Chemistry 11 – Course Review

Introduction to Chemistry

1. 0.0006 mm = ? μm

Answer _____

2. 0.054 mL = ? nL

Answer _____

3. 3.5 μg/L = ? mg/mL

Answer _____

4. The density of iron is 7860 g/L. Calculate the mass of a 3.2 mL sample of iron.

Answer _____

5. Manganese has a density of 7.20 g/mL. Calculate the volume occupied by a 4.0 kg piece of manganese.

Answer _____

6. A 0.0460 L piece of copper has a mass of 410.32 g. Calculate the density of copper in g/mL.

Answer _____

7. Give the number of significant digits in each of the following. Assume they are all measurements.

a) 0.0023 ....._____ d) 3.2×10^{-4} ....._____

b) 3953 000 ....._____ e) 50020.000 ....._____

c) 1.0200×10^{5} ....._____ f) 3450 ....._____

8. Perform the following calculations and round the answers off to the correct number of significant digits as justified by the data. Assume all numbers are measurements.

a) 2.1500×0.31 ....._____ f) $8.90 \times 10^{3} \div 4.400 \times 10^{-6}$ ....._____

b) $0.05 + 394.7322$ ....._____ g) $83.00 \div 1.2300 \times 10^{2}$ ....._____

c) $4.905 \times 10^{6} \div 4 \times 10^{-2}$..._____ h) $98.0076 - 2.195$ ....._____

d) $(3.33 \times 9.52) + 13.983$.._____ i) $0.00000200 \times 245.912$ ....._____

e) $3.813 + 98.98 + 2.669$.._____ j) $5.802 \div 6.21 + 2.41 \div 9.2565$..._____

9. Round the following numbers to 2 significant digits. (4 marks)

a) 2 000 000 000....._____ c) 3.88945×10^{28} ....._____

b) 106 000 ....._____ d) 0.000 000 7895 ....._____

Properties of Matter

1. Define: Observation, Interpretation, Qualitative, Quantitative, Data, Experiment, Hypothesis, Theory, Laws, Matter, Chemistry, Physical and Chemical Properties, Malleability, Ductility, Lustre, Viscosity and Diffusion.

2. Classification of Matter: Draw a diagram showing the relationship between the following words.. Make sure you can define each classification. (element, atom, molecule, ion, particle, pure substance, mixture, solution, solvent, solute, aqueous)

4. Define a physical change –

   Give some examples of physical changes.

5. Define a chemical change –

   Give some examples of chemical changes.

Names and Formulas for Compounds

1. Write the correct formula for the following compounds:

   a) ammonium chlorate ..... _____

   b) copper (II) sulphite..... _____

   c) zinc carbonate tetrahydrate ..... _____

   d) nitric acid ..... _____

   e) phosphorus pentaiodide ..... _____

   f) iron (III) thiocyanate..... _____

   g) sulphuric acid..... _____

   h) dinitrogen tetrafluoride ..... _____

2. Write the correct names for the following compounds:

   a) $Mn(SO_4)_2$ ..... _____

   b) $PbCrO_4 \cdot 6H_2O$ ..... _____

   c) As_2O_3 ..... _____

   d) CH_3COOH ..... _____acid

   e) $Ni_2(C_2O_4)_3$ ..... _____

   f) NF_3 ..... _____

   g) $(NH_4)_2HPO_4$ ..... _____

   h) $Ba(OH)_2 \cdot 10H_2O$..... _____

The Mole Concept

1. Make the following conversions, clearly showing your steps. Include proper units in all of your work and in your answer.

   a) 133.44 grams of PCl_5 = ? moles

   Answer _____

   b) 0.00256 moles of $Li_2Cr_2O_7$ = ? grams

   Answer _____

   c) 170.24 L of NO_2 at STP = ? moles

   Answer _____

   d) 570.625 g of PCl_3 gas = ? L (STP)

   Answer _____

   e) 1030.4 mL of C_2H_6 gas at STP = ? g

   Answer _____

f) 5.00 kg of nitrogen gas = ? L (STP)

Answer _____

g) 0.5696 kg of $CH_{4(g)}$ = ? mL (STP)

Answer _____

2. The density of liquid ethanol (C_2H_5OH) is 0.790 g/mL. Calculate the number of molecules in a 35.0 mL sample of liquid ethanol. (NOTE: You CAN'T use 22.4 L/mol since this is NOT a gas at STP!)

