Chemistry 11

Midterm Review Package

- Introduction to Chem. & Safety
- Organic Chemistry
- Measurement
- Matter & Naming
- The Mole
- Chemical Reactions

Name: KEY **Block:**_____

Unit 1: Measurement & Communication

B 32. Standards of measurement are chosen because they
a. can be related to everyday objects.
b. are reproducible in another laboratory.
c. cannot be destroyed by any common physical or chemical means.
d. are easily changed.

C 33. Which of these statements does *not* describe a measurement standard?
a. Measurement standards avoid ambiguity.
b. Measurement standards must be unchanging.
c. A standard can be easily changed to suit the experiment.
d. Confusion is eliminated when the correct measurement is applied.

C 34. Which of these statements about units of measurement is *not* true?
a. A unit compares what is being measured with a previously defined quantity.
b. A unit is usually preceded by a number.
c. Measurements can be compared without knowing their units.
d. The choice of unit depends on the quantity being measured.

C 35. Which of these is *not* an SI base unit?
a. kilogram
b. second
c. liter
d. Kelvin

D 36. The SI base units for length and time are
a. centimeter and second.
b. meter and hour.
c. centimeter and hour.
d. meter and second.

C 37. The metric unit for length that is closest to the diameter of a pencil is the
a. micrometer.
b. millimeter.
c. centimeter.
d. decimeter.

D 38. The symbols for units of length in order from largest to smallest are
a. m, cm, mm, km.
b. mm, m, cm, km.
c. km, mm, cm, m.
d. km, m, cm, mm.

C 39. Which of these metric units is used to measure mass?
a. m
b. mm
c. g
d. L

B 40. The liter is defined as
a. 1000 m^3.
b. 1000 cm^3.
c. 1000 g^3.
d. 1000 c^3.

D 41. The standard base unit for mass is the
a. gram.
b. cubic centimeter.
c. meter.
d. kilogram.

A 42. Which of these symbols represents a unit of volume?
a. mL
b. mg
c. mm
d. cm

D 43. Which of these is the abbreviation for the SI base unit of time?
a. hr
b. h
c. sec
d. s

C 44. The most appropriate SI unit for measuring the length of an automobile is the
a. millimeter.
b. kilometer.
c. meter.
d. liter.

D 45. All of the following are SI units for density *except*
a. kg/m^3.
b. kg/L.
c. g/cm^3.
d. g/m^2.

C 46. A change in the force of gravity on an object will affect its
a. mass.
b. density.
c. weight.
d. kinetic energy.

D 47. Which of these is a measure of the amount of material?
a. density
b. weight
c. volume
d. mass

D 48. Which of these statements about mass is true?
a. Mass is expressed in pounds or newtons.
b. Mass is usually measured with a spring scale.
c. The mass of an object depends on the force of gravity acting on it.
d. The mass of an object is determined by comparing it to an object of known mass.

C 49. The relationship between the mass *m* of a material, its volume *V*, and its density *D* is
a. $D = mV$.
b. $D = V/m$.
c. $D = m/V$.
d. $D = m + v$.

B 50. The density of an object is calculated by
a. multiplying its mass times its volume.
b. dividing its mass by its volume.
c. dividing its volume by its mass.
d. adding its mass to its volume.

C 51. When density is measured,
a. a graduated cylinder is always used.
b. the units are always kg/m^3.
c. the temperature should be specified.
d. the material must be a pure substance.

C 52. Which of these statements about density is true?
a. Larger objects are more dense.
b. Density does not depend on temperature.
c. Density is a physical property.
d. The density of an object depends on the force of gravity.

B 53. A sample of gold has a mass of 96.5 g and a volume of 5.00 cm^3. The density of gold is
a. 0.0518 g/cm^3.
b. 19.3 g/cm^3.
c. 101.5 g/cm^3.
d. 483 g/cm^3.

A 54. The density of pure diamond is 3.5 g/cm^3. What is the volume of a diamond with a mass of 0.25 g?
a. 0.071 cm^3
b. 0.875 cm^3
c. 3.75 cm^3
d. 14 cm^3

B 55. What is the density of 37.72 g of material whose volume is 6.80 cm^3?
a. 0.180 g/cm^3
b. 5.55 g/cm^3
c. 30.9 g/cm^3
d. 256. g/cm^3

D 56. 100 milliliters is equivalent to
a. 1 hectoliter.
b. 1 microliter.
c. 1 centiliter.
d. 1 deciliter.

B 57. 0.25 g is equivalent to
a. 250 kg.
b. 250 mg.
c. 0.025 mg.
d. 0.025 kg.

D 58. 0.05 cm is the same as
a. 0.000 05 m.
b. 0.005 mm.
c. 0.05 m.
d. 0.5 mm.

C 59. How many minutes are in 1 week?
a. 168 min
b. 1440 min
c. 10 080 min
d. 100 800 min

D 60. If 1 inch equals 2.54 cm, how many centimeters equal 1 yard?
a. 0.0706 cm
b. 14.2 cm
c. 30.5 cm
d. 91.4 cm

B 61. How is the measurement 0.000 065 cm written in scientific notation?
a. 65×10^{-6} cm
b. 6.5×10^{-5} cm
c. 6.5×10^{-6} cm
d. 6.5×10^{-4} cm

C 62. The measurement 0.020 L is the same as
a. 2.0×10^{-3} L.
b. 2.0×10^{2} L.
c. 2.0×10^{-2} L.
d. 2.0×10^{-1} L.

A 63. The speed of light is 300 000 km/s. In scientific notation, this speed is written to one significant figure as
a. 3×10^{5} km/s.
b. 3.0×10^{5} km/s.
c. $3. \times 10^{6}$ km/s.
d. 3.0×10^{6} km/s.

D 64. The average distance between the Earth and the moon is 386 000 km. Expressed in scientific notation, this distance is written as
a. 386×10^{3} km.
b. 39×10^{4} km.
c. 3.9×10^{5} km.
d. 3.86×10^{5} km.

C 65. When 6.02×10^{23} is multiplied by 9.1×10^{-31}, the product is
a. 4.3×10^{-8}.
b. 4.3×10^{54}.
c. 4.3×10^{-7}.
d. 4.3×10^{-53}.

C 66. Two variables are directly proportional if their ____ has a constant value.
a. sum
b. difference
c. quotient
d. product

C 67. Two variables are inversely proportional if their ____ has a constant value.
a. sum
b. difference
c. product
d. quotient

D 68. The graphs of two variables that are inversely proportional to one another is
a. a straight line.
b. an ellipse.
c. a parabola.
d. a hyperbola.

A 69. In the equation *density* = *mass*/*volume*, mass divided by volume has a constant value. This means that the
a. equation graphs as a straight line.
b. variables mass and volume are inversely proportional.
c. equation graphs as a hyperbola.
d. product of mass and volume is a constant.

Measurement and Communication:

1. Complete the following table of prefixes.

Factor	Prefix	Abbreviation
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

2. A student weighed a mass 4 times and obtained the following masses:

25.5g, 29.6g, 23.6g, 27.3g

The actual value is known to be 10.20045g

What can be said about the accuracy and precision of the measurements?

- not accurate (correct) or precise (reproducable)

3. Write the following numbers in scientific notation with the same number of significant digits.

a) 0.000005187 5.187×10^{-6}

b) 7,247 7.247×10^{3}

c) 16,140 1.614×10^{4}

d) 0.0921 9.21×10^{-2}

4. Convert the following numbers from scientific notation into decimal form.

a) 4.562×10^{6} 4,562,000

b) 8.276×10^{-8} 0.000000008276

5. Complete the following calculations. Include all units and don't forget about sig figs.

a) 1.0068g + 2.15g + 8.3g = 11.5g

b) 21.05cm – 12.1cm = 9.0cm

c) $\frac{1.50 \times 10^{-2}\ \text{mol}}{40.0\text{mL}} = 3.75 \times 10^{-4}\ \text{mol/mL}$

d) $\frac{432.8\text{g}}{21.8\text{cm} \times (7.645\text{cm} - 3.58\text{cm})} = \frac{432.8\text{g}}{21.8\text{cm} \times 4.065} = 4.88\text{g/cm}^2$

6. Convert 12 milliamperes into megaamperes.

$$12\,\text{mA} \times \frac{1\,\text{A}}{10^{3}\,\text{mA}} \times \frac{1\,\text{MA}}{10^{6}\,\text{A}} = 1.2 \times 10^{-8}\,\text{MA}$$

Unit 2: Matter & Naming

C 1. Which of the following is an extensive property of matter?
   a. melting point
   b. boiling point
   c. volume
   d. density

B 2. The two most important properties of all matter are
   a. the ability to carry an electric current well and to hold electric charge.
   b. taking up space and having mass.
   c. being brittle and hard.
   d. being malleable and ductile.

A 3. An atom is
   a. the smallest unit of matter that maintains its chemical identity.
   b. the smallest unit of a compound.
   c. always made of carbon.
   d. smaller than an electron.

B 4. A compound is
   a. a pure substance that cannot be broken down into simpler, stable substances.
   b. a substance, made of two or more atoms that are chemically bonded, that can be broken down into simpler, stable substances.
   c. the smallest unit of matter that maintains its chemical identity.
   d. any substance, whether it is chemically bonded or not.

D 5. A measure of the quantity of matter is
   a. density.
   b. weight.
   c. volume.
   d. mass.

B 6. Matter includes all of the following *except*
   a. air.
   b. light.
   c. smoke.
   d. water vapor.

D 7. A true statement about mass is that
   a. mass if often measured with a spring scale.
   b. mass is expressed in pounds.
   c. as the force of Earth's gravity on an object increases, the object's mass increases.
   d. mass is determined by comparing the mass of an object with a set of standard masses that are part of a balance.

C 8. A student recorded the following while completing an experiment.
Color of substance: yellow, shiny powder
Effect of magnet: yellow, shiny powder was attracted
The student should classify the substance as a(n)
   a. element.
   b. compound.
   c. mixture.
   d. plasma.

D 9. Which of the following is *not* a physical change?
   a. grinding
   b. cutting
   c. boiling
   d. burning

C 10. Which of the following is *not* a chemical change?
   a. rusting
   b. igniting
   c. melting
   d. burning

D 11. A physical change occurs when a
   a. peach spoils.
   b. silver bowl tarnishes.
   c. bracelet turns your wrist green.
   d. glue gun melts a glue stick.

D 12. Nitrogen monoxide and oxygen, both colorless gases, form a red-brown gas when mixed. Nitrogen monoxide and oxygen are called the
a. products.
b. equilibria.
c. synthetics.
d. reactants.

B 13. A state of matter in which a material has no definite shape but has a definite volume is the ____ state.
a. gas
b. liquid
c. plasma
d. solid

B 14. Under ordinary conditions of temperature and pressure, the particles in a gas are
a. closely packed.
b. very far from one another.
c. held in fixed positions.
d. unevenly distributed.

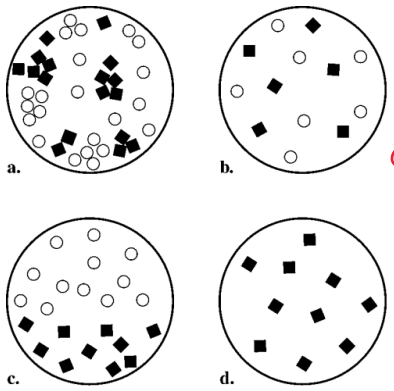
D 15. The liquid state of matter can be described as
a. having definite shape and definite volume.
b. having neither a definite shape nor a definite volume.
c. having lost electrons owing to energy content.
d. having a definite volume but not a definite shape.

C 16. A solid substance is
a. always frozen regardless of its container.
b. always a crystal regardless of its container.
c. always the same shape regardless of its container.
d. always losing particles regardless of its container.

X 17. Plasma is the fourth state of matter. In the plasma state
a. atoms gain electrons.
b. atoms lose electrons. ← FYI
c. atoms form molecules.
d. atomic nuclei break down.

C 18. What happens to the energy in a substance when it changes state?
a. It is destroyed.
b. It is changed into matter.
c. It changes form, but is neither destroyed nor increased.
d. The energy remains unchanged.

A 19. Which part of the illustration below shows the particles in a heterogeneous mixture?



a. a
b. b
c. c
d. d

C 20. A mixture is
a. a combination of pure substances bonded chemically.
b. any substance with a uniform composition.
c. a blend of any two or more kinds of matter, as long as each maintains its own unique properties.
d. any group of elements that are chemically bonded to one another.

A

21. If a mixture is uniform in composition, it is said to be
    a. homogeneous.
    b. chemically bonded.
    c. heterogeneous.
    d. a compound.

C

22. A homogeneous mixture is also called
    a. chemically bonded.
    b. a compound.
    c. a solution.
    d. a solute.

B

23. If a mixture is not uniform throughout, it is called
    a. homogeneous.
    b. heterogeneous.
    c. chemically bonded.
    d. a solution.

C

24. Which of the following is an example of a heterogeneous mixture?
    a. a gold ring
    b. seawater
    c. granite
    d. sucrose

A

25. Which of the following is an example of a homogeneous mixture?
    a. air
    b. orange juice
    c. raw milk
    d. marble

B

26. All known chemical elements are organized into groups based on similar chemical properties in the
    a. chemical chart.
    b. periodic chart.
    c. element table.
    d. None of the above

D

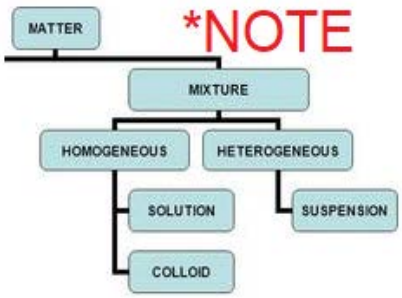
27. It is easy to determine whether a substance is a metal if the substance is
    a. easy to break down into its components.
    b. very hard.
    c. very brittle.
    d. a good electrical and heat conductor.

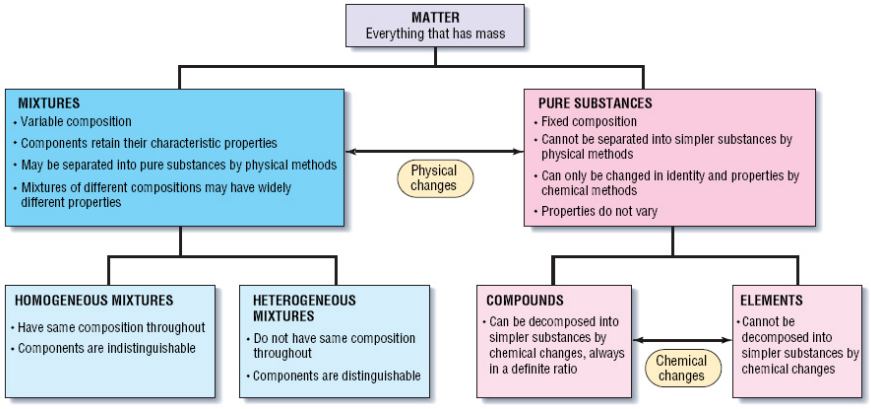
Properties of Matter

1. Define: Qualitative vs Quantitative Data, Physical and Chemical Properties, Malleability, Ductility, Lustre, Viscosity and Diffusion. Review the Phases of Matter.

* answers will vary - check all definitions with notes or an online scientific dictionary.

. Draw the diagram from your notes outlining the Classification of Matter. Make sure you can define each classification.





Matter:

1. Define the term "matter".

-anything with mass and volume

2. Differentiate between an atom, ion and molecule (hint, use their definitions).

-atom: smallest particle of an element that still has the chemical properties of the element; neutral → protons = electrons

-ion: atom or group of atoms that has gained or lost electrons to form a negative or positive charge

-molecule: neutral group of atoms connected by covalent bonds

Mixtures vs. Pure Substances:

1. Match each separation technique with its appropriate description.

Technique	Description
D centrifugation	A. components of a mixture separate into layers on their own
	B. solid component of the mixture becomes trapped in a screen, allowing the liquid component to pass through
G chromatography	
	C. oil, detergent, or some other chemical is added to a mixture, air is forced through the mixture as a means of stirring, and the desired component is skimmed off the top
F crystallization	
	D. mixture is spun at high speeds creating a force which pulls heavier solid particles towards the bottom of the container
E distillation	
	E. the mixture is heated until a liquid component reaches its boiling point and is evaporated, leaving the other component behind
H electrolysis	
	F. the mixture is concentrated and cooled until the solid component slowly forms at the bottom of the container
B filtration	
	G. the mixture is applied to a solid support and separated into its components by a solvent which carries the various components up the solid support at different rates
C floatation	
	H. a process in which an electric current is applied to a sample, decomposing the sample into its component elements
A settling	

2. State three things that distinguish a pure substance from a mixture (consider nature, properties)

Pure Substances	Mixture
-only one type of compound	- more than one type of compound present
-cannot be separated physically	-can be separated physically
-unique set of chemical + physical properties	-chemical + physical properties change based on proportions of components

3. Describe what a MECHANICAL MIXTURE is (its nature and properties), provide an example, and state the separation method that should be used to isolate its component parts.

-a heterogeneous mixture (can tell there is more than one component) because there is more than one phase present

-separate using mechanical separation (physically pick apart or use magnets)

4. How is it possible to determine whether a pure substance is an element or a compound? Provide an example of an element and a compound.

-a compound can be separated by chemical means (electrolysis), elements cannot be separated

-examples will vary

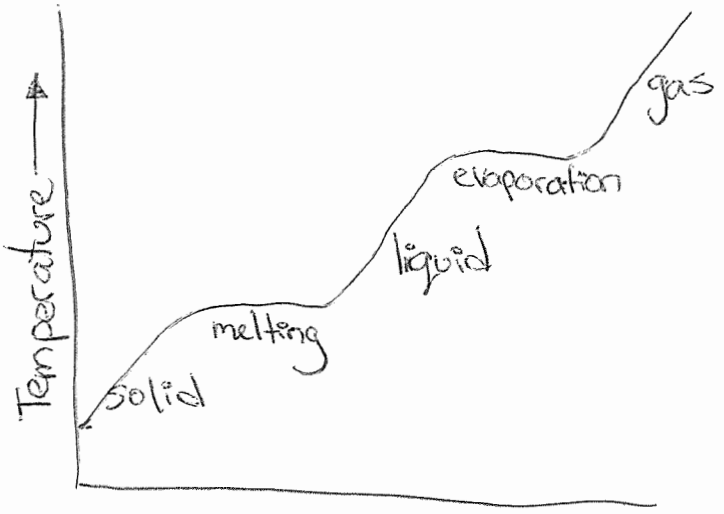
5. How can you determine whether a material is "homogeneous" or "heterogeneous"?

-visual inspection

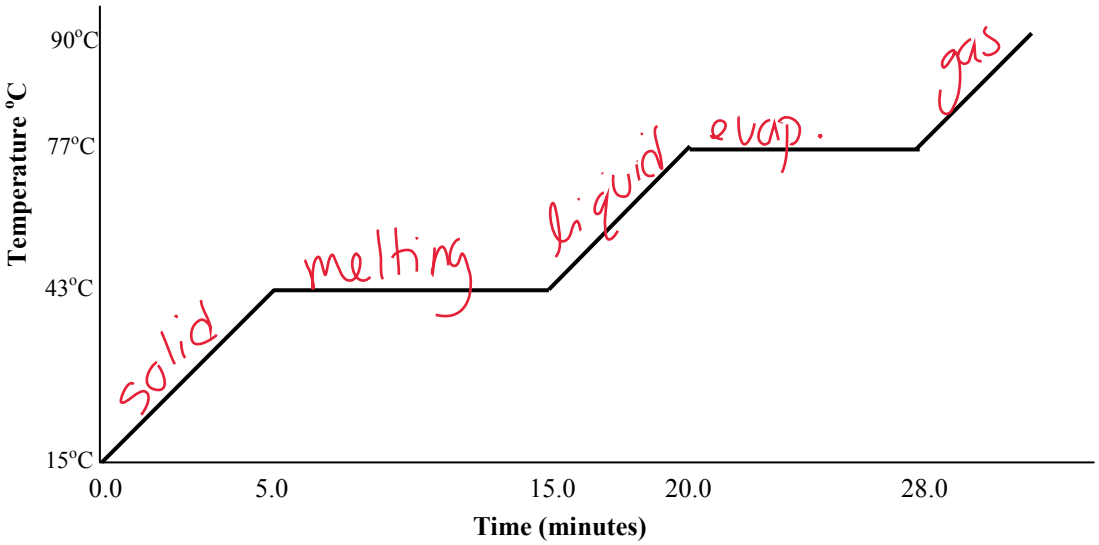
-homogeneous is the same throughout (no visible difference)

-heterogeneous is different in composition (visible difference)

6. Sketch the phase diagram that would be produced when solid nitrogen is heated. Label all states and phase changes.



6. Given the following graph of Temperature vs. Time for warming substance "X" which starts out as a solid, answer the questions below:



a) During time 0.0 – 5.0 minutes, the added heat energy is being used to increase the temp. of the solid

b) During time 5.0 – 15.0 minutes, the added heat energy is being used to melting of the solid

c) During time 15.0 – 20.0 minutes, the added heat energy is being used to increase temp. of liquid

d) During time 20.0 – 28.0 minutes, the added heat energy is being used to. boiling / evaporation of the liquid.

e) The melting point of substance "X" is ~ 43°C

f) The boiling point of substance "X" is ~ 77°C

g) If a greater amount of substance "X" was used, the melting point would be
1. a lower temperature
2. a higher temperature
3. the same temperature

Answer M.P. is an intrusive property

h) What phase is substance "X" at 90°C? gas.

i) Explain WHY the curve levels off between 5.0 min. and 15.0 min.

an added energy is used for melting (ie: breaking bonds + changing state) no "extra" energy is available to raise the temp. of the substance.

Ionic Compounds:

1) Compare the following properties of both IONIC and MOLECULAR compounds:
   (a) Component elements (metal vs nonmetal)
   (b) Type of chemical bonding (ionic vs covalent)
   (c) Most likely states at room temperature (solid, liquid, gas)
   (d) General trend in melting point temperatures
   (e) General trend in electrical conductivity

Ionic	Molecular (Covalent)
- metal – non-metal	- non-metal – non-metal
- ionic	- covalent
- usually solid (due to strong bonding)	- gases or liquids usually
- high melting point	- melting points usually low
- conduct electricity in water / in molten form	- don't conduct electricity

2) Write the chemical formulae resulting from the combination of the following ions.

a) Na^+ O^{2-} Na_2O c) Sr^{2+} Br^- $SrBr_2$

b) Au^{3+} S^{2-} Au_2S_3 d) Pb^{4+} $C_2O_4^{2-}$ $Pb(C_2O_4)_2$

3) Write the correct name for each of the following ionic compounds.

a) Li_2O Lithium oxide c) Mg_3N_2 Magnesium nitride

b) $CoCl_3$ Cobalt(III) chloride d) $Cr_3(PO_4)_2$ Chromium(II) phosphate

4) Write the correct formula for each of the following ionic compounds.

a) Cesium iodide CsI d) Aluminum oxide Al_2O_3

b) Strontium cyanide $Sr(CN)_2$ e) Iron (III) hydroxide $Fe(OH)_3$

c) Copper (I) bicarbonate $CuHCO_3$ f) Potassium permanganate $KMnO_4$

5) Write the correct name for each of the following ionic hydrates.

a) $Cd(NO_3)_2 \cdot 4H_2O$ Cadmium nitrate tetrahydrate

b) $NaSCN \cdot 5H_2O$ Sodium thiocyanate pentahydrate

Acids and Bases:

1. State three properties of acids and three properties of bases. (you might need your textbook)

Acids	Bases
-dissolve in water to form "H^+" ions	-form "OH^-" ions
-sour/tart taste	-bitter taste
-sting on skin	-feel slippery on skin
-react with most metals	-don't react react with most metals
-conduct electricity	-conducts electricity

2. Write the correct names for the following bases.

a. $Ca(OH)_2$ Calcium hydroxide b. LiOH Lithium hydroxide

3. Provide the missing formula or name for the following simple (binary) acids.

a. Hydrofluoric acid HF c. $H_2S_{(aq)}$ Hydrosulphuric acid

b. Hydrobromic acid HBr d. $HI_{(aq)}$ Hydroiodic acid

4. Provide the missing formula or name for the following complex acids.

a. Chromic acid H_2CrO_4 d. $H_2CO_{3(aq)}$ Carbonic acid

b. Sulphurous acid H_2SO_3 e. $H_3PO_{4(aq)}$ Phosphoric acid

c. Hypochlorous acid HClO f. $HNO_{2\,(aq)}$ Nitrous acid

Molecular Compounds:

1. Write the correct name for each of the following molecular compounds.

a. NF_3 Nitrogen trifluoride d. N_2O_4 Dinitrogen tetroxide

b. CO_2 Carbon dioxide e. SCl_6 Sulphur hexachloride

c. P_2O_5 Diphosphorus pentoxide f. N_2O Dinitrogen monoxide

2. Write the correct formula for each of the following molecular compounds.

a. Silicon disulphide SiS_2 d. Triarsenic pentabromide As_3Br_5

b. Carbon tetrachloride CCl_4 e. Dicarbon hexahydride C_2H_6

c. Oxygen gas O_2 f. Iodine heptachloride ICl_7

Mixed Naming:

1) Provide the correct name for each of the following compounds.

a) CsBr Cesium bromide c) H_2SO_4 Sulphuric acid

b) ICl iodine monochloride d) $Cu(NO_3)_2$ Copper(II) nitrate

Names and Formulas for Compounds

1. Write the correct formula for the following compounds:

   a) ammonium chlorate ..... NH_4ClO_3

   b) copper (II) sulphite..... $CuSO_3$

   c) zinc carbonate tetrahydrate ..... $ZnCO_3 \cdot 4H_2O$

   d) nitric acid ..... HNO_3

   e) phosphorus pentaiodide ..... PI_5

   f) iron (III) thiocyanate..... $Fe(SCN)_3$

   g) sulphuric acid..... H_2SO_4

   h) dinitrogen tetrafluoride ..... N_2F_4

2. Write the correct names for the following compounds:

   a) $Mn(SO_4)_2$..... manganes (IV) sulphate

   b) $PbCrO_4 \cdot 6H_2O$ ..... lead (II) chromate hexahydrate

   c) As_2O_3..... diarsenic trioxide

   d) CH_3COOH ..... acetic acid

   e) $Ni_2(C_2O_4)_3$..... nickel (III) oxalate

   f) NF_3 ..... nitrogen trifluoride

   g) $(NH_4)_2HPO_4$ ..... ammonium monohydrogenphosphate

   h) $Ba(OH)_2 \cdot 10H_2O$..... barium hydroxide decahydrate

Unit 3: The Mole

B 71. If each atom of element D has 3 mass units and each atom of element E has 5 mass units, a molecule composed of one atom each of D and E has
a. 2 mass units.
b. 8 mass units.
c. 15 mass units.
d. 35 mass units.

C 72. If 6.0 g of element K combine with 17 g of element L, how many grams of element K combine with 85 g of element L?
a. 17 g
b. 23 g
c. 30. g
d. 91 g

C 73. If two or more compounds are composed of the same two elements, the ratio of the masses of one element that combine with a fixed mass of the other element is a simple whole number. This is a statement of the law of
a. conservation of mass.
b. mass action.
c. multiple proportions.
d. definite composition.

B 74. If 63.5 g of copper (Cu) combine with 16 g of oxygen (O) to form the compound CuO, how many grams of oxygen will be needed to combine with the same amount of copper to form the compound CuO_2?
a. 16 g
b. 32 g
c. 64 g
d. 127 g

A 75. According to the law of conservation of mass, when sodium, hydrogen, and oxygen react to form a compound, the mass of the compound is ____ the sum of the masses of the individual elements.
a. equal to
b. greater than
c. less than
d. either greater than or less than

B 107. The number of atoms in a mole of any pure substance is called
a. its atomic number.
b. Avogadro's constant.
c. its mass number.
d. its gram-atomic number.

C 108. Molar mass
a. is the mass in grams of one mole of a substance.
b. is numerically equal to the average atomic mass of the element.
c. Both (a) and (b)
d. Neither (a) nor (b)

D 109. The mass of a sample containing 3.5 mol of silicon atoms (atomic mass 28.0855 amu) is approximately
a. 28 g.
b. 35 g.
c. 72 g.
d. 98 g.

A 110. A prospector finds 39.39 g of pure gold (atomic mass 196.9665 amu). She has
a. 1.204×10^{23} atoms of Au.
b. 2.308×10^{23} atoms of Au.
c. 4.306×10^{23} atoms of Au.
d. 6.022×10^{23} atoms of Au.

The Mole:

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 $MM\ PCl_5 = 208.5\ g/mol$

$$?\ moles\ PCl_5 = 133.44\ g\ PCl_5 \times \frac{1\ mol}{208.5\ g} = 0.6400\ mols$$

Answer 0.6400 mols

b) 0.00256 moles of $Li_2Cr_2O_7$ = ? grams $MM\ Li_2Cr_2O_7 = 229.88\ g/mol$

$$g\ ?\ Li_2Cr_2O_7 = 0.00256\ mols \times \frac{229.88\ g}{1\ mol} = 0.588\ g$$

Answer 0.588 g

c) 170.24 L of NO_2 at STP = ? moles $1\ mol = 22.4\ L$

$$?\ moles\ NO_2 = 170.24\ L \times \frac{1\ mol}{22.4\ L} = 7.60\ mol\ NO_2$$

Answer 7.60 mol NO_2

d) 570.625 g of PCl_3 gas = ? L (STP) $MM = 137.5\ g/mol$

$$?\ L = 570.625\ g\ PCl_3 \times \frac{1\ mol}{137.5\ g} \times \frac{22.4\ L}{1\ mol} = 92.96\ L = 93.0\ L$$

Answer 93.0 L

e) 1030.4 mL of C_2H_6 gas at STP = ? g $MM = 30.0\ g/mol$

$$?\ g\ C_2H_6 = 1030.4\ mL \times \frac{1\ L}{1000\ mL} \times \frac{1\ mol}{22.4\ L} \times \frac{30.0\ g}{1\ mol} = 1.38\ g$$

Answer 1.38 g

f) 5.00 kg of nitrogen gas = ? L (STP) $N_2 = 28.0\ g/mol$

$$?\ L\ N_2 = 5.00\ kg \times \frac{1000\ g}{1\ kg} \times \frac{1\ mol}{28.0\ g} \times \frac{22.4\ L}{1\ mol}$$

Answer 4.00×10^3 g

g) 0.5696 kg of $CH_{4(g)}$ = ? mL MM = 16.0 g/mol

$$?\,mL\,CH_4 = 0.5696\,kg \times \frac{1000\,g}{1\,kg} \times \frac{1\,mol}{16.0\,g} \times \frac{22.4\,L}{1\,mol} \times \frac{1000\,mL}{1\,L} =$$

Answer 7.97×10^5 mL

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!)

MM = 46.0 g/mol

$$?\,molecules\,C_2H_5OH = 35.0\,mL \times \frac{0.790\,g}{mL} \times \frac{1\,mol}{46.0\,g} \times \frac{6.02 \times 10^{23}\,molec}{1\,mol} = 3.62 \times 10^{23}\,molec$$

Answer 3.62×10^{23} molec

3. A 100.0 mL sample of liquid mercury contains 6.78 moles. Calculate the density of liquid mercury from this data. MM = 200.59 g/mol

$$?\,mols\,Hg = 6.78\,mols \times \frac{200.59\,g}{1\,mol} = 1360.0\,g$$

$$D = g/L = \frac{1360.0\,g}{0.1000\,L} = 1.36 \times 10^4\,g/L$$

Answer 1.36×10^4 g/L

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

MM = 137.5 g/mol

$$?\,Density = \frac{137.5\,g}{mol} \times \frac{1\,mol}{22.4\,L} = 6.14\,g/L$$

Answer 6.14 g/L

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

$$?\,MM = \frac{4.955\,g}{L} \times \frac{22.4\,L}{1\,mol} = 111\,g/L$$

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

$$1\,Se + 2\,O \rightarrow SeO_2$$
$$79.0 \quad 32.0 \rightarrow 111\,g$$

Answer SeO_2

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

(working out on next page)

Answer 38.04 %Sr, 13.69 %P, 28.27 %O

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

MM = 452.8 g/mol

$\%\ Sr = \frac{262.8\ g/mol}{452.8\ g/mol} \times 100\% = 58.0\%$

$\%\ P = \frac{62.0\ g/mol}{452.8\ g/mol} = 13.7\%$

$\%\ O = \frac{128.0\ g/mol}{452.8\ g/mol} = 28.3\%$

Answer 58.0%Sr, 13.7%P, 28.3%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

KSO

a) Determine the mass of oxygen in the sample.

Answer 76.8 g

b) Determine the empirical formula for this compound.

$P_{mol}O = 76.8\ g \times \frac{1\ mol}{16.0\ g} = 4.8\ mol \div 4$

$P_{mol}K = 46.92 \times \frac{1\ mol}{39.1} = 1.2\ mol \div 1$

$P_{mol}S = 38.52\ g \times \frac{1\ mol}{32.1} = 1.27\ mol \div 1.$

Answer: Empirical Formula: KSO_4

MM = 135.2 g/mol

c) Determine the molecular formula for this compound.

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{270.4\ g/mol}{135.2\ g/mol} = 2$

Answer: Molecular Formula: $K_2S_2O_8$

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.

$MM = 165.39\ g/mol$

$?\ mols\ Zn(NO_3)_2 = 123.11\ g \times \frac{1\ mol}{165.4\ g} = 0.7444\ mols$

$C = \frac{n}{V} = \frac{0.7444\ mols}{0.6500\ L} = 1.145\ M$

Answer 1.145 M

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.

$MM = 158.3\ g/mol$

$?\ g\ K_2SO_3 = 0.8000\ L \times \frac{0.200\ mol}{L} \times \frac{158.3\ g}{mol} = 25.3\ g$

Answer 25.3g

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.

$MM = 73.8\ g/mol$

$?\ L\ Li_2CO_3 = 47.232\ g \times \frac{1\ mol}{73.8\ g} \times \frac{1\ L}{2.50\ mols} = 0.256\ L$

Answer 0.256 L

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.

$C_1 = 0.45\ M$

$V_1 = 400.0\ mL$

$V_2 = 550.0\ mL$

$C_2 = ?$

$C_2 = C_1 \cdot \frac{V_1}{V_2}$

$= 0.45M \cdot \frac{400.0\ mL}{550.0\ mL} = 0.36M$

Answer 0.36M

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.

$V_1 = 150.0\,mL$

$C_1 = 4.00\,M$

$C_2 = 2.50\,M$

$V_2 = ?$

$$V_2 = V_1 \cdot \frac{C_1}{C_2}$$

$$V_2 = 150.0\,mL \cdot \frac{4.00\,M}{2.50\,M} = 240\,mL$$

added $90\,mL$

Answer $90.0\,mL$

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.

$MM = 143.08\,g/mol$

$$?\,g\,Ca(ClO)_2 = 5.00\,L \times \frac{0.020\,mol}{1\,L} \times \frac{143.08\,g}{1\,mol} = 14.3\,g$$

$= 14\,g$

① weigh out 14g

② add 14g to a graduated cylinder

③ fill cylinder to 5.00 L

Molarity Calculations:

1. If a 4.50g sample of solid NaOH is dissolved to make 0.500L of solution, what is the molarity of the solution? (40.0 g/mol)

$$\frac{4.50\text{g}}{0.500\text{L}} \times \frac{1\text{mol}}{40.0\text{g}} = 0.225\text{M}$$

2. How many grams of Na_2CO_3 would be required to produce 400.0mL of 0.600M Na_2CO_3? (106.0 g)

$$400.0\text{mL} \times \frac{1\text{L}}{10^3\text{mL}} \times \frac{0.600\text{mol}}{1\text{L}} \times \frac{106.0\text{g}}{1\text{mol}} = 25.4\text{g } Na_2CO_3$$

