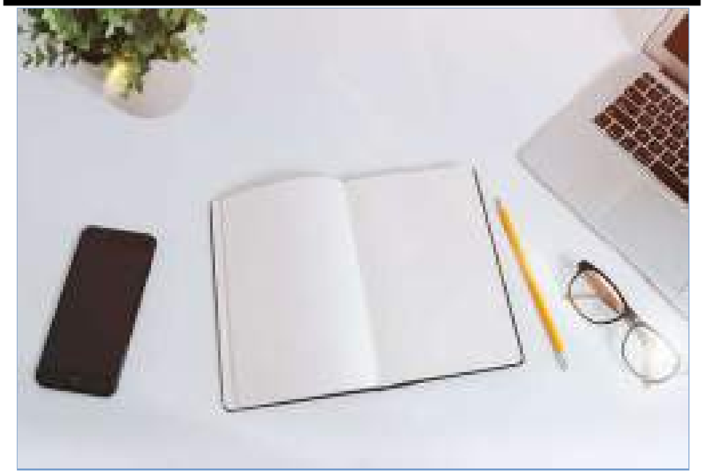
ST.MARY'S PUBLIC SCHOOL

Study Material



Note:-

1. Check the website regularly.
2. Visit relevant subject links.
3. Utilize your time well to explore, learn and share.

Class: XI (English Core)

Snapshots (Supplementary Reader)

Lesson: The Summer of the beautiful White horse
By William Saroyan

Work sheet No. 2

Q.1 Answer the following questions in about 40-50 words each.

a. What did Aram see when he looked out of the window? Why could he not believe what he saw?

b. What do we learn about uncle Khosrove from the extract?

c. What was Mourad's hide out for the horse?

d. How did Khosrove react to John Byro's problems?

e. The farmer studied the horse carefully. What do you think John must be thinking?

f. Why was Aram delighted and frightened at the same time when he saw his cousin, Mourad on a beautiful white horse?

Q.2 Answer the following questions in about 120-150 words each.

a. Both boys in the story are adventure lovers. Discuss

b. Describe the ride of Mourad and Aram on the stolen horse

Chapter – 2

The Address by Marga Minco

Q.3. Answer the following questions in about 40-50 words each.

1. Why did the narrator ask the woman; do you still know me & what could be the relationship between the woman and the girl who stood outside the door?

2. What is the importance of the question: Have you agreed with her that she should keep everything?

3. What memories did the girl have of Mrs. Dorling?

4. Why did the narrator feel horrified and oppressed once she was in the living room?

5. Mention some of the precious possessions that Mrs Dorling has carried to her place?

Q.4 Answer the following questions in about 120-150 words each.

1. Describe the narrators meeting with Mrs Dorling after the war was over.

Old memories are not always pleasant.

Discuss in relation to the story. 'The Address'.

Date → 11/04/2019
Day → Thursday

PHYSICS

UNIT-1

PHYSICAL WORLD

Science
It is a systematic and organized knowledge about the various natural phenomena which is obtained by careful experimentation, keen observations and accurate reasoning.

The Sanskrit word 'shastra' and arabic world Ilm also have a similar meaning ie, organized knowledge

Scientific method
The step by step approach used by scientists in studying natural phenomena and estabilising laws which governs these phenomena is called scientific method

Generally it involves the following steps
1. systematic observation
2. controlled experiments
3. qualitative and quantitative reasoning
4. mathematical modelling
5. prediction
6. verification or falsification

Physics

The word physics originates from a greek word which means nature. The world was introduced by ancient scientific scientists, Aristotle in year 350 BC.

"Physics is the branch of science that deals with the study of basic laws of nature and their manifestation in various natural phenomena."

It is concerned with the interaction of matter with matter or energy. It deals with the various features of the natural world such as space, time, matter, motion, energy, radiation, etc.

Physics is the most fundamental of all the sciences as it is concerned with the study of various natural phenomena.

Two basic quests in physics are
1. Unification
2. Reductionism

Unification

In Physics attempt is made to explain various physical phenomena in terms of just few concepts and laws.

We try to see the physical world as manifestation of some universal laws.

For example:-

The same Newton's law of gravitation can be used to describe the motion of the body falling towards the earth, motion of moon around the earth and the motion of planets around the sun.

Reductionism

Another attempt made in physics is to explain a macroscopic system in terms of its microscopic constituents. This persued is called reductionism.

For example:

Thermodynamics was developed to explain the macroscopic properties such as temperature, internal energy, entropy, etc. of the bulk system lather on these properties were explained in terms of molecules in kinetic theory and statical mechanics.

Scope of physics
The scope of physics is very wide-ever. Every event which occurs around us in our daily life is governed by one or the other principle of physics.

Physics has two main domain of study
1. Macroscopic
2. Microscopic

Macroscopic
Classical physics deals with macroscopic phenomena which may be at the laboratory, terrestrial and astronomical scales. It includes branches like:
1. Mechanics 3. Thermodynamics
2. Optics 4. Electrodynamics

Microscopic
Quantum mechanics deals with microscopic phenomena at the minute scale of atoms, molecules and nuclei. This is also known as modern physics

1. Mechanics
It deals with the equilibrium or motion of material bodies at low speed. It is based on the law of gravitation.

The propulsion of rocket, equilibrium of test band under a load, propagation of water waves or sound waves in air etc. are studied in mechanics.

2. Optics
It deals with the nature and propagation of light. It deals with the formation of images by mirrors and lenses, colour and in thin films, etc.

3. Thermodynamics
It deals with a macroscopic system in equilibrium and is concerned with the changes in internal energy, temperature, entropy, etc of the system through external work and heat.
Here, we studied the efficiency of heat engines and refrigerators.

4. Electrodynamics
It deals with electric and magnetic phenomena with charged and magnetic bodies. It is based on the laws given by Coulomb, Oersted, Ampere, Faraday.
It deals with problems like motion of current carrying conductor in a

magnetic field, propagation of radiowaves through the atmosphere, etc.

Quantum Mechanics
It deals with the mechanical behaviour of sub-microscopic particles like atom and nuclei and their interaction with projectiles like electrons, photons and other elementary particles.

Relativity
It is theory of invariants in nature. It deals with the motion of particles having speeds comparable to the speed of light.

Fundamental Forces in Nature
In the macroscopic world we observe several kind of forces such as :-
1. Muscular force
2. Contact force of support
3. Friction
4. Forces exterted by springs and strings
5. Viscous force
6. Electric force
7. Magnetic force, etc.

All these forces between macroscopic objects arise from two fundamental forces.

1. Gravitational force
2. Electromagnetic force

In microscopic world, in addition of above forces two more basic forces are required to account for the various atomic and nuclear processes. These are:

1. Strong Nuclear force
2. Weak Nuclear force

Gravitational force
It is the force of mutual attraction between two bodies by virtue of their masses. It is a universal force.

Every body attracts every other body of the universe with this force.

According to the Newtons law of gravitation :-
The gravitational attraction between two bodies of masses m_1 and m_2 and separated by the distance r is given by

$$F = G \times \frac{m_1 m_2}{r^2}$$

where G is gravitational constant.

Properties of gravitational force

1. It is a universal attraction force.

2. It is directly proportional to the product of their masses.

3. It obeys inverse square laws.

4. It is long range force and does not need any medium for its operation.

5. Gravitational force between two bodies does not depend upon the presence of other bodies.

6. It is a central force and conservative force (i.e. it acts along the line joining the centre of two bodies).

7. It is the weakest force known in nature

Ex:- all bodies fall because of the gravitational force of attraction exerted on them by the earth.

2 Gravitational force governs the motion of the moon and the artificial satellites around the earth.

Electromagnetic force

The force acting between two electric charges at rest is electrostatic force.

According to coulomb's law :
The magnitude of electrostatic force (F) between two point charges (q_1 and q_2) separated by distance (r) in vacuum is given by

$$F = \frac{1}{4\pi \epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

ϵ_0 ~~Apsylu Zero~~
ϵ_0 Epsilon Zero

where epsilon zero is the ~~permity of~~ permititity vacuum.

The force acting between two magnetic poles is called magnetic force. Infact electrostatic and magnetic force are closely inter-related.

For exam:-
A moving charge produces a magnetic field. also magnetic field exerts a force on ~~of~~ moving charge. This force depends on the magnitude and direction of

velocity of the electric charge.

Thus, electrostatic and magnetic force are inseparable and are considered as the two ~~forts~~ facets of a general force known as electromagnetic force.

Properties of electromagnetic force

1. Electromagnetic force may be attractive or repulsive.

2. It obeys inverse square law.

3. It is a long range force and does not require any intervening medium for its operation. 4. It is a central force and conservative force.

5. It is 10^{36} times stronger than gravitational force.

Ex:- when a spring is compressed/elongated, it exerts a force of elasticity due to the net repulsion/attraction between its neighbouring atoms. This net attraction or repulsion is the sum of electrostatic force between the electrons and nuclei of atom.

The strong Nuclear Force

The strong attractive force which binds together the protons and neutrons in a nucleus is called strong nuclear force.

This force cannot be electrostatic force because positively charged protons strongly repels each other at such small separation of the order of 10^{-15} m.

Also the gravitational attraction between two protons being much weaker, cannot overcome this electrostatic repulsion. So a new attractive force must be acted between the nucleons. This strong nuclear force is strongest of all the fundamental forces, about 100 times stronger than the electromagnetic force.

Properties of strong nuclear force.

1. It is the strongest interaction known in the nature which is about 10^{38} times stronger than the gravitational force.

2. It is a short range force that operates

only over the size of the nucleus (10^{-15} m)

3. It is basically an attraction force, but becomes repulsive when the distance between the nucleons becomes less than 0.5 fermi $\boxed{1 \text{ fermi} = 10^{-15} m}$

4. It is non central and non conservative force.

5. It has charge independent character i.e. nuclear forces between proton-proton, proton-neutron and neutron-neutron are almost equally strong.

Ex:- The concept of nuclear force is useful in obtaining nuclear energy ~~today~~ via the process of nuclear fission or fusion.

Weak Nuclear Force

It is a force that appears only between elementary particles involved in a nuclear process such as the β-decay of a nucleus. In a β-decay, the nucleus emits an electron and an uncharged particle called neutrino.

The electron and neutrino interacts with each other through the weak nuclear force.

The weak nuclear force is much stronger than the gravitational force, but much weaker than the strong nuclear and electromagnetic force.

Properties of weak nuclear force

1. Any process involving neutrino and anti-neutrino is governed by weak nuclear force because these particles can experience only weak interaction and not the strong nuclear interaction.

2. Weak nuclear force is 10^{25} times stronger than the gravitational force.

3. It operates only through a range of nucleus size 10^{-15} m.

The relative strength of these forces are

$$F_G : F_W : F_E : F_S = 1 : 10^{25} : 10^{36} : 10^{38}$$

Conservation laws

In any physical phenomena governed by different forces, some physical quantities may change with time while other remain constant with time under certain conditions.

The quantities that donot change with times are called conserved quantities. The condition under which a given physical quantity remain conserved is called a conservative law.

There are five conservation principles:-

1. Principle of conservation of energy
It states that the total energy of an isolated system is always conserved. It means that the energy can never be created nor destroyed, but it may be transformed from one form to another.

2. Principle of conservation of linear momentum
It states that if ~~line~~ no external force acts on a system its total linear momentum remains conserved.

3. Principle of conservation of angular momentum
It states that if no external torque acts on a system its total angular momentum remain conserved

4. Principle of conservation of electric charge
It states that the total electric charge of an isolated system remain conserved.

5. Principle of conservation of mass-energy
According to Einstein's mass energy equivalence, mass and energy are not separate entities, but one can be converted into other. The equivalence relation between mass and energy is given by

$$\boxed{E = mc^2}$$

Date → 16/04/2019
Day → Tuesday

CHAPTER-2

UNITS AND MEASUREMENT

Power of 10	Preffix
10^{18}	exa
10^{15}	peta
10^{12}	tera
10^{9}	giga
10^{6}	mega
10^{3}	kilo
10^{2}	hecto
10^{-18}	atto
10^{-15}	femto
10^{-12}	pico
10^{-9}	nano
10^{-6}	micro
10^{-3}	milli
10^{-2}	centi
10^{-1}	deci

Example 2·1
Calculate the angle of
(a) $1°$ (degree)
(b) $1'$ (minute of arc or arc of second)
(c) $1''$ (second of arc or arc second) in radians. Use $360° = 2\pi$ rad, $1° = 60'$ and $1' = 60''$

Ans we have $360^\circ = 2\pi$ rad

$1^\circ = \left(\frac{\pi}{180}\right)$ rad

$= 1.745 \times 10^{-2}$ rad

$1^\circ = 60' = 1.745 \times 10^{-2}$ rad

$1' = 2.908 \times 10^{-4}$ rad

$\simeq 2.91 \times 10^{-4}$ rad

$1' = 60'' = 2.908 \times 10^{-4}$ rad

$1'' = 4.847 \times 10^{-4}$ rad $\simeq 4.85 \times 10^{-6}$ rad

Example 2.2

A man wishes to estimate the distance of a nearby tower from him. He stands at a point A in front of the tower C and spots a very distance object O in line with AC. He then walks perpendicular to AC upto B, a distance of 100m, and looks at O and C again. Since O is very distant, the direction BO is practically the same as AO, but he finds the line of sight of C shifted from the original line of sight by an angle $\theta = 40^\circ$ estimate the distance of the tower C from his original position A.

Ans

$\theta = 40^\circ$

$AB = AC \tan\theta$

$AC = \frac{100}{\tan\theta}$

$$= \frac{100}{\tan 40^\circ}$$

$$= \frac{100}{0.8391}$$

$$= 119 m$$

Example 2.3

A man observed the moon from two diametrically opposite points A and B on Earth. The angle θ subtended at the moon by the two directions of observation is $1^\circ 54'$. Given the diameter of the Earth to be about 1.276×10^7 m, compute the distance of the moon from the Earth.

Ans We have $\theta = 1^\circ 54' = 114'$

$$= (114 \times 60)'' \times (4.85 \times 10^{-6}) \text{ rad}$$

$$= 3.32 \times 10^{-2} \text{ rad}$$

since $1'' = 4.85 \times 10^{-6}$ rad

Also $b = AB = 1.276 \times 10^7$ m.

We have the earth-moon distance

$$D = \frac{b}{\theta}$$

$$= \frac{1.276 \times 10^7}{3.32 \times 10^{-2}}$$

$$= 3.84 \times 10^8 m$$

Example 2·4
The Sun's angular diameter is measured to be 1920". The distance D of the sun from the Earth is $1·496 \times 10^{11}$ m. What is the distance of diameter of the sun?