Answer _____

3. A 100.0 mL sample of liquid mercury contains 6.78 moles. Calculate the density of liquid mercury from this data.

Answer _____

4. Calculate the density of $PCl_{3(g)}$ at STP.

Answer _____

5. a) The density of a gas at STP is 4.955 g/L. Calculate the molar mass of this gas.

b) The gas is an oxide of selenium. Determine the molecular formula.

Answer _____

6. Find the percent composition (% by mass of each element) in the following compound: $Sr_3(PO_4)_2$. Show your work.

Answer _____%Sr, _____%P, _____%O

7. A compound was analyzed and the following results were obtained:
Molar mass: 270.4 g/mol
Mass of sample: 162.24 g
Mass of potassium: 46.92 g
Mass of sulphur: 38.52 g
Mass of oxygen: the remainder of the sample is oxygen

a) Determine the mass of oxygen in the sample.

Answer _____

b) Determine the empirical formula for this compound.

Answer: Empirical Formula: _____

c) Determine the molecular formula for this compound.

Answer: Molecular Formula: _____

8. 123.11 g of zinc nitrate, $Zn(NO_3)_2$ are dissolved in enough water to form 650.0 mL of solution. Calculate the $[Zn(NO_3)_2]$) Include proper units in your work and in your answers.

Answer _____

9. Calculate the mass of potassium sulphite (K_2SO_3) needed to make 800.0 mL of a 0.200 M solution of K_2SO_3. Include proper units in your work and in your answers.

Answer _____

10. What volume of 2.50 M Li_2CO_3 would need to be evaporated in order to obtain 47.232 g of solid Li_2CO_3? Include proper units in your work and in your answers.

Answer _____

11. 150.0 mL of water are added to 400.0 mL of 0.45 M HNO_3 . Calculate the final $[HNO_3]$. Include proper units in your work and in your answers.

Answer _____

12. What volume of water needs to be added to 150.0 mL of 4.00 M H_2SO_4 in order to bring the concentration down to 2.50 M? Include proper units in your work and in your answers.

