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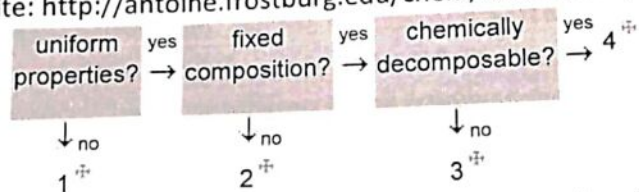
COPPERBELT UNIVERSITY

CHEMISTRY DEPATMENT

CH110 TUTORIAL SHEET 1-INTRODUCTION

Question 1

a) Write the names of the numbered categories of matter indicated in the figure below. Use the website: http://antoine.frostburg.edu/chem/senese/101/matter/index.shtml



b) In the process of attempting to characterize a substance, a chemist makes the following observations: The substance is **a silvery white metal**, it **melts at 649 °C** and boils at 1105 °C. Its **density at 20 °C is 1.738 g/cm^3**. The substance **burns in air**, producing an intense white light. It **reacts with chlorine** to give a **brittle white solid**. The substance can be **pounded into thin sheets and drawn into wires**. It is a **good conductor of electricity**. Which of these bolded characteristics are physical properties and which are chemical properties.

c) Learn the names and symbols of the first 36 elements of the periodic table by the end of term one.

d) Label the following as either a physical or chemical process: (i) corrosion of an iron nail (ii) melting ice (iii) digesting a handful of groundnuts (iv) explosion of nitroglycerin (v) dissolving salt in water.

e) The table below relates to separation of substances. Complete the missing items. Use the website: http://antoine.frostburg.edu/chem/senese/101/matter/index.shtml

Separation method	Description of method
1.	Select components by particle size
2.	Select components by density
3.Crystallisation	
4.Extraction	

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5.	Select components by boiling point
6.	Select components by affinity for a 'stationary phase'

Question 2

a) Use appropriate prefixes to write the following measurements without exponents: (i) 6.35×10^{-4} L (ii) 7.2×10^{-6}s (iii) 9.5×10^{-11} m (iv) 12.4×10^{-8}g (v) 10.1×10^{-2} K (vi) 5.2×10^{-9} m^3.

b) Use exponential notation to express the number 385,500 to (i) 1 significant figure (ii) 2significant figures (ii) 3 significant figures and (iv) 5 significant figures.

c) Convert the following temperatures to Kelvin: (i) The melting point of sodium bromide (a salt) is 755 °C. (ii) Neon, a gaseous element at room temperature, melts at -248 °C. (iii) a gas temperature of 600°F.

d) A cube of osmium metal 1.500 cm on a side has a mass of 76.31 g at25 °C. What is its density in g/cm^{-3}?

Question 3

a) Indicate which of the following are exact numbers: (i) the mass of a paper clip (ii) the surface area of a 10 ngwee coin (iii) the number of grams in a kilogram (iv) the number of microseconds in an hour (iv) the mass of the tallest person your family.

b) What is the number of significant figures in the following measured quantities: (i) 325 km (ii) 0.0520 g (iii) 7.0500×10^{-3} m^3 (iv) 340.00 K

c) Round off each of the following numbers to four significant figures:

(i) 102.53070 (ii) 656,980 (iii) 0.008543210 (iv) 0.0353551

d) Carry out the following calculations and express the answer to the appropriate number of significant figures:
(i) 12.0550 + 9.05 (ii) 257.2 – 19.789 (iii) (0.0045×21,000.00) +(2813 / 1.2)

Question 4

a) Perform the following conversions:
(i) 0.076 L to mL (ii) 6.88×10^5 ns to s (iii) 500 days to seconds (iv) 22.50 gal/min to L/s (v) 0.510 in./ms to km/hr
(1 gal = 3.7854 L, 1 in. = 2.54 cm)

b) The speed of light in vacuum is 2.998×10^8 ms^{-1}. Calculate its speed in km/hr.

c) The density of air at ordinary atmospheric pressure and 25 °C is 1.19 g/L. What is the mass of air in kilograms in a room that measures $3.0\ m \times 4.0\ m \times 5.0\ m$?

Question 5

a) Explain the difference between (i) a law and a theory (ii) precision and accuracy and (iii) a homogeneous and a heterogeneous mixture

b) What is a hypothesis?