Ans Sun's angular diameter $= \alpha$
$= 1920''$
$= 1920 \times 4·85 \times 10^{-6}$ rad
$= 9·31 \times 10^{-3}$ rad

Sun's diameter (d) $= \alpha D$
$= (9·31 \times 10^{-3}) \times (1·496 \times 10^{11})$ m
$= 1·39 \times 10^{9}$ m

Absolute Error, Relative Error and Percentage Error

Let me take $a_1, a_2, a_3 \cdots a_n$

$$a_{mean} = \frac{a_1 + a_2 + a_3 \cdots + a_n}{n}$$

$$a_{mean} = \sum_{i=1}^{n} a_i$$

$\Delta a_1 = a_1 - a_{mean}$
$\Delta a_2 = a_2 - a_{mean}$
$\Delta a_n = a_n - a_{mean}$

$$\boxed{\Delta a_{mean} = \frac{\Delta a_1 + \Delta a_2 + \Delta a_3 + \cdots \Delta a_n}{n}}$$ Absolute Error

Relative Error = $\frac{\Delta a_{mean}}{a_{mean}}$

Percentage Error = $\frac{\Delta a_{mean}}{a_{mean}} \times 100\%$.

Example 2·7

We measure the period of oscillation of a simple pendulum. In successive measurements, the readings turn out to be 2·63s, 2·56s, 2·42s, 2·71s and 2·80s. Calculate the absolute error, relative error and percentage error

$a_1 = 2{\cdot}63s$
$a_2 = 2{\cdot}56s$
$a_3 = 2{\cdot}42s$
$a_4 = 2{\cdot}7s$
$a_5 = 2{\cdot}80s$

$$Mean = \frac{(2{\cdot}63 + 2{\cdot}56 + 2{\cdot}42 + 2{\cdot}7 + 2{\cdot}80)s}{5}$$

$$= \frac{13{\cdot}12}{5}s = 2{\cdot}624s$$
$$= 2{\cdot}62s$$

$\Delta a_1 = 2{\cdot}63 - 2{\cdot}62 = 0{\cdot}01s$
$\Delta a_2 = 2{\cdot}6 \quad - 2{\cdot}56 = 0{\cdot}06s$
$\Delta a_3 = 2{\cdot}6 \quad - 2{\cdot}42 = 0{\cdot}20s$
$\Delta a_4 = 2{\cdot}6 \quad - 2{\cdot}7 = 0{\cdot}09s$
$\Delta a_5 = 2{\cdot}6 \quad - 2{\cdot}80 = 0{\cdot}18s$

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Δa mean - $\frac{(.01+.06+.20+.09+.18)s}{5}$

$= \frac{.54}{500} = 0.11s$

Absolute error $= 0.11s$

Relative error $= \frac{0.11}{2.62} = .0410 = .04$

Percentage error $= .0410 \times 100$
$= 4\%$

Combination of Errors

Sum of errors
Let the two physical quantities A and B
Measured value of A $= A \pm \Delta A$
Measured value of B $= B \pm \Delta B$
Let sum of measured value A and B is Z

$$Z = A + B$$

$$Z \pm \Delta Z = (A \pm \Delta A) + (B \pm \Delta B)$$

$$= (A+B) \pm (\Delta A + \Delta B)$$

$$\cancel{Z} \pm \Delta Z = \cancel{Z} \pm (\Delta A + \Delta B)$$

$$\pm \Delta Z = \pm (\Delta A + \Delta B)$$

$$\boxed{\Delta Z = \Delta A + \Delta B}$$

Difference of errors

Let the two physical quantities A and B
Measured value of A = $A \pm \Delta A$
Measured value of B = $B \pm \Delta B$
Let difference of measured value of A and B is Z

$$Z = A - B$$
$$Z \pm \Delta Z = (A \pm \Delta A) - (B \pm \Delta B)$$
$$= (A-B) \pm (\Delta A + \Delta B)$$
$$\cancel{Z} \pm \Delta Z = \cancel{Z} \pm (\Delta A + \Delta B)$$
$$\pm \Delta Z = \pm(\Delta A + \Delta B)$$
$$\boxed{\Delta Z = \Delta A + \Delta B}$$

Rule:- When two quantities are added or subtracted, the absolute error in the final result is the sum of the absolute error in the individual quantities.

Example 2-8

The temperature of two bodies measured by a thermometer are $t_1 = 20^\circ C \pm 0.5^\circ C$ and $t_2 = 50^\circ C \pm 0.5^\circ C$. Calculate the temperature difference and error.

$$t' = t_2 - t_1 = (50^\circ \pm 0.5^\circ C) - (20^\circ C \pm 0.5^\circ C)$$
$$t' = 30^\circ C \pm 1^\circ C$$

Errors of product or a quotient

Product of error in two quantities

Let A and B are two physical quantities
Measured value of A = $A \pm \Delta A$
Measured value of B = $B \pm \Delta B$
Measured value of Z = $Z \pm \Delta Z$

$$Z = A \cdot B$$

$$Z + \Delta Z = (A \pm \Delta A)(B \pm \Delta B)$$

$$= AB \pm A\Delta B \pm \Delta A B \pm \Delta A \cdot \Delta B$$

$$\cancel{Z} \pm \Delta Z = \cancel{Z} \pm A\Delta B \pm \Delta AB$$

Dividing by Z on both sides

$$\frac{\pm \Delta Z}{Z} = \frac{\pm A\Delta B}{Z} \pm \frac{\Delta AB}{Z}$$

$$= \pm \frac{\cancel{A}(\Delta B)}{\cancel{A} \cdot B} \pm \frac{(\Delta A)\cancel{B}}{A \cdot \cancel{B}}$$

$$\frac{\pm \Delta Z}{Z} = \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B}$$

$$\pm \frac{\Delta Z}{Z} = \pm \left(\frac{\Delta A}{A} + \frac{\Delta B}{B}\right)$$

$$\boxed{\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}}$$

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Binomial Theorem

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{\lfloor 2}x^2 + \frac{n(n-1)(n-2)}{\lfloor 3}x^3 + \ldots$$

factorial :- $\lfloor 2$ or $2!$

$\lfloor 2 = 2\times 1$

$\lfloor 3 = 3\times 2\times 1$

$\lfloor 8 = 8\times 7\times 6\times 5\times 4\times 3\times 2\times 1$

Division of error in two quantities

let A and B are the two physical quantities

Measured value of A = $A \pm \Delta A$

Measured value of B = $B \pm \Delta B$

Measured value of Z = $Z \pm \Delta Z$

$$Z = \frac{A}{B}$$

$$Z \pm \Delta Z = \frac{A \pm \Delta A}{B \pm \Delta B}$$

$$= \frac{A\left(1 \pm \frac{\Delta A}{A}\right)}{B\left(1 \pm \frac{\Delta B}{B}\right)}$$

$$Z \pm \Delta Z = \frac{A}{B}\left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm \frac{\Delta B}{B}\right)^{-1}$$

$$Z \pm \Delta Z = Z\left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm (-1)\frac{\Delta B}{B} + \frac{(-1)(-2)}{\lfloor 2}\left(\frac{\Delta B}{B}\right)^2 \ldots\right)$$

$$Z \pm \Delta Z = Z\left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm \frac{\Delta B}{B}\right)$$

$$Z \pm \Delta Z = Z\left(1 \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B} \pm \frac{\Delta A}{A} \times \frac{\Delta B}{B}\right)$$

$$Z \pm \Delta Z = Z\left(1 \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B}\right)$$

$$\cancel{Z}\left(1 \pm \frac{\Delta Z}{Z}\right) = \cancel{Z}\left(1 \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B}\right)$$

$$\cancel{1} \pm \frac{\Delta Z}{Z} = \cancel{1} \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B}$$

$$\pm \frac{\Delta Z}{Z} = \pm\left(\frac{\Delta A}{A} + \frac{\Delta B}{B}\right)$$

$$\boxed{\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}}$$

Rule:- When two quantities are multiplied or divided, the relative error in the result is the sum of the relative errors in the multipliers

Error in case of a measured quantity raised to a power

Let the physical quantity A^n

Measured value $= (A \pm \Delta A)^n$

$$Z \pm \Delta Z = (A \pm \Delta A)^n$$

$$= A^n\left(1 \pm \frac{\Delta A}{A}\right)^n$$

$$= A^n\left[1 \pm n\frac{\Delta A}{A} \pm \frac{n(n-1)}{\lfloor 2}\left(\frac{\Delta A}{A}\right)^2 \ldots\right.$$

$$Z \pm \Delta Z = Z\left(1 \pm n\frac{\Delta A}{A}\right)$$

$$1 \pm \frac{\Delta Z}{Z} = \frac{Z}{Z}\left(1 \pm \frac{n\Delta A}{A}\right)$$

$$1 \pm \frac{\Delta Z}{Z} = 1 \pm \frac{n\Delta A}{A}$$

$$\pm \frac{\Delta Z}{Z} = \pm \frac{n\Delta A}{A}$$

$$\frac{\Delta Z}{Z} = \frac{n\Delta A}{A}$$

Rule:- The relative error in a physical quantity raised to the power n is then n times the relative error in individual quantity.

Example 2.11 Find the relative error in Z, if $Z = \frac{A^4 B^{1/3}}{CD^{2/3}}$

$$\frac{\Delta Z}{Z} = 4\left(\frac{\Delta A}{A}\right) + \frac{1}{3}\left(\frac{\Delta B}{B}\right) + \frac{\Delta C}{C} + \frac{2}{3}\left(\frac{\Delta D}{D}\right)$$

Example 2.12

The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{L/g}$. Measured value of L is 20cm known to 1mm accuracy and time for 100 oscillation of pendulum is found to be

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T^2 = 4\pi^2\frac{l}{g}$$

$$g = \frac{4\pi^2 l}{T^2}$$

The errors in both l and T are the least count errors

$$\frac{\Delta g}{g} = \frac{\Delta l}{l} + \frac{2\Delta T}{T}$$

$$= \frac{0.1}{20.0} + \frac{2 \times 1}{90}$$

$$= \frac{1}{200} + \frac{1}{45}$$

$$= \frac{9 + 40}{1800}$$

$$= \frac{49}{1800}$$

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Significant figures

The reliable digits plus the first uncertain digits are known as significant digits or significant figures.

Example:- the time period of oscillation of a simple pendulum is 1.62s, the digit 1 and 6 are reliable and certain while the digit 2 is uncertain. Thus, the measured value has three significant figures

Rules of the significant figures

1. All the non-zero digits are significant
EX → 1234, 3584, 283

2. All the zeroes between two non-zero digits are significant, no matter where the decimal point is, if at all.
Ex → 1.0034 (5)

3. If no. is less than 1, the zero on the right of decimal point but to the left of the first non-zero digit are not significant.
Ex → 0.00348 (3)
less than 1

4 The terminal or trailing zero in a number without a decimal point are not significant
EX → 123400 (3)

5 The trailing zero in a number with a decimal point are significant
EX → 3.500 (4)
0.06900 (4)

Q) State the no. of significant figures in the following :-

a) $0.007 m^2$ → 1

b) $2.64 \times 10^{24} kg$ → 3

c) $0.2370 g cm^{-3}$ → 4

d) 6.320 J → 4

e) $6.032 Nm^2$ → 4

f) $0.0006032 m^2$ → 4

Mathematical operation of significant figures

Addition / Subtraction

4.327 and 2.51

2.51 and 4.33

$$\begin{array}{r} 4.33 \\ +2.51 \\ \hline 6.84 \end{array} \qquad \begin{array}{r} 4.33 \\ -2.51 \\ \hline 1.82 \end{array}$$

Roundoff

4.327 = 4.33   4.324 = 4.32

4.325 = 4.32   4.335 = 4.34

even (no change)   odd (+1) preceding no.

Division / Multiplication

7.325 × 16.3 = 119.3975

4   3   = 119

$$\begin{array}{r} 7325 \\ \times 163 \\ \hline 21975 \\ 43950\times \\ 7325\times\times \\ \hline 1193975 \end{array}$$

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Example 2·13

Each side of a cube is measured to be 7·203m. What are the total surface area and volume of the cube to the appropriate significant figures?

$a = 7.203m$

Total surface area $= 6a^2$

$= 6 \times 7.203 \times 7.203$

$= 6 \times 51.883209$

$= 311.299254$

$= 311.3 \, m^2$

Volume $= a^3$

$= 7.203 \times 7.203 \times 7.203$

$= 373.714754427 \, m^3$

$= 373.7 \, m^3$

Example 2·14

5·74g of a substance occupies 1·2 cm³. Express its density.

Mass = 5·74g   Volume = 1·2cm³

Density $= (\rho) = \frac{Mass}{Volume} = \frac{5.74}{1.2} = \frac{574}{120}$

↓

Rho

$= 4.783$

$= 4.8 \, g \, cm^{-3}$

Physical Quantity

These quantities which can be measured are known as physical quantities.

1. Base quantities or fundamental quantities
All physical quantities represented by seven base quantities which are known as fundamental quantities.