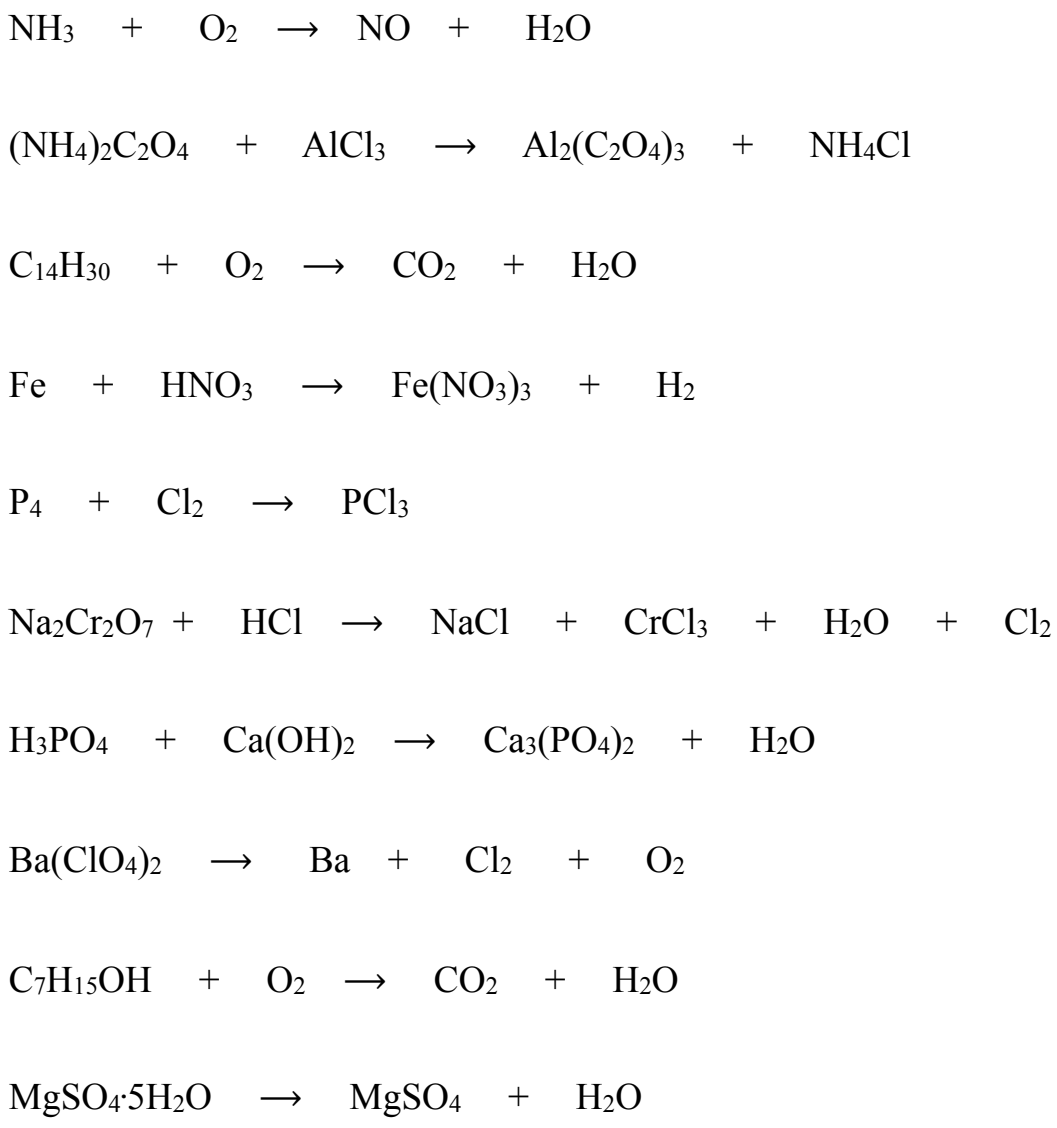
Answer _____

13. Give directions on how to make 5.00 L of 0.020 M $Ca(ClO)_2$ using solid $Ca(ClO)_2$ and water. Include proper units in your work and in your answers.

Directions:

Chemical Reactions

1. Balance the following equations



2. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

a) potassium sulphate is mixed with cobalt (III) nitrate

b) liquid propanol (C_3H_7OH) is burned in air

c) ammonium nitrate is decomposed into it's elements

d) a piece of zinc is placed in a test-tube containing a solution of silver nitrate

e) bromine reacts with sodium iodide

f) bromine reacts with aluminum

g) rubidium reacts with chlorine gas

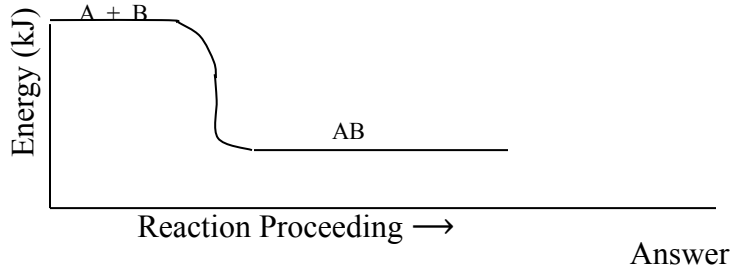
h) hydrochloric acid reacts with strontium hydroxide

3. State whether each of the following are ***exothermic*** or ***endothermic***.

$HCl + 432\ kJ \longrightarrow H + Cl$ Answer _____

$C_{12}H_{22}O_{11} + 12\ O_2 \longrightarrow 12CO_2 + 11H_2O$ $\Delta H = -5638\ kJ$ Answer _____

$H_2O_{(s)} \longrightarrow H_2O_{(l)}$ Answer _____



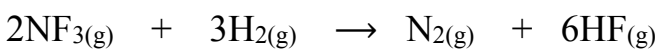
Answer _____

$CD \longrightarrow C + D$ $\Delta H = 65.7\ kJ$ Answer _____

$E + F + 437\ kJ \longrightarrow G + H$ Answer _____

Stoichiometry

1. Given the following balanced equation, answer the questions following it:



$$2NF_{3(g)} + 3H_{2(g)} \longrightarrow N_{2(g)} + 6HF_{(g)}$$

a) If 5.5 moles of H_2 are reacted, how many moles of NF_3 will be consumed?

Answer _____

b) In order to produce 0.47 moles of HF, how many moles of NF_3 would be consumed?

Answer _____

c) If you needed to produce 180.6 g of N_2, how many moles of H_2 would you need to start with?

Answer _____

d) If you completely react 17.04 g of NF_3 , what mass of HF will be produced?

