Measurement and Matter Notes

Measurement

Scientific notation

Practice 1

1. Convert the following numbers from standard form to scientific notation.
    a. 24500
    b. 356
    c. 0.000985
    d. 0.222
    e. 12200
2. Convert the following to standard form.
    a. 4.2×10^{3}
    b. 2.15×10^{-4}
    c. 3.14×10^{-6}
    d. 9.22×10^{5}
    e. 9.57×10^{2}

Units of measurement

Complete the following table for the SI units of measurement

Base Quantity	Name of Unit	Symbol
Mass		
Length		
Time		
Temperature		
Amount of substance		
Electric current		
Luminous intensity		

Complete the following table for metric system prefixes

Prefix	Meaning
Giga (G_)	
Mega (M_)	
Kilo (k_)	
BASE UNIT (m, g, s,)	
Deci (d_)	
Centi (c_)	
Milli (m_)	
Micro (μ_)	
Nano (n_)	
Pico (p_)	

Accuracy, precision, and errors

Define precision and give a science/chemistry example:

Define accuracy and give a science/chemistry example:

Practice 2

1. Consider three sets of data that have been recorded after measuring a piece of wood that is exactly 6.000 m long.

	Set #1	Set #2	Set #3
	5.864 m	6.002 m	5.872 m
	5.878 m	6.004 m	5.868 m
Average lengths	5.871 m	6.003 m	5.870 m

   a. Which set of data is the most accurate?

   b. Which set of data is the most precise?

Formula for percent error:

Practice 3

1. Working in the laboratory, a student finds the density of a piece of pure aluminum to be 2.850 g/cm^3. The accepted value for this density is 2.699 g/cm^3. What is the student's percent error?

Define random error and give a science/chemistry example:

Define systematic error and give a science/chemistry example:

Uncertainty and significant figures

Write down the significant figure rules that make the most sense to you:

Measurement	Number of sig figs	Measurement	Number of sig figs
25 g		0.12 kg	
0.030 kg		1 240 560. cm	
1.240560 mg		300 000 000 m/s	
60 000 s		6.0×10^6 kg	
246.31 g		4.09×10^3 cm	
20.06 cm		29.200 cm	
1.050 m		0.025 00	

Practice 4

1. Determine the number of significant figures in the following measurements.
    a. 250.7 km
    b. 0.00077 g
    c. 1024 mL
    d. 4.7×10^{-5} mg
    e. 34000000 µs
    f. 5 dogs

Adding and subtracting rule:

Multiplying and dividing rule:

Exact numbers rule:

Calculation	Answer with SF	Calculation	Answer with SF
3.24 m + 7.0 m		3.24 m + 7.0 m	
0.02 cm * 2.371 cm		100.0 g – 23.73 g	
35 cm^2 /0.62 cm		0.02 cm + 2.371 cm	
6.54 m * 0.37 m		0.036 m * 0.0002 m	
713.1 L – 3.872 L		40.8 m^2 / 5.050 m	
39 g / 24.2 g		1800 lb + 3.37 lb	
2.030 mL – 1.870 mL		0.58 dm^3 / 2.15 dm	

Practice 5

1. Use a calculator to carry out the following calculations and record the answer to the correct number of significant figures.
    a. (34.5 m)(23.46 m)
    b. 123 m / 3 s
    c. $(2.61 \times 10^{-1}$ m)(356 m)
    d. 21.78 g + 45.86 g
    e. 23.888897 mL – 11.2 mL

f. 6 mL – 3.0 mL

g. (11.6 g/cm^3 – 11.342 g/cm^3) / 11.342 g/cm^3

Temperature Conversions

Temperature conversion factors	
Celsius to Kelvin	
Kelvin to Celsius	
Celsius to Fahrenheit	
Fahrenheit to Celsius	

Practice 6

1. Convert the following temperatures:
   a. 263 K to °F
   b. 38 °F to K
   c. 13 °F to °C
   d. 1390 °C to K
   e. 3000 °C to °F

2. When discussing a <u>change</u> in temperature, why will it not matter if the change is recorded in Celsius or Kelvin?