- Length → [L] → m
- Mass → [M] → kg
- Time → [T] → sec
- Electric current → [A] → A
- Thermodynamic Temperature → [K] → K
- Luminous intensity → [cd] → cd
- Amount of substance → [mol] → mol

Two supplementary quantities
- Plane angle → [rad] → radian
- Solid angle → [sr] → steradian

Derived quantities
They are combination of fundamental quantities

Dimensions
They are the powers or exponents to which the base quantities are raised to represent that quantity.
It is denoted in square brackets. [ ]

some important dimensional formula

- Mass → [M] → $[ML^0T^0]$
- length → [L] → $[M^0LT^0]$
- Time → [T] → $[M^0L^0T]$
- Height, radius, displacement, distance → [L] → $[M^0LT^0]$
- Area → l×b = [L]×[L] = $[L^2]$ → $[M^0L^2T^0]$
- volume → [L][L][L] → $[M^0L^3T^0]$
- Density → $\frac{Mass}{Volume}$ → $\frac{[M]}{[L^3]}$ = $[ML^{-3}T^0]$
- velocity/speed = $\frac{D}{T}$ = $\frac{[L]}{[T]}$ = $[LT^{-1}]$
- Force = ma = $[M][LT^{-2}]$ = $[MLT^{-2}]$
- Acceleration = $[LT^{-2}]$
- linear Momentum = mv = $[M][LT^{-1}]$ = $[MLT^{-1}]$
- Impulse = F×ΔT = $[MLT^{-2}][T]$ = $[MLT^{-1}]$
- Workdone = Force × disp = $[MLT^{-2}][L]$ = $[ML^2T^{-2}]$
- Energy (K.E / P.E) → mgh = $[M][LT^{-2}][L]$ = $[ML^2T^{-2}]$
- Power = $\frac{Workdone}{Time}$ = $\frac{[ML^2T^{-2}]}{[T]}$ = $[ML^2T^{-3}]$

- Moment of Inertia → $I = mr^2 = [M][L^2] = [ML^2]$
- Angle → (angular displacement) → $\theta = \frac{l}{r} = \frac{[L]}{[L]} = [M^0L^0T^0]$

(Dimensionless)

- Angular velocity → ω = $\frac{\text{angular displacement}}{\text{Time}} = \frac{[M^0L^0T^0]}{[T]}$

↓ omega

$= [T^{-1}]$

- Wavelength = $(\lambda) = [L]$
- Frequency $= (\nu) = \frac{1}{T} = [T^{-1}]$
- Pressure $= P = \frac{\text{Force}}{\text{Area}} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$
- Gravitational constant

$$F = \frac{Gm_1m_2}{r^2}$$

$$G = \frac{Fr^2}{m_1m_2}$$

$$= \frac{[MLT^{-2}][L^2]}{[M][M]}$$

$$= [M^{-1}L^3T^{-2}]$$

Checking the dimensional consistency of Equation

$$S = ut + \frac{1}{2}at^2$$

$$x - x_0 = v_0 t + \frac{1}{2}at^2$$

$$x = x + v_0 t + \frac{1}{2}at^2$$

Dimensions of LHS $x = [L]$

R·H·S $x_0 = [L]$

$v_0 t = [LT^{-1}][T]$

$= [L]$

$\frac{1}{2}at^2 = [LT^{-2}][T^2]$

$= [L]$

R·H·S $=$ L·H·S

Example 2·15

Consider $\frac{1}{2}mv^2 = mgh$ where m is the mass of body, v its velocity, g is the acceleration due to gravity and h is height. Calculate whether correct or not.

$$\frac{1}{2}mv^2 = mgh$$

Dimensions of LHS $= [M][LT^{-1}]^2$

$= [M][L^2T^{-2}]$

$= [ML^2T^{-2}]$

Dimension of RHS = mgh
$= [M][LT^{-2}][L]$
$= [ML^2T^{-2}]$

It is correct.

Example 2·16

The SI unit of energy is $J = kg\,m^2 s^{-2}$, that of speed v is ms^{-1} and of acceleration a is ms^{-2}.

(a) $K = m^2 v^3$
(b) $K = (1/2) mv^2$
(c) $K = ma$
(d) $K = (3/16) mv^2$
(e) $K = (1/2) mv^2 + ma$

(a) $K = m^2 v^3$

Dimension of L·H·S $K = [ML^2T^{-2}]$
R·H·S $= [M^2][LT^{-1}]^3$
$= [M^2L^3T^{-3}]$ X

b) $K = \frac{1}{2} mv^2$

Dimension of L·H·S $K = [ML^2T^{-2}]$
R·H·S $= [M][LT^{-1}]^2$
$= [ML^2T^{-2}]$ ✓

c) $K = ma$

$L\cdot H\cdot S = [ML^2T^{-2}]$

$R\cdot H\cdot S = [M][LT^{-2}]$

$= [MLT^{-2}]$ X

d) $K = \frac{3}{16} mv^2$

$L\cdot H\cdot S = [ML^2T^{-2}]$

$R\cdot H\cdot S = [M][LT^{-1}]^2$

$= [ML^2T^{-2}]$ ✓

(e) $K = \frac{1}{2} mv^2 + ma$

$L\cdot H\cdot S = [ML^2T^{-2}]$

$R\cdot H\cdot S = [M][LT^{-1}]^2 + [M][LT^{-2}]$

$= [ML^2T^{-2}] + [MLT^{-2}]$ X

Example 2·17

$$\boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

$T \propto mlg$

$T = k m^x l^y g^z$

Dimension of L·H·S $T = [T]$

$= [M^0L^0T^1]$

Dimension of R·H·S $= [M]^x [L]^y [LT^{-2}]^z$

$= [M^x L^{y+z} T^{-2z}]$

$$[M^0 L^0 T^1] = [M^x L^{y+z} T^{-2z}]$$

$$x = 0 \quad \text{--- (1)}$$

$$y + z = 0 \quad \text{--- (2)}$$

$$-2z = 1$$

$$z = \frac{-1}{2} \quad \text{--- (3)}$$

$$y = \frac{1}{2}$$

$$T = K l^{1/2} g^{-1/2}$$

$$= K \frac{l^{1/2}}{g^{1/2}}$$

$$= K \sqrt{\frac{l}{g}}$$

$$\boxed{T = 2\pi \sqrt{\frac{l}{g}}}$$

Physical Quantities

The quantities by means of which laws of physics are described are known as physical quantities.

Units

The standard which is used to measure any physical quantity is called units. Any physical quantity contains two parts :-

1. Numerical part
2. Unit

$$q = nu$$

q = physical quantity
n = numerical number
u = unit

$F = 5N$ $\quad$ $M = 5kg$
$= 5 \times N$ $\quad$ $= 5 \times kg$

classification of units

1. Fundamental units
2. Derived units

Fundamental units
Those units which cannot be further break down into other simpler units.
Metre, kilogram, second, kelvin, ampere, mole and candela

Derived units
The units which can be further break down into fundamental units or in other words The derived units are the combination of fundamental units.
Velocity $= \frac{m}{sec}$ $\quad$ acceleration $= \frac{m}{s^2}$

Supplementary units
Radian
Steradian

Measurements of very small distances

1. Micrometre $= 10^{-6} m$
2. Nanometre $= 10^{-9} m$
3. Angstrom $= 10^{-10} m$
4. Picometre $= 10^{-12} m$
5. Fermimetre $= 10^{-15} m$
7. Attometre $= 10^{-18} m$

Measurements of very large distances

1. Astronomical units - The average distance from Earth to sun. $1 AU = 1.496 \times 10^{11} m$

2. Light year → The distance travelled by light in one year

$$1 \text{ light year} = 3 \times 10^{8} \times 1 \text{ year}$$
$$= 3 \times 10^{8} \times 365.25 \times 24 \times 3600$$
$$= 9.46 \times 10^{15} m.$$

3. Parsec → It is a distance at which one arc of one second of one astronomical unit describe an angle.

$$1 \text{ Parsec} = 3.08 \times 10^{16} m$$

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Relation between Parsec and light year

$$\frac{1\,Parsec}{1\,ly} = \frac{3.08 \times 10^{16}}{9.46 \times 10^{15}}$$

$$= \frac{30.8}{9.46}$$

$$1\,Par = 3.26\,ly$$

Relation between Parsec and Astronomical unit

$$\frac{1\,Parsec}{1} = \frac{3.08 \times 10^{16}}{1.496 \times 10^{11}}$$

$$1\,Parsec = 2.06 \times 10^{5}\,AU$$

Methods of direct measurement

1. Metre scale
2. Vernier callipers
3. Screw gauge
4. ~~spann~~ spherometre

Methods for indirect measurement

1. Trigonometric method
2. Parallax method
3. ~~Ca~~ Kepler's Law - square of the time period of the planet is directly proportional to the cube of average distance b/w sun and planet

$\cancel{T^2 \alpha r^3}$, $T^2 \propto r^3$

Indirect method of measuring of small distances

<u>Atomic radius</u> by Avagadro Hypothesis

According to Avagadro Hypothesis actual volume of atom in 1gram of substance is equal to $\frac{2}{3}$ of the volume of atom of 1g substance

Let 'M' is the molecular mass of substance then 'M' gram of substance contains 'n' atoms

1gram $= \frac{n}{M}$ atom

Volume of each atom $= \frac{4}{3}\pi r^3$

Volume of atom of 1gm $= \frac{N}{M} \times \frac{4}{3}\pi r^3$

A. to Avagadro Hypothesis

$$\text{Actual atom} = \frac{2}{3}V$$

$$\frac{N}{M} \times \frac{4}{3}\pi r^3 = \frac{2}{3}V$$

$$r^3 = \frac{M \cdot V}{2\pi N}$$

$$r = \frac{1}{3}\left(\frac{M \cdot V}{2\pi N}\right)$$

(i)

(ii)

(iii)

(iv)

System of units

(i) CGS system → length, mass

(ii) FPS system in this system, length, mass and time is measured in foot, pound and second respectively.

(iii) MKS system → In this system length, mass and time are measured in terms of meter, kilogram and seconds.

(iv) SI units → (International System of Units) It is based on seven basic units and two supplementary units length, mass, time, temperature, current, luminous intensity, quantity of matter are measured in metre, kilogram, second, kelvin, ampere, candela, mole respectively. And two supplementary units plain angle and solid angle are measured in radian and steradian.

Principle of homogenity.
According to the principle of homogenity, the dimension formula of each and every term on either side of equation remain same.

eg:- $s = ut \pm \frac{1}{2}at^2$

Notes

1. We can determine the formula is correct or not including the sign addition and subtraction.

2. Formula containing (+) or (−) is always correct according to the principle of homogenity.

Uses

1. To convert 1 system of units into other system of units.

2. To check the correctness of formula.

3. Derive the relationship of various physical quantities.

Numerical

How many ~~times~~ dynes are in one (N) newton. convert one Newton into dynes.

Solution

$$n_1 u_1 = n_2 u_2$$

$$n_1 [M_1^a L_1^b T_1^c] = n_2 [M_2^a , L_2^b , T_2^c]$$

$$n_2 = \frac{n_1 [M_1^a , L_1^b , T_1^c]}{[M_2^a , L_2^b , T_2^c]}$$

$$n_2 = n_1 \left[\left(\frac{M_1}{M_2}\right)^a \left(\frac{L_1}{L_2}\right)^b \left(\frac{T_1}{T_2}\right)^c \right]$$

$$= 1 \left[\left(\frac{Kg}{g}\right)^a \left(\frac{m}{cm}\right)^b \left(\frac{s}{s}\right)^c \right]$$

$$= 1 \left[\left(\frac{1000g}{g}\right)^a \left(\frac{100cm}{1cm}\right)^b (1)^c \right]$$

MKS

$n_1 = 1$ Newton

$F = 1$ Newton

$= [M^1 L^1 T^{-2}]$

$a = 1, b = 1, T = -2$

CGS

$n_2 = ?$

$$= 1 [(1000)^1 (100)^1 (1)^{-2}]$$

$$= 1000 \times 100 = 100000$$

$n_2 = 10^5$ dyne

Q2 Convert 1 joule into CGS? (1 erge)

Sol.

MKS | CGS

$W = M^1 L^1 T^{-2}$ $\quad a = 1 \quad b = 2 \quad c = -2$

$n_2 = n_1 \left[\left(\frac{m_1}{m_2}\right)^a \left[\frac{L_1}{L_2}\right]^b \left[\frac{T_1}{T_2}\right]^c \right]$

$= 1 \left[\left(\frac{kg}{g}\right)^1 \left(\frac{m}{cm}\right)^2 \left(\frac{\cancel{s}}{\cancel{s}}\right)^{-2} \right]$

$= 1 \left[\left(\frac{1000\cancel{g}}{\cancel{g}}\right) \left(\frac{100\cancel{cm}}{\cancel{cm}}\right)^2 (1)^{-2} \right]$

$= 1 [(1000)^1 (100)^2 \times 1]$

$= 1 \times 1000 \times 10000$

$= 10000000$

$= 10^7$

Q3. Convert $6.67 \times 10^{-11}\ N m^2/kg^2$ into Dyne cm^2/g^2

Sol

$F = G \frac{m_1 m_2}{r^2}$

$G = \frac{F r^2}{m_1 m_2} = \frac{[\cancel{M}LT^{-2}][L^2]}{[\cancel{M}][M]}$

$= [M^{-1} L^3 T^{-2}]$ $\quad a = -1 \quad b = 3 \quad c = -2$

$= n_1 \left[\left(\frac{m_1}{m_2}\right)^a \left(\frac{L_1}{L_2}\right)^b \left(\frac{T_1}{T_2}\right)^c \right]$

$= 6.67 \times 10^{-11} \left(\frac{1000\cancel{g}}{\cancel{g}}\right)^{-1} \left(\frac{100\ \cancel{cm}}{\cancel{cm}}\right)^3 \left(\frac{s}{s}\right)^{-2}$

$= 6.67 \times 10^{-11} \left[\frac{1000\cancel{000}}{1\cancel{000}}\right]$

$n_2 = 6.67 \times 10^{-8}$ dyne cm^2/g^2

Check the ~~corrected~~ ~~the~~ correctness of the formula

(i) $\frac{1}{2}mv^2 = mgh$

Dimensions of LHS $= [M][LT^{-1}]^2$
$= [ML^2T^{-2}]$

Dimensions of RHS $= [M][LT^{-2}][L]$
$= [ML^2T^{-2}]$

Dimension of L·H·S = Dimension of R·H·S
∴ Equation is correct

(ii) Escape velocity (v) $= \sqrt{\frac{2GM}{R}}$

Dimension of $v = LT^{-1}$

Dimension of $\sqrt{\frac{GM}{R}} = \frac{[M^{-1}L^3T^{-2}]^{1/2}[M]^{1/2}}{[L]^{1/2}}$
$= [M^{1/2}L^{1/2}T^{-1}]$
$= [M^0L^1T^{-1}]$

L·H·S = R·H·S

(iii) $F = \frac{mv^2}{r}$

Dimension of $F = [MLT^{-2}]$

Dimension of R·H·S $= \frac{[M][LT^{-1}]^2}{[L]}$
$= [MLT^{-2}]$

R·H·S = L·H·S
formula is correct

(iv) $F = 6\pi \eta r v$

Dimension of L·H·S = $[MLT^{-2}]$

Coefficient of viscosity (η) $= \frac{F \times \text{distance}}{\text{Area} \times \text{velocity}}$

$= \frac{[MLT^{-2}] \times [L]}{[L^2][LT^{-1}]}$

$= [ML^{-1}T^{-1}]$

Dimension of R·H·S $= 6\pi \eta r v$

$= [ML^{-1}T^{-1}][L][LT^{-1}]$

$= [MLT^{-2}]$

Dime LHS = RHS.

Formula is correct.