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Question 6

a) Which (if any) of the following can be determined by knowing the number of protons in a neutral element? Explain your answer:
(i) the number of neutrons in the neutral element (ii) the number of electrons in the neutral element (iii) the name of the element

b) Explain the law of conservation of mass, the law of definite proportion, and the law of multiple proportions.

c) Distinguish between the following terms.
(i)molecule versus ion (ii) covalent bonding versus ionic bonding (iii) molecule versus compound (iv) anion versus cation.

d) Which of the following statements is(are) *true?* For the false statements, correct them.
(i) Most of the known elements are metals (ii) Element 118 should be a nonmetal (iii) Hydrogen has mostly metallic properties (iv) A family of elements is also known as a period of elements (v) When an alkaline earth metal, A, reacts with a halogen, X, the formula of the covalent compound formed should be A_2X.

Question 6

a) A sample of chloroform is found to contain 12.0 g of carbon, 106.4 g of chlorine, and 1.01 g of hydrogen. If a second sample of chloroform is found to contain 30.0 g of carbon, what is the total mass of chloroform in the second sample?

b) Write the atomic symbol (^A_ZX) for each of the followingisotopes.
(i)Z = 8, number of neutrons = 9 (ii) the isotope of chlorine in which A= 37 (iii) Z = 27, A = 60 (iv) number of protons = 26, number of neutrons = 31 (v) the isotope of I with a mass number of 131 (vi) Z= 3, number of neutrons = 4

c) For each of the following sets of elements, label each as either noble gases, halogens, alkali metals, alkaline earth metals, or transition metals.
(i)Ti, Fe, Ag (ii) Mg, Sr, Ba (iii) Li, K, Rb (iv) Ne, Kr, Xe (v) F, Br, I

d) For each of the following ions, indicate the number of protons and electrons the ion contains.
(i) Ba^{2+}(ii) Zn^{2+}(iii) N^{3-} (iv) Rb^{+}(v) Co^{3+}(vi) Te^{2-}(vii) Br^{-}

Question 7

a) Name the compounds in parts (i)-(iv) and write the formulae for the compounds in parts (v)- (viii): **(i)** NaBr (ii) Rb_2O (iii) CaS (iv) AlI_3 (v) strontium fluoride (vi) aluminum selenide (vii) potassium nitride (viii) magnesium phosphide.

b) Name the compounds in parts (i)-(iv) and write the formulas for the compounds in parts (v)-(viii): (i) Hg_2O (ii) $FeBr_3$ (iii) CoS (iv) $TiCl_4$ (v) tin(II) chloride (vi) cobalt(III) iodide (vii) chromium(VI) sulphide (viii) mercury(II) oxide

c) Name each of the following compounds: (i)$BaSO_3$ (ii)$KMnO_4$ (iii) $NaNO_2$(iv)$K_2Cr_2O_7$

d) Write the formula for each of the following compounds: (i) chromium(III) hydroxide (ii) lead(IV) carbonate (iii) magnesium cyanide (iv) ammonium acetate

e) Knowing the names of similar chlorine oxyanions and acids,deduce the names of the following: IO^-, IO_2^-, IO_3^- and IO_4^-;HIO, HIO_2, HIO_3, and HIO_4.

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f) Write the formula for each of the following compounds: (i) sulphur difluoride (ii) sulphur hexafluoride (iii) sodium dihydrogen phosphate (iv) lithium nitride (v) chromium(III) carbonate (v) Bromous acid (vi) dinitrogen pentoxide

g) As appropriate, give the name or chemical formula for each of the following binary molecular substances: (i) SF_6, (ii) IF_5, (iii) XeO_3, (iv) dinitrogen tetroxide, (v) hydrogen cyanide, (vi) tetraphosphorushexasulphide.

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Question 1

(a) 1 = Heterogeneous Mixture

2 = Homogeneous mixture

3 = Element

(b)

	Property	Physical	Chemical
i	Silvery white metal	✓	
ii	melts at 649°C	✓	
iii	Density at 20°C is 1.738g/cm³	✓	
iv	burns in air.		✓
v	reacts with Chlorine		✓
vi	brittle white solid	✓	
vi	Pounded into thin-sheets and drawn into wires	✓	
vii	Good conductor of electricity	✓	

(c) (i) corrosion of iron → Chemical

(ii) melting ice → Physical

(iii) digesting Groundnuts → Chemical

(iv) Explosion → Chemical

(v) dissolving salt → Physical

e

Seperation Method	Description of Method
Filtration	Select Components by size
floatation	Select comp by density
Crystallisation	Select comp by solubility
Extraction	Select comp by solubility
distillation	Select comp by boiling point
Chromatography	Select comp by affinity for a stationary phase

Question 2

a (i) 6.35×10^{-4} l = 635×10^{-6} l = 635 microliters

(ii) 7.2×10^{-6} s = 7.2 microseconds = 7.2 μs

(iii) 9.5×10^{-11} m = 95×10^{-12} m = 95 picometers (pm)