3. If 75.7g of Magnesium chloride are mixed with sufficient water to make a 0.885M solution, what is the volume of the solution? $MgCl_2 = 95.3\text{g/mol}$

$$75.7\text{g} \times \frac{1\text{mol}}{95.3\text{g}} \times \frac{1\text{L}}{0.885\text{mol}} = 0.898\text{L}$$

4. How many mL of 16.4 M H_2SO_4 are needed to prepare 755mL of 0.25M H_2SO_4?

$M_1 = 16.4\text{M}$ $V_1 = ?$ $M_2 = 0.25\text{M}$ $V_2 = 755\text{mL}$

$M_1V_1 = M_2V_2$ $\quad V_1 = \frac{M_2V_2}{M_1}$ $\quad V_1 = \frac{0.25\text{M} \times 755\text{mL}}{16.4\text{M}}$ $\quad V_1 = 12\text{mL}$

Unit 4: Chemical Reactions and Equations:

1. Balance and classify the following chemical reactions.

	Type of Reaction
a) 2 $KNO_3 \rightarrow$ 2 KNO_2 + 1 O_2	Decomposition
b) 1 CaC_2 + 2 $O_2 \rightarrow$ 1 Ca + 2 CO_2	Single Replacement
c) 1 C_5H_{12} + 8 $O_2 \rightarrow$ 5 CO_2 + 6 H_2O	Combustion
d) 1 K_2SO_4 + 1 $BaCl_2 \rightarrow$ 2 KCl + 1 $BaSO_4$	Double Replacement
e) 2 KOH + 1 $H_2SO_4 \rightarrow$ 1 K_2SO_4 + 2 H_2O	Neutralization
f) 1 $Ca(OH)_2$ + 2 $NH_4Cl \rightarrow$ 2 NH_4OH + 1 $CaCl_2$	Double Replacement
g) 4 C_4H_9S + 29 $O_2 \rightarrow$ 16 CO_2 + 4 SO_2 + 18 H_2O	Combustion
h) 2 $C_{15}H_{30}$ + 45 $O_2 \rightarrow$ 30 CO_2 + 30 H_2O	Combustion
i) 2 BN + 3 $F_2 \rightarrow$ 2 BF_3 + 1 N_2	Single Replacement
j) 2 Na + 1 $ZnI_2 \rightarrow$ 2 NaI + 1 Zn	Single Replacement

2. Classify, complete AND balance the following chemical equations. Type of Reaction

a) $1\ Ni_{(s)} + 1\ Cu(NO_3)_{2(aq)} \rightarrow 1\ Cu + 1\ Ni(NO_3)_2$ Single Replacement

b) $4\ Fe_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Fe_2O_3$ Synthesis

c) $2\ NaCl_{(s)} \rightarrow 2\ Na + 1\ Cl_2$ Decomposition

d) $1\ H_2SO_{4(aq)} + 2\ NaOH_{(aq)} \rightarrow 2\ H_2O + 1\ Na_2SO_4$ Neutralization

e) $2\ C_4H_{10(l)} + 13\ O_{2(g)} \rightarrow 8\ CO_2 + 10\ H_2O$ Combustion

f) $2\ Ag_{(s)} + 1\ Cl_{2(g)} \rightarrow 2\ AgCl$ Synthesis

g) $1\ Cl_{2(g)} + 2\ KI_{(s)} \rightarrow 2\ KCl + 1\ I_2$ Single Replacement

h) $1\ Fe_{(s)} + 3\ AgCl_{(aq)} \rightarrow 3\ Ag + 1\ FeCl_3$ Single Replacement

i) $2\ AgNO_{3(aq)} + 1\ BaCl_{2(aq)} \rightarrow 2\ AgCl + 1\ Ba(NO_3)_2$ Double Replacement

j) $1\ BaCO_{3(aq)} + 1\ Sr(OH)_{2(aq)} \rightarrow 1\ SrCO_3 + 1\ Ba(OH)_2$ Double Replacement

k) $1\ C_2H_5OH_{(l)} + 3\ O_{2(g)} \rightarrow 2\ CO_2 + 3\ H_2O$ Combustion

l) $1\ HNO_{3(aq)} + 1\ KOH_{(aq)} \rightarrow 1\ H_2O + 1\ KNO_3$ Neutralization

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

$3\ K_2SO_4 + 2\ Co(NO_3)_3 \rightarrow 6\ KNO_3 + Co_2(SO_4)_3$ double replacement

b) liquid propanol (C_3H_7OH) is burned in air

$2\ C_3H_7OH + 7\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$ combustion

c) ammonium nitrate is decomposed into it's elements

$NH_4NO_3 \rightarrow$

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

$Zn + 2\ AgNO_3 \rightarrow Zn(NO_3)_2 + 2\ Ag$ single replacement

e) bromine reacts with sodium iodide

$Br_2 + 2\ NaI \rightarrow 2\ NaBr + I_2$ single replacement

f) bromine reacts with aluminum

$3\ Br_2 + Al \rightarrow 2\ AlBr_3$ synthesis

g) rubidium reacts with chlorine gas

$2\ Rb + Cl_2 \rightarrow 2\ RbCl$ synthesis

h) hydrochloric acid reacts with strontium hydroxide

$HCl + Sr(OH)_2 \rightarrow H_2O + SrCl_2$ double replacement + neutralization