Answer _____

2. Given the following balanced equation, answer the questions following it:

$$HBrO_3 + 5\ HBr \longrightarrow 3\ H_2O_{(l)} + 3\ Br_{2(g)}$$

a) If 3.56 moles of HBr are reacted, how many Litres of Br_2 will be formed at STP?

Answer _____

b) In order to produce 3.311×10^{24} molecules of Br_2, what mass of HBr is needed?

Answer _____

3. Given the following balanced chemical equation, answer the question below it.

$$MgCO_{3\,(s)} + 2HCl_{\,(aq)} \longrightarrow CO_{2\,(g)} + H_2O_{\,(l)} + MgCl_{2(aq)}$$

a) What mass of $MgCO_3$ will react completely with 15.0 mL of 1.5 M HCl?

Answer _____

b) Calculate the volume of 2.0 M HCl which would be needed to react completely with 37.935 grams of magnesium carbonate.

Answer _____

4. Given the following balanced equation, answer the questions below it.

$$Ba(OH)_{2(aq)} + 2\,HNO_{3(aq)} \longrightarrow 2\,H_2O_{(l)} + Ba(NO_3)_2$$

a) In a titration, 18.20 mL of 0.300 M $Ba(OH)_2$ is required to react completely with a 25.0 mL sample of a solution of HNO_3. Find the [HNO_3].

Answer _____

b) In a titration, 11.06 mL of 0.200 M HNO_3 is required to react completely with a sample of 0.250M $Ba(OH)_2$. Find the volume of the $Ba(OH)_2$ sample.

Answer _____

5. Given the following balanced equation, answer the questions below it.

$$3\,Cu_{(s)} + 8HNO_{3(l)} \longrightarrow 3\,Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4\,H_2O_{(l)}$$

a) If 317.5 grams of Cu are placed into 756.0 grams of HNO_3, determine which reactant is in excess.

Answer _____

b) If the reaction in (a) is carried out, what mass of NO will be formed?

Answer _____

6. Given the balanced equation: $2BN + 3F_2 \longrightarrow 2BF_3 + N_2$

When 161.2 grams of BN are added to an excess of F_2, a reaction occurs in which 326.118 grams of BF_3 are formed.

a) Calculate the *theoretical* yield of BF_3 in grams.

Answer _____

b) Calculate the *percentage* yield of BF_3.

Answer _____

7. When reacting NH_3 with O_2 according to the reaction:

$$4\ NH_3 + 5\ O_2 \longrightarrow 4\ NO + 6\ H_2O$$

Using 163.2 grams of NH_3 with an excess of O_2 produces a 67% yield of NO.

a) Calculate the *theoretical yield* of NO in grams.

Answer _____

b) Calculate the *actual yield* of NO in grams.

Answer _____

Atoms, Periodic Table and Bonding

1. The Greek who developed the idea of atoms was _____.

2. Consider the following ideas:
   - ➢ Compounds are made up of molecules which are combinations of atoms
   - ➢ All atoms of an element are the same
   - ➢ Atoms of different elements are different
   - ➢ Atoms are indivisible particles

   Who came up with these ideas? _____ He called the ideas, the

   _____ Theory.

3. _____ measured the charge/mass ratio of an electron and came up with the so-called "plum pudding" model of the atom.

4. _____ devised the Scattering Experiment, which showed that all atoms had a small dense _____.

5. Bohr came up with an atomic model to explain the spectrum of _____.

   He said that the atom has certain _____ levels which are allowed. These levels corresponded to _____ in which electrons move. If an electron absorbs a certain photon of energy, it will jump to a _____ level. It will release this energy (in the form of _____) when it jumps back to a _____ level.

   What were two limitations of Bohr's atomic model?

6. Give the number of protons, neutrons and electrons in the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{194}Ir^{3+}$			
$^{202}Hg^{2+}$			
$^{125}Te^{2-}$			
^{263}Sg			
$^{2}H^{+}$			

7. Give the nuclear notation of the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
	105	157	103
	51	72	48
	33	42	36
	54	79	54
	94	150	91

8. Element "X" is composed of the following naturally occurring isotopes:

Isotope	% Abundance
^{79}X	50.69
^{81}X	49.31

Calculate the average atomic mass of element "X" to 3 decimal places.

Element "X" is actually the real element _____.