(iv) 12.4×10^{-8} g = 124×10^{-9} g = 124 nanogram

(v) 10.1×10^{-2} K = 101×10^{-3} K = 101 mK

(vi) 5.2×10^{-9} m^3 = ~~5.2 nano~~ 5.2 nm^3

b 385 500

b 385 500

(i) 4×10^5 (ii) 3.9×10^5 (iii) 3.86×10^5

(iv) 3.8550×10^5

c (i) 755 °C

$K = °C + 273.15$

$K = 755 + 273.15$

$K = 1020.15 K$ = 1020 K

(ii) −248 °C

$K = °C + 273.15$

$= -248 + 273.15$

$= 25.15 K$

$= 25.2 K$

(iii) 600 °F

$K = \frac{5}{9}(°F - 32) + 273.15$

$K = \frac{5}{9}(600 - 32) + 273.15$

$= \frac{5}{9}(568) + 273.15$

$= 588.706 K$

$= 589 K$

d volume $= l^3$

$= (1.500\,cm)^3$

$= 3.375\,cm^3$

$D = \frac{m}{V}$

$= \frac{76.31\,g}{3.375\,cm^3}$

$= \underline{22.61\,g/cm^3}$

Question 3

(a.) Exact number are values that are known with complete certainty.

→ The exact numbers in the question are;

→ (iii), (iv)

b (i) 325 km → 3 s.f (iii) $7.0500 \times 10^{-3}\,m^3$ → 5 s.f

(ii) 0.0520 g → 3 s.f (iv) 340.00 k → 5 s.f

c 102.53070 → 102.5

(ii) 656 980 → 6.5670×10^5

(iii) 0.008543210 → 0.008543

(iv.) 0.0355551 → 0.03536

d (i) 12.0550 + 9.05

= 21.105

= 21.11

(ii) 257.2 − 19.789

= 237.411

= 237.4

(iii) (0.0045 × 21000.00) + (2813 / 1.2)

94.5 + 2344.16666-7

2438.666667

2438

Question 4

a. (i) 0.076 L to mL

→ $0.076\ L = 76 \times 10^{-3}\ L = 76\ mL$

or

$$0.076\ L \times \frac{1\ mL}{10^{-3}\ L} = \underline{76\ mL}$$

(ii) 6.88×10^{5} ns to s

$$6.88 \times 10^{5}\ ns \times \frac{10^{-9}\ s}{1\ ns} = \underline{6.88 \times 10^{-4}\ s}$$

(iii) 500 days to seconds

$$500\ days \times \frac{3600\ s}{1\ hour} \times \frac{24\ hours}{1\ day} = 43\ 200\ 000\ s$$

(iv) 22.50 gal/min to L/s

$$\frac{22.50\ gal}{min} \times \frac{3.78541\ L}{1\ gal} \times \frac{1\ min}{60\ s} = \underline{1.420\ L/s}$$

(v) 0.510 in./ms to km/hr

$$\frac{0.510\ in}{ms} \times \frac{1\ ms}{10^{-3}\ s} \times \frac{3600\ s}{1\ hr} \times \frac{2.54\ cm}{1\ in} \times \frac{1\ km}{100\ 000\ cm}$$

$$= \underline{46.6\ km/hr}$$

Question 4

b $2.998 \times 10^8 \, m s^{-1}$

$\rightarrow 2.998 \times 10^8 \, m/s$

$$\rightarrow \frac{2.998 \times 10^8 \, m}{s} \times \frac{1 km}{1000 m} \times \frac{3600 s}{1 h} = \underline{1.079 \times 10^9 \, km/h}$$

c Volume $= 3 \times 4 \times 5 = 60 m^3$

$$60 m^3 \times \frac{1000 l}{1 m^3} = 60000 l$$

mass $= D \times V = 1.19 g/l \times 60000 l$

$= 71400 . g$

$71400g \times \frac{1kg}{1000g} = 71.4kg = \underline{71kg}$

Question 5

a(i) a law and theory

→ A law is a summary of an observed behaviour while a theory is a set of tested hypotheses that gives an overal explanation of some natural phenomenon

(ii) Precision and Accuracy

→ Precision refers to how closely two or more measurements of the same quantity agree with one another, whereas Accuracy is how close a measurement is to the true value.

(iii) Homogenous and Heterogeneous mixture

→ Homogeneous mixtures are uniform throughout while heterogenous mixtures have uneven distribution and visible differences in composition.

b A hypothesis is a possible explanation for an observation

Question 6

(a) (i) no, coz to know the number of neutrons you also need the mass number

(ii) Yes, since in a neutral element number of protos is

equal to number of electrons

(iii) Yes, since elements are arranged in ascending order of the proton number, where each element has its own distinct proton number

(b) Law of conservation of mass
→ Mass is neither created nor destroyed. The total mass before a chemical reaction always equals the total mass after a chemical reaction

Law of definite Proportion
→ A given compound always contains exactly the same proportion of elements by mass.