Dimensional Analysis

*Convert 45.6 µL (microliters) to ML (megaliters)

*Convert 100 m^3 to cm^3

Convert 75 miles/hr to m/s

Practice 7

1. Convert the following quantities from one unit to another using the following equivalence statements: 1.000 m = 1.094 yd, 1.000 mile = 1760 yd, 1.000 kg= 2.205 lbs, 1000 mm = 1 m
   a. 30 m to miles
   b. 1500 yd to miles

c. 306 miles to m

d. 34 kg to lbs

e. 195 mm to m

2. Which is the larger quantity?
   a. A distance of 3.00 miles or 3000 m?

   b. A mass of 10.0 kg or 25 lbs?

3. Jacques, the speeding Canadian, gets pulled over in the US. His speedometer reads 120 km/hour. How fast is he going in ft/sec? (0.305 m = 1 ft)

4. Light travels at 3.0×10^8 m/s. How many miles/hour is this?

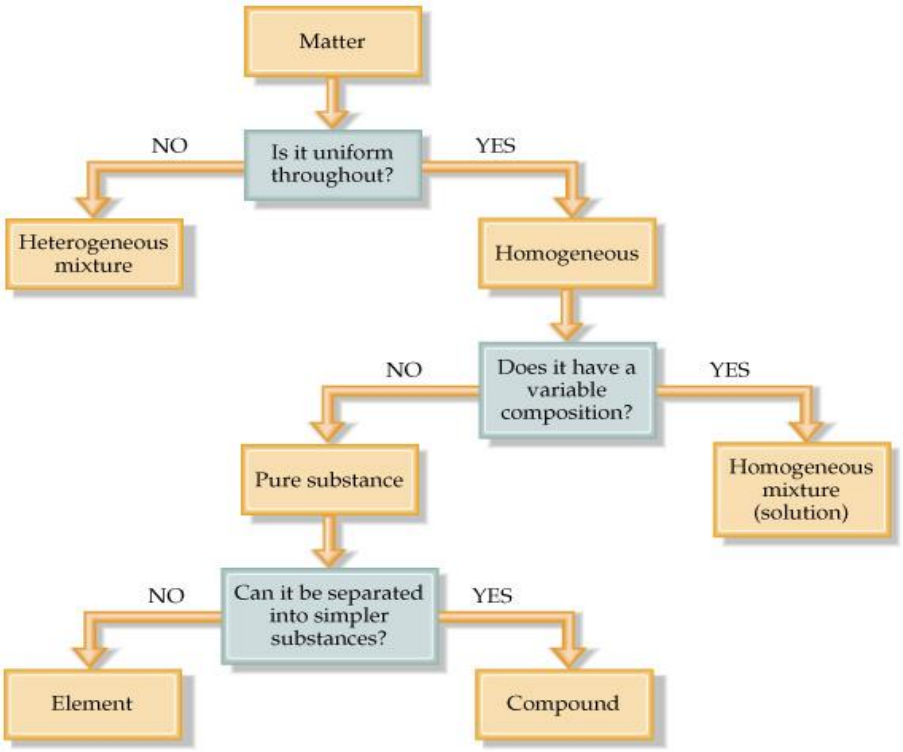
5. A swimming pool measures 2.0 m x 25.0 m x 15.0 m. What is the volume of the pool in m^3? In cm^3? In km^3?

6. Chatfield reservoir holds 0.033 km^3 of water. How many gallons is this? (1 cm^3 = 1 mL, 1 gallon = 3.785 L)

7. *The density of water is 1.00 g/cm^3. Convert this to kg/dm^3.

