Virtual Study

Learn, Connect, Succeed

Chemistry

Grade 9

Prepared by: Virtual Study

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UNIT – ONE

1 .1 Chemistry and its importance

Definition Of Chemistry

Chemistry: is a science that deals with the

- ✓ Properties
- ✓ Composition and
- ✓ Structure of of elements & compounds.

Substance: is a particular kind of matter With uniform properties.

E . g : Sliver, water, Soap, salt etc.

Matter : a physical substance that occupies space & has rest mass.

E . g : Stool, television, pencil, book etc.

N.B : Every substance has its own properties.

Composition :- Is the nature of something in gradient how a whole mixture is made up.

E . g : Table salt composed of sodium & chlorine.

- Stain less stell spoon are alloy of chromium, carbon & other elements.

Structure:- The arrangement between parts & elements of something complex known as structure.

Example:- School building is made up of root, window, & floor arranged in a certain order.

⇨ Every substance in our environment is continuously changed from time to time by external & internal force.

Scope Of Chemistry

- There are **five** main branches of chemistry

1. Physical Chemistry:- Is the study of macroscopic, atomic properties & phenomena in chemical reaction.

- It also study physical structure of material in the molecular level.

2. Organic Chemistry:- It is the study of carbon & its compound except CO_3^{-2}, HCO_3^-, CO_2 and CO.

OR the study of a substance containing carbon is the most a abundant element on the earth due to its catenation nature.

3. In organic Chemistry:- It is the study of in organic chemical that are found in rocks & minerals.

4. Analytical Chemistry:- It study the composition of matter.

- It focus on ↳ Separation
  ↳ Identification and
  ↳ Quantifying sample of chemicals.

✷ Analytical chemist may use complex instrument to analyze component in unknown sample.

5. Bio Chemistry:- It is the study of chemical process in living thing.

- It covers from basic cellular process to disease state.

✷ Chemistry affect life & natural events and involved in providing useful and dangerous substance that have negative impact to environment & life like
- Chloro fluoro carbon
- Oxides of nitrogen and
- Sculpture

1.2 The relationship b/n chemistry & other natural Science

⇉ Chemistry is a branch of science

Science:- A process by which focus on natural universe by
▲ Observing
▲ Testing &
▲ Explanation our observation

- To study physical universe, there are many different branches of science.
  A. Biology:- The study of living thing.
  B. Geography:- Is the study of rock & earth.
  C. Physics:- mainly concern with nature, properties of matter and energy.
  These science is over lap with each other.

Example:- ✷ **Bio Chemistry:-** the study of chemical reaction in living thing

✷ **Geo Chemistry:-** It is the study of the processes that control ↳ abundance

↳ Composition & distribution of chemicals & isotopes in geologic environment.

✷ Physical Chemistry:- It study application of techniques & theory of physics in a chemical system.

1.3 Role of Chemistry in Production & in Society

Everyday life is involved in the knowledge application and rules of chemistry.

A. Agriculture:- system of agriculture is mainly related to chemistry because chemistry involves in the production of:-

▲. Fertilizer to increase crop production

Example:- $(NH_2)_2CO$, DAP, $(NH_4)_2SO_4$ etc.

▲ Pesticides:- It causes crop damage.

- It includes – Herbicide, insecticide and fungicides.

▲ pipe production for irrigation process

B. Food production:- Chemistry discover d/t type of food preservation.

Example: NaCl used to preserve a raw meat.

C. Medicine:- chemistry used to produce lifesaving medicine.

Example

✷ AZT:- For AIDS victim to fight multiplication of virus

✷ Cisplatin & Taxol:- for cancer therapy

✷ Sculpture drug & penciline:- for dysentery cure.

Note: There some common drugs that are provided by chemistry

These are

⇨ **Disinfectant:-** kill microb that present in toilet, floor & drain

Example: Dettol & Sanitizer.

⇨ **Analgesics:-** drugs that used to relief from pain

- Also called pain killer.

Example: Asprine & parace tamol.

⇨ **Anesthetics:-** It is sleep produce that on medical treatment for operation

Example: barbiturates.

⇨ **Antibiotics:-** used to control in factions.

⇨ **Antiseptics:-** prevent infection from wounds by killing bacteria.

Example: acryflavine

⇨ **Tranquilizers:-** drugs that used to reduce tension & bring about calm.

D. Building Construction Material

Chemistry provides building resource like Glass, cement & steel.

- It also used in construction of dam & bridge.

Example: GERD / Grand Ethiopian ressistance dam generate 6456 MW /mega watt/ hydro power project.

1.4. Some Common Chemical industry in Ethiopia.

Industry:- It is an economic activity concerned with processing of raw material & manufacture of goods in industry. Or a group of companies that linked primarily business activities.

Chemical industry

A company that manufacture

- ↳ Organic & in organic chemicals
- ↳ Fragrances
- ↳ Agro chemical
- ↳ Polymers
- ↳ Explosives
- ↳ Ceramic product
- ↳ Petro chemical and oleo chemical (oil, waxes & fats)

≠ Chemical Products:- It a products that manufactured, processed, sold or distributed by the company that are chemical substances. There are three general classes of product.

I. Basic Chemical:- chemicals like alkalis, acids, organic chemical & salts.

II. Chemical products to be used in further manufactures like - plastic material
- Synthetic fiber
- pigment & dry color.

III. Finished Chemical products to be used for ultimate consumption like soap, cosmetic, drug, fertilizer etc.

1.5 Some Chemical interprises in Ethiopia

Name of interprise: City : Product

1. Chorra gas ⇨ A . A ⇨ plastic, chemical & petroleum
2. Ziway caustic soda ⇨ Ziway ⇨ NaOH.
3. Abisata sodaash ⇨ Bulbula ⇨ Trona / $Na_3HlCO_3/_2 . 2H_2O$
4. Natas silk paint

   Factory ⇨ A.A ⇨ paints, varnishes & glues
5. Teamco soap factory ⇨ Burayu ⇨ soap & detergent etc

✷ **Other chemical product industry in Ethiopia**

- ▲ Cement (Mugher, Mesoba, Derba
- ▲ Sugar (Metehara, Fincha
- ▲ Psper & pula (Wonji)
- ▲ Pharmaceutical A.A, Adigrate)
- ▲ Tyre (Tire) Horizon Addis Tyr

Unit – One Review exercise

1. What will be the future effect of chemistry?

Answer:- It likely the chemical science will be increasingly required to solve challenges in energy & climate

change , food production and clean water.

- It might have increasing role in pharmaceutical industry.

2. What is the role of chemistry played in production & society

Answer:- chemistry is significant in our civilization because it affects our basic need, for foods, clothing & shelter, health and energy

- Chemistry also have a vital role in water treatment, cleaning air & prevent soil acidity.

3. What jobs can you do with chemistry?

Answer:- Chemical engineer air involved the design & development of new products from raw materials.

4. Which branch of chemistry has highest scope & why?

Answer:- organic chemistry has very high scope because the compounds of carbon covers a wide range / field), wider than that covered by any other elements.

- Its scope embrace all living matter as well as the vast number of nonliving substance which are produced through the agency of life.

Unit – 1 Review exercise

Part I True/False

1) False
2) True
3) True
4) False
5) False

Part II Fill Blank Space

6. Attribute, quality or characteristics
7. Composition
8. Structure
9. Energy
10. Physical chemistry
11. Analytical chemistry

Part III Give Short answer

12. Define the term industry, chemical industry & chemical product?

★ **Industry:-** defined as economic activity concerned with the processing of raw material & manufacture goods in factories.

★ **Chemical product:-** the products manufactured, processed, sold or distribute by the company that are chemical substance.

★ **Chemical industry:-** a plant or factory involved in a manufacturing activity that converts raw material in to desirable finished or semi finished products.

13. What is the role chemistry played in production and society?

- Chemistry applies in every aspect of our society such as
  - ➥ Cooking
  - ➥ Medicine
  - ➥ Cleaning
  - ➥ environmental process and
  - ➥ good manufacturing

14. How does chemistry play a role in increasing comfort, pleasure and luxuries?

Answer: Chemistry provides large number of synthetic fiber like nylon, terylene which are easily to wash, dry quickly & resistant to chemicals.

★ **Transportation:** all transport vehicles use diesel or petrol as a fuel which are chemical products.

16. Which branch of chemistry has the highest scope & why?

➥ Organic chemistry has highest scope because it capable of forming many chemicals.

➥ It has made a tremendous contribution today's world.

➥ Organic chemistry deals with carbon containing compounds.

17. What are the five field of chemistry?

➥ Organic chemistry

➥ In Organic chemistry

- ➥ Physical chemistry
- ➥ Analytical chemistry
- ➥ Bio chemistry

18. What will be the future efforts of chemistry?

The chemical science will be increasingly require to solve challenges in energy & climate change, food production & clean water and chemistry might have an increased role in bio chemical & pharmaceutical industry as well as maintenance.

19. What jobs can you do with chemistry?

⇒ Jop options for chemistry

- ➥ Biotechnologist
- ➥ Colour technologist
- ➥ Medicinal chemist
- ➥ food technologist
- ➥ Environmental chemist
- ➥ Chemical engineering

UNIT – 2

2.1 Measurement & Scientific Method

Measurement is the comparison of unknown quantity with known fixed quantity.

Or Measurement is the assessment of numbers to character tics of an object or event, which can be compared with other object or event.

✷ The study of chemistry highly depend on measurement.

- Common device enable to make simple measurement of substance properties are
  - ⇨ Volumetric flask = to measure volume
  - ⇨ Balance = to measure mass
  - ⇨ Thermometer = to measure temperature

✷ instruments can provide measurement of macroscopic / direct method / or microscopic / In direct method/

Q. List some common measuring device found in chemistry laboratory?

Answer:- Buret, volumetric flask e.t.c

SI unit / International system of units)

✷ Base quantity:- is one of the conviential chosen subset of physical quantity, no quantities in the subset can be expressed in terms of the other.

✷ it consists of ⇨ Length - meter

⇨ Time – second

⇨ Current – Ampere

⇨ Amount of substance - mole

⇨ Mass - killograme &

⇨ Luminous intensity - candela

2.2 Heat & temperature

Temperature:- It is a measure of hotness and coldness of an object.

- Its scale includes °C, °F &k

Heat:- It is a form of energy that flows from hot to cold body until thermal equilibrium established.

Note:-

$$°C + 273 = K$$

- In "°C" freezing point = °C
  Scale boiling point = 100°C
- In "°F" freezing point = 32°F
  Scale boiling point = 212°F
- In "*K*" freezing point = 273k
  Scale boiling point = 373k

Question: the relationship b/n °C & °F ?

$$\frac{100-0}{°C-0} = \frac{212-32}{°F-32}$$

$$\frac{100}{°C} = \frac{180}{°F-32}$$

$$\frac{180°C}{180} = \frac{100\,(°F-32)}{180}$$

$$\Rightarrow \quad °C = 5/9\,(°F - 32 \quad \text{Or} \quad °F = 9/5\,(°C - 32)$$

Q2: At what point does °C is equal to °F ?