9. Regions in space occupied by electrons are called _____

10. The principal quantum number is given the letter ____ and refers to the _____ level.

11. Write the ground state electron configurations (eg. $1s^2\ 2s^2\ 2p^6$) for the following atoms or ions. You may use the core notation.

a) P

b) Mo

c) Se

d) Rb

e) Cl^-

f) Al^{3+}

g) K^+

h) S^{2-}

12. In order to become stable,

an atom of Sr will _____ ___ electrons and become the ion _____

an atom of As will _____ ___ electrons and become the ion _____

an atom of Al will _____ ___ electrons and become the ion _____

an atom of Se will _____ ___ electrons and become the ion _____

an atom of N will _____ ___ electrons and become the ion _____

an atom of I will _____ ___ electrons and become the ion _____

an atom of Cs will _____ ___ electrons and become the ion _____

an atom of Te will _____ ___ electrons and become the ion _____

13. Circle the metalloid: Be Rb Os Ge Pb Al

14. Circle the most reactive element in the following: Na Mg Si Al Ar

15. Circle the most reactive element in the following: Na K Rb Cs Li

16. Circle the most reactive element in the following: Cl Br I At Ne

17. Circle the element with the largest atomic radius of these: Na Mg Si Al Ar

18. Circle the element with the largest atomic radius of these: N P As Sb Bi

19. Circle the element with the largest ionization energy of these: K Ca Ga As Kr

20. Circle the element with the largest ionization energy of these: C Si Ge Sn Pb

21. What is meant by ionization energy?

24. Circle the element with the highest electronegativity of these: Mg Sr Ba Ra

25. Circle the element with the highest electronegativity of these: Mg Si S Cl

26. Circle the element with the highest electronegativity of these: F Cl Br I

27. What is meant by electronegativity?

28. Circle the most metallic element of these: Be Mg Ca Sr Ba

29. Circle the most metallic element of these: B Al Ga In Tl

30. Circle the most metallic element of these: Ga Ge Se Br Kr

31. In an ionic bond, electrons are
    a. shared equally by two atoms
    b. shared unequally by two atoms
    c. transferred from a metal to a non-metal
    d. transferred from a non-metal to a metal
    e. closer to one end of a molecule, forming a temporary dipole Answer _____

32. In a covalent bond, electrons are
    f. shared equally by two atoms
    g. shared unequally by two atoms
    h. transferred from a metal to a non-metal
    i. transferred from a non-metal to a metal
    j. closer to one end of a molecule, forming a temporary dipole Answer _____

33. In a polar covalent bond, electrons are
    k. shared equally by two atoms
    l. shared unequally by two atoms
    m. transferred from a metal to a non-metal
    n. transferred from a non-metal to a metal
    o. closer to one end of a molecule, forming a temporary dipole Answer _____

34. In London forces, electrons are
    p. shared equally by two atoms
    q. shared unequally by two atoms
    r. transferred from a metal to a non-metal
    s. transferred from a non-metal to a metal
    t. closer to one end of a molecule, forming a temporary dipole Answer _____

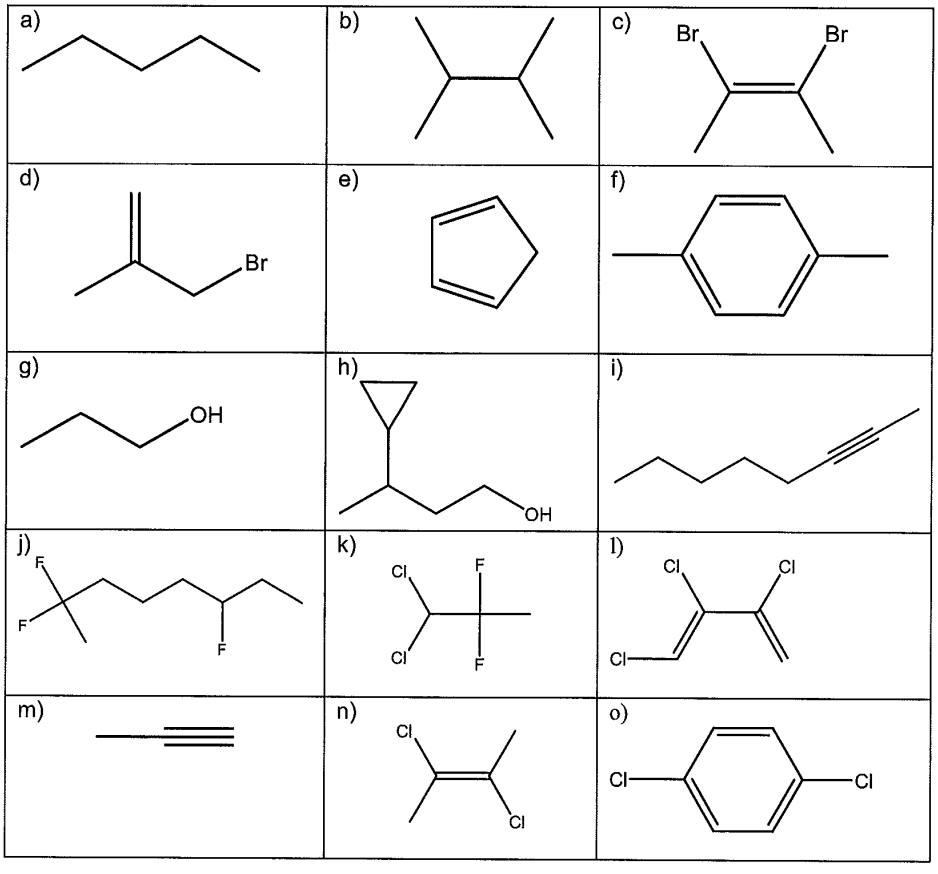
35. What evidence do we have that ionic bonds are very strong?

