\text{empirical formula mass}} = \frac{119.6 \text{ u}}{119.52 \text{ u}} = 1$$

The molecular formula of the compound is CCl_3H.

7.

mole ratio: $\quad$ $AlCl_3$:NaCl = 1:3

$$n_{AlCl_3} = 4.46 \text{ g} \times \frac{1 \text{ mol}}{133.33 \text{ g}} = 3.34 \times 10^{-2} \text{ mol}$$

$$n_{NaCl} = 3.34 \times 10^{-2} \text{ mol } AlCl_3 \times \frac{3 \text{ mol NaCl}}{1 \text{ mol } AlCl_3} = 0.100 \text{ mol}$$

$$m_{NaCl} = 0.100 \text{ mol} \times \frac{58.44 \text{ g}}{1 \text{ mol}} = 5.86 \text{ mol}$$

The mass of sodium chloride that can be obtained is 5.86 g.

8. We can determine the number of moles of chlorine needed to react completely with 15.9 g of Na.

$$n_{Na} = 15.9 \text{ g} \times \frac{1 \text{ mol}}{22.99 \text{ g}} = 0.692 \text{ mol}$$

mole ratio: $\quad$ Na:Cl_2 = 2:1

$$n_{Cl_2} \text{ needed} = 0.692 \text{ mol Na} \times \frac{1 \text{ mol } Cl_2}{2 \text{ mol Na}} = 0.346 \text{ mol}$$

$$n_{Cl_2} \text{ available} = 27.4 \text{ g} \times \frac{1 \text{ mol}}{70.90 \text{ g}}$$

$$= 0.386 \text{ mol}$$

More chlorine is available than is required, therefore, chlorine is in excess. The sodium is the limiting reagent.

$$n_{Na} = 0.692 \text{ mol}$$

mole ratio: Na:NaCl = 1:1

$$n_{NaCl} = n_{Na}$$

$$= 0.692 \text{ mol}$$

$$m_{NaCl} = 0.692 \text{ mol} \times \frac{58.44 \text{ g}}{1 \text{ mol}}$$

$$= 40.4 \text{ g}$$

The theoretical yield of the NaCl is 40.4 g.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

$$= \frac{36.9 \text{ g}}{40.4 \text{ g}} \times 100\%$$

$$= 91.3\%$$

The percentage yield is 91.3%.

ANSWERS: **1.** Avogadro's number is 6.02 x 10^{23} and it represents the number of particles in one mole. **2**. 3.69 g **3.** Molar mass = 44.009 g/mol **4**. % O = 94.1% H = 5.9% **5.** 6.38 g **6.** a) Hydrogen is LR b) 4 mol HCl **7.** a) 5.11 g b) 13%

Solutions and Solubility Review

MULTIPLE CHOICE

1.E 2.E 3.C 4.A

PROBLEM

5. $m_{Na_3PO_4} = 150.0 \text{ g}$

$C_{Na_3PO_4} = 0.23 \text{ mol/L}$

$M_{Na_3PO_4} = 163.94 \text{ g/mol}$

$$n_{Na_3PO_4} = 150.0 \text{ g} \times \frac{1 \text{ mol}}{163.94 \text{ g}}$$

$$= 0.9150 \text{ mol}$$

$$v_{Na_3PO_4} = \frac{0.9150 \text{ mol}}{0.23 \text{ mol/L}}$$

$$= 4.0 \text{ L}$$

The volume of the solution will be 4.0 L.

6. $v_f = 2.0\ \text{L}$ $\quad v_iC_i = v_fC_f$

$C_i = 17.4\ \text{mol/L}$

$C_f = 1.5\ \text{mol/L}$

$$v_{i\,(\text{acetic acid})} = \frac{v_fC_f}{C_i}$$

$$= \frac{2.0\ \text{L} \times 1.5\ \text{mol/L}}{17.4\ \text{mol/L}}$$

$$= 1.7 \times 10^{-1}\ \text{L}$$

$$= 1.7 \times 10^{2}\ \text{mL}$$

The volume of the stock acetic solution needed is 1.7 x 10^2 mL.

7. $3BaCl_{2(aq)}$ + $Fe_2(SO_4)_{3(aq)}$ → $3BaSO_{4(s)}$ + $2FeCl_{3(aq)}$

100.0 mL	100.0 mL	*m*
0.100 mol/L	0.100 mol/L	

$$n_{BaSO_4} = 0.100\ \text{L} \times 0.100\ \text{mol/L BaCl}_2 \times \frac{3\ \text{mol BaSO}_4}{3\ \text{mol BaCl}_2}$$

$$= 0.01\ \text{mol}$$

$$m_{BaSO_4} = 0.01\ \text{mol} \times \frac{233.39\ \text{g}}{1\ \text{mol}}$$

$$= 2.3\ \text{g}$$

The theoretical mass of barium sulfate is 2.3 g.

$$\%\ \text{yield BaSO}_4 = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$= \frac{2.0\ \text{g}}{2.3\ \text{g}} \times 100$$

$$= 87\ \%$$

The % yield of the barium sulfate precipitate was 87%.

8. $[H^+_{(aq)}] = 10^{-pH}$

$$= 10^{-7.5}\ \text{mol/L}$$

$$= 3.2 \times 10^{-8}\ \text{mol/L}$$

The hydrogen ion concentration of the swimming pool is 3.2 x 10^{-8} mol/L.

9. $H_2SO_{4(aq)}$ + $2NaOH_{(aq)}$ □ $Na_2SO_{4(aq)}$ + $2H_2O_{(l)}$

10.00 mL	8.66 mL
C	0.00512 mol/L

$$n_{NaOH} = 8.66\ \text{mL} \times \frac{0.0512\ \text{mol}}{1\ \text{L}}$$

$$= 0.4434\ \text{mmol}$$

$$n_{H_2SO_4} = 0.4434\ \text{mmol} \times \frac{1}{2}$$

$$= 0.2217\ \text{mmol}$$

$$C_{H_2SO_4} = \frac{0.2217 \text{ mmol}}{10.00 \text{ mL}}$$
$$= 0.02217 \text{ mol/L}$$

The sulfuric acid concentration in the lake is 2.22 x 10^{-2} mol/L.

$$pH = -\log[H^+_{(aq)}]$$
$$= -\log(0.02217)$$
$$= 1.654$$

The pH of the lake water is 1.65.

10. $pH = -\log[H^+_{(aq)}]$

$$= -\log[3.12 \times 10^{-5}]$$
$$= 4.506$$

The pH of beer is 4.506.

Unit 4: Organic Chemistry Review

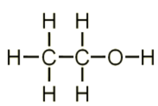
Multiple Choice: *Identify the letter of the choice that best completes the statement or answers the question.*

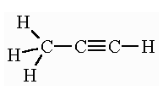
1. A 2. B 3. B 4. D 5 C 6. C

Problems

7. Give the IUPAC name for each of the following:
a) propane b) 3-heptene c) butanal d) 2-pentanol

8. Draw structural diagrams for the following compounds:
a) Ethanol b) propyne c) hexanoic acid





d) 2-butanone

e) propanal

f) 3-heptene

g) ethanoic acid

h) 2-butanol