Solution: °C = 5/9 (°F - 32) but °C = °F .

$$°C = 5/9$$

$$\frac{°C}{1} = \frac{5°C-160}{9}$$

$$9°C = 5°C - 160$$

$9℃ = 5℃ = -160$

$\frac{4℃}{4} = \frac{-160}{4}$

$℃ = -40$

⇨ at – 40 ℃, ℃ & ℉ become equal

Q3. Convert 100 ℉ in to ℃ ?

Solution :- $℃ = 5/9\ (℃ - 32)$

$= 5/9\ (100 - 32)$

$= 5/9\ (68)^0$

$℃ = 37.77^0$

Derived units

A unit of measurement that derived from base unit is called derived unit.

Example: Area, speed, volume, density etc.

✹ **Area:-** SI unit length X SI unit of width mx m $= m^2$

✹ **Volume:-** defined as the space occupied by an object.

- SI unit m^3 which is large unit for laboratory. So we can use other convent unit of volume like cm^3, ml, dm^3, L e t c

✹ **Speed:-** the rate of change of distance per unit time.

- SI unit m/s $= v/T$

✹ **Density:-** The mass of an object per unit volume

- SI unit $kg/m^3 = m/v$

Density used to determine characteristic and purity of substance.

Example: Pure gola has higher density than impure gold

Exercise

A piece of metal wire has a volume of 20.2 cm^3 and a mass 159g. What is the density of a metal

Given

m = 159g = 0.159kg

v = 20.2 m^3

Required

S = ?

Solution

$S = \frac{m}{V}$ ------ x

$= \frac{0.159\ kg}{20.2 m^3}$

S = 0.00787 kg/m^3 = 7.87g/m^3

There for this wire made up of iron because the density of iron is **7.87**g/m^3

2.3 Common On prefix Used in SI unit

✷ Prefixes:- a letter or group of letters that added to at the beginning of symbol or words.

Some SI prefix in measurement.

Prefix	Symbol	factor	Example
Giga	G	$1x10^9$	1 giga Meter = $1x10^{9m}$
Micro	N	$1x10^{-6}$	1 micro meter 10^{-6}m
Mega	M	$1x10^6$	1 mega meter = $1x10^6$m
Killo	K	$1x10^3$	1 kilogram = $1x10^3$g
Tera	T	$1x10^{12}$	1 Tetrameter = $1x10^{12}$m
Hector	H	$1x10^2$	1 hectometer = $1x10^2$m
Pico	P	$1x10^{-12}$	1 Pico meter = $1x10^{-12}$m e t c

Example: How many μF are pre sent in 0.5F

Solution: 1F = $10^{-6}\ \mu$F

0.5F = x

X = $0.5x10^{-6}\ \mu$F

X = **$5x10^{-5}\ \mu$F**

2.4 Uncertainty in Measurement

Uncertainty: is the quantification of the doubt about measurement result.

- It exist in all quantitative measurement.

✷ uncertainty is the interval around the estimated value between which the true value of the measured Parameter is expected to lie.

Answer:- ✓ Measuring device

✓ unit under test

✓ Environment of the measurement

✓ Skill of estimator

✓ Calibration & Method of measurement

✷ There are two categories of uncertainty

These are

I) Systematic uncertainty

- It is caused by the limitation of the measuring instrument
- In systematic uncertainty all measured value consistently larger or smaller than true value
- It includes in accurate meters tics and mis calibrated balance.

Note: Systematic uncertainty can be eliminated

II) Random uncertainty

- It caused the skill of the experiment making the measurements.
- Variation in the measurement occur without a predictable pattern

Random Uncertainty can reduce but not eliminate totally.

How can we calculate uncertainty?

$$\% \text{ uncertainty} = \frac{absolute\ uncertainty}{measured\ value} \text{ x } 100$$

Example: Atypical uncertainty of a top loading balance is 0.05g, on weighing of 23.25g . Then determine.

a) Percent uncertainty
b) Report your answer

Solution

$$\text{Percent uncertainty} = \frac{absolute\ uncertainty}{measured\ value} \text{ x } 100$$

$$= \frac{0.05}{23.25} \text{ x } 100$$

Percent uncertainty = **0.2 %**

Therefore the answer reported as:

Absolute uncertainty : 23.25 ± 0.05

Percent uncertainty : 23.25 ± 0.2 %

Exercise

1. A barometer reading of 723.5 tors, & the absolute uncertain is 0.1 torr. Then

   a) Calculate percent uncertainty

   b) how can you report your answer

Solution

$$\% \text{ Uncertainty} = \frac{absolute\ uncertainty}{measured\ value} \text{ x } 100$$

$$= \frac{0.1\ torr}{723.5\ torr} \text{ x } 100$$

⇨ % uncertainty $= 0.014\%$

Then the answer may be reported as

Absolute uncertainty : 723.5 ± 0.1

Percent uncertainty : 723.5 ± 0.114

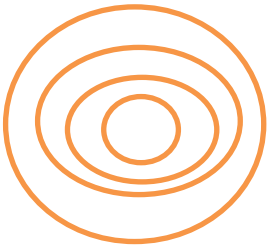
2.5 Precision and accuracy

✷ precision :- It is the close ness of individual measurement.

- It may nearest to the true value or not

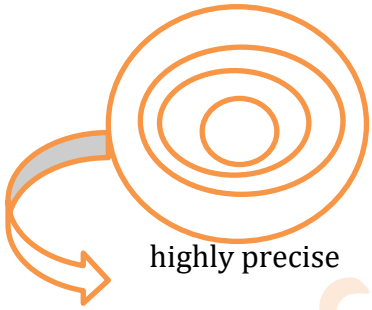
✷ Accuracy:- the close ness of individual measurement to the true value.

Examples: of precision & Accuracy



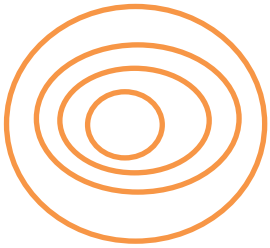
⇨ In accurate

But a set of precise



highly precise

& accuracy



⇨ It is neither precise nor accuracy.

Significant Figure

Rules for counting Significant Figure

Rule 1: Any nonzero digits are significant.

Example: 123cm : has three significant figure.

1284cm : has four significant figure.

Rule 2: Zero b/n non zero digits are significant figure.

Example: ✷ 104km : has three significant figure.

✷ 11026cm^3 : has five significant figure.

Rule 3: Zero to the left of the first nonzero digits are not significant

Example: ✷ 0.012 ℓ : has two significant figure.

✷ 0.001 : has one significant figure.

Rule 4: For a number that do not contain decimal point, zeros after the a stone zero digits may or may not be significant (it is ambiguous)

Example: 400m : has no clear significant figure.

Until it express in scientific notation.

i. e : $4.0x10^2$m : has two significant figure.

$4.00x10^2$m: has three significant figure.

Rule 5 : If a number is greater than "1" then all the zeros written to the right of the decimal point count as significant figure.

Example: ✷ 2.0m has two significant figure.

✷ 40.02lm has five significant figure.

If a number is less than "1" then only the zeros that are at the end of the number & zeros that between non zero digits are significant.

Example: ✷ 0.010kgb has two significant figure.

✷ $0.30005cm^3$ has five significant figure.

Calculation On Significant figure

Addition and Subtraction

In addition & subtraction , the answer cannot have more digits to the right of the decimal point than either of the original number.

Example 1: $\begin{pmatrix} 89.332 \\ +1.1 \end{pmatrix} = 70.432$ then the answer should contain one digit after decimal points

$\therefore$ 90.432 round of **90.4**

Example 2: 2.045 $= 1.935 \rightarrow$ round of 7 to **1.94**
- 0.11

✷ **Multiplication & Division**

In multiplication and division the number of significant figure in the final product or quotient is determined by the original number which have the lowest significant figure.

Example 1 : 2.5 x 3.504 = 8.76 then it should be written as lowest significant figure.

i. e 8.76 round off to 8.8

Example 2 : $\frac{7.95}{10.246}$ = **0.775**91 then it round off to **0.776**

Exercise 2.5

1. Determine the number of in each of the following

a) 35ml = has two significant figure.

b) 2008 kg = has four significant figure.

C) 0.0580m^3 has three significant figure.

Exercise

1. Carry out the following arithmetic operation to the correct number of significant figure.

a) 11,254.1g + 0.1983g = 11, 254.2983 then it should convert to the smallest decimal place, 11,254.2983g round off to **11254.30g**

b) 66.59L – 3.113L = 63.477L then the answer should round off to **63.48** ℓ

C) 8.16m x 5.1535m = 42.05256 → round off **42.1**m^2

d) $\frac{0.0154kg}{88.3m\ell} = \frac{0.0154kg}{0.088.3L} = 0.174405\frac{kg}{L}$ → round off to

$\begin{pmatrix} hint\ 1L = 100m\ell \\ ?= 88.3m\ell \end{pmatrix}$ **0.174kg/L**

2. What is the area of rectangle 1.23 cm wide & 12.34 cm long

Solution

Area of rectangle = width × Length

= 1.23 cm × 12.34 cm

= 15.1782 cm^2

Finally it round off to **15.2**cm^2

2.6 Chemistry as experimental Science

Chemistry is mainly experimental science

- It deals a knowledge comes from laboratory research.
- Chemistry participate in the development of drug and & agricultural research starting from atomic & molecular level.
- It is evidence based because all chemical statements are based on experiment.
- Chemistry also provides theoretical & experimental tools for modern science.
- General due to diverse application it call it central science.

Scientific Method

Defined as a series of steps to collect information & solve problems. OR It is a process of objectively establishing facts through testing & experiment.

Steps of Scientific method

Scientific method follow a series of steps Observation & formulation of question → Data collection & hypothesis → Testing hypothesis → Analysis and conclusion.

① Observation Y Formulation of question

- It is the first step of scientific method & made observation from the observable aspect of phenomena of the universe.

② Data Collection & hypothesis

Based on the observation collect all related data & formulate hypothesis.

③ Testing the hypothesis

In this method hypothesis hold be tested scientifically by conducting an experiment.

- The experiment helps to know whether the hypothesis agree or contradicted to our observation.

④ Analysis & Conclusion

- Use mathematical and scientific procedure to determine the result of the experiment.

Some experimental Skill in Chemistry Laboratory Safety rules

Safety rule:- principal Deregulation governing action procedure to lower risk of injury

Safety rules in laboratory is very important b/c chemical laboratory posse hazards to cause an accidents.

≠ **Some of the following safety rules are given bellow**

1. Responsible behavior is important.
2. Wear eye goggle in laboratory room.
3. Do not perform un authorized experiment
   - If there is doubt about instruction consult to your immediate boss.
4. Do not smoke in laboratory.
5. Report all injuries to your instructor.
6. Do not eat or drink in laboratory room.
7. Long hair must be tied back.
8. Wash be for & after working equipment.
9. Add acid to water when mixing.
10. Do not work alone.
11. You never pointed to the test tube.
12. Read the instruction car fully.
13. Never put any chemicals at the edge of the table.
14. If an acid splash your hand, wash the affected part with running water repeatly.
15. Do not any chemical with mouth.
16. Do not test any chemicals.

✷ There are so many laboratory equipment but all laboratory equipment classified in to three classes.