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Q1. The velocity (v) of a water wave depends on the water wavelength (λ) density of water (ρ) acceleration due to gravity (g). Find the relationship in these quantities.

$$v \propto \lambda^a \rho^b g^c$$
$$v = k\lambda^a \rho^b g^c$$
$$[M^0 L T^{-1}] = [L]^a [M L^{-3}]^b [L T^{-2}]^c$$
$$[M^0 L^1 T^{-1}] = [M^b L^{a-3b+c} T^{-2c}]$$

comparing the powers

$$b = 0$$
$$a - 3b + c = 1 \qquad \boxed{c = \frac{1}{2}}$$
$$-2c = -1$$
$$b = 0 \qquad \boxed{b = 0}$$
$$a + \frac{1}{2} = 1$$
$$a = 1 - \frac{1}{2}$$
$$\boxed{a = \frac{1}{2}}$$

$$v = k\lambda^{1/2} \rho^0 g^{1/2}$$
$$v = k\lambda^{1/2} g^{1/2}$$
$$v = k\sqrt{\lambda g}$$

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Q3 A large fluid star oscillates face under the influence of gravitational field expression for period of oscillation (t) in terms of radius of star (R) mean density of fluid (ρ) universal gravitational constant (G).

$$F = \frac{G m_1 m_2}{r^2}$$

$$T \propto R^a \rho^b G^c$$

$$T = K R^a \rho^b G^c \qquad G = \frac{F r^2}{m_1 m_2}$$

$$= K[L]^a [ML^{-3}]^b [M^{-1}L^3T^{-2}]^c \qquad = \frac{[MLT^{-2}][L^2]}{[M][M]}$$

$$T = [L^{a-3b+3c} M^{b-c} T^{-2c}] \qquad = [M^{-1}L^3T^{-2}]$$

$$[M^0L^0T] = [L^{a-3b+3c}$$

$$a-3b+3c = 0$$

$$b-c = 0$$

$$b = c$$

$$-2c = 1$$

$$c = \frac{-1}{2} \qquad b = \frac{-1}{2}$$

$$a - \frac{3}{2} + \frac{3}{2}$$

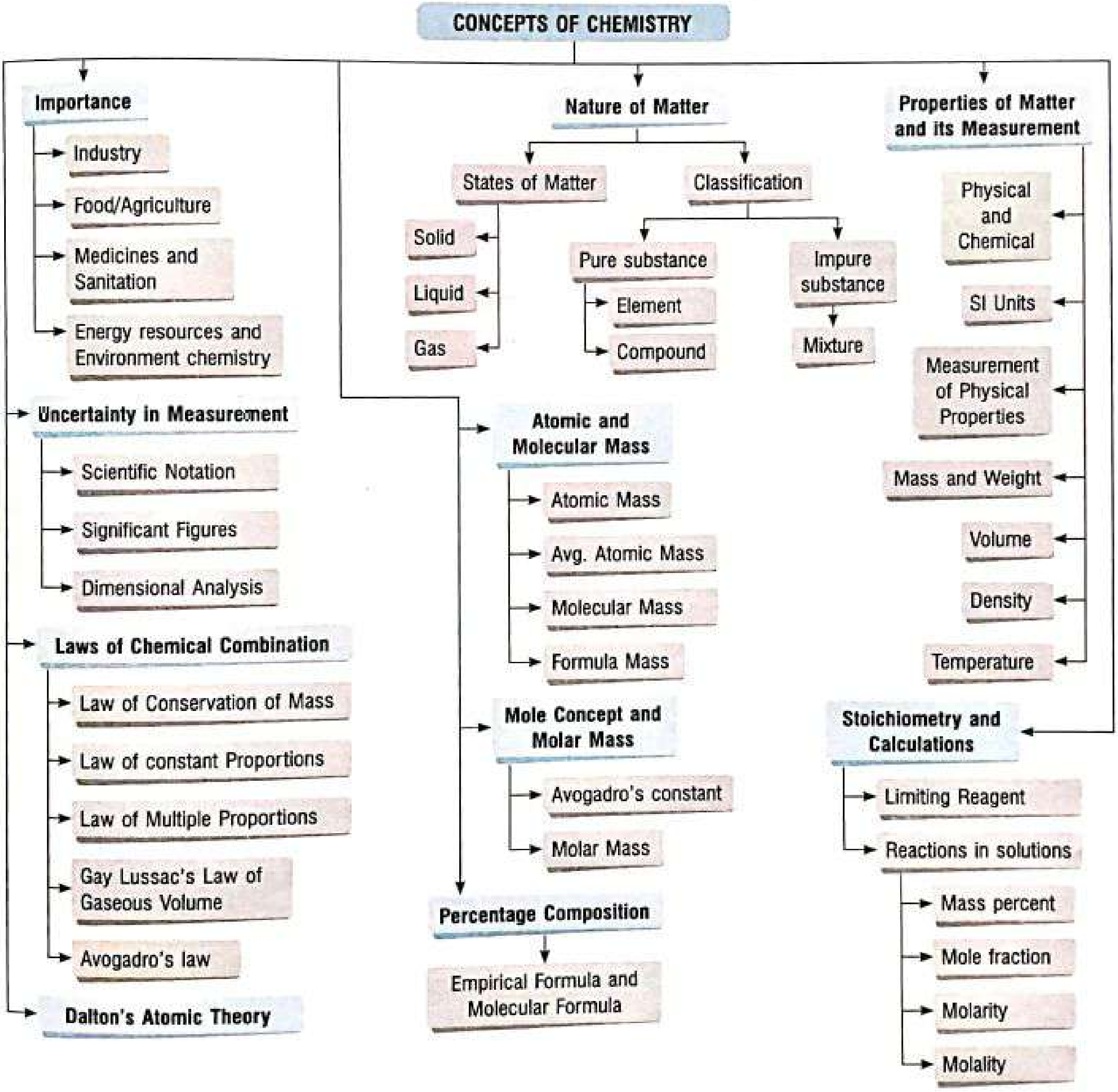
$$a = 0$$

$$T = R^0 \rho^{-1/2} G^{-1/2}$$

$$= K\sqrt{\frac{\rho}{G}}$$

1 SOME BASIC CONCEPTS OF CHEMISTRY

CHAPTER AT A GLANCE



1. Chemistry is the branch of science that studies the composition, properties and interaction of matter.
2. Chemical principles are important in diverse areas, such as : weather patterns, functioning of brain and operation of a computer.
3. Chemical industries manufacturing fertilisers, alkalis, acids, salts, dyes, polymers, drugs, soaps, detergents, metals, alloys and other inorganic and organic chemicals, including new materials, contribute in a big way to the national economy.
4. Many life saving drugs such as cisplatin and taxol, are effective in cancer therapy and AZT (Azidothymidine) used for helping AIDS victims, have been isolated from plant and animal sources or prepared by synthetic methods.
5. Anything which has mass and occupies space is called matter.
6. Everything around us, for example, book, pen, pencil, water, air, all living beings etc., are composed of matter.
7. Matter can exist in three physical states *viz.*, solid, liquid and gas.

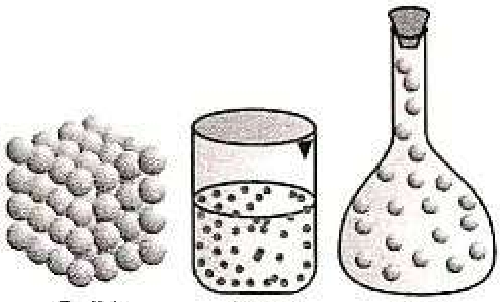


Fig. 1.1 Arrangement of particles in solid, liquid and gaseous states

8. Solids have definite volume and definite shape.
9. Liquids have definite volume but not the definite shape. They take the shape of the container in which they are placed.
10. Gases have neither definite volume nor definite shape. They completely occupy the container in which they are placed.
11. These three states of matter are interconvertible by changing the conditions of temperature and pressure.

$$\text{Solid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Liquid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Gas}$$

12. Matter can be classified as mixtures or pure substances.

13. A mixture contains two or more substances present in it (in any ratio) which are called its components.
14. A mixture can be homogeneous or heterogeneous.
15. In a homogeneous mixture, the components completely mix with each other and its composition is uniform throughout.
16. In heterogeneous mixture, the composition is not uniform throughout and sometimes the different components can be observed.
17. Pure substances have fixed composition, whereas mixtures may contain the components in any ratio and their composition is variable.
18. Pure substances can be further classified into elements and compounds.
19. An element consists of only one type of particles. These particles may be atoms or molecules.
20. Hydrogen, nitrogen and oxygen gases consist of molecules in which two atoms combine to give their respective molecules. This is illustrated in Fig.1.2.

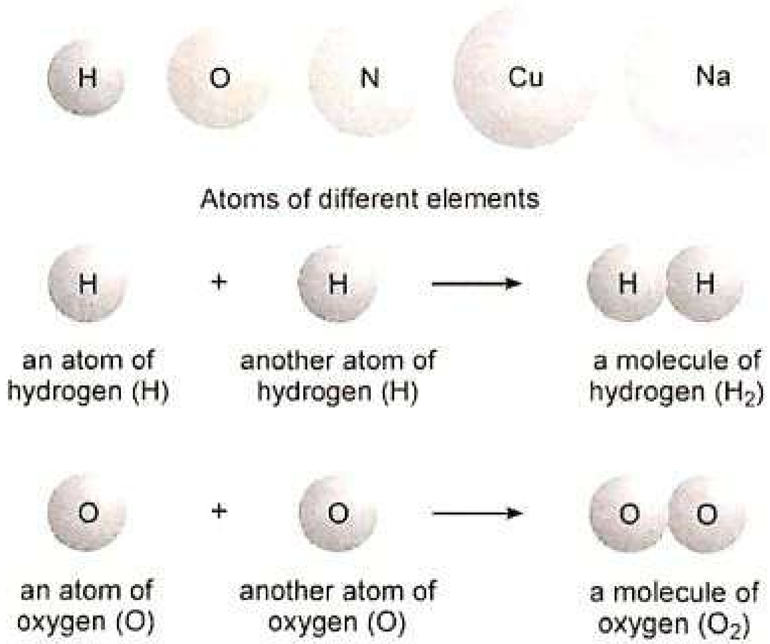


Fig. 1.2 A representation of atoms and molecules

21. When two or more atoms of different elements combine, the molecule of a compound is obtained.
22. The molecules of water and carbon dioxide are represented in Fig. 1.3.

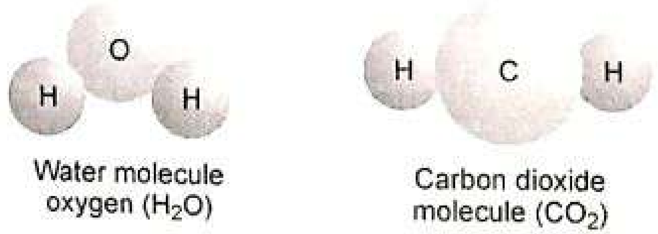


Fig. 1.3 Depiction of molecules of water and carbon dioxide

23. Every substance has unique or characteristic properties. These properties can be classified into two categories — physical properties and chemical properties.
24. Physical properties are those properties which can be measured or observed without changing the identity or the composition of the substance.
25. The measurement or observation of chemical properties require a chemical change to occur.
26. The International System of Units (in French *Le Systeme International d'Unités* – abbreviated as SI) was established by the 11th General Conference on Weights and Measures (CGPM from

Conference Generale des Poids at Measures). The CGPM is an inter governmental treaty organisation created by a diplomatic treaty known as Metre Convention which was signed in Paris in 1875.

27. The SI system has seven base units and they are listed in Table. These units pertain to the seven fundamental scientific quantities.

Base Physical Quantity	*Name of SI Unit*	*Symbol for SI Unit*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

28. The other physical quantities such as speed, volume, density, etc., can be derived from these quantities.

29. The SI system allows the use of prefixes to indicate the multiples or submultiples of a unit. These prefixes are listed in Table.

Multiple	*Prefix*	*Symbol*
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	µ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d
10	deca	da
10^{2}	hecto	h
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T

30. Mass of a substance is the amount of matter present in it while weight is the force exerted by gravity on an object.

31. The mass of a substance is constant whereas its weight may vary from one place to another due to change in gravity.

32. A common unit, litre (L) which is not an SI unit, is used for measurement of volume of liquids.

$$1 \text{ L} = 1000 \text{ mL}, 1000 \text{ cm}^3 = 1 \text{ dm}^3$$

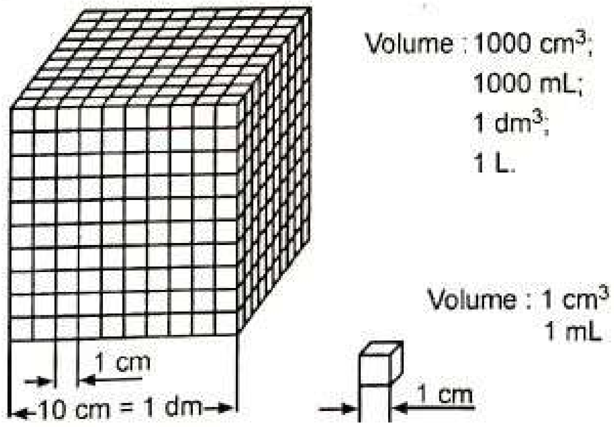


Fig. 1.4 Different units used to express volume

33. Density of a substance is its amount of mass per unit volume. So, SI units of density can be obtained as follows :

$$\text{SI unit of density} = \frac{\text{SI unit of mass}}{\text{SI unit of volume}}$$

$$= \frac{\text{kg}}{\text{m}^3} \text{ or kg m}^{-3}.$$

34. This unit is quite large and a chemist often expresses density in g cm^{-3}, where mass is expressed in gram and volume is expressed in cm^3.

35. The temperatures on Fahrenheit and Celsius scales are related to each other by the following relationship :

$$°F = \frac{9}{5}(°C) + 32$$

The kelvin scale is related to celsius scale as follows :

$$K = °C + 273.15$$

36. The problem of very large and very small molecules is solved by using scientific notation *i.e.*, exponential notation in which any number can be represented in the form $N \times 10^n$, where n is an exponent having positive or negative value and N can vary between 1 to 10.

37. Precision refers to the closeness of various measurements for the same quantity. However, accuracy is the agreement of a particular value to the true value of the result.

38. The uncertainty in the experimental or the calculated values is indicated by mentioning the number of significant figures.

39. Significant figures are meaningful digits which are known with certainty. The uncertainty is indicated by writing the certain digits and the last uncertain digit.

40. **Dimensional Analysis :** Often, there is a need to convert units from one system to other. The method used to accomplish, this is called factor label method or dimensional analysis.

Example : A piece of metal is 3 inch (represented by in) long. What is its length in cm ?