8. A pressure washer might have a nozzle pressure of 500 pounds/in^2. Convert this to kg/m^2. (454 g = 1 pound, 2.54 cm = 1 in)

Matter and Separation Techniques



Define and give examples of:

Matter:

Substance:

Element:

Compound:

Mixture:

Homogeneous mixture:

Heterogeneous mixture:

Solution:

Solid:

Liquid:

Gas:

Melting point:

Boiling point:

Physical property:

Chemical property:

Intensive property:

Extensive property:

Draw particle diagrams for the following:

Substances and mixtures

Element

Compound

Mixture

States of matter

Solid

Liquid

Gas

For the following separation techniques, describe what it separates and how it works

Filtration:

Distillation:

Centrifugation:

Evaporation:

Chromatography:

Atomic theory and structure

Dalton's atomic theory:

1. Elements are made from tiny particles called atoms. All atoms are a given element are identical.
2. The atoms of a given element are different to those of any other element.
3. Atoms of different elements combine to form compounds. A given compound always has the same relative numbers and types of atoms. (*Law of definite proportions/constant composition*)
4. Atoms cannot be created or destroyed in a chemical reaction they are simply rearranged to form new compounds. (*Law of conservation of mass*)

Summary of experiments to identify subatomic particles

Scientist	Experiment	Knowledge gained	Relating to
Crookes			Electron
J.J. Thompson			Electron
Milikan			Electron
Rutherford, Marsden and Geiger			The nucleus of an atom and the proton

Atomic structure

For each of the following, indicate the number of protons, neutrons, and electrons:

	p^+	n^0	e^-
$^{17}_{8}O$			
$^{63}_{29}Cu^{2+}$			
$^{25}_{12}Mg$			
$^{199}_{80}Hg$			
$^{80}Br^{-}$			
$^{31}P^{-3}$			
$^{238}_{92}U$			
$^{226}_{88}Ra$			
^{195}Pt			

Average atomic mass

What is the average atomic mass for magnesium if there is 78.99% magnesium-23.985, 10.00% magnesium-24.986 and 11.01% magnesium-25.983?

Rubidium has two isotopes, ^{85}Rb and ^{87}Rb. ^{85}Rb has a mass of 84.912 amu and an abundance of 72.17%. Use the average atomic mass from the periodic table to determine the mass and abundance of ^{87}Rb.

The average atomic mass of copper is 63.55 amu. If the only two isotopes of copper have masses of 62.94 amu and 64.93 amu, what are the percentages of each?

Practice 8

1. Strontium consists of four isotopes with masses of 83.9134 amu (0.5%), 85.9094 amu (9.9%), 86.9089 amu (7.0%) and 87.9056 amu (82.6%). Calculate the average atomic mass of strontium.

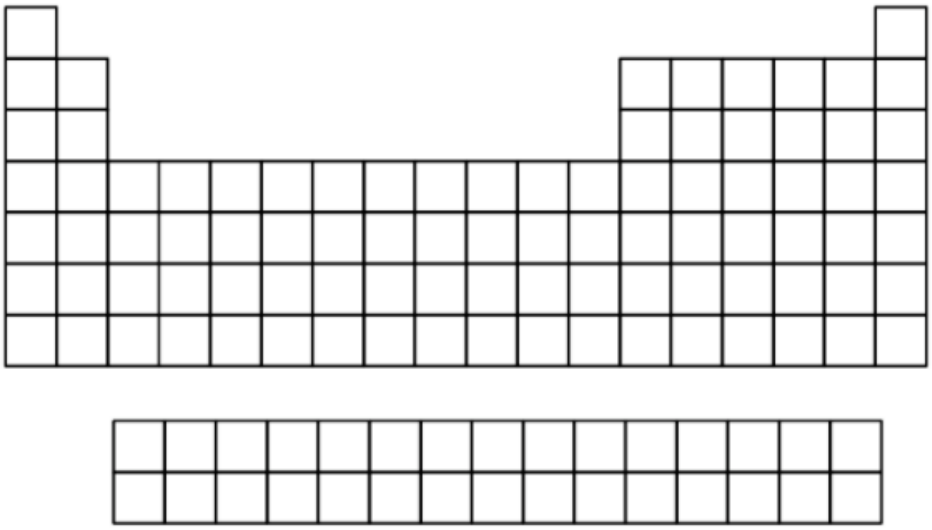
2. 50.54% of the naturally occurring isotopes of bromine have an atomic mass of 78.92 amu while the remaining bromine is a different isotope.
    a. Determine the abundance of the different isotope.