36. Write electron-dot diagrams for the following:
$MgCl_2$ (ionic) PBr_3(covalent) SeF_2(covalent) CH_3CH_2I(covalent)

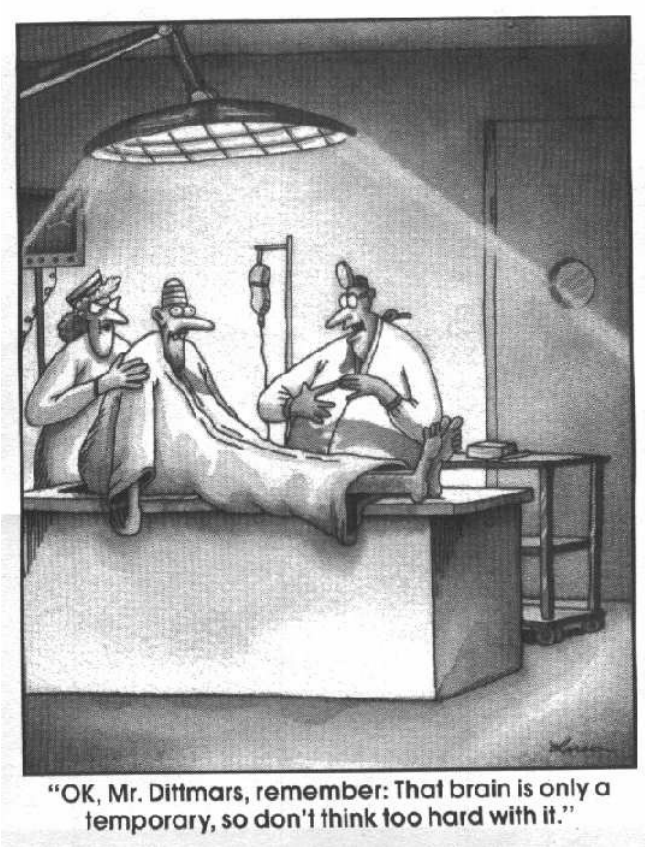
37. Predict the shape of $MgCl_2$ _____, PBr_3 _____ & SeF_2 _____

Organic Chemistry

1. List the 10 straight chain alkanes by name.
2. Draw:
   a. 1,3,3-trifluoro-2-pentanol
   b. *trans*-2-hexene
   c. 3,4,5,6-tetraethyl-nonane
   d. 2-octyne
   e. 3,5-diethyl-4-methyl-heptane
   f. cyclooctene
   g. 2-bromo-3-heptyne
   h. 3-chloro-1-cyclobutanol
   i. 1-ethyl-3-propyl-benzene
   j. 1,3-cyclohexadiene
   k. 2,2,3,3-tetrabromo-pentane
   l. cis-3-nonene
3. Draw and name all 9 isomers of C_5H_{10}
4. Name:



Remember…



Lab Safety Questions are also Fair game for the Final!!

Study Hard!

