



THE COPPERBELT UNIVERSITY
SCHOOL OF MATHEMATICS AND NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY

CHEMISTRY (CH 110/ FO 130) TUTORIAL SHEET 1 TERM ONE YEAR 2024

1. Explain the difference between:
 - (i) law and theory
 - (ii) hypothesis and theory
 - (iii) precision and accuracy
 - (iv) homogeneous and heterogeneous mixture
2. Many atomic dimensions are expressed in angstroms. What is the angstrom equal to in terms of the SI Units nanometer (nm) and picometer (pm)
3. Convert each of following:
 - (a) 1.5 g cm^{-3} to g dm^{-3}
 - (b) 100 cm^3 to dm^3
 - (c) 0.36 m to \AA
 - (d) 16 cm^3 to m^3
4. Define each of the following terms:
 - (a) Quantitative measurement
 - (b) Precision
 - (c) Qualitative measurement
 - (d) Systematic error
5. 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 $3.0 \text{ m} \times 4.0 \text{ m} \times 5.0 \text{ m}$?
6. Convert the following temperatures to Kelvin:
 - (a) The freezing point of water 0°C .
 - (b) Melting temperature of Neon -248°C .
 - (c) Body temperature of 98.6°F .
7. Cesium atoms are the largest naturally occurring atoms. Each has a radius of 2.62 \AA . How many atoms of cesium would have to be laid side by side to a row of cesium atoms 1.0 mm long, assuming the atoms are spherical?
8. Perform the following mathematical operations and express each result in to the correct number of significant figures.
 - (a) $(9.04 - 8.23 + 21.954 + 81.0) \div 3.1416$
 - (b) $0.1654 + 2.07 - 2.114$
 - (c) $8.27(4.987 - 4.962)$
 - (d) $485 \div 9.231$
9. State the postulates of John Dalton's theory of the atom.

10. State the law of constant composition.
11. Indicate the number of protons, neutrons and electrons in each of the following species.
- (a) Ca^{2+} (b) Cu^{2+} (c) P^{3-} (d) Cl^- (e) Ni^{2+} (f) Fe (g) Fr^+
12. If an element consists of 47.50 % atoms with a mass of 120.052 amu each and 52.50 % atoms with a mass of 122.855 amu each, what is the atomic mass of the element?
13. Provide the systematic name of each of the following compounds:
- (a) AlCl_3 (b) $\text{Cu}(\text{NO}_3)_2$ (c) $\text{K}_2\text{Cr}_2\text{O}_7$ (d) IF_5 (e) P_2O_5 (f) HClO (g) H_3PO_4
14. Provide the chemical formula of each of the following compounds:
- (a) Potassium chromate (b) Iron (III) hydroxide (c) hydrogen cyanide
(d) Potassium permanganate (e) tetraphosphorus hexasulphide (f) Iodic acid

THE END_{FM2024}

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 overall explanation of some natural phenomenon

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.

Homogeneous and Heterogeneous mixture

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

A hypothesis is a possible explanation for an observation

Q.2

$$1\text{Å} = 10^{-10}\text{m}$$

$$1\text{Å} = 10^{-10}\text{m}$$

$$1\text{Å} = 10^{-1} \times 10^{-9}\text{m}$$

$$1\text{Å} = 10^2 \times 10^{-12}\text{m}$$

$$1\text{Å} = 10^{-1}\text{nm}$$

$$1\text{Å} = 10^2\text{pm}$$

$$\underline{1\text{Å} = 0.1\text{nm}}$$

$$\underline{1\text{Å} = 100\text{pm}}$$

Q.3

(a) 1.5g cm^{-3} to g dm^{-3}

$$\frac{1.5\text{g}}{\text{cm}^3} \times \left(\frac{100\text{cm}}{1\text{m}}\right)^3 \times \left(\frac{1\text{m}}{10\text{dm}}\right)^3$$

$$\frac{1.5\text{g}}{\text{cm}^3} \times \frac{10^6\text{cm}^3}{1\text{m}^3} \times \frac{1\text{m}^3}{10^3\text{dm}^3}$$

$$\underline{1.5 \times 10^3 \text{g/dm}^3}$$

(b) 100cm^3 to dm^3

$$100\text{cm}^3 \times \left(\frac{1\text{m}}{100\text{cm}}\right)^3 \times \left(\frac{10\text{dm}}{1\text{m}}\right)^3$$

$$\cancel{100\text{cm}^3} \times \frac{1\text{m}^3}{10^6\text{cm}^3} \times \frac{10^3\text{dm}^3}{1\text{m}^3}$$

$$\underline{0.1\text{dm}^3}$$

$$(c) 0.36\text{m} \rightarrow \text{A}$$

$$(d) 16\text{cm}^3 \rightarrow \text{m}^3$$

$$0.36\text{m} \times \frac{1\text{m}}{10^{-10}\text{A}}$$
$$0.36 \times 10^{10} \text{A}$$
$$\underline{3.6 \times 10^9 \text{A}}$$

$$16\text{cm}^3 \times \left(\frac{1\text{m}}{100\text{cm}}\right)^3$$
$$16\text{cm}^3 \times \frac{1\text{m}^3}{10^6\text{cm}^3}$$

$$16 \times 10^{-6} \text{m}^3$$
$$\underline{1.6 \times 10^{-5} \text{m}^3}$$

Q.5

$$V = lbh$$
$$= 3 \times 4 \times 5$$

$$V = 60\text{m}^3$$

$$60\text{m}^3 \times \left(\frac{10\text{dm}}{1\text{m}}\right)^3$$
$$60\text{m}^3 \times \frac{10^3\text{dm}^3}{1\text{m}^3} = 60 \times 10^3 \text{dm}^3$$

$$\rightarrow 1\text{dm}^3 = 1\text{L}$$

$$\rightarrow 60 \times 10^3 \text{L}$$

$$\text{mass} = D \times V$$
$$= 1.1 \text{g/L} \times (60 \times 10^3 \text{L})$$
$$= 71400 \text{g}$$

$$\underline{\text{mass} = 71.4 \text{kg}}$$

Q.6

(a) $K = 0^\circ C + 273.15^\circ C$ (b) $K = {}^\circ C + 273.15$
 $K = 0^\circ C + 273.15$ $= -248^\circ C + 273.15$
 $\underline{K = 273.15^\circ K}$ $= \underline{25.15 K}$

c # first convert to ${}^\circ C$ then to K

$${}^\circ C = \left({}^\circ F - 32^\circ F \right) \times \frac{5^\circ C}{9^\circ F}$$

$${}^\circ C = (98.6 - 32) \times \frac{5}{9}$$

$${}^\circ C = 66.6 \times \frac{5}{9} \rightarrow$$

$${}^\circ C = 37^\circ C$$

$$K = {}^\circ C + 273.15$$
$$= 37^\circ C + 273.15$$

$$\underline{K = 310.15 K}$$

Q.7

$$\text{Diameter} = 2 \times 2.62 \text{ Å} \rightarrow \frac{0.1}{5.2 \times 10^{-7}}$$
$$= 5.24 \text{ Å}$$

$$5.24 \text{ Å} \times \frac{10^{-10} \text{ m}}{\text{Å}} \times \frac{10^3 \text{ mm}}{\text{m}} \# \underline{190.839.7 \text{ atoms}}$$
$$5.24 \times 10^{-7} \text{ mm}$$

$$\# \text{ of atoms} = \frac{0.1 \text{ mm}}{5.24 \times 10^{-7} \text{ mm}}$$

Q. 8

(a) $(9.04 - 8.23 + 21.954 + 81.0) \div 3.1416$
 $(103.764) \div 3.1416$

33.03

b. $0.1654 + 2.07 - 2.114 = 0.1214$
= 0.12

(c) $8.27(4.987 - 4.962) = 8.24 (0.025)$
= 0.206

(d) $485 \div 9.231 = 52.5403531578$
= 52.5

Q. 11

	Protons	Neutrons	Electrons
Ca^{2+}	20	20	18
Cu^{2+}	29	35	27
P^{3-}	15	16	18
Cl^{-}	17	18	18
Ni^{2+}	28	31	26
Fe	26	30	26
Fr^{+}	87	136	86