    b. Use the average atomic mass of bromine from the periodic table to determine the atomic mass of this different isotope.

3. Chlorine has two naturally occurring isotopes: ^{35}Cl and ^{37}Cl. ^{35}Cl has a mass of 34.97 amu and an abundance of 75.53%. Use the average atomic mass of chlorine from the periodic table to determine the mass and abundance of ^{37}Cl.

4. Use the average atomic mass for lithium to determine the percent abundance of each isotope. ^{6}Li has a mass of 6.0151223 amu and ^{7}Li has a mass of 7.0160041 amu.

Periodic table



Nomenclature

Practice naming and writing formulas for these ionic compounds:

KH_2PO_4
K_2HPO_4
Li_2CO_3
NH_4NO_2
NaSCN
Cadium Iodide
Lead (III) hydroxide
Cesium carbonate
Iron (III) phosphate
Mercury (I) Iodide

Practice 8

1. Write the formulas for:
    a. Tin (IV) chromate
    b. Calcium dihydrogen phosphate
    c. Ammonium silicate
    d. Beryllium acetate
    e. Strontium nitride
    f. Tin (II) cyanide

g. Lead (IV) phosphate
h. Sodium hypochlorite
i. Zinc nitrite

2. Write the names for:
   a. $LiHCO_3$
   b. $Mg(OH)_2$
   c. $Cr(NO_3)_3$
   d. NaF
   e. Rb_3As
   f. Na_3PO_4
   g. $FeCl_3$
   h. $PbCr_2O_7$
   i. Na_2SO_4

Practice naming and writing formulas for these molecular compounds:

Phosphorus pentafluoride
Iodine heptafluroide
Tetraphosphorus hexaoxide
Boron trichloride
Sulfur trioxide
N_2O_4
$SiCl_4$
P_4O_{10}
Cl_2O_7
NF_3

Practice naming and writing formulas for these acids:

HBr
HI
HClO
$HClO_2$
$HClO_3$
$HClO_4$
Hydrocyanic acid
Phosphoric acid
Phosphorous acid
Hypophosphorous acid

Practice 9

1. *Practice naming these acids:*
   a. HNO_2
   b. $HMnO_4$
   c. HCN
   d. H_2S
   e. $HClO_4$

2. *Write the formulas for these acids:*
    a. Carbonic acid
    b. Sulfurous acid
    c. Phosphoric acid
    d. Sulfuric acid
    e. Hydroiodic acid
    f. Acetic acid
    g. Nitrous acid
    h. Chlorous acid

Practice naming and writing formulas for these compounds:

$CaCO_3$
$Sr(NO_3)_2 \bullet 4H_2O$
$Ca(OH)_2$
H_2S
$NaNO_3$
HBrO
NH_3
P_4S_{10}
LiF
$PbCO_3$
Hg_2Cl_2
H_2O_2
$CuCrO_4$
H_2SO_4
$Na_2CO_3 \bullet 7H_2O$
NaCl
Carbon dioxide
Chloric acid
Rubidium hydroxide
Lithium sulfite
Lead (II) oxide
Copper (II) chloride
Calcium hydrogen phosphate
Hydroiodic acid
Copper (I) cyanide
Tetraphosphorus decasulfide
Titanium (IV) Chloride
Ammonium sulfate
Barium chloride dihydrate