I. Heating Support it includes ⇨ Wire gauze

⇨ lamp

⇨ crucible

⇨ tong

II. Measuring device includes ⇨ balance

⇨ Graduated cylinder

⇨ Buvrete

⇨ Volumetric pipet

⇨ thermometer

⇨ volumetric flask

III. Reaction Vessel:- includes ✓ test tube

✓ beaker

✓ Elementary flask

✓ Conical flask e t c .

Writing a laboratory report

A. Pre laboratory report

Pre-lab report are a task or home work that someone complete before arriving the laboratory class.

Example: - Know the hazard of the chemical

- Read the laboratory manual car fully

- Wear lab coat, eye goggle & glove.

B. Post laboratory

It is a guid for writing lab report

- It is a final draft.

Note: Initial draft of lab report helps for two reasons.

i. To get everything correct on the first attempt

ii. If you lost the report, you can easily re write the report from the note book.

Post laboratory activity includes

↳ Return chemicals to wards original store.

↳ Cool Bunsen burner after use it.

↳ Clean working are before leaving the room e t c

≠ **Lab report have generally seven main parts**

- Title
- Abstract
- Introduction
- Material & method
- Result

- Discussion & Conclusion
- Reference or works cited.

Graph:- It is a pictorial representation or a diagram that representation data or value in an organized manner.

- The points on the graph represent the relationship b/n two /more things.

Essential elements of good graphs

Δ Title which describe the experiment

Δ It should the space allotted for the graph.

Δ Each axis should be labeled with the quantity being measured

Δ Each data point should be plotted in proper position

Δ A line of best fit.

Measurement & density

Using the mass difference & the known volume the reference body, the density of the liquid sample can be determined.

- The mass difference divided by the volume of the pycnometer is the density of the liquid.

✷ The density of an object is one of most fundamental and useful characteristics.

Material and Chemicals

Material

⇨ metal bar / Al, CU, brass

⇨ 20 / 25ml pipets

⇨ 125ml Erlenmeyer flask

⇨ Stoper

⇨ balance

Chemicals

⇨ Saturated NaCl Solution or

⇨ Saturated KCl Solution

i.e. 36g NaCl / 100ml required ⇨ Thermomete

Safety precautions

- ❖ Take care when you insert a bar in to graduated cylinder.
- ❖ Do not drop it in! b/c the cylinder may be break.
- ❖ Use pipet to suck any chemicals.

Procedure:- good procedures are ⇨ clear
⇨ specific
⇨ to the point

✷ Rules to write procedure

- ✓ Avoid many words
- ✓ Use listed & bullets
- ✓ Write actions out in the order in which they happens.
- ✓ Use active voice e t c

Part I Measurement

A. Mass Measurement

By using sensitive balance use the following procedure

1. Zero the balance after cleaning the pan.
2. Measure the mass of 50ml beaker
3. Record your observation on your note book
4. Remove beaker from par and clean pan by adjusting balance with zero reading
5. Weigh the same beaker & record the result
6. Repeat step 4 & 5 more than once
7. From three mass measurement calculate the average mass of the beaker.
8. Repeat step4 & 5 using second balance
9. Report step4 & 5 using third balance

B. Volume Measurement

Pipet is very important to transfer volume of liquids.

1. Measure temperature in the laboratory & density of water at this temperature is given
2. Determine the mass of liquid of water by using 50ml of beaker.
3. Pour 20/25ml of water through pipet in to 50ml beaker
4. Record the volume of water is appropriate significant figure.
5. Record the number of significant in volume measurement$\pm A = \pi r^2$
6. Weigh beaker & water to the nearest mg(10.001.g)
7. Calculate the mass of water in the beaker

8. Determine volume of water measured by using mas & density of water / S ≡ m/v/.
9. Repeat steps 3 – 8 using 50/100ml graduated cylinder

Part II density

A density of metal bar (use the same metal bar for all trials)

1. Zero your balance weigh a metal bar with sensitive balance nearst mg/ ± 0.001g). report weighing operation twice.
2. Determine the volume of metal bar by each of the following methods , making at least three measurement for each method

Unit – 2 Review exercise

Part I Basic level question (True/False)

6) True 3) True 5) True 7) True
7) False 4) True 6) ? error there is no sign

Part II Intermediate question / Choice /

8) C 12) A 16) C

9) C 13) A 17) D

10) A 14) A 18) B

11) D 15) C

Part III Advanced level question / Choice /

19) Given SI unit for

a) length = m d) mass = kg

b) Area = m^2 e) time = sec

C) volume = m^3 f) force = Neuton (N)

g) energy = Jule (J)

h) temperature = kelvin (k)

20) Write the number for these prefixes

a) mega = 1000000 f) micro = 0.000001

b) kilo = 1000 g) nano = 0.000000001

C) deci = 0.1 h) pico = 0.000000000001

d) centi = 0.01

e) milli = 0.001

21) define density what unit chemist normally use for density?

Answer: Density is the mass of an object per unit volume, even if it SI unit is kg/m^3, chemists widely use $g/m\ell$ for unit of density. Because kg/m^3 is a large unit it is not advisable in lab room hence it leads to wastage of chemicals.

22) Write the equation for converting degree Celsius to degree fahreahe it & vice versal

Answer: $°C = 5/9\ (°F - 32)$ - - - *

$°F = 9/5\ (°C) + 32$ - - - - **

23) Carry out the following arithmetic operation to the correct number of significant figure

a) $12{,}343.2g + 0.1893g = 12{,}343.3893$ → round off to **12,343.4g**

b) $55.67L - 2.386L = 53.284$ → round off to **53.28L**

C) $7.52m \times 6.9232m = 52.062464$ → round off to $52.1m^2$

d) $0.0239\ kg \div 46.5m\ell = 0.0005139785$ → round off to $0.000514\ \frac{kg}{m\ell}$

e) $5.21 \times 10^3\ cm + 2.92 \times 10^3\ cm + 0.292 \times 10^3\ cm$

The answer should contain two decimal place

$= 5.492 \times 10^3 cm$ → round off to **5.49×10^3** cm

24) Carry out the following arithmetic operation & round of the answer to appropriate number of significant figure.

C) $7.1 \times 10^4 dm \times 2.2654 \times 10^2 dm$.

In multiplication & division, the answer should contain the same significant figure to the smaller one i. e: it should be write in two significant figure

$\therefore 7.1 \times 10^4 dm \times 2.2654 \times 10^2 dm = 16.08434 \times 10^6 dm^2$

Then this round off to **$16\times10^6 dm^2$**

25) Carry out each of the following conversion.

a) 18.5m to km

Solution 1km = 1000m

? = 18.5m

$\times \frac{18.5km}{1000}$ = **0.0185km**

b) 16.3km m

1km = 1000m $\Rightarrow$ = 16.3×1000m

16.3km = ? = **16300m**

d) 4.32L to mℓ

Solution 1L = 1000mℓ $\Rightarrow \times = 432 \times 100 m\ell$

4.32ℓ = ? **= 4320ml**

f) 8251l to cm^3 ?

Solution 1L = $1000cm^3$ $\Rightarrow \times = 825\times1000cm^3$

8251L = ? $\times$ = **$8251000cm^3$**

26) Ⓐ 283℃ in to k ?

Solution k = ℃ + 273:

K = 283 + 273 = **556k**

Ⓑ 15.25k in to ℃ ?

Solution k = ℃ + 273

15.25k = ℃+273

$\Rightarrow$ ℃ = 15.25 – 273 = **-257.75℃**

Ⓒ 32.0 ℃ to ℉ ?

Solution $°F = \frac{9}{5}°C + 32$, but $°C = 32$

$°F = \left(\frac{9x32}{5}\right) + 32)°C \quad = \underline{89.6°C}$

Ⓓ 100°F in to k

Solution 1st convert to °C

$°C = \frac{5}{9}(°F - 32)$

$= 5/9\ (100-32)$

$°C = 5/9\ (68) = 37.78°C$

Then $k = °C + 273$

$= 37.78+273$

$= \underline{310.78k}$

27) Express

a) 0°F in °C

Solution $°C = \frac{5}{9}(°F+32)$

$= \frac{5}{9}(0+32)$

$°C = \frac{5}{9}x\ 32 \quad = 17.78°C$

b) 98.6 °C in k ? 1st convert to °C

$°C = \frac{5}{9}(°F+32)$

$= 5/9\ (98.6+32)$

$= 5/9\ (66.6) = 37°C \quad 37°C$

Then $k = °C + 273$

$= 37.00 + 273 \quad = \underline{340.00k}$

C) 298k in to °F ?

Solution 1st convert to °C

$K = 273 + °C$

$298 = 273 + °C \quad \Rightarrow °C = 298\text{-}273 = 25°C$ then

$°F = \frac{9°C}{5} + 32 \quad = \frac{9x25}{5} °C + 32°C \quad = \underline{77°F}$

d) 11.3°C in to °F

Solution $°F = \frac{9°C}{5} + 32$

$°F = \frac{9x11.3}{5} + 32 \quad = \underline{20.34\ °F}$

28) Given the formula

Percent error =	$\frac{/True\ value - measureed\ value/}{True\ value} \times 100$ (Experimental value)

Where the vertical line indicate absolute value.

Calculate the percent error for these measurement.

a) The density of ethanol is found to be 0.802g/ml

True value 0.798g/ml

Solution : percent error $= \frac{/True\ value - measureed\ value/}{True\ value} \times 100$

$= \frac{/0.798 - 0.802/}{/0.798/} \times 100$

percent error $= \frac{/-0.004/}{10.798} = \underline{0.5\ \%}$

b) The mass of the gold in an earing is analyzed to be 0.837g. (True value : 0.864g)

Given

True value = 0.864g

Experimental value = 0.837g

Required

Percent error = ?

Solution

$$\text{percent error} = \frac{/True\ value - experimental\ \ value/}{True\ value} \times 100$$

$$= \frac{/0.864 - 0.837/}{/0.864/} \times 100$$

$$\text{percent error} = \frac{/-0.027/}{0.864} \times 100 = \underline{\mathbf{3\ \%}}$$

UNIT – 3

Structure of atom

Ancient Greek philosopher develop atheary of matter that was not based on experimental evidence.

A Greek philosopher Democritus believed that all matter is composed of indivisible particle called atomos . The word atom comes from Greek word atomos meaning un cattable.

3.1 Historical development of atomic theories of matter

Scientific theories are a well tested, broad explanation of natural phenomena. All modern scientist accept the concept of atom.

- In the middle 5th century ancient Greek philosopher, Empedocles though that all materials are made up of four thing called elements: earth, air, water & fire.
  Plato (students of "Socratus" & teacher of Aristototle) adopted empedocles' theory.
- Aristotle who is the successor of plato also adopted the concept of four elements.

The Greek Concept of atoms

About 2, 5oo years ago, early Greek philosopher be lived the entire universe was a single huge entity. In other words every thing was one.

Around 440BC, Leucippus originated the atom concept. He & his pupil Democritus / 460-371BC/ refined. and extended it in future years.

N.B : The work of Leucippus & Democritus was developed by Epicurus (341-270BC), who made the more general known idea.

1. All matter is composed of atom.
2. There is a void, which is empty space between atoms
3. Atoms are completely solid / no void inside atom
4. Atoms are homogeneous, with no internal structure
5. Atoms are different in their size, shape & weight.