Q 12

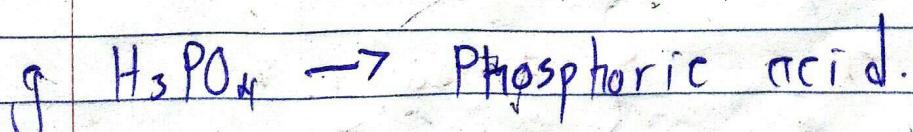
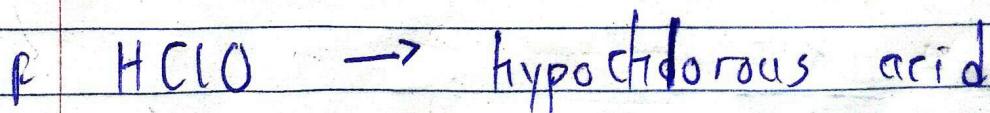
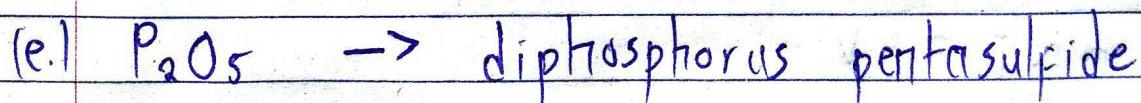
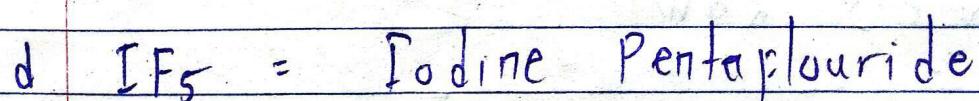
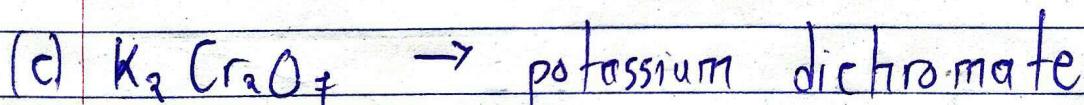
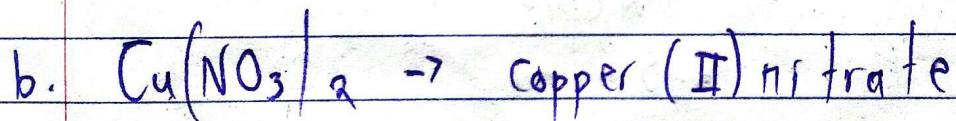
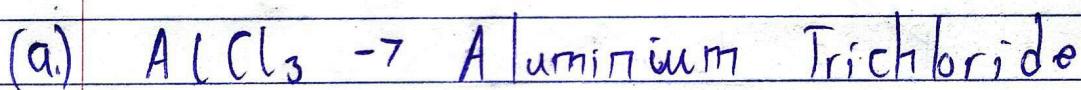
$$R.A.M = \left(\% \text{ of A} \times \text{mass of A} \right) + \left(\% \text{ of B} \times \text{mass of B} \right)$$

$$= \left(\frac{47.50}{100} \times 120.052 \right) + \left(\frac{52.5}{100} \times 122.855 \right)$$

$$= 57.0247 + 64.498875$$

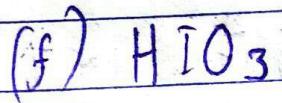
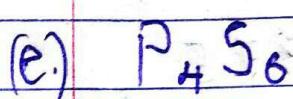
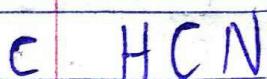
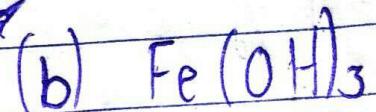
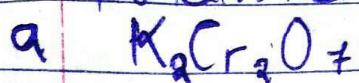
$$= 121.523 \text{ amu}$$

Q. 13



Q. 14

a Potassium Chromate



c, ii

$$P_1 V_1 = P_2 V_2$$
$$P_1 \times 4 \text{ cm}^3 = 10 \text{ cm}^3 \times 1 \text{ atm}$$

$$P_1 = \frac{10 \text{ cm}^3 \cdot \text{atm}}{4 \text{ cm}^3}$$

$$P_1 = 2.5 \text{ atm.}$$

Boyle's Law

d. $nRT = PV$

$$P = \frac{nRT}{V}$$

Dalton's Atomic Theory

Presented his theory in a series of postulates:

- Elements are made up of atoms – tiny indivisible particles of an element that cannot be created or destroyed.
- Atoms of each element are identical. Atoms of different elements are different.

Dalton's Atomic Theory

- Compounds are formed when atoms of different elements combine. Each compound has a specific number and kinds of atoms.
- Chemical reactions are a rearrangement of atoms. i.e. atoms are rearranged, combined, or separated. Atoms are not created or destroyed or changed into atoms of another element.