Solutions

Introduction to Chemistry

1. 0.6µm **2.** 5.4 x 10^{4}nL 10 **3.** 3.5 x 10^{-6} mg/mL **4.** 25 g **5.** 560 mL **6.** 8.92 g/mL **7.** a. 2 b. 4 c.5 d. 2 e. 8 f. 3 **8.** a. 0.67 b. 394.78 c. 1 x 10^{8} d. 45.7 e. 105.46 f. 2.02 x 10^{9} g. 0.6748 h. 95.813 i. 4.92 x 10^{-4} j. 1.195 **9.** a. 2.0 x 10^{9} b. 1.1 x 10^{5} c. 3.9 x 10^{28} d. 7.9 x 10^{-7} **10.** a. 1.9 g/mL b. 0.0 g c. Mass = 1.9 g/mL · volume d. 285 g e. 126 mL f. D = slope= 1.9 g/mL

Properties of Matter

1. See textbook or notes. **2**. See textbook or notes. **3**. a. Components have different melting points. Increase in temperature until only one boils. Vapour condensed to liquid. Other substances stay in the flask. b. Small amounts of ink, pigments, etc. c. filtration. d. immiscible, separatory e. Spins quickly. Dense materials forced outward to the bottom of the test tube. **4.** No new substance formed. Ex. melting ice, ripping paper, holding clay. **5.** New chemical substances formed. Eg: Burning, photosynthesis, neutralization, etc. **6.** a. Increase in temperature of the solid. b. Melting the solid. c. Warm up the liquid of substance "X". d. Boil the liquid. e. 43°C f. 77°C g. 3 h. gaseous i. All the E is being used for melting the solid. No E is available to warm the substance until melting is complete.

Names and Formulas for Compounds

1. a. NH_4ClO_3 b. $CuSO_3$ c. $ZnCO_3 \cdot 4H_2O$ d. HNO_3 e. PI_5 f. $Fe(SCN)_3$ g. H_2SO_4 h. N_2F_4 **2.** a. Manganese (IV) sulphate b. Lead (II) chromate hexahydrate c. Diarsenic trioxide d. Acetic acid e. Nickel (III) oxalate f. Nitrogen trifluoride g. Ammonium monohydrogen phosphate h. Barium hydroxide decahydrate

The Mole Concept

1. a. 0.64 mol b. 0.588 g c. 7.6 mol d. 92.96 L e. 1.38 g f. 4.00×10^3 L g. 7.97×10^5 mL **2.** 3.62×10^{23} molecules **3.** 13.6 g/mL **4.** 6.14 g/L **5.** a. 111 g/mol b. SeO_2 **6.** 58.04% Sr, 13.69% P, 28.27% 0 **7.** a. 76.8 g b. KSO_4 c. $K_2S_2O_8$ **8.** $[Zn(NO_3)_2]$ =1.000 M **9.** 25.328 g **10.** 0.256 L **11.** $[HNO_3]$ = 0.33 M **12.** 240.0 mL **13.** Add 14.31 g of Ca(ClO) to less than 5.00 L of water and dissolve. Add more water to a final volume of 5.00 L.

Chemical Reactions

1. a. 4, 5, 4, 6 b. 3, 2, 1, 6 c. 2, 43, 28, 30 d. 2, 6, 2, 3 e. 1, 6, 4 f. 14, 2, 2, 7, 3 g. 2, 3, 6 h. 1, 1, 1, 4 i. 2, 21, 14, 16 j. 1, 1, 5
2. a. $3\ K_2SO_4 + 2\ Co(NO_3)_3 \rightarrow Co_2(SO_4)_3 + 6\ KNO_3$ (D.R.)
   b. $2\ C_3H_7OH + 9\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$ (Comb.)
   c. $2\ NH_4NO_3 \rightarrow 2\ N_2 + 4\ H_2 + 3\ O_2$ (Dec.) d. $Zn + 2\ AgNO_3 \rightarrow 2\ Ag + Zn(NO_3)_2$ (S.R.)
   e. $Br_2 + 2\ NaI \rightarrow I_2 + 2\ NaBr$ (S.R.) f. $3\ Br_2 + 2\ Al \rightarrow 2\ AlBr_3$ (Syn.)
   g. $2\ Rb + Cl_2 \rightarrow 2\ RbCl$ (Syn.) h. $2\ HCl + Sr(OH)_2 \rightarrow 2\ H_2O + SrCl_2$ (Neut.)