We know that 1 in = 2.54 cm

From this equivalence, we can write

$$\frac{1 \text{ in}}{2.54 \text{ cm}} = 1 = \frac{2.54 \text{ cm}}{1 \text{ in}}$$

Thus $\frac{1 \text{ in}}{2.54 \text{ cm}}$ equals 1 and $\frac{2.54 \text{ cm}}{1 \text{ in}}$ also equals 1. Both of these are called unit factors. If some number is multiplied by these unit factors (*i.e.*, 1), it will not be affected otherwise.

Say, the 3 in given above is multiplied by the unit factor. So,

$$3 \text{ in} = 3 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 3 \times 2.54 \text{ cm} = 7.62 \text{ cm}$$

Now, the unit factor by which multiplication is to be done is that unit factor ($\frac{2.54 \text{ cm}}{1 \text{ in}}$ in the above case) which gives the desired units *i.e.*, the numerator should have that part which is required in the desired result.

41. **Law of Conservation of Mass :** It states that *matter can neither be created nor destroyed.* This law was put forth by Antoine Lavoisier in 1789.

42. **Law of Definite Proportions :** This law was given by a French chemist, Joseph Proust. He stated that a *given compound always contains exactly the same proportion of elements by weight.*

43. **Law of Multiple Proportions :** This law was proposed by Dalton in 1803. According to this law, *if two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element, are in the ratio of small whole numbers.*
44. **Gay Lussac's Law of Gaseous Volumes :** This law was given by Gay Lussac in 1808. He observed that *when gases combine or are produced in a chemical reaction they do so in a simple ratio by volume provided all gases are at same temperature and pressure.*
45. **Avogadro's Law :** *Equal volumes of gases at the same temperature and pressure should contain equal number of molecules.*
46. **Dalton's Atomic Theory :** In 1808, Dalton published 'A New System of Chemical Philosophy' in which he proposed the following :
    1. Matter consists of indivisible atoms.
    2. All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.
    3. Compounds are formed when atoms of different elements combine in a fixed ratio.
    4. Chemical reactions involve reorganisation of atoms. These are neither created nor destroyed in a chemical reaction.
    5. Dalton's theory could explain the laws of chemical combination.
47. **Atomic Mass :** The present system of atomic masses is based on carbon-12 as the standard and has been agreed upon in 1961. Here, Carbon-12 is one of the isotopes of carbon and can be represented as ^{12}C.
48. In this system, ^{12}C is assigned a mass of exactly 12 atomic mass unit (amu) and masses of all other atoms are given relative to this standard.
49. One atomic mass unit is defined as a mass exactly equal to one-twelfth the mass of one carbon-12 atom.
50. Today, 'amu' has been replaced by 'u' which is known as unified mass.
51. **Average Atomic Mass :** Carbon has the following three isotopes with relative abundances and masses as shown against each of them.

Isotope	*Relative Abundance* (%)	*Atomic Mass* (amu)
^{12}C	98.892	12
^{13}C	1.108	13.00335
^{14}C	2×10^{-10}	14.00317

From the above data , the average atomic mass of carbon will come out to be :

$$(0.98892)(12\ u) + (0.01108)(13.00335\ u) + (2 \times 10^{-12})(14.00317\ u) = 12.011\ u.$$

52. **Molecular Mass :** Molecular mass is the sum of atomic masses of the elements present in a molecule. It is obtained by multiplying the atomic mass of each element by the number of its atoms and adding them together.
53. **Formula Mass :** The formula such as NaCl is used to calculate the formula mass instead of molecular mass as in the solid state sodium chloride does not exist as a single entity.
    Thus, formula mass of sodium chloride = atomic mass of sodium + atomic mass of chlorine
    = 23.0 u + 35.5 u = 58.5 u.
54. **Mole Concept and Molar Masses :** One mole is the amount of a substance that contains as many particles or entities as there are atoms in exactly 12 g (or 0.012 kg) of the ^{12}C isotope.
55. The mole of a substance always contain the same number of entities, no matter what the substance may be.

56. The number of entities in 1 mol is so important that it is given a separate name and symbol, known as 'Avogadro constant', denoted by (N_A).

57. The mass of one mole of a substance in grams is called its molar mass. The molar mass in grams is numerically equal to atomic/molecular/formula mass in u.

58. Mass % of an element = $\dfrac{\text{mass of that element in the compound} \times 100}{\text{molar mass of the compound}}$

59. An empirical formula represents the simplest whole number ratio of various atoms present in a compound whereas the molecular formula shows the exact number of different types of atoms present in a molecule of a compound.

60. If the mass per cent of various elements present in a compound is known, its empirical formula can be determined. Molecular formula can further be obtained if the molar mass is known.

61. Stoichiometry, deals with the calculation of masses (sometimes volumes also) of the reactants and the products involved in a chemical reaction.

62. A balanced chemical equation has the same number of atoms of each element on both sides of the equation. Many chemical equations can be balanced by *trial* and *error*.

63. The reactant which gets consumed, limits the amount of product formed and is, therefore, called the limiting reagent.

64. The concentration of a solution or the amount of substance present in its given volume can be expressed in any of the following ways :
    1. Mass per cent or weight per cent (w/w%)
    2. Mole fraction
    3. Molarity
    4. Molality.

65. **Mass per cent :** It is obtained by using the following relation :

$$\text{Mass per cent} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

66. **Mole fraction :** It is the ratio of number of moles of a particular component to the total number of moles of the solution.

67. **Molarity :** It is the number of moles of the solute in 1 litre of solution. Thus,

$$\text{Molarity } (M) = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

68. **Molality :** It is defined as the number of moles of solute present in 1 kg of solvent. It is denoted by m.

Thus, $$\text{Molality } (m) = \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kg}}.$$

Some numericals

1. Calculate the number of molecules present in 22.0 g of CO_2. [C = 12u, O = 16u]

Solution:- Number of moles $= \frac{\text{Mass}}{\text{Molar mass}} = \frac{22}{(12 + 2\times16)}$

$$= \frac{22}{44} = \frac{1}{2} \text{ mole}$$

1 mole of $CO_2 = 6.022\times10^{23}$ molecules

$\frac{1}{2}$ ——"—— $= \frac{1}{2}\times 6.022\times10^{23}$

Ans $= 3.011\times10^{23}$ molecules

2. Calculate the % of N in NH_3. [N=14u, H=1u]

Solution

$$\%\text{ of N in } NH_3 = \frac{\text{Total mass of Nitrogen}}{\text{Molar mass of } NH_3}\times100$$

$$= \frac{14}{17}\times100 = 82.3\% \text{ Ans}$$

3. Hydrogen reacts with nitrogen to produce NH_3 according to the equation:

$$3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$$

Determine how much ammonia would be produced if 100 g of N_2 reacts?

Solution:-

$$3H_2 + \underset{(2\times14=28g)}{N_2} \longrightarrow \underset{(2\times17=34g)}{2NH_3}$$

Now 28 g of N_2 reacts with hydrogen to form 34 g NH_3

$\therefore$ 100 g N_2 ——"—— $\frac{34}{28}\times100$

Ans $= 121.4$ g. NH_3

4. What is the molarity of a solution made by dissolving 9.8 g of H_2SO_4 in enough water to make 0.400 L of solution

Solution

$$\text{Moles of } H_2SO_4 = \frac{\text{Mass of } H_2SO_4}{\text{Molecular mass}(H_2SO_4)}$$

$$\frac{9.8\ g}{98\ g\ mol^{-1}} = 0.1\ mol$$

$$\text{Molarity of } H_2SO_4 = \frac{\text{Moles}}{\text{Volume in L}} = \frac{0.1\ mol}{0.4\ L}$$

Ans $= 0.25$ M

5. Calculate the mole fraction of water in a mixture of 15 g water, 78 g acetic acid and 84 g ethyl alcohol.

Solution

$$n(H_2O) = \frac{\text{Mass of water}}{\text{Molar mass } (H_2O)} = \frac{15}{18} = 0.84\ mol$$

$$n(CH_3COOH) = \frac{\text{Mass of acetic acid}}{\text{Molar mass} (CH_3COOH)} = \frac{78}{60} = 1.64\ mol$$

$$n(C_2H_5OH) = \frac{\text{Mass of ethyl alcohol}}{\text{Molar mass } (C_2H_5OH)} = \frac{84}{46} = 1.82\ mol$$

Total no. of moles in solution

$$n_{total} = (0.84 + 1.64 + 1.82)\ mol = 4.30\ mol$$

$$x_{H_2O} = \frac{n(H_2O)}{n_{total}} = \frac{0.84}{4.30} = 0.19 \quad \text{Ans}$$

Similary

$$x_{CH_3COOH} = \frac{n(CH_3COOH)}{n_{total}} = \frac{1.64}{4.3} = 0.38$$

and $$x_{C_2H_5OH} = \frac{n(C_2H_5OH)}{n_{total}} = \frac{1.82}{4.3} = 0.42$$

6. If the density of a solution is 3.12 g mL^{-1}, what is the mass of 1.5 mL solution in significant figures?

Solution:- Mass of solution = Volume of solution × density

$= 1.5\ mL \times 3.12\ g\ mL^{-1}$

Ans $= 4.680 = 4.7$ g

Now try to solve these :-

1. What is the mass of 1 L of mercury in grams and kilograms, if the density of liquid mercury is 13.6 $g\,cm^{-3}$?
2. Calculate the mass percent of Ca, P and O in $Ca_3(PO_4)_2$. [Ca = 40u, P = 31 u, O = 16 u]
3. Calculate the molecular mass of
   (a) C_2H_6 (b) $C_6H_{12}O_6$
4. What will be molality of the solution containing 18.25 g of HCl gas in 500 g of water ?
5. Calculate :-
   (i) Mass in grams of 5.8 mol of N_2O.
   (ii) Number of moles in 8.0 g of O_2.

CBSE Quick Revision Notes

CBSE Class-11 Biology

CHAPTER-01

THE LIVING WORLD

Life is a unique, complex organization of molecules that expresses itself through chemical reactions which lead to growth, development, responsiveness, adaptation and reproduction.

The objects exhibiting growth, development, reproduction, respiration, responsiveness and other characteristics of life are designated as living beings.

Unique features of living organism:-

1. Growth- Living organisms grow in mass and number. A multicellular organism increases its mass by cell division. In plants growth continuous throughout life in their meristematic area but in animals, growth occurs to a certain age. Unicellular organisms also grow by cell division. Living organisms show internal growth due to addition of materials and formation of cells inside the body. Non living organism like mountains, boulders, crystals also grow but due to addition of similar materials to their outer surface.
2. Reproduction- It is the formation of new individuals of the similar kind. Reproduction is not essential for survival of the individuals. It is required for perpetuation of the population. In sexual reproduction two parents are involved to produce more or less similar kinds of individuals. In asexual reproduction single parent is involved and individual is copy of the parent. Asexual reproduction may occurs by fission, fermentation, regeneration, vegetative propagation etc. In unicellular organism, growth and reproduction are synonyms. Many organisms like mules, sterile worker bees, infertile human couples do not reproduce. Therefore, reproduction is not an all-inclusive characteristic of living organism. However, no nonliving object has the power to reproduce or replicate.
3. Metabolism- The sum total of all types of chemical reactions occurring in an individual due to specific interactions amongst different types of molecules in the interior of cells is called metabolism. All activities of an organism including growth, movements, development, reproduction etc. are due to metabolism. There are two types of

metabolism- Catabolism and Anabolism. Anabolism includes all the building up reactions to increase the mass of the organism like photosynthesis. In catabolism breakdown reactions are involved, such as respiration, digestion etc. no nonliving object show metabolism.

4. Consciousness- It is the awareness of the surroundings and responding to external stimuli. External stimuli may be physical, chemical or biological. Plants also responds to stimuli like light, water, gravitation, pollution etc. All living organisms prokaryotic to eukaryotic responds to different kinds of stimuli. Human being is only organism who is aware of himself. Consciousness therefore, becomes the defining property of living organisms.
5. Life span- every living organism has a definite life span of birth, growth, maturity, senescence and death.
6. Living organisms are therefore, self-replicating, evolving and self-regulatory interactive systems capable of responding to external stimuli.

Diversity in the living world or biodiversity is the occurrence of variety of life forms differing in morphology, size, colour, anatomy, habitats and habits. Each different kind of plant, animal or microorganisms represents a species.

Currently there are some 1.7 – 1.8 million living organisms known to science. Out of which 1.25 are animals and about 0.5 millions are plants.

- Identification
- Nomenclature
- Classification
- Systematics is branch of biology that deals with cataloguing plants, animals and other organism into categories that can be named, compared and studied.
- Identification is the finding of correct name and place and place of an organism in a system of classification. It is done with the help of keys. This is carried out by determining similarity with already known organisms.
- Nomenclature is the process of standardize naming of living organism such that a particular organism is known by the same name all over the world. For plants scientific names are based on international code of botanical nomenclature (ICBN) and animals names on international code of zoological nomenclature (ICZN). Scientific name ensures that each organism has only one name.

Biological nomenclature- It is the universally accepted principles to provide scientific name to known organisms. Each name has two components- generic name (genus) and specific epithet (species). This system of nomenclature was provided by Carolus Linnaeus.

Mango- *Mangifera indica*.

Human beings- *Home sapience.*

Universal rules of nomenclature:-

1. Biological names are generally in Latina and written in italics.
2. The first word in a biological name represents the genus while the second component denotes the specific epithet.
3. Both the words in biological name, when handwritten, are separately underlined, or printed in italics.
4. The first word denoting the genus starts with a capital letter while the specific epithet starts with small letter.

- Classification- It is the process by which anything is grouped into convenient categories based on some easily observable characteristics. Classification makes the study of organisms convenient.
- Taxonomy- The process of classification on the basis of external and internal structure along with internal structure of cell, development process and ecological information is known as taxonomy.

Taxonomic categories

A taxonomic category is a rank or level in the hierarchical classification of organism. There are seven obligate categories and some intermediate categories. Since the category is a part of overall taxonomic arrangement, it is called taxonomic category and all categories together constitute the taxonomic hierarchy.

Taxonomic hierarchy is shown below:-

KINGDOM

⇑

DIVISION/PHYLLUM

⇑

CLASS

⇑

ORDER

⇑

FAMILY

⇑

GENUS

⇑

SPECIES

- **Species-** Species are the natural population of individuals or a group of population which resemble one another in all essential morphological and reproductive characters so that they are able to interbreed freely and produce fertile offspring. For Mango tree *indica* is species of genus *Mangifera*(*Mangifera indica*).
- **Genus-** it is a group of related species which resemble one another in certain correlated characters. All species of genus presumed to have evolved from a common ancestor. Lion, Tiger, Leopard are closely related species and placed in same genus *Panther*.
- **Family-** It is a taxonomic category which contains one or more related genera. All genera of a family have some common features or correlated characters. Family Solanacaeae contains a number of genera like *Solanum, Withania, Datura* etc.
- **Order-** This category includes one or more related families. Families felidae and canidae are included in same order carnivore.
- **Class-** A class is made of one or more related orders. The class dicotyledoneae of flowering plants contains all dicots which are grouped into several orders like roales, polemoniales, renales etc.