✷ The general accepted atomic model of Democritus is called the solid sphere.

3.2 Draw backs of Early Greek philosopher

Early philosopher trid to understand the nature the world through reason & logic, but not experiment & observation. As a result they had some very thought- provoking idea but they felt no need to justify they ideas based on life experience.

- Other drawback of Greek philosopher as being all through and no action.

Exercises

Give the correct answer for the following questions.

1. Where, by whome & when was the concept of otom originated?

Answer: in greek Leucippus atom concept was originated around 440BC.

2. What does the word atom mean?

Answer: Atom comes from atomos meaning un cattable.

✷ According to ancient Greek philosopher, what do you think in an atom like? Can you draw it

- In greek, the prefix "a" means not and tomos means cut. The word atomos means **un cattable**.
- It is impossible to draw it b/c they very small.

Fundamental Law of chemical reaction

✷ **Law:-** generalized observation about a relationship between two or more things in natural world.

✷ **Scientific law:-** are statements based on repeated experiment that arang of natural phenomena. They do not explain why phenomena exist or what causes it.

✷ **Scientific theory:-** is the explanation of phenomena.

✷ **Chemical Law:-** are those law of nature relevant to chemistry.

N.B: there are three chemical laws

A. The Law of Conservation of mass

- States that the amount of matter in the system is conserved.
- Matter is neither created nor destroyed during chemical reaction.
- This law also law of indestructible of matter, meaning mass of reactant is equal to mass of product in chemical reaction.

B. law of definite proportion

States that the masses of the element in the compound always occur in the same proportion.

OR pure compound always composed of the same elements combined in a define it ratio by mass.

Example: H_2O always composed of 2:1 by volume and 11.19% hydrogen to 88.81 oxygen by mass.

C. Law of multiple proportion

States that the ratio of masses in a compounds of element are small whole numbers

OR when two d/t compounds formed from the same elements, the mass of one element in the two compounds compare to a given mass of other element is small whole number ratio.

Example: CO & CO_2 are two compounds composed from the same element

CO: 12g c = 16g oxygen

1g c = ?

$\frac{12x}{12} = \frac{16g\ of\ "O"}{12}$

$= x = 1.33g\ of\ "O"$

CO_2: 12g of "c" = 32g of "O"

1g of "c" = x

$\frac{12x}{12} = \frac{12}{12}$

$\Rightarrow x = 2.66g$ of "O" Then

Take the ratio of mass of "CO" to "CO_2" we get $CO : CO_2 \Rightarrow 1.33 : 2.66 = 1:2$ simple whole number ratio for masses of oxygen.

Exercises

Give answer for the following question.

① Define the term law.

- **Law:-** general observation about the relationship b/n two /more things in natural world

② What is scientific law.

- **Scientific Law:-** are statements based on the repeated experiment that arrange the natural phenomena.

③ Who discover the law of conservation of mass?

- Antoine Lavoisier in 1789.

✷ State the law of conservation of mass

- States that during a chemical reaction mater neither created nor destroyed.

3.3 Atomic theory

The word theory refers to the way how we interpret facts.

Atomic theory:- the way how we interpret facts about atoms.

Dalton atomic theory

Dalton proposed his atomic theory around 1803 based on certain observation and experimental results.

Dalton atomic theory can be summarized as

⇨ Elements are made up of smaller particle called atoms

⇨ Atoms are neither created nor destroyed.

⇨ Atoms of the same elements are identical in mass & size.

⇨ Atoms combined in small whole numbers to form compounds.

⇨ Atoms are indivisible.

Note: Dalton's effort was not limited to formulating atomic theory, but he proposed symbols for elements & compounds.

- The symbol of element was proposed by Dalton even if difficult to remember & draw

Exercises

Provide the correct answer for the following question.

① What are the successes of Dalton atomic theory?

Answer: The atomic theory explains the law of chemical combination the law of constant composition & law of multiple proportions.

⇨ Dalton was the 1st person to recognize workable distinction b/n fundamental particle of an atom & that of compound.

Modern Atomic theory

Modern atomic theory establishes the concept of atoms and how they compose matter.

Development of Modern atomic theory

Some chronological discoveries of atoms are:-

- ✓ Proton discovered by Goldstein by his anode ray experiment in 1886.

- ✓ Electrons & its charge to mass ratio discovered by J.J. Thomson, in 1897.
- ✓ Next to this in 1904 Thomson develop the "plum Pudding" model of atom.
- ✓ In 1909 Robert Millikan found the charge & mass of an electron.
- ✓ Ernest Ruther fored amd his students Geiger & Marsden discovered the planetary model of an atom in 1911. & also he discover the existence of Proton in the nucleus.
- ✓ James chad wick discovered neutron in 1932

Draw backs of Dalton atomic theory

⇨ indivisibility of atom was proved wrong b/c atoms divided in to three sub atomic partied
⇨ Atoms of the same element may hot have similar properties in aspects, due to the presence of isotopes.
⇨ Atoms of different element hare different is mass has been proven wrong due to existence of isobar.
Example: Argon and calcium atom have atomic mass 400 mass
⇨ The law of multiple proportion is not observed in complex organic compounds like, sugar and protein molecule.

Postulates of Modern atomic theory

⇨ Elements are made up of small particles called **atoms**.
✷ Atoms are neither created nor destroyed during chemical reaction.
✷ Atoms of the same element have the same atomic number but may vary in mass number
✷ Atoms of different element have d/t in chemical properties.
✷ Atoms combine in a small whole number ratio to for compounds.

Exercises

① Compare and contrast Dalton's atomic with modern atomic theory.

Dalton's atomic theory	Modern atomic theory
↳ Atoms are indivisible	↳ Atoms are divisible
↳ Atoms of the same elements	↳ Atoms of the same elements may not have identical in mass.
↳ have identical in mass	may not have identical in mass.
↳ Atoms of the same element Have the same physical & Chemical properties.	↳ Atoms of the same elements have different physical propertied.

4) What are the draw backs of Dalton's atomic theory in your own word.
Answer
⇨ Atoms are indivisible, this postulates was wrong b/c atoms further divided in to *proton*, *neutron*, & *electron.*
⇨ Atoms of the same element have identical in mass, this postulates also disproved by the existence of isotopes.

3.4 Discoveries of the fundamental sub atomic particles and the atomic nucleus.

Discovery Of electron

- The sub atomic particle that identified first.
- It is discovered by J.J. Thomson by discharge tube experiment.
- Thomson conducted some experiment with discharge tube to study the properties of cathode rays.
- Thomson placed small object, between cathode and the a mode, the formation of a shadow of the object in the opposite side of the cathode revealed that cathode rays travel in straight line.
- Cathode ray travel towards the anode because they are attracted by positive charge anode.
- In the particle nature of cathode rays, a paddle wheel placed in the plate of cathode ray rotates. This shows that cathode rays are particle nature & the particle strike the paddle & there fore move the wheel. When electric field applied the cathode ray the cathode ray deflected to wards the positive plate. This shows that the cathode rays are negatively charged particle.

Note: The properties of cathode ray do not depend on nature of the gas in the discharge tube and the material of the cathode.

Summaries of Properties Cathode rays

- ✓ They are travel in straight line.
- ✓ They posses kinetic energy.
- ✓ Their properties are independent of the electrode & gas present in the cathode.
- ✓ The charge to mass of the rays is constant.
- ✓ They are negatively charged.
- ✓ They have higher penetrating power.

Exercises

① Defınal anode ray or canal rays?

Answer: Anode rays are a stream of positively charged particles, un like cathode ray they are deflected towards negative plate.

② What is the other name of anode ray?

Answer: The other name of anode ray is *proton*.

③ list the properties of anode ray?

Answer:
- ➥ They are travel in straight line.
- ➥ They consist of material particle.
- ➥ They are positively charge gaseous ion.
- ➥ The nature of charge to mass ratio of anode ray depends the gas present in the cathode ray tube.

Exercises

① Why was the ray bended? Shadow seen? The paddle rotate?

Answer: The cathode ray bended towards a positive plate this shows that cathode ray posses the negatively

charged. When a paddle wheel placed in the path of cathode rays rotate this indicates that the particle nature of the cathode ray.

② Why did Thomson take gas at low pressure while conducting the experiment?

Answer: Low pressure means less number of gas molecule present in the discharge tube. Thus there would be fewer collision b/n gas molecules & electron travel towards the anode.

③ How did Thomson discover the particle nature of electron?

Answer: when a positively charged magnetic field applied in the path of cathode ray, the ray bent towards the field. When magnetic field is negatively charged, the ray bent away from the field. This allowed Thomson to proposed that cathode rays were actually proposed that cathode rays were actually made of a ting particle caring a negatively charged. Thus the electron was discovered.

④ What happen to the cathode ray when they are allowed to pass through electric & magnetic field? What does this prove?

Answer: Up on passing electric field, the cathode ray bent towards the positive plate. Passing cathode ray in a magnetic field result in the deflection of cathode ray perpendicular to magnetic field. This proved that cathode rays are negatively charged particle.

J.J Thomson Atomic Model

- Thomson develop plum pudding model in 1904 In Thomson's plum pudding model, electron were embedded in a uniform sphere of position charged like blueberries stuck in to a muffin .
  The positive matter was thought to be jelly like or similar to a thick soup.

Validity Thomson's atomic model

His model could successfully explain the electrical neutrality of an atom . It , however failed to explain how the positive charged particle are shielded from the negatively charged electron without getting neutralized.

- Thomsons prediction is not totally reject although it lacks some knowledge.

≠ Millikian oil drop experiment

Millikan carried out a series of experiment by using electrically charged oil droplets. It this experiment time oil droplet was allowed to be sprayed in to the chamber by atomizer.

The air in the chamber is subjected to ionization by X-ray. The electron produce by ion ionization of air attached themselves to the oil drops. When sufficient electric field is applied, which can just balance the gravitational force acting on the oil drop, the drop remains suspended in the air.

From this experiment Millikan observe that the smallest charged found on the cathode ray was approximately $1.59x10^{-19}C$ & the charge on each drop was always integral multiple of the value.

Finally he determine the mass of an electron

i. e : Mass of electron $= \frac{e}{e/m} = \frac{1.59x10^{-19}}{1.76x10^{8}g}C$

$\Rightarrow$ Mass of electron $= \underline{9.0x10^{-28}}\,g$

Exercises

① The mass of electron is calculated from ____&___value of electron.

Answer: Charge & charge to mass /e/m/ of electron.

② Describe Millikan oil drop experiment.

Answer: Balancing oil drop, calculate the velocity of the drop, calculate the mass, & basic charge of an electron.

Discovery of Proton The presence of proton in an atom predicted by Goldstein (1886 based on electrical neutralist of an atom by using ***Perforated*** cathode ray In his experiment some rays were found to emanate from anode & pass through perforations in the cathode with deflection by the cathode. The are called anode / canal ray.

Properties of Canal rays

▲ Anode rays are travel in straight line

▲ They consisted material particle

▲ They are simply positively charged particle

▲ They are deflected in electric & magnetic field in the opposite of cathode rays.

Discovery of Nucleus

British physicist Ernest Ruther forced showed explicitly that Thomson's model of an atom was incorrect. He used "∝" particle in his experiment . "∝" particles are composite particle consisting of two protons and two neutrons tightly bound together. He targeted a stream of positively charged alpha particle at a very thin gold foil inspected and hold the "∝" particle were scattered by the foil.

- Gold foil was chosen due to easily hammered in to very thin sheet. If the Thomson's model of atom is correct, the positively charged "∝" particle should smash through the regular dispersed mass of the gold.

⇨ Ruther fored suggested that both mass and positive charge are concentrated in the nucleus.

- He explained the revaluing electron under the influence of two types of force .

I. The electrostatic attraction force between electron & nucleus.

II. The centrifugal force directed a way from the revolving electron, Thus two forces are equal & opposite & hence keeps the electron to stay in its orbit. This reason why electrons are not fall in to the nucleus in spite of in ward nuclear pull.

Ruther fored Atomic model

⇨The atom is composed of empty space

⇨ The mass of an atom concentrated in the nucleus.

⇨ The size of the nucleus is too small, it's diameter is 10^5cm times less than that of the atom. In diameter the nucleus was being estimated to be 10^{-13} cm & diameter of atom was 10^{-8} cm To counter balance this force electron revolve ou side the nucleus

Note: Ruther fored atomic model bear resemblance to planetary motion in the solar system. There for his model was called planetary or nuclear model.

In nuclear model of atom proton and neutron exist in the nucleus of an atom whereas electron exist outside the nucleus.

⇔ Ruther fored experiment discovered the following aspect of the nucleus.

- ✓ The nucleus of an atom is positively charged
- ✓ Most of the mass of an atom is concentrated in the nucleus.
- ✓ There is a large space with in the atom.

Legitimacy of Rutherford's atomic model

Rutherford's experiment / atomic model could explain the presence of positively charged nucleus and negatively charged electrons outside the nucleus an atom.

- The failer of Rutherford's theory, however stemmed from two major objections.

➥ This model is in consistent to the principle of classical electro dynamics.

➥ his model comes from the pattern of atomic spectra.

Exercises

1) Why Rutherford model called nuclear model?

Answer: Hince he discovered the nucleus

2) Who discover proton ? what was base of the experiment.

- Goldstein discover proton by using discharge tube experiment.

3) According to Rutherford experiment where are proton & electron located?

Answer: Proton inside the nucleus & electron outside the nucleus

4) What are draw backs of Rutherford atomic model

I . Continuous radiation energy by electron

II. Spiral path of electron toward the nucleus

III. The collapse of an atom.

The Niels Bohr atomic Model

Bohr could overcome the limitation of Rutherford atomic model based on Quantum theory of radiation proposed by Max planck.

There are five principle of Bohr atomic model

A. Electrons are arranged in circular orbit around the nucleus

B. Electrons occupy only certain orbit around the nucleus

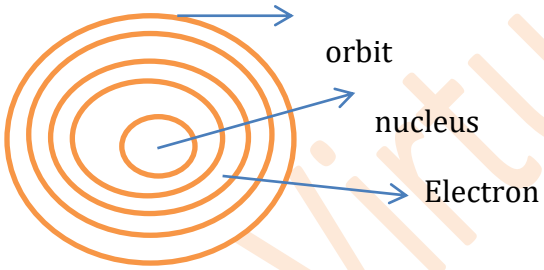
C. Each orbit (shell) associated with definite fixed amount of energy.

D. Energy increase with increase the distance from the nucleus

i. e: for K, L, M shell where H = E_1, L = E_2, M = E_3

$$E_3 > E_2 > E_1$$

E. As long as electron stays in a given orbit, electron does not lose or gain energy



Neil Bohr's atomic model

Exercises

2) The circular path in which electron revolve around called? Orbit.

3) On what basis did Bohr proposed his atomic model?

- plant Quantum theory.

4) What are the orbits and why they are called stationary orbit?

- The path where electron wove it, on specific path electron does not absorb or release energy.

Discovery of the neutron

Neutron is discharged particle present inside the nucleus like proton.

⇨ Chad wick discover neutron by bombarding "∝" particle with Be nucleic.

Some radiation (" r" ray) were observed . These radiation were unperfected in an electric field.

✷ Chad wick experiment & his observation

i. A paddle wheel was placed behind Beryllium nucleus & the nucleus were bombarded with "∝" particles. It was observed that the paddle wheel rotate from this he conclude that Be nucleus emit some invisible radiations having material particles.

ii. When these invisible radiation allowed to pass through an electric field, there was no deviation seen. These confirmed that the ray contained neutral particle chad wick call it ***neutron***.

3.5. Composition of atom & Isotopes

Atoms show different properties due to different number of sub atomic particle **Electron**, **Proton** & **neutron**

Electron:- One of the three fundamental particle that make up the atom.

- ✓ It is extremely small.
- ✓ Its mass is 1/2000 mass of proton / neutron or 9×10^{-31}kg, so electrons do not contribute to the total mass of atoms.
- ✓ Electron have negative charge.
- ✓ All matter have identical number of proton & electron.

Proton :- One of the three fundamental sub atomic particle.

- ✓ Has positive charge (+1)
- ✓ Exist in side the nucleus.
- ✓ Its mass is 1.673×10^{27}kg

Neutron :- Un like proton & electron, neutron has no charge. (n^0)

- ✓ Its mass slighty greater than mass of proton ($1.675\times$ $^{10-27}$kg).

N.B: Atoms have two regions

I. Nuclear region:- very small region located at the center of the nucleus.

II. Electronic region:- the region occupied by negatively charged particle

- It is the vast region

Properties of sub atomic particle given by

Particle	Symbol	Charge	Relative mass (amu)	Actual mas (kg)
Proton	P^+	+1	$1.007276 \approx 1$	1.673×10^{-27}
Electron	e^-	-1	$0.0005486 \approx 0$	9.109×10^{-31}
neutron	n^0	0	$1.008665 \approx 1$	1.675×10^{-27}

Atomic number & Mass number

≠ **Atomic number:** is the number of proton in an atom.

⇨ It is also equal to the number of electron for neutral atom ($Z = P^+$ or $Z = e^-$)

⇨ Different elements have different no of proton.

⇨ Atomic no of elements helps us to tell no of electrons & neutrons in a neutral atom.

✷ Atoms are neutral in electrical charge because they have the same no of proton (+ve) & electron (-ve).

Example: Carbon has atomic no "6" , $P^+ = 6$& $e^-=6$

≠ Mass number:- It is the sum of number of proton & neutron in the nucleus of atom

Given by $\boxed{A = P^+ + n^0}$ where P^+ = no of proton, A = atomic mass & Z = atomic no.

Example: 1 What is the mass no of Berrlium that contain 5 neutrons?

Solution: $A = P^+ + n^0 = 4+5 = 9$

Example : 2 How many proton, electron & neutron in an atom of ca/mass no is 40/?

- $Z = 20$, $A = P^+ + n$

$40 = 20 + n^0 \Rightarrow n^0 = 40 - 20 = 20$

For neutral atom ≠P^+ = ≠ electron = 20.

Representation of mass number and atomic number in a nuclear symbol of an element

- The common way that scientists used to write a nuclear symbol given by

$\boxed{{}^{A}_{Z}\times}$ Where A = Atomic mass

Z = Atomic no

× = Chemical symbol

Q: Write the complete nuclear symbol for carbon mass no 12 & Magnesium mass no 24?

Solution: ${}^{12}_{6}C$, ${}^{24}_{12}Mg$

Proton = 6 Proton = 12
Symbol = C Symbol Mg

Exercises

2. Aluminum has 13 proton & 14 neutron. What is the mass no ? $A = P^+ + n^0 = 13+14 =$ **27**

3. If Si has "A" is 28 & "Z" 14 the $\neq P^+$ & $\neq n^0$ = ?

Solution: $A = P^+ + n^0 \Rightarrow n^0 = A - P^+$

$n^0 = 28 - 14$

$n^0 = 14$ but $\neq P^+ = \neq Z =$ **14**

Atomic mass & Isotopes

All atoms of the same element have the same no of proton, but may have d/t no of *neutron*

Isotopes:- atoms of the same elements that have the same no of proton, but d/t no of neutron is called isotopes.

- Many isotopes occur naturally.
- Isotopes have the same physical and chemical properties because they posses the same no of proton & electron

Hydrogen isotopes

- Has three isotopes

① **Protium:-** ➥ has 1 proton with no neutron
➥ written as $^{1}_{1}H$, most common

② **Deuterium:-** ➥ has 1 proton & 1 neutron
➥ written as ^{2}H.

③ **Tritium:-** ➥ has 1 proton & $^{2}_{1}$ neutrons
➥ written as $^{3}_{1}H$.
➥ It is unstable & exist in small amount due to radioactive.

Stability of isotopes

Atoms need certain proportion of neutron to proton to have stable nucleus having too many too few neutron relative to proton lead to unstable or radioactive nucleus that will sooner breack down to stable form.

✷ **Radica isotopes:-** isotopes that decay in to stable form.
When they decay they release particles that may be destructive & leads to risk.

Calculating mass no of isotopes

Average atomic mass

Due to the existence of isotopes chemists use a verge atomic mass. It we know natural abundance & mass of isotopes, we can calculate a verge atomic mass.

Average atomic mass	$= \frac{mass1\ x\ \%1 + mass2\ x\ \%2}{100}$

Example: Find average mass chlorine / Cl – 35, 75,.77%& Cl – 37, 24.23%)

Given

$\%_1 = 75.77\%$

$M_1 = 35$ amu

$\%_2 = 24.23\%$

$M_2 = 37$ amu

Solution: AAM $= \frac{\%1M1 + \%2M2}{100}$

$= \frac{75.77x35 + 24.23x37}{100}$

AAM $=$ **35.45 amu**

Required

Average atomic

Mass = ?

Example 1: From Exercise 3.17 Question "3" calculate average atomic mass of copper CU – 63,69.15% & CU – 65, 30.85%

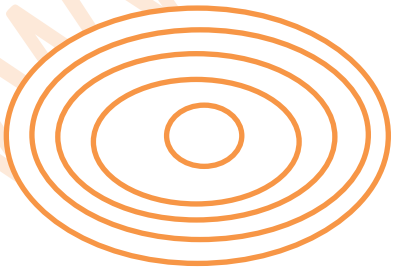
- Average atomic mass $= \frac{\%1m1 + \%2m2}{100}$

$= 69.15\frac{\%x63 + 30.85\%x65}{100}$

Average atomic mass $= \frac{6{,}361.7}{100} =$ **63.617** amu

Main energy level

Main energy level of electron refers to the shell in which electron is located relative the atomic nucleus . Thus level denoted by the principal quantum number n . And this quantum no also denoted by whole numbers 1, 2, 3 - - - or the letter K, L, M, N etc.



Main energy level

⇒ K < L < M < n in energy level

Exercises

1. What is the main energy level of an electron?

- The shell or orbital in which the electrons are located relative to the atom's nucleus

2. How many energy level does each of the first twenty element (H to Ca)have

✷ H & He ⇒ two energy level

✷ Li, Be, B, C, N, O, F, Ne ⇒ Two energy level.

Na, Mg, Al, Si, P, S, Cl, Ar ⇒ Three energy level

✷ Ca & K have four energy level.

3.6 Electron Configuration On Main Shell.

- The small nucleus of an atom surrounded large volume of space having electron divided in to regions called principal energy level.
- Each energy level contain up to $2n^2$ where "n" is the number of level

Example: How many electron can accommodate in the first energy level?

Solution: n = 1

Total electron $= 2n^2 = 2x2^1 = \underline{2}$

Q: Define electron configuration?

- The systematic arrangement of electrons in the various shell or orbit of an atom is called electron configuration.
- It describes that how electrons are distributed in their energy level or shell
- Filling energy level with electron starts from lower energy or closer to the nucleus K, L, M etc

✷ The outer most shell from the nucleus with in electron called *valence shell*

✷ The iner shell is called *Penultimate shell.*

✷ The one inner to penultimate shell is called *antepenultimate* shell

Shell	$2n^2$
K ⟶	2
L ⟶	8

M ⟶ 18

N ⟶ 32

Note: The maximum number of electron that can filled in the valence shell is "8"

Example 1 : Write the electronic configuration the atomic no of calcium is 20?

Answer: 20^{Ca} : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

2, 8, 8, 2

i. e : K: $n = 1 \Rightarrow 2n^2 = 2$

L: $n = 2 \Rightarrow 2n^2 = 8$

M: $n = 3 \Rightarrow 2n^2 = 18$

Q: Write the electron configuration on of Ar 18^{Ar} : 2, 8, 8 b/c the valence shell can hold a maximum of "8"electron

⇔ The electron configuration of element also done by using atomic diagram

Example: a) Li, 3 has 2, 1 Maine energy level

b) S : 16 Proton

M , 2, 8, 6 main energy

Energy diagram

Exercises

1. Define electron configuration

Answer: The distribution of electrons in their energy level.

✷ Valence electron

The electron that occupy the outer most shell of an atom is called *Valence electron*.

⇨ Valence electron is farthest from the nucleus of an atom.

⇨ They are most easily lost.

⇨ Properties & reaction of chemical equation determined by valence electron.

✷ During chemical reaction the valence electron may be lose, gain or share.

Q: What is the valence electron of "Ca" by using main energy level

20^{Ca} 2, 8, 8, 2 ⇒ valence electron is "2"

Exercises

1. What are valence electron?
   - Electrons that occupy the out most shell is called valence electron.
2. What are the purpose of identifying valence electron?
   - To know how they react with other element or atoms.
4. Which electron is difficult to remove from neutral atom, inner or outer electron

Answer: The inner electron is difficult to release electron because inner electron have strong electrostatic force of attraction b/n nucleus & electrons.

Unit – 3 Review Exercise

Part I . Short answer

① All matter is composed of an atom

⇨ Atoms of the same elements are identical

⇨ Atoms combine in simple whole no ratio to form a compound

② The discover of isotopes

③ Law of chemical combination

④⇨ All matter is composed of an atom

⇨ Atom is the smallest particle of an elements

⇨ Atoms combine together in a whole no ratio to form a compound.

⑤ Atoms are composed of electron & nucleus the electron are revolve around the nucleus & the nucleus consist of proton & neutron bound together in nuclear energy

⑥ Less inter molecular attraction

⑦ Proton = Mass = 1.673×10^{-27} kg

Charge = +1

Electron = Mass = 9.1×10^{-31} kg

Charge = -1

Neutron = Mass = 1.675×10^{-27} kg

Charge = 0

⑧ Proton

⑨ Neutron

⑩ Arrangement of fundamental particle

⑪ Goldstein, by using discharge tube

⑫ In the nucleus

⑬ Increase

⑭ Doubly ionized helium ion

⑮ I. Uniform distributed positive charge

II. electron embedded

Diagram of "B" atom

⑰

21. Atoms of the same element that have the same no of proton but d/t in neutron no is called isotope.

22. Deuterium has two neutron & "1" proton tritium has three neutron & "1" proton.

23. $^{4}_{2}He$ & $^{3}_{2}He$ repents isotope b/c they have the same no of proton with d/t neutron.

24. a) $^{16}_{8}O$ d) $^{24}_{12}Mg$

b) $^{39}_{19}K$ e) $^{27}_{12}Mg$

C) $^{7}_{3}Li$

25. $^{247}_{95}Am$

26. $^{14}_{6}C$

Part II True / False

27. False

28. True

29. True

30. False

Part III Fill blank space

31. Positive charged particle

32. Positively charged

33. less

Part IV choice

34. B **38.** C **44.** C

35. A **39.** **45.** A

36. A **40.** A **46.** A

37. D **41.** C

42. B

43. B

✷ Q3 & Q4 are the same

UNIT – 4

4.1 Periodic Classification of Elements

Historical development of Periodic Classification of the element

In the 19thC chemists had a vague idea of atom & molecule and did not know the existence of electron & protons They devised periodic table with atomic mass of elements.

Eerily chemists can arrange elements in periodic table in order of their atomic mass.

Dob ere inner's Triads

The first attempt to classify elements based on atomic mass. According to him when elements of triads in the same group are arranged in increasing order of atomic mass the atomic mass of the middle is the average atomic mass of the other two

Example 1: Li ⟶ 7

Na ⟶ 23

K ⟶ 39

At . weight of Na $= \frac{7+39}{2}$

$= \underline{23}$

Element At. We ight

Example 2: Ca ⟶ 40

Sr ⟶ 88

Ba ⟶ 137

Mass of Sr $= \frac{40+137}{2}$

$= \underline{88.5}$

After the discovery of Dobereiner's law Replaced by New land's law of octaves.

Newland's Law Of Octave

➥ Also called law of octave.

➥ This law is based on atomic mass of 56 elements.

➥ Law of octave states that when elements arranged in increasing order of atomic mass, the first and the eighth elements have similar properties

Example: Li, Be B C N O F Na

Mg Al Si P S Cl K

From this Li & Na have similar properties.

Limitation of Law Of Octave

➥ Innert gases were not discovered till

➥ Beyond "Ca" this is law is not applicable.

Mendeleev's classification of elements

He states that the properties of elements are aperiodic function of atomic mass.

- He was able to construct periodic table even though its periodic table is short His periodic table include

1) Only 63 elements, no innert gas includes.

2) Elements were arranged in 7 periodic & "8" groups.

3) he left empty space for undercover elements

After the discovery of noble gas and other many elements mensleev's periodic table was modified.

Exercises

1. Why does the first period contain only two elements?

- Because their electron configuration finishes "15" orbital & "15 orbital contain only two electron.

2. To which group & period belong

a) Carbon period "2" group PVIA

b) Neon period "2" group PVIIIA

4.2 Periodicity

1. Horizontal Rows Or Periods

Periods are horizontal row of periodic table.

- Elements in a periodic table are arranged in increasing order of their atomic number from left to right.
- Periods are written with Arabic no.
- There are seven periods in modern periodic table.

★ **period 1:** Consist of two element

- Known as the shortest element

★ **Period 2 & 3:** Short period contain "8" elements

★ **Period 4&5:** Long period, contain 18 element

★ **Period 6:** The longest period contain 32 elements

★ **Period 7:** In complete period.

2. Vertical Column / Group

★ Group IA, called alkali metal except "H"

★ Group IIA, called alkali earth metal

★ Group IIIA, called Boron family

★ Group PIVA, called Carbon Family

★ Group PVA, called nitrogen Family

★ Group PVIA, chalcogen Families

★ Group PVIIA, Known as halogen group.

✷ Group O element are called noble gas.

Merits Of Mendleev Periodic table

➥ The study of properties of elements become more systematic & easier.

➥ There are several vacant position from which the guidance of discovery of new elements were found.

Demerits of Mendleev's Periodic table

✓ Some elements are wrongly placed in their atomic weight are larger compared to the next one.

Example: a) Ar = 40 C) Co = 58.9

K = 39 Ni = 58.6

b) Te = 127.6

I = 126.9

4.3 Modern Periodic table

Periodic Law:- This law states that the physical & chemical properties of an element is a periodic function of their atomic no.

Group & Periods

Period: ⇨ also called series

⇨ Period is equal to no of shell

⇨ There are 7 period in modern periodic table.

Note: Except the first period, all periods starts from alkali metal & ends with noble gas.

Period no	Orbital Occupy	No of element
1	1S	2
2	2S, 2P	8
3	3S, 3P	8
4	4S, 3d, 4P	18

The position of elements in a given period can be determined by no of shell occupied with its electrons.

Electron Configuration

- Arrangement of electron in an atom. Because different atoms have different electron configuration.

✹ Group State Electron configuration → the lowest arrangement Of electrons in an atom

Quantum mechanical model is designated by the following notation.

$1\ S^2$

Where

"1" Coefficient shows main energy level

"S" Letter shows sub level of electron.

"2" Superscript shows no of electrons in a particular sub level.

Example: write the electron configuration of "Na" by using sub level

Na: $1S^2, 2S^2, 2P^6, 3S^1$, : 2,8,1

This shows that

There are "2" electrons in 1^{st} S – sub level

"2" electrons in 2^{nd} S-sub level

6 electrons in 2^{nd} P- sub level

Group:- Vertical column of elements in periodic table.

- There are 18 column of elements in periodic table
- Group no designated by Roman no from IA to VIIIA for main group or IB to VIIIB for sub group

N.B: For main groups no of group is equal to the outer most shell.

- Elements in the same group have similar chemical properties

⇔ Group is equal to valence electron for main group.

Classification of elements

Based on the electron configuration & sub level being filled, elements can classified as

1. S – block element:- last electron ends with "S" sub level.

⇨ Found in left side of the periodic table.

⇨ The general valence / outer most) shell electronic configuration is nS^{1-2}

i. e: for group IA nS^1

for group IIA nS^2

2. P – block element:- the last electron enter in to "P" sub level.

➥ most of "P" block elements are nonmetal

➥ Contain group IIIA to group VIIIA

➥ Found in the right side of the periodic table

➥ Have general valence electronic configuration $nS^2\ nP^{1-6}$ except helium.

3. d – block element:- the elements in which the last electron enter in to "d" sub level.

➥ Found between "S" & "P" block elements

➥ Have valence shell electron configuration $nS^{0-2}\ (n-1)d^{1-10}$ OR $nS^{1-2}\ (n-1)d^{1-10}$ except palladium

4. f – block element:- the elements in which last electron enter in to "f" – sub level.

➥ They also called inner transition element

➥ Have general valence shell electronic configuration $nS^2\ (n-1)\ d^{(0-10)}(n-2)f^{1-14}$

Exercises

Identify the sub level / sub shell/ in which the last electron of each element enters

a) Nitrogen / atomic number) = 7

- $1S^2, 2S^2, 2P^3$ ⇒ p – block element

b) sodium / atomic number) = 11

- $1S^2, 2S^2, 2P^6, 3P^3$ ⇒ "P" – block element

e) Zinc / atomic number) = 30

- $1S^2, 2S^2, 2P^6, 3S^2, 3p^6, 4S^2, 3d^{10}$ ⇒ P – block

Representative elements

⇨ Also called main group elements.

⇨ The last electron enter in to "S" & "P" sub shell.

✷ The outer electron of an atom called valence electron determine chemical bonding of an atom.

Major Trends in periodic table

Periodic trends are patterns in elements on the periodic table.

✷ Major trends are ✓ Electron negatively
✓ Ionization energy
✓ Electron affinity
✓ Atomic radius
✓ Metallic character

① Atomic radius

It is one half of the distance b/n two neigh bouring nuclei of atom

✷ For diatomic molecule, atomic radius is one half of the distance bet weene the nuclei of two atoms.

✷ For metals atomic radius defend as one half of the distance between the center of two adjacent atoms.

⇨ Down a group atomic radius increase because no of shell increase.

⇨ Across a period from left to right atomic radius decrease because effective nuclear charge increase.

② Ionization energy

The amount of energy required to remove the outer most electron from gas. Eouse atom is called ionization energy. Given by $X(g) \longrightarrow X^-(g) + e^-$.

- Ionization energy is a function of atomic radius; the larger the radius, the smaller the amount of energy required to remove the electron from outer most shell.

Note: Full filled > half filled > unfilled in Ionization energy because full filled is more stable & it is difficult to remove electron from this, so it require higher energy to remove the last electron Ionization energy can be first, second & third ionization Energy (IE_1 , $I E_2$ & $I E_3$)

IE_1 :- energy required the 1st valence electron

$X(g) + IE_1 \longrightarrow X^+(g) + e^-$

IE_2 :- The energy required to remove 2nd valence electron

$X^+ (g) + IE_2 \longrightarrow X^{++} (g) + e^-$

IE_3 :- Energy required to remove 3rd valence electron

$X^+ (g) + IE_3 \longrightarrow X^{+++} (g) + e^-$

Generally $\boxed{IE_1 < IE_2 < IE_3}$

The farther the electron from the nucleus the lower the energy required to remove that electron.

Shielding effect:- an effect that reduce the force of attraction between nucleus & valence electron is called *Shielding effect*.

- The higher the shielding effect, the lower the ionization energy Down a group IE decrease because shielding effect increase.

⇔ Metals have lower IE_1 than nonmetal & noble gas.

Q: Which one has second ionization energy Li Or Be ?

Answer: Li $1S^2, 2S^1$ group state

$Li^+ (g) + IE_2 \longrightarrow Li^{+2}(g) + e^-$

$1S^2 \quad 1S^1$

$Be^+(g) + IE_2 \longrightarrow Be^{+2} (g) + e^-$

$1S^2, \ 2S^1 \quad 1S^2$

Because 1 S electron shield 2 S electron more effectively in Be, SO electrons are easily remove from Be than Li

∴ IE_2 of Be < IE_2 of Li due to shielding effect.

③ Electron affinity

It is the energy released when an electron is added to an electoral gaseous atom to form negative ion.

Given by $X (g) + e \longrightarrow X^- (g) + \text{energy}$

Energy of an atom is defined when the atom lose / gain energy through chemical reaction that cause to lose or gain electrons.

- When electron is added to a neutron atom, energy is released , so the first electron affinity is *negative*.
- More energy is required to added electron to a negative ion, so second electron affinity is positive.
  i. e: $X (g) + e^- \longrightarrow X^{2-} (g)$
  electron affinity have negative value.

N.B: Metals have less likely chance to gain electrons because it is easier to lose their valence electron & form

cation , so an affinity of metals require more energy (endothermic).

⇒ Metals have lower electron affinity

Electron affinity down a group decrease because metallic character increase Acros a period from left to right electron affinity increase.

Exercises

1) Why does the electron affinity of chlorine is less than Fluorine?

- The electron affinity of chlorine is higher than fluorine due to small size of fluorine.

i. e: Fluorine has 5 electrons in "2P" sub shell & chlorine has 5 electrons in 3P sub shell "3P" sub shell is relatively larger than 2P – sub shell is relatively larger than 2P – sub shell. Therefore, repulsion among the electron will be more in 2P – sub shell of fluorine than 3P- sub shell in chlorine. Due to the small size and thus, greater electron – electron repulsion, fluorin will not accept an incoming with the same as chlorine As a result less amount of energy is released when one electron is added in to the 2P sub shell of F(g) to form F^- (g) ion.

2) Explain why noble gases have Low electron affinities?

Answer: Noble gases have extremely low electron affinities due to stable electron configuration & Low tendency to accept additional electrons.

3) Explain why halogens have the highest electron affinity?

Answer: Halogens have highest negative value because it needs only one electron to be stable. They have high tendently to gain an electron & form stable negative ion.

4. Electro – negativity

It is the ability of an atom to attract bonded electron towards itself.

- Decrease down a group & increase across a period from left to right.
- It is a dimensionless property because it is only a tendency

✯ Why is the most EN whereas C_3 is the lowest EN ($F = 4$ & $C_S = 0.7$)

Q: Why EN increase across a period from left to right?

Answer: Across a period from left to right, nuclear charge & atomic size decrease which leab to increase EN. Generally metals have lower EN than non-metal. Metals are electro positive and no metal are electron negative in nature.

Exercises

Arrange in order of decreasing EN & explain the observed trend.

a) Ba, Mg, Be, Ca

Answer: Be > Mg> Ca> Ba b/c down a group EN decrease

b) Cl, F, I, Br: ⇒ F> Cl> Br > I

c) C, Pb, Ge, Si : ⇒ C> Si> Pb> Ge

Elements that require few electrons to being stable electron configuration are the most electro negative.

Chapter – 4 Review Exercise

Part I True / False

1. True
2. True
3. False
4. False
5. True

Part II Choice

6. A
7. A
8. C
9. B
10. B
11. C
12. B
13. C

Part III fill Blank space

	Group	Period	Block type
Mg	IIVA	3	S
P	VA	3	P
Kr	VIIIA	4	P
Mn	VIIB	4	d
AU	IB	6	d
K	IA	4	S

Part IV Short answer

14. Briefly describe the significance of Mendeleev's periodic table?

- It provides a systematic frame work for understanding the properties of elements, predicting their behavior, studying atomic structure & development of materials.
- Mendeleev arranged the elements in order of atomic mass, the properties were repeated . Because the properties repeated themselves regularly or periodically.

15. What is Moseley's contribution for modern periodic table?

- ✓ The contribution of Moseley to modern periodic table was, he arranged elements in periodic table according to their atomic number.
- ✓ He realized his finding identify of an element is how many protons it has number of proton represents atomic number of elements.

17. Describe the general lay out of modern periodic table.

- There are eighteen vertical column known as groups in modern periodic table which are arranged from left to right & seven horizontal rows known as periods.
- In modern periodic table elements are arranged in order of their atomic no & groups atoms with similar properties in the same vertical column.

18. What is the most important relationship among elements in the same in periodic table?

⇒ Elements in each group have the same number of valence electron As a result elements in the same group often display similar properties & relativity.

UNIT – 5

5.1 Chemical Bonding

A chemical bond is the force that hold atoms together to form molecules or compounds.

Q: Why do atoms form chemical bond?

- To being more stable.

✷ Octet Rule:- States that atoms tend to form compound to have them eight valence electron, and to be noble gas electron configuration except helium.

✓ The eight valence electron ensure that atoms is stable.

How do atoms satisfy octet rule

✓ Atoms satisfy the octet rule through

- ➥ By losing their own valence electron
- ➥ By gaining valence electron from other.
- ➥ By sharing valence electron with other atom.

✯ To become more stable, atoms of metal tend to lose valence electrons

Example: Na lose $1\ e^-$ to be more stable

i. e $Na^+ = 2, 8$ iso electronic with Ne.

On the other hand, atoms of non-metal tend to gain electron to fill valence electron with an octet.

Example: Cl 2, 8, 7

$Cl^- = 2, 8, 8$ = iso electric configuration with Argon by gaining $1\ e^-$.

Non-metal also satify its octet rule by sharing valence electrons.

Example: HCl is formed by sharing of valence electrons of Cl & valence electron of H

i. e: :Cl . + . H ⟶ H ⟷ :Cl : ⟷ H -Cl

Exercises

1. What is the electron configuration of noble gas?
   - It is the configuration where the no of valence electron in the valence shell of valence electron in the valence shell is eight or two.
2. Why noble gas configuration is important
   - noble gas configuration is very important to determine the stability of atoms.

3) Define octet rule?

- Atoms tend to form compound in ways that give them eight valence electron and thus electron configuration of noble gas.

4) Do most element follow octet rule?

- by losing where most nonmetal obey the octe rule by sharing valence electrons.

⇒ Most of the second row elements follow octet rule.

Ionic Bonding

What are ions ?

➥ Ions are a net positive or negative charge of any atom or molecule.

Net electric charge = no proton – no of electron

➥ Ions are very reactive species.

➥ Ions of like charges repelled each other but opposite charges attract each other but opposite charges attract each other.

N.B: Based on the type of electric charge that atom or group of atoms possess

Ion can be
- An ion have more e^- than proton.
- Cation, have more proton than electron

Example: Na^+: 2, 8

Electron = 10

Proton = 11 ⇒ proton > electron

So it is cation

Cl^-: 2, 8, 8 ✓ Electron = 18

✓ Proton = 17

∴ Electron > Proton ⇒ an ion

How do ions form?

- Ions can be formed when a neutral atom lose or gain its valence electrons.

  Inner electron do not participate ion formation.

Ionic bonding

A chemical bond that formed by transfer of electron from one atom to other atom is called ionic bond.

- It is electrostatic force of attraction b/n two oppositely charged ion are called ionic bond.

Example: Na C l: obtained when Na^+ lose one electron & chlorine gain that lost electron by "Na"

i. e: $Na^+ = 2,8$ They obey octet rule.

$Cl^- = 2,8,8$

- Mostly ionic bond formed between metallic & non-metallic element. The metal and non-metal should have higher EN difference or nonmetal should have higher electronegative & metals should be low IE.

Exercises

1) Define the term cation & an ions?

★ **Cation :-** a positively charged atom or group of atoms.

★ **anion :-** A group of atom having negative charge

2) How do cation & anion form?

➥ **Cation :-** formed when an atom lose it valence electrons

➥ **anion :-** formed when an atom gain electrons to outer most shell.

3) What is chemical bond?

➥ A force that binds an atom / group of atoms together.

4) How ionic bond are formed?

➥ Ionic bond formed by attraction between oppositively charged ions.

Lewis formed ionic compounds

Lewis dot formula:- it is a chemical symbol of elements with its valence electron is represented as dots surrounding it.

- Only valence elections are participate in this notation.
- Number of dot is equal to number of valence electrons.
- These dots are arranged to ✓ right
  ✓ Left
  ✓ above
  ✓ bellow symbol

But there is no more than two dots in one side of the symbol

Example: Na: 2, 8, 1 → Na .

Cl: 2, 8, 7 :Cl .
..

Ar: 2, 8, 8 → :Ar :
..

Q: Write the Lewis formula that obtained from ionic bond b/n Na & Cl

➥ Na. + :Cl. → Na^+ [:Cl :]$^-$
.. ..

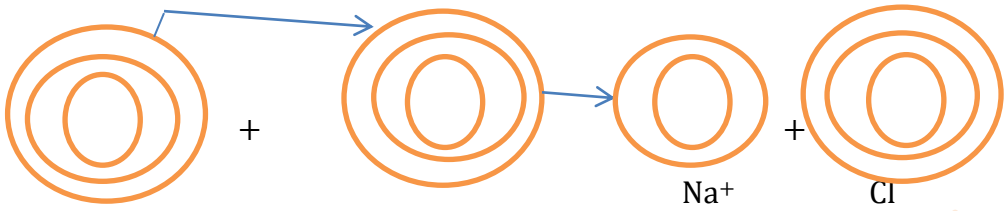
Metal non metal Ionic compound

★ Write lew is dot formula of Ca & O_2 to form CaO.

Solution: .Ca. + .O . → Ca^{2+} [:O :]$^{-2}$

⇒ The Lewis dot formula also represented by using atomic diagram.

Example:



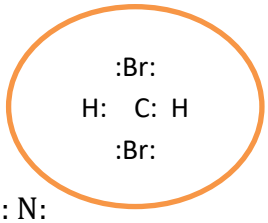
Sodium atom Chlorin atom

Exercises

1) Draw lewis dot structure for

a) H_2S:- ⟶ $2H^+$ $:S:^{-2}$

b) (CH_2Br_2) =



C) ((HCN) ⟶ H:C::: N:

d) ((K_2O) ⟶ $2K^+[:O:]^{-2}$ | K^+ $[:O:]^{-2}$ K^+

General Properties of ionic compound

- They form crystal most ionic cpds exist in crystalline solid.
- They have higher b, Pt & m, pt.
- They are hard & brittle.
- They are soluble in polar solvent.
- They conduct electricity in molten state
- They have high density

Exercises

2) Why do ionic compound form crystal?

B/c the cation & anion are strongly held by electros tic force which make ions to have regular packed structure called crystal.

4) Why ionic compounds conduct electricity in molten state but not in solid state?

➥ When ionic compound is molten state there are free ions or mobile ions that carry electric charge. But in solids there is no free ions present to carry charge.

Covalent bonding

A bond formed by sharing of valence electron is called *Covalent bond*

➥ Also called electron pair bond

➥ In covalent bond the electron resides between the nuclei of atom.

✯ When one a pair of electron shared, single covalent bond is formed

Example: H. + .H ⟶ H – H

✯ When two pairs of electron paired b/n two atoms double bond is formed

✯ When three pairs of electron are shared b/n two atoms, triple bond is formed

Example: : N ≡ N:

✯ In bond length single bond ? double bond > Triple bond

Note ⇒ A pair of electron that are used for bonding are called bonding pair electrone

⇒ Pair of electrons that are not used in bonding are called *non- bonding* pair electron (lone pair electron).

Example: How many bonding & non-bonding electrons present in O_2 molecule?

Q2 ⇒ $2\times6 = 12\ e^-$ = 6 pair of electron

:O: :O: ⇒ O = O

bonding pair = 2

nonbonding pair = **4**

Exercises

1. How many different types of covalent bond you know so far?

There are two types covalent bond

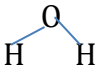
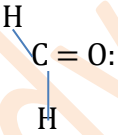
Depending on Polarity

➥ Polar covalent bond

➥ non-polar covalent bond

These bond can be single, double or triple bond.

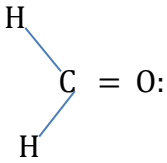
Lewis formation of covalent bond for simple covalent molecules Lewis

★ Element	★ Dot formula	★ line formula
1. Hydrogen	H : H	H - H
2. Nitrogen	: N ≡N:	: N ≡N:
3. Oxygen	O: : O	O = O
4. H_2O	H: O : H	
5. Acetylene	H: C::: C:H	H – C ≡ C - H
6. Form aldehyde	:O: H:C:H	

Exercises

2. Write Lewis structure for

a) O_2 O = O

b) H_2CO 

:F:

C) ASF_3 : F - AS – F:

Polarity in Covalent Molecules

When covalent bond is formed between two similar atoms like (H_2, O_2, Cl_2, N_2 & F_2) the shared pair of electrons are equally attracted by two atoms.

These bond is called non polar covalent bond.

➥ Hetro neuclear molecule like HF, the electron spent it time near to high electronegative element fluorine which leads to the formation of polar covalent bond.

✷ Polar covalent bond

A bond formed by un equal sharing of electrons

- a bond b/n two atoms of d/t electronegativity . Example: HCl, HF, H_2O etc

✷ Non-polar covalent bond

- The net dipole movement is zero.

A bond formed by equal sharing of electrons is called non polar covalent bond

- A bond b/n two atoms that have similar electronegativity

Example: O_2, H_2, N_2, CH_4 etc.

✷ There are nonpolar molecule with polar bond for example "CO_2"

i.e: The molecule is non-polar but the bond b/n (C – 0) is un equal sharing electron which is polar bond.

≠ Coordinate Covalent bond

/ Dative bond /

A bond formed by when both electrons are donated by a single atom is called dative or donor- acceptor bond.

Given by: $A + :B \longrightarrow A - B$ or $A : B$

Where A: electron pair acceptor

B: electron pair donor

A – B Coordinate covalent bond

Example 1: $H^+ + O(H)(H) \longrightarrow H_3O^+$ Or $[O(H)(H)H]^+$

Example 2: $H^+ + NH_3 \longrightarrow N^+H_4$ Or $[N(H)(H)(H)-H]^+$

From the above example H_2O & NH_3 are electron pair donor whereas H^+ is electron pair acceptor because it has vacant space to accept electron.

5.2 General properties of Covalent Compound

➥ At room temperature, most covalent bond are gases or liquid, some covalent compounds are soft solid.

➥ Most covalent compounds have are low melting and boiling points.

➥ Most covalent compounds are poor conductors of electricity.

➥ Most covalent compounds are soluble in non- polar solvents and are insoluble in polar solvents like water.

➥ Reactions of covalent compounds are slow compared to that of ionic compounds.

➥ They have low density.

Metallic Bonding

⇨ is the electrostatic force of attraction between metal cation & delocalized valence electrons.

⇨ The strength of metallic bond depends on:

① number of valence electrons

② Size of the cations

⇨ The more the no of valence electrons and the smaller the size of the cations, the stronger the metallic bond.

5.3 Physical Properties of metals

⇨ They are malleable and ductile.

⇨ They conduct electricity , b/c they have free electrons that carry charge.

⇨ They have high melting & boiling points.

≠ Chapter – 5 Review Exercise

Part I Choice

1. A
2. C
3. B
4. C
5. D

Part II True / False

6. True
7. True
8. False
9. True
10. False
11. False
12. False
13. True
14. True
15. True
16. False
17. False

Part III fill Blank space

18) Sharing and Transferring
19) Energy changes
20) Metals
23) Lewis symbol
24) Like dissolves like
25) Multiple covalent bond

21) Ions

22) Ionic bond

26) Covalent bond

27) Pure non-polar covalent bond

28) Electronegativity

29) Non-Polar

30) Coordinate Covalent bond

Part IV Short answer

31) How many types chemical bond are there? What are they?

⇨ Three: These are ① Ionic bond
② Covalent bond
③ Metallic bond

32) Name one solvent in which most of ionic compounds dissolve.

⇨ Water (H_2O)

33) In which state ionic compounds conduct electricity?

⇨ In mother state / solution form/

34) Why do non-polar covalent compounds not conduct electricity?

⇨ B/C there is no mobile ions present in non-polar covalent compounds

35) What type of chemical bond are found in the following compounds?

a) KCl – Ionic bond

b) CO_2 – Covalent bond

C) HCl - Covalent bond

i) PCl_5 - Covalent bond

36) In what type of solvents do the a) polar compounds and b) non- polar compounds dissolve.

⇨ According to like dissolves like principle polar molecules dissolves with polar solvents and non-polar molecules dissolves with non-polar solvents.

37) Why are molecules more stable than atoms.

⇨ B/c molecules attained eight or two valence electrons.

38) What are the criteria due to which a covalent bond becomes polar or non –polar.

⇨ The electronegativity d/ce b/n two atoms.

39) Why are the partial positive and negative charge developed with in a polar covalent molecule.

⇨ B/C the shared electron distributed un equally b/n bonded atom.

40) What is Coordinate covalent bond?

⇨ A covalent bond that formed by donating pair of electrons by single atom.

41) Define polar and non-polar covalent bond.

⇨ Polar covalent: bond is a bond that formed by un equal sharing of electrons.

⇨ Non-Polar Covalent bond: is a bond that formed by equal sharing of electrons.

42) Give some examples in w/c coordinate covalent bond formation takes place.

⇨ $H^+ + O:H_2 \longrightarrow [H_3O]^+$ / H_3O^+/

⇨ $H^+ + N:H_3 \longrightarrow [NH_4]^+$ / NH_4^+/

43) Draw the Lewis dot formula for the following compounds.

a) NaCl

$Na + .Cl: \longrightarrow Na^+ [:Cl:]^-$

b) CaF_2

$Ca + 2.F: \longrightarrow Ca^{2+} [:F:]_2$

C) H_2

$H. + .H \longrightarrow H:H$ /H – H/

e) N_2

$:N: + :N: \longrightarrow :N::N>$ /:N≡N:/

44) What are the factors responsible for the formation of covalent, and ionic bond.

⇨ Ionization potential & electron affinity

45) Why do noble gas not take part in a chemical reactions.

⇨ B/C noble gases fulfill the octane nucleus & Duet nucleus they hare stable valence shell.

46) What type of bond takes place between

a) metal & non-metal

b) b/n metal & non-metal ionic bond is formed whereas b/n two non-metal covalent bond is formed.

⇨ b/n metal & non-metal ionic bond is formed whereas b/n two non-metal covalent bond is formed.

47) Why do most of ionic compound exist in solid state while covalent compounds found in gaseous or liquid state?

⇨ Ionic compounds exist in solid state b/c they have strong electrostatic force b/n a compound. Covalent bond have vander waal's force.

48) Why the density of ionic compound high & that of covalent compound is low?

⇨ The oppositely charged ion in ionic compound are held closely the electrostatic force of attraction. Hence the number of per unit volume in ionic compound is mare making their density high. In covalent compound, the interaction & is not comparable that of the electrostatic attraction between ions. Hence most covalent compounds are liquid or gases & leads to low density.

49) Why m.pt & b.pt of ionic compounds are higher than that of covalent compounds.

⇨ The strong electrostatic force between ionic compound need high energy. This high heat energy is associated with high temperature . hence ionic compounds need a high temperature to melt or boil. In covalent compounds, the relative weak dipole-dipole force relatively less energy which turn needs low temperature to melt or boil.

50) Why do pure covalent compound not conduct electricity?

Pure covalent compounds have zero charge. In the absence of charge carrier, electricity can not be conducted.

OR pure covalent compounds are ionize

51) Why ionic compounds soluble in H_2O

⇨ Like water ionic compound are polar so like dissolves like principle ionic cpd dissolves in water.

52) Polary covalent compound dissolve in water why?

➪ Because polar covalent compound have partially negative & partially positive like water. There force, Partially negative of polar cpd interact with partially positive of water & uice versal.

53) Why type of bond exist in NHY^{+4} & H_3O^+

★ **In N^+H4:** covalent bond b/n three H & N & coordinate covalent bond b/n the to urth with nitrogen.

★**In H_3O^+:** covalent bond b/n two hydrogen & oxygen. Coordinate covalent bond b/n third hydrogen & oxygen.