Law of multiple Proportions
→ When two elements form a series of compounds, the ratio of the mass of the second element that combine 1 g of the first element always can be reduced to small whole numbers

c Molecule versus Ion
→ Ion have extra electrons added or removed to form either cations or anions while molecules have no overall charge

(ii) Covalent bonding versus Ionic bonding
→ The sharing of electrons will take place between atoms in covalent bonding. An ionic bond is the force of attraction between two oppositely charged ion

(iii) Molecule versus Compound

-> A molecule is a collection of atoms held together by covalent bonds. A compound is composed of two or more different elements having constant composition.

(iv) Anion versus Cation

- Anion is a negatively charged ion. A cation is a positively charged ion

d (i) True

(ii) True

(iii) False -> Hydrogen has mostly nonmetallic properties

(iv) False -> A family of elements is also known as a group of elements

(v) False -> The formula of the ionic compound formed should be AX_2

Question 6

(a.) $12.g + 106.4g + 1.01g = 119.41g$

$$\frac{12.09}{119.4g} \times 100 = 10.05\%$$

$\frac{30.0}{x} \times 100 = 10.05\%$ of C by mass

$\frac{30.0}{x} \times 100\% = 10.05\%$ of C by mass

$\frac{3000}{x}\% = 10.05\%$

$x = 298.507$

$x = 299\,g$ of chloroform

b (i) Element 8 is oxygen $^{17}_{8}O$

(ii) $^{37}_{17}Cl$ (iii) 27 is cobalt $^{60}_{27}Co$

(iv) $z = 26$ $A = 26 + 31 = 57$; $^{57}_{26}Fe$.

(v) I (Iodine) : $^{131}_{53}I^-$

(vi) Lithium is element 3 ; $^{7}_{3}Li$

c (i) Transition metals

(ii) Alkaline earth metals

(iii) Alkali metals

(iv) Noble Gases

(v) Halogens

d (i) Ba^{2+} has 54

	Ion	Protons	Electrons
i	Ba^{2+}	56	54
ii	Zn^{2+}	30	28
iii	N^{3-}	7	10
iv	Rb^{+}	37	36
v	Co^{3+}	27	24
vi	Te^{2-}	52	54
vii	Br^{-}	35	36

Question 7

(a, i) $NaBr$ → Sodium Bromide

Rb_2O → Rubidium Oxide

CaS → Calcium Sulfide

AlI_3 → Aluminum Iodide

Strontium Flouride → SrF_2

Aluminum selenide → Al_2Se_3

Potassium Nitride → K_3N

viii Magnesium Phosphide → Mg_3P_2

b Hg_2O → Mercury (I) oxide

$FeBr_3$ → Iron (III) Bromide

CoS → Cobalt (II) sulfide

$TiCl_4$ → Titanium (IV) Chloride

tin (II) chloride → $SnCl_2$

Cobalt (III) iodide → CoI_3

Chromium (VI) sulphide → CrS_3

Mercury (II) oxide → HgO

c i) $BaSO_3$ → Barium Sulfite

$NaNO_2$ → Sodium Nitrite

$KMnO_4$ → Potassium Permanganate

$K_2Cr_2O_7$ → Potassium dichromate

d. (i) Chromium (III) hydroxide → $Cr(OH)_3$

(ii) lead (IV) carbonate → $Pb(CO_3)_2$

iii Magnesium Cyanide → $Mg(CN)_2$

iv Ammonium acetate → $NH_4C_2H_3O_2$

e IO^- → Hypoiodite

IO_2^- → Iodite

IO_3^- → Iodate

IO_4^- → Periodate

HIO → hyporodous acid

HIO_2 → iodous acid

HIO_3 → Iodic acid

HIO_4 → Periodic acid

(f.) Sulphur difluoride → SF_2

Sulphur Hexafluoride → SF_6

Sodium dihydrogen phosphate → NaH_2PO_4

Lithium nitride → Li_3N

Chromium (III) carbonate → $Cr_2(CO_3)_3$

Bromous Acid → $HBrO_2$

dinitrogen pentoxide → N_2O_5

(9.) SF_6 ⟶ Sulphur hexafluoride

IF_5 ⟶ Iodine Pentafluoride

XeO_3 ⟶ Xenon trioxide

dinitrogen tetroxide ⟶ N_2O_4

hydrogen Cyanid ⟶ HCN

Tetraphosphorus hexasulphide ⟶ P_4S_6