- **Division/Phylum-** The term phylum is used for animals while division is used for plants. They are formed of one or more class. The phylum chordate of animals contains not only the mammals but also aves, reptiles, amphibians, etc.
- **Kingdom-** It is the highest taxonomic category. All plants are included in the kingdom Plantae while all animals belong to kingdom Animalia.
- **Taxonomic Aids:-** Techniques, procedures and stored information that are useful in identification and classification of organisms are called taxonomic aids.
- **Herbarium-**Herbarium is a place where dried and pressed plants specimens, mounted on sheets are kept systematically according to a widely accepted system of classification. The herbarium sheets also carry a label providing information about date and place of collection, English, local and botanical names, family, collector's name etc.
- **Botanical garden-** They are specialized gardens having collection of living plants for reference. Plants in these gardens are grown for identification purpose and each plant is labelled indicating its scientific name and family. The famous botanical garden includes Royal botanical garden, Kew (London), Indian botanical garden, Kolkata and National botanical garden, Lucknow.
- **Museums-** Biological museum is set up in educational institutions like colleges and school for reference purposes. Specimens are preserved in the containers or jars in preservative solutions or as dry specimens. Insects are preserved in insect boxes after collecting, killing and pinning.
- **Zoological parks-** These are the places where wild animals are kept in protected environments under human care and which enable us to learn about their food habits and behavior. Natural habitats are provided as far as possible.

Key- Taxonomic key is an artificial analytic device having a list of statements with dichotomic table of alternate characteristics which is used for identifying organisms. Usually two contrasting characters are used. The one present in the organism is chosen while other is rejected. Each statement of a key is called lead. Separate taxonomic keys are used for each taxonomic category like species, genus, family, etc. Keys are generally analytical in nature.

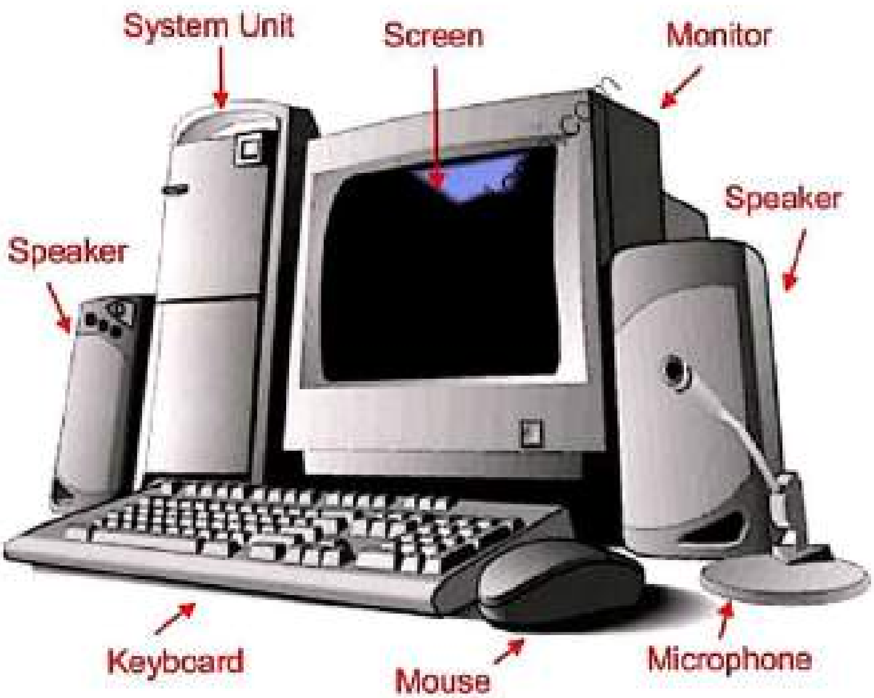
Flora, manuals, monographs and catalogues are some other means of recording descriptions.

COMPUTER SYSTEM ORGANIZATION

What is Computer?

- A computer is an electronic device that can perform a variety of operations in accordance with set of instructions called program.
- A computer can be defined as an electronic device which accepts input from the user, process the input and produce the desired output.

Basic Computer Components

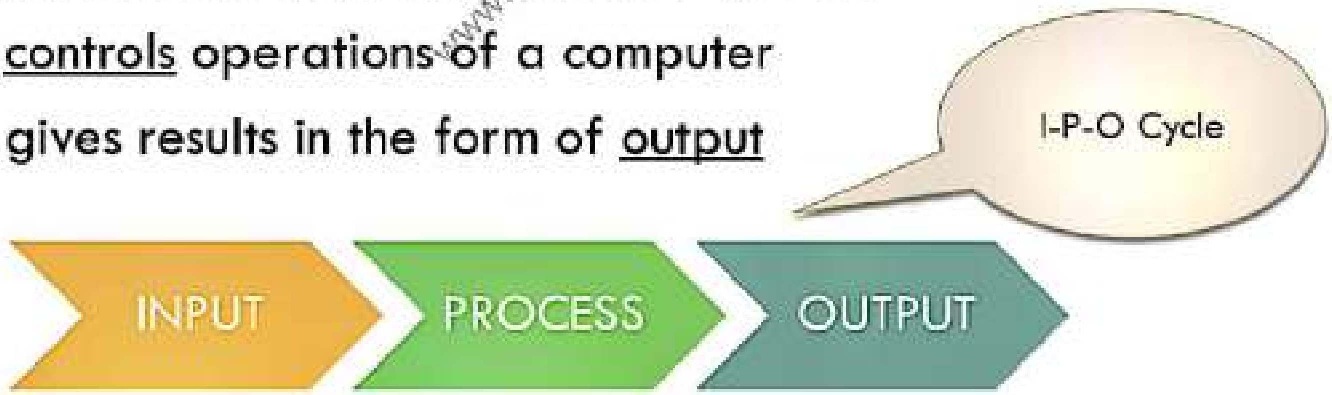


Introduction

- Our present day life is so automatic that most of the tasks are accomplished with a click of a button. In every sphere of life, machines dominate human efforts. Let us take the case of cash withdrawal from a bank ATM. The user is required to press only a few buttons to authenticate his identity and the amount he wishes to withdraw. Then within seconds the money pops out of the ATM. During this process, the inside working of bank ATM is beyond imagination of the user. Broadly speaking, the ATM receives certain data from the user, processes it and gives the output (money). This is exactly what a computer does. Formally, a computer can be defined as follows:
- " An electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals."

Introduction

- computer performs basically five major functions irrespective of its size and make.
  - It accepts data or instructions by way of input
  - It stores data
  - It processes data as required by the user
  - It controls operations of a computer
  - It gives results in the form of output



Block Diagram of Computer

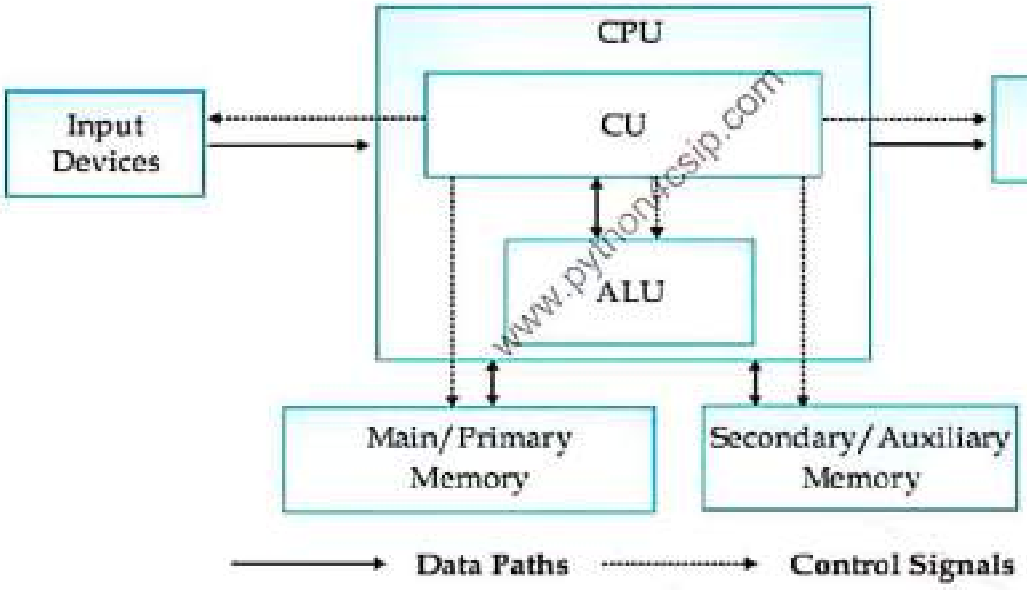


Figure 1.1 Block diagram of functional units of a computer

Block Diagram of Computer

- The above diagram describes the basic layout of a computer. A computer receives data and instructions through "Input Devices" which get processed in Central Processing Unit, "CPU" and the result is shown through "Output Devices". The "Main / primary Memory" and "Secondary / Auxiliary Memory" are used to store data inside the computer. These are the basic components that each computer possess. Each of these components exists in various types and variety that differ in shape, size, usage and performance. The user makes a choice according to his specific requirement.

CPU

- Stands for Central Processing Unit
- Also known as the Brain of Computer.
- It convert the Input into Output
- CPU perform its operation with the help of its 2 subunits :-
  - ALU : Arithmetic and Logic Unit
  - CU : Control Unit

ALU

- ALU Perform all the arithmetical and logical operations.
- Arithmetic operations like +, -, *, /
- Logical operation like comparison or decision making like: >, <, =, >=, <=, <>

CU

- Control and guides the interpretation of all the data and information.
- It coordinates the different units attached to computer system.
- It takes input from Input device and store it in main memory, then it send the data to ALU if any arithmetic operation is required after this it transfer the output to output devices.

Memory of Computer

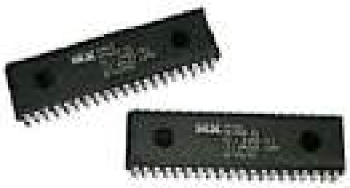
- Memory refers to the place where data is stored temporarily or permanently.
- Input must goes to Memory Unit then only any action on it can be performed.
- Computer Memory is basically of 2 types:
  - Primary Memory
    - Primary or main memory stores information(data and instruction)
  - Secondary Memory
    - Stores the data permanently for future retreival

Primary Memory

- Random Access Memory (RAM)
  - It is the working memory, right from the booting of computer till the computer is shutdown this memory is in use to store all the operation done by the computer
  - is used for primary storage in computers to hold active information of data and instructions.
  - It holds data temporarily i.e. Volatile Memory
  - Data is lost if Power Off

Primary Memory

- Read Only Memory (ROM)
  - ROM (Read Only Memory) is used to store the instructions provided by the manufacturer, which holds the instructions to check basic hardware inter connecter and to load operating system from appropriate storage device
  - It is also known as **FIRMWARE**
  - Its data is stored permanently on it so it is non-volatile device.



Unit of Memory

The elementary unit of memory is a bit (binary digit)
Zero(0) & One(1)

GROUP OF	KNOWN AS
4 BIT	NIBBLE
8 BIT	BYTE
1024 BYTES	1 KILO BYTE(KB)
1024 KB	1 MEGA BYTE(MB)
1024 MB	1 GIGA BYTE(GB)
1024 GB	1 TERA BYTE(TB)
1024 TB	1 PETA BYTE(PB)

Secondary Storage Devices

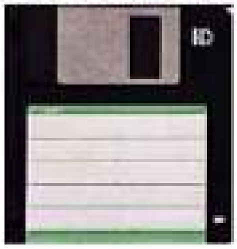
- If we want to save data for future reference and retrieval then it needs to be saved in memory other than primary memory, which is called secondary memory, or auxiliary memory. Normally hard disk of computer is used as secondary memory but this is not portable so there are many other secondary storage media in use.
- Example:
  - Hard Disk
  - CD/DVD
  - Pen Drive
  - Floppy, etc.

Secondary Storage Devices

- HARD DISK :
  - A **hard disk drive** (**HDD;** also **hard drive, hard disk,** or **disk drive**) is a device for storing and retrieving digital information, primarily computer data.
  - It consists of one or more rigid (hence "hard") rapidly rotating discs (often referred to as platters), coated with magnetic material and with magnetic heads arranged to write data to the surfaces and read it from them.
  - Generally hard disks are sealed units fixed in the cabinet. It is also known as fixed disk

Secondary Storage Devices

- FLOPPY DISK : It is a data storage medium that is made up of a disk of thin, flexible magnetic material enclosed in a cover. Its capacity is 1.44 MB.



- COMPACT DISK (CD) : Capacity of standard 120mm CD is 700MB. It is a thin optical disk which is commonly used to store audio and video data. Transfer speed is mentioned as multiple of 150 KB/s. 4x means

Secondary Storage Devices

- DIGITAL VIDEO DISK (DVD) : This is an optical disc storage device. It can be recorded on single side or on double side. Its capacity may range from 4.7 GB to 8.5 GB.
- PEN DRIVE :This is small, portable memory, which can be plugged into a computer with USB Port.

They have capacity lesser than hard disk but much larger than a floppy or CD. They are more reliable also. They are also called pen drive.

Input Devices

- These are the devices used to give input to computer for processing.
- Input may be in form of text, images, audio, etc.
- Input Devices example:
  - Keyboard
  - Mouse
  - Joystick
  - Scanner
  - Etc.

KEYBOARD

This is the most common input device which uses an arrangement of buttons or keys. In a keyboard each press of a key typically corresponds to a single written symbol. However some symbols require pressing and holding several keys simultaneously or in sequence. While most keyboard keys produce letters, numbers or characters, other keys or simultaneous key presses can produce actions or computer commands.

MOUSE

A mouse is a pointing device that functions by detecting two-dimensional motion relative to its supporting surface. The mouse's motion typically translates into the motion of a cursor on a display, which allows for fine control of a Graphical User Interface. A mouse primarily comprises of three parts: the buttons, the handling area, and the rolling object. Using left button of mouse different operations like selection, dragging, moving and pasting can be done. With the right button we can open a context menu for an item, if it is applicable.

SCANNER

Scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to digital image.

JOYSTICK

A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.

Many people use joysticks on computer games involving flight such as flight simulator.

Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer

TOUCH SCREEN

A touch screen is a computer display screen that is also an input device. The screens are sensitive to pressure; a user interacts with the computer by touching pictures or words on the screen.

You may see it at as KIOSKS installed in various public places like ATM machines, Railway's PNR Checking machine etc.

MICROPHONE

It is used to input audio data into the computer. They are mainly used for sound recording.

OUTPUT DEVICE

- Output device is used to display the output to user either in soft copy or hard copy.
- Soft copy output appears on monitor whereas hard copy output appears on paper by printer.
- Various output devices are:
  - Monitor
  - Printer
  - Speaker
  - Projector etc.

Monitor

- Also known as Visual Display Unit (VDU)
- It is the primary output device where we see the output. It looks like TV.
- Its display may be CRT, LCD or LED
- CRT – Cathode ray tube
- LCD – Liquid Crystal Display
- LED – Light Emitting Diode

Printer

- Printer produces output on paper.
- There are various types of printer available in market like:
- **Dot Matrix Printer :** uses ribbon and hammer technology. Its quality is not very good. Output is printer by making object using small dots.

Printer

- Inkjet/Deskjet Printer: is a type of computer printer that creates a digital image by propelling droplets of ink onto paper.
- Laser Printer : These printers use laser technology to produce printed documents. These are very fast printers and are used for high quality prints.

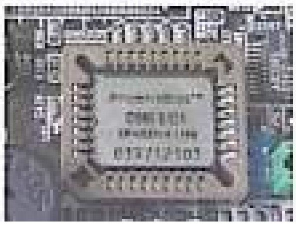
CMOS

- **complementary metal-oxide semiconductor**
- CMOS is an onboard, battery powered semiconductor chip inside computers that stores information.
- This information ranges from the system time and date to system hardware settings for your computer.
- CMOS battery is generally used to give backup support to BIOS program.

CMOS Battery

BIOS

- The basic input/output system (BIOS) is also commonly known as the System BIOS. The BIOS is boot firmware, a small program that controls various electronic devices attached to the main computer system.
- It is designed to be the first set of instructions run by a Computer when powered on. The initial function of the BIOS is to initialize system devices such as the RAM, hard disk, CD/DVD drive, video display card, and other hardware.



ST. MARY'S PUBLIC SCHOOL

H.H.W

(2020-2021)

Mathematics

CLASS-XI

NOTES

CHAPTER-1

SETS

(40 MARKS)

Mathematics

(041)

SETS

1. SET

A set is a collection of well-defined and well distinguished objects of our perception or thought.

1.1 Notations

The sets are usually denoted by capital letters A, B, C, etc. and the members or elements of the set are denoted by lower-case letters a, b, c, etc. If x is a member of the set A, we write $x \in A$ (read as 'x belongs to A') and if x is not a member of the set A, we write $x \notin A$ (read as 'x does not belong to A,). If x and y both belong to A, we write $x, y \in A$.

2. REPRESENTATION OF A SET

Usually, sets are represented in the following two ways :

(i) Roster form or Tabular form

(ii) Set Builder form or Rule Method

2.1 Roster Form

In this form, we list all the member of the set within braces (curly brackets) and separate these by commas. For example, the set A of all odd natural numbers less that 10 in the Roster form is written as :

$A = \{1, 3, 5, 7, 9\}$

Note...

(i) In roster form, every element of the set is listed only once.

(ii) The order in which the elements are listed is immaterial.

For example, each of the following sets denotes the same set $\{1, 2, 3\}$, $\{3, 2, 1\}$, $\{1, 3, 2\}$

2.2 Set-Builder Form

In this form, we write a variable (say x) representing any member of the set followed by a property satisfied by each member of the set.

For example, the set A of all prime numbers less than 10 in the set-builder form is written as

$A = \{x \mid x$ is a prime number less that $10\}$

The symbol '|' stands for the words 'such that'. Sometimes, we use the symbol ':' in place of the symbol '|'.

3. TYPES OF SETS

3.1 Empty Set or Null Set

A set which has no element is called the null set or empty set. It is denoted by the symbol ϕ.

For example, each of the following is a null set :

(a) The set of all real numbers whose square is –1.

(b) The set of all rational numbers whose square is 2.

(c) The set of all those integers that are both even and odd.

A set consisting of atleast one element is called a non-empty set.

3.2 Singleton Set

A set having only one element is called singleton set.

For example, $\{0\}$ is a singleton set, whose only member is 0.

3.3 Finite and Infinite Set

A set which has finite number of elements is called a finite set. Otherwise, it is called an infinite set.

For example, the set of all days in a week is a finite set whereas the set of all integers, denoted by $\{..........-2, -1, 0, 1, 2, ...\}$ or $\{x \mid x$ is an integer$\}$, is an infinite set.

An empty set ϕ which has no element in a finite set A is called empty of void or null set.

3.4 Cardinal Number

The number of elements in finite set is represented by n(A), known as Cardinal number.

3.5 Equal Sets

Two sets A and B are said to be equals, written as $A = B$, if every element of A is in B and every element of B is in A.

3.6 Equivalent Sets

Two finite sets A and B are said to be equivalent, if $n(A) = n(B)$. Clearly, equal sets are equivalent but equivalent sets need not be equal.

For example, the sets $A = \{4, 5, 3, 2\}$ and $B = \{1, 6, 8, 9\}$ are equivalent but are not equal.

3.7 Subset

Let A and B be two sets. If every elements of A is an element of B, then A is called a subset of B and we write $A \subset B$ or $B \supset A$ (read as 'A is contained in B' or B contains A'). B is called superset of A.

Note

(i) Every set is a subset and a superset itself.

(ii) If A is not a subset of B, we write $A \not\subset B$.

(iii) The empty set is the subset of every set.

(iv) If A is a set with $n(A) = m$, then the number of subsets of A are 2^m and the number of proper subsets of A are $2^m - 1$.

For example, let $A = \{3, 4\}$, then the subsets of A are ϕ, $\{3\}$, $\{4\}$, $\{3, 4\}$. Here, $n(A) = 2$ and number of subsets of $A = 2^2 = 4$. Also, $\{3\} \subset \{3,4\}$ and $\{2,3\} \not\subset \{3,4\}$

3.8 Power Set

The set of all subsets of a given set A is called the power set of A and is denoted by P(A).

For example, if $A = \{1, 2, 3\}$, then

$P(A) = \{\phi, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\}, \{1,2,3\}\}$

Clearly, if A has n elements, then its power set P(A) contains exactly 2^n elements.

4. OPERATIONS ON SETS

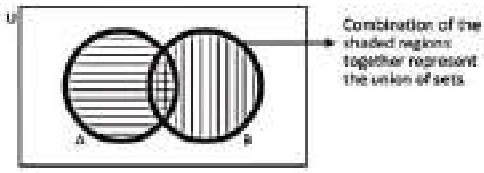
4.1 Union of Two Sets

The union of two sets A and B, written as $A \cup B$ (read as 'A union B'). is the set consisting of all the elements which are either in A or in B or in both Thus,

$A \cup B = \{x : x \in A \text{ or } x \in B\}$

Clearly, $x \in A \cup B \Rightarrow x \in A$ **or** $x \in B$, and

$x \notin A \cup B \Rightarrow x \notin A$ **and** $x \notin B$.



For example, if $A = \{a, b, c, d\}$ and $B = \{c, d, e, f\}$, then $A \cup B = \{a, b, c, d, e, f\}$

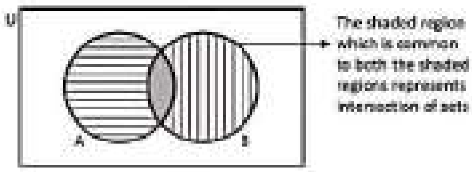
4.2 Intersection of Two sets

The intersection of two sets A and B, written as $A \cap B$ (read as 'A' intersection 'B') is the set consisting of all the common elements of A and B. Thus,

$A \cap B = \{x : x \in A \text{ and } x \in B\}$

Clearly, $x \in A \cap B \Rightarrow x \in A$ **and** $x \in B$, and

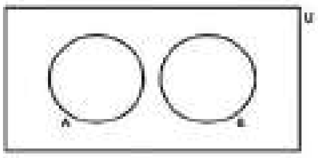
$x \notin A \cap B \Rightarrow x \notin A$ **or** $x \notin B$.



For example, if $A = \{a, b, c, d\}$ and $B = \{c, d, e, f\}$, then $A \cap B = \{c, d\}$.

4.3 Disjoint Sets

Two sets A and B are said to be disjoint, if $A \cap B = \phi$, i.e. A and B have no element in common.



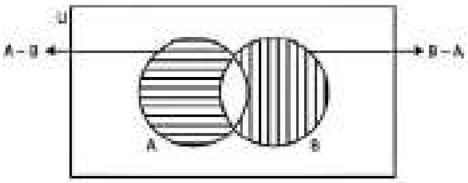
For example, if A = {1, 3, 5} and B = {2, 4, 6}, then $A \cap B = \phi$, so A and B are disjoint sets.

4.4 Difference of Two Sets

If A and B are two sets, then their difference A - B is defined as :

$A - B = \{x : x \in A \text{ and } x \notin B\}$.

Similarly, $B - A = \{x : x \in B \text{ and } x \notin A\}$.



For example, if A = {1, 2, 3, 4, 5} and B = {1, 3, 5, 7, 9} then A - B = {2, 4} and B - A = {7, 9}.

Important Results

(a) $A - B \neq B - A$

(b) The sets A - B , B - A and $A \cap B$ are disjoint sets

(c) $A - B \subseteq A$ and $B - A \subseteq B$

(d) $A - \phi = A$ and $A - A = \phi$

4.5 Symmetric Difference of Two Sets

The symmetric difference of two sets A and B , denoted by $A \Delta B$, is defined as

$A \Delta B = (A - B) \cup (B - A)$.

For example, if A = {1,2,3,4,5} and B = {1,3,5,7,9} then

$A \Delta B = (A - B) \cup (B - A) = \{2,4\} \cup \{7,9\} = \{2,4,7,9\}$.

4.6 Complement of a Set

If U is a universal set and A is a subset of U, then the complement of A is the set which contains those elements of U, which are not contained in A and is denoted by A' or A^c. Thus,

$A^c = \{x : x \in U \text{ and } x \notin A\}$

For example, if U = {1,2,3,4 ...} and A {2,4,6,8,...}, then, A^c = {1,3,5,7, ...}

Important Results

a) $U^c = \phi$ b) $\phi^c = U$ c) $A \cup A^c = U$

d) $A \cap A^c = \phi$

5. ALGEBRA OF SETS

1. For any set A , we have

a) $A \cup A = A$ b) $A \cap A = A$

2. For any set A, we have

c) $A \cup \phi = A$ d) $A \cap \phi = \phi$

e) $A \cup U = U$ f) $A \cap U = A$

3. For any two sets A and B, we have

g) $A \cup B = B \cup A$ h) $A \cap B = B \cap A$

4. For any three sets A, B and C, we have

i) $A \cup (B \cup C) = (A \cup B) \cup C$

j) $A \cap (B \cap C) = (A \cap B) \cap C$

5. For any three sets A, B and C, we have

k) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

l) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

6. If A is any set, we have $(A^c)^c = A$.

7. Demorgan's Laws For any three sets A, B and C, we have

m) $(A \cup B)^c = A^c \cap B^c$

n) $(A \cap B)^c = A^c \cup B^c$

o) $A - (B \cup C) = (A - B) \cap (A - C)$

p) $A - (B \cap C) = (A - B) \cup (A - C)$

Important Results on Operations on Sets

(i) $A \subseteq A \cup B$, $B \subseteq A \cup B$, $A \cap B \subseteq A$, $A \cap B \subseteq B$

(ii) $A - B = A \cap B'$ (iii) $(A - B) \cup B = A \cup B$

(iv) $(A - B) \cap B = \phi$ (v) $A \subseteq B \Leftrightarrow B^c \subseteq A^c$

(vi) $A - B = B' - A'$ (vii) $(A \cup B) \cap (A \cup B') = A$

(viii) $A \cup B = (A - B) \cup (B - A) \cup (A \cap B)$

(ix) $A - (A - B) = A \cap B$

(x) $A - B = B - A \Leftrightarrow A = B$ (xi) $A \cup B = A \cap B \Leftrightarrow A = B$

(xii) $A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C)$

Example – 1

Write the set of all positive integers whose cube is odd.

Sol. The elements of the required set are not even.

[$\because$ Cube of an even integer is also an even integer]

Moreover, the cube of a positive odd integer is a positive odd integer.

$\Rightarrow$ The elements of the required set are all positive odd integers.

Hence, the required set, in the set builder form, is :

$\{2k+1 : k \geq 0,\ k \in Z\}$.

Example – 2

Write the set $\left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{5}{6}, \frac{6}{7}, \frac{7}{8}\right\}$ in the set builder form.

Sol. In each element of the given set the denominator is one more than the numerator.

Also the numerators are from 1 to 7.

Hence the set builder form of the given set is :

$\{x : x = n/n+1,\ n \in N \text{ and } 1 \leq n \leq 7\}$.

Example – 3

Write the set $\{x : x$ is a positive integer and $x^2 < 30\}$ in the roster form.

Sol. The squares of positive integers whose squares are less than 30 are : 1, 2, 3, 4, 5.

Hence the given set, in roster form, is $\{1, 2, 3, 4, 5\}$.

Example – 4

Write the set $\{0, 1, 4, 9, 16, ...\}$ in set builder form.

Sol. The elements of the given set are squares of integers :

$0, \pm 1, \pm 2, \pm 3, \pm 4, ...$

Hence the given set, in set builder form, is $\{x^2 : x \in Z\}$.

Example – 5

State which of the following sets are finite and which are infinite

(i) $A = \{x : x \in N$ and $x^2 - 3x + 2 = 0\}$

(ii) $B = \{x : x \in N$ and $x^2 = 9\}$

(iii) $C = \{x : x \in N$ and x is even$\}$

(iv) $D = \{x : x \in N$ and $2x - 3 = 0\}$.

Sol. (i) $A = \{1, 2\}$.

[$\because x^2 - 3x + 2 = 0 \Rightarrow (x-1)(x-2) = 0 \Rightarrow x = 1, 2$]

Hence A is finite.

(ii) $B = \{3\}$.

[$\because x^2 = 9 \Rightarrow x = \pm 3$. But $3 \in N$]

Hence B is finite.

(iii) $C = \{2, 4, 6, ...\}$

Hence C is infinite.

(iv) $D = \phi$. $\left[\because 2x - 3 = 0 \Rightarrow x = \frac{3}{2} \notin N\right]$

Hence D is finite.

Example – 6

Which of the following are empty (null) sets ?

(i) Set of odd natural numbers divisible by 2

(ii) $\{x : 3 < x < 4, x \in N\}$

(iii) $\{x : x^2 = 25$ and x is an odd integer$\}$

(iv) $\{x : x^2 - 2 = 0$ and x is rational$\}$

(v) {x : x is common point of any two parallel lines}.

Sol. (i) Since there is no odd natural number, which is divisible by 2.

$\therefore$ it is an empty set.

(ii) Since there is no natural number between 3 and 4.

$\therefore$ it is an empty set.

(iii) Now $x^2 = 25 \to x = \pm 5$, both are odd.

$\therefore$ The set $\{-5, 5\}$ is non-emptry.

(iv) Since there is no rational number whose square is 2,

$\therefore$ the given set is an empty set.

(v) Since any two parallel lines have no common point,

$\therefore$ the given set is an empty set.

Example – 7

Find the pairs of equal sets from the following sets, if any, giving reasons :

$A = \{0\}, B = \{x : x > 15$ and $x < 5\}$,

$C = \{x : x - 5 = 0\}, D = \{x : x^2 = 25\}$,

E = {x : x is a positive integral root of the equation $x^2 - 2x - 15 = 0\}$.

Sol. Here we have,

$A = \{0\}$

$B = \phi$

[$\because$ There is no number, which is greater than 15 and less than 5]

$C = \{5\}$ [$\because x - 5 = 0 \Rightarrow x = 5$]

$D = \{-5, 5\}$ [$\because x^2 = 25 \Rightarrow x = \pm 5$]

and $E = \{5\}$.

[$\because x^2 - 2x - 15 = 0 \Rightarrow (x-5)(x+3) = 0 \Rightarrow x = 5, -3$. Out of these two,

5 is positive integral]

Clearly $C = E$.

Example – 8

Are the following pairs of sets equal ? Give reasons.

(i) $A = \{1, 2\}, B = \{x : x$ is a solution of $x^2 + 3x + 2 = 0\}$

(ii) A = {x : x is a letter in the word FOLLOW},

B = {y : y is a letter in the word WOLF}.

Sol. (i) $A = \{1, 2\}, B = \{-2, -1\}$

[$\because x^2 + 3x + 2 = 0 \Rightarrow (x+2)(x+1) = 0 \Rightarrow x = -2, -1$]

Clearly $A \neq B$.

(ii) A = {F, O, L, L, O, W} = {F, O, L, W}

B = {W, O, L, F} = {F, O, L, W}.

Clearly A = B.

Example – 9

Let $A = \{1, 2, 3, 4, 5\}, B = \{3, 4, 5, 6, 7\}, C = \{6, 7, 8, 9\}$ and $D = \{7, 8, 9, 10\}$. Find :

(a) **(i)** $A \cup B$ **(ii)** $B \cup D$

(iii) $A \cup B \cup C$ **(iv)** $B \cup C \cup D$

(b) **(i)** $A \cap B$ **(ii)** $B \cap D$ **(iii)** $A \cap B \cap C$

Sol. (a) (i) $A \cup B = \{1, 2, 3, 4, 5\} \cup \{3, 4, 5, 6, 7\}$

$= \{1, 2, 3, 4, 5, 6, 7\}$.

(ii) $B \cup D = \{3, 4, 5, 6, 7\} \cup \{7, 8, 9, 10\}$

$= \{3, 4, 5, 6, 7, 8, 9, 10\}$.

(iii) $A \cup B \cup C = \{1, 2, 3, 4, 5\} \cup \{3, 4, 5, 6, 7\} \cup \{6, 7, 8, 9\}$.

$= \{1, 2, 3, 4, 5, 6, 7\} \cup \{6, 7, 8, 9\} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

(iv) $B \cup C \cup D = \{3, 4, 5, 6, 7\} \cup \{6, 7, 8, 9\} \cup \{7, 8, 9, 10\}$.

$= \{3, 4, 5, 6, 7, 8, 9\} \cup \{7, 8, 9, 10\} = \{3, 4, 5, 6, 7, 8, 9, 10\}$.

(b) (i) $A \cap B = \{1, 2, 3, 4, 5\} \cap \{3, 4, 5, 6, 7\} = \{3, 4, 5\}$

(ii) $B \cap D = \{3, 4, 5, 6, 7\} \cap \{7, 8, 9, 10\} = \{7\}$.

(iii) $A \cap B \cap C = \{1, 2, 3, 4, 5\} \cap \{3, 4, 5, 6, 7\} \cap \{6, 7, 8, 9\} = \{3, 4, 5\} \cap \{6, 7, 8, 9\} = \phi$.

Example – 10

If $A_1 = \{2, 3, 4, 5\}$, $A_2 = \{3, 4, 5, 6\}$, $A_3 = \{4, 5, 6, 7\}$, find $\cup A_i$ and $\cap A_i$, where $i = \{1, 2, 3\}$.

Sol. (i) $\cup A_i = A_1 \cup A_2 \cup A_3 = \{2,3,4,5\} \cup \{3,4,5,6\} \cup \{4,5,6,7\}$

$= \{2,3,4,5\} \cup \{3,4,5,6,7\} = \{2,3,4,5,6,7\}$.

(ii) $\cap A_i = A_1 \cap A_2 \cap A_3 = \{2,3,4,5\} \cap \{3,4,5,6\} \cap \{4,5,6,7\}$

$= \{2,3,4,5\} \cap \{4,5,6\} = \{4,5\}$.

Example – 11

Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8\}$. Find :

(i) A^C (ii) B^C (iii) $(A^C)^C$ (iv) $(A \cup B)^C$

Sol. (i) A^C = Set of those elements of U, which are not in $A = \{5, 6, 7, 8, 9\}$.

(ii) B^C = Set of those elements of U, which are not in $B = \{1, 3, 5, 7, 9\}$.

(iii) $(A^C)^C$ = Set of those elements of U, which are not in $A' = \{1, 2, 3, 4\} = A$.

(iv) $A \cup B = \{1,2,3,4\} \cup \{2,4,6,8\} = \{1,2,3,4,6,8\}$.

$(A \cup B)^C$ = Set of those elements of U, which are not in

$(A \cup B) = \{5, 7, 9\}$.

Example – 12

If U = {x : x is a letter in English alphabet}, A = {x : x is a vowel in English alphabet}.

Find A^c and $(A^c)^c$.

Sol. (i) Since A = {x : x is a letter in English alphabet},

$\therefore A^C$ is the set of those elements of U, which are not vowels = {x : x is a consonant in English alphabet}.

(ii) $(A^C)^C$ is the set of those elements of U, which are not consonants = {x : x is a vowel in English alphabet} = A.

Hence $(A^C)^C = A$.

Example – 13

Let $A = \{1, 2, 3, 4, 5, 6\}$, $B = \{3, 4, 5, 6, 7, 8\}$. Find $(A - B) \cup (B - A)$.

Sol. We have, $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{3, 4, 5, 6, 7, 8\}$.

$\therefore A - B = \{1, 2\}$ and $B - A = \{7, 8\}$

$\therefore (A - B) \cup (B - A) = \{1, 2\} \cup \{7, 8\} = \{1, 2, 7, 8\}$.

Some Basis Results about Cardinal Number

If A, B and C are finite sets and U be the finite universal set, then

(i) $n(A') = n(U) - n(A)$

(ii) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

(iii) $n(A \cup B) = n(A) + n(B)$, where A and B are disjoint non-empty sets.

(iv) $n(A \cap B') = n(A) - n(A \cap B)$

(v) $n(A' \cap B') = n(A \cup B)' = n(U) - n(A \cup B)$

(vi) $n(A' \cup B') = n(A \cap B)' = n(U) - n(A \cap B)$

(vii) $n(A - B) = n(A) - n(A \cap B)$

(viii) $n(A \cap B) = n(A \cup B) - n(A \cap B') - n(A' \cap B)$

(ix) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

(x) If $A_1, A_2, A_3, \ldots A_n$ are disjoint sets, then $n(A_1 \cup A_2 \cup A_3 \cup \ldots \cup A_n) = n(A_1) + n(A_2) + n(A_3) + \ldots + n(A_n)$

(xi) $n(A \Delta B)$ = number of elements which belong to exactly one of A or B.

Example – 14

If $A = \{1, 2, 3\}$, $B = \{4, 5, 6\}$ and $C = \{7, 8, 9\}$, verify that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

Sol. We have, $A = \{1, 2, 3\}$, $B = \{4, 5, 6\}$ and $C = \{7, 8, 9\}$.

$A \cup B = \{1, 2, 3\} \cup \{4, 5, 6\} = \{1, 2, 3, 4, 5, 6\}$ ...(1)

$A \cup C = \{1, 2, 3\} \cup \{7, 8, 9\}$

$= \{1, 2, 3, 7, 8, 9\}$ ...(2)

and $B \cap C = \{4, 5, 6\} \cap \{7, 8, 9\} = \phi$ ...(3)

Now $A \cup (B \cap C) = \{1, 2, 3\} \cup \phi = \{1, 2, 3\}$ ...(4)

and $(A \cup B) \cap (A \cup C) = \{1, 2, 3, 4, 5, 6\} \cap \{1, 2, 3, 7, 8, 9\} = \{1, 2, 3\}$ ...(5)

From (4) and (5), $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$, which verifies the result.

Example – 15

Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{2, 4, 6, 8\}$ and $B = \{2, 3, 5, 7\}$. Verify that

(i) $(A \cup B)^C = A^C \cap B^C$ (ii) $(A \cap B)^C = A^C \cup B^C$.

Sol. We have, $A = \{2, 4, 6, 8\}$ and $B = \{2, 3, 5, 7\}$.

(i) $A \cup B = \{2, 4, 6, 8\} \cup \{2, 3, 5, 7\}$

$= \{2, 3, 4, 5, 6, 7, 8\}$

$(A \cup B)^C = \{1, 9\}$ ...(1)

Also $A^C = \{1, 3, 5, 7, 9\}$

and $B^C = \{1, 4, 6, 8, 9\}$

$A^C \cap B^C = \{1, 3, 5, 7, 9\} \cap \{1, 4, 6, 8, 9\}$

$= \{1, 9\}$ ...(2)

From (1) and (2), $(A \cup B)^C = A^C \cap B^C$, which verifies the result.

(ii) $A \cap B = \{2, 4, 6, 8\} \cap \{2, 3, 5, 7\} = \{2\}$

$(A \cap B)^C = \{1, 3, 4, 5, 6, 7, 8, 9\}$ ...(3)

and $A^C \cup B^C = \{1, 3, 5, 7, 9\} \cup \{1, 4, 6, 8, 9\}$

$= \{1, 3, 4, 5, 6, 7, 8, 9\}$ ...(4)

From (3) and (4), $(A \cap B)^C = A^C \cup B^C$, which verifies the result.

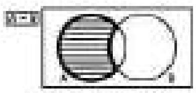
Example – 16

If A and B are any two sets, prove using Venn Diagrams

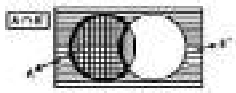
(i) $A - B = A \cap B^C$ (ii) $(A - B) \cup B = A \cup B$.

Sol.

(i)

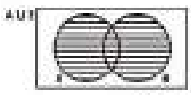


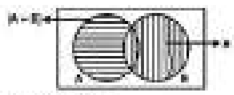
Shaded regions in both are the same.



The common shaded area represents the intersection.

(ii)





Combination of all the shaded regions represents the union.

Example – 17

Prove that :

$A \cap (B - C) = (A \cap B) - (A \cap C)$

Sol. Let x be an arbitrary element of $A \cap (B - C)$.

Then $x \in A \cap (B - C)$

$\Rightarrow$ $x \in A$ and $x \in (B - C)$

$\Rightarrow$ $x \in A$ and ($x \in B$ and $x \notin C$)

$\Rightarrow$ ($x \in A$ and $x \in B$) and ($x \in A$ and $x \notin C$)

$\Rightarrow$ $x \in (A \cap B)$ and $x \notin (A \cap C)$

$\Rightarrow$ $x \in \{(A \cap B) - (A \cap C)\}$

$A \cap (B - C) \subseteq (A \cap B) - (A \cap C)$ ...(1)

Let y be an arbitrary element of $(A \cap B) - (A \cap C)$.

Then $y \in (A \cap B) - (A \cap C)$

$\Rightarrow$ $y \in (A \cap B)$ and $y \notin (A \cap C)$

$\Rightarrow$ ($y \in A$ and $y \in B$) and ($y \in A$ and $y \notin C$)

$\Rightarrow$ $y \in A$ and ($y \in B$ and $y \notin C$)

$\Rightarrow$ $y \in A$ and $y \in (B - C)$

$\Rightarrow$ $y \in A \cap (B - C)$

$(A \cap B) - (A \cap C) \subseteq A \cap (B - C)$ ...(2)

Combining (1) and (2),

$A \cap (B - C) = (A \cap B) - (A \cap C)$.

Example – 18

Prove the following :

$A \subset B \Leftrightarrow B' \subset A'$

Sol. Let $x \in B'$, where x is arbitrary.

Now $x \in B'$

$\Rightarrow$ $x \notin B$

$\Rightarrow$ $x \notin A$ $[\because A \subset B]$

$\Rightarrow$ $x \in A'$

$B' \subset A'$ ...(1)

Conversely : Let $x \in A$, where x is arbitrary.

Now $x \in A$

$\Rightarrow$ $x \notin A'$

$\Rightarrow$ $x \notin B'$, $[\because B' \subset A']$

$\Rightarrow$ $x \in B$

$A \subset B$

Combining (1) and (2), $A \subset B \Leftrightarrow B' \subset A'$.

Example – 19

Prove the following :

$A - B = A - (A \cap B)$

where U is the universal set.

Sol. Let $x \in (A - B)$, where x is arbitrary.

Now $x \in (A - B)$

$\Leftrightarrow$ $x \in A$ and $x \notin B$

$\Leftrightarrow$ $(x \in A$ and $x \in A)$ and $x \notin B$

[Note this step]

$\Leftrightarrow$ $x \in A$ and $(x \in A$ and $x \notin B)$

[Associative Law]

$\Leftrightarrow$ $x \in A$ and $x \notin (A \cap B)$

$\Leftrightarrow$ $x \in A - (A \cap B)$

Hence $A - B = A - (A \cap B)$.

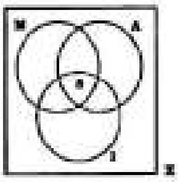
Example – 20

In a class of 200 students who appeared in a certain