3. a. endo b. exo c. endo d. exo e. endo f. endo **4.** a. 9396.67 kJ b. 2870.25 kJ c. 3758.67 kJ

Stoichiometry

1. a. 3.67 mol b. 0.157 mol c. 19.35 mol d. 14.4 g HF **2.** a. 47.85 L Br_2 b. 741.6 g HBr **3.** a. 0.948 g b. 0.450 L **4.** a. $[HNO_3]$ = 0.437 M b. 0.004424 L **5.** a. Cu in excess. b. 90.0 g **6.** a. 440.7 g BF_3 b. 74.0% **7.** a. 288.0 g NO b. 192.96 g

Atoms, Periodic Table and Bonding

1. Democritus **2.** John Dalton; Atomic **3.** J.J. Thompson **4.** Ernest Rutherford; nucleus **5.** a. Hydrogen; energy; orbitals (shells); higher; light (photons); lower b. Only worked for hydrogen; no evidence that e- travel in orbits.

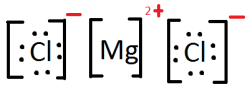
6.

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{194}Ir^{3+}$	77	117	74
$^{202}Hg^{2+}$	80	122	78
$^{125}Te^{2-}$	52	73	54

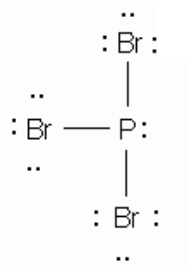
^{263}Sg	106	157	106
$^{2}H^{+}$	1	1	0

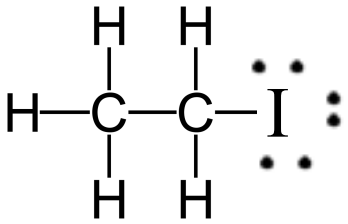
7. a. $^{262}_{105}Db^{2+}$ $^{23}_{51}Sb^{3+}$ c. $^{75}_{33}As^{3-}$ d. $^{133}_{54}Xe$ e. $^{244}_{94}Pu^{3+}$ **8.** 79.986 g/mol; Bromine **9.** orbitals **10.** n; energy **11.** a. [Ne] $3s^2\ 3p^3$ b. [Kr] $5s^2\ 4d^4$ c. [Ar] $4s^2\ 3d^{10}\ 4p^4$ d. [Kr] $5s^1$ e. [Ne] $3s^2\ 3p^6$ f. [He] $2s^2\ 2p^6$ g. [Ne] $3s^2\ 3p^6$ h. [Ne] $3s^2\ 3p^6$ **12.** lose, 2, Sr^{2+}; gain, 3, As^{3-}; lose, 3, Al^{3+}; gain, 2, Se^{2-}; gain, 3, N^{3-}; gain, 1, I^{-}; lose, 1, Cs^{+}; gain, 2, Te^{2-} **13.** Ge **14.** Na **15.** Cs **16.** Cl **17.** Na **18.** Bi **19.** Kr **20.** C **21.** Energy required to remove outermost e-. **22.** Pb **23.** Cs **24.** Mg **25.** Cl **26.** F **27.** The attraction an atom has for the e- of another atom. **28.** Ba **29.** Tl **30.** Ga **31.** c **32.** F **33.** l **34.** t **35.** High melting points.

36.

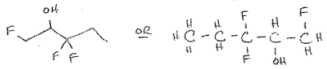


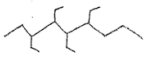
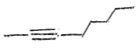
37. linear, trigonal pyramidal, bent

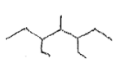


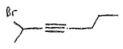


1. methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, decane

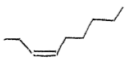
2. a)  b) 

c)  d) 

e)  f) 

g)  h) 

i)  j) 

k)  l) 

4. a) pentane
b) 2,3-dimethyl-butane
c) cis-2,3-dibromo-2-butene
d) 3-bromo-2-methyl-1-propene
e) 1,3-cyclopentadiene
f) 1,4-dimethyl-benzene
g) 1-propanol
h) 3-cyclopropyl-1-butanol
i) 2-octyne
j) 2,2,6-trifluoro-octane
k) 1,1-dichloro-2,2-difluoro-propane
l) 1,2,3-trichloro-1,3-butadiene
m) propyne
n) trans-2,3-dichloro-2-butene
o) 1,4-dichloro-benzene or para-dichloro-benzene

3. C_5H_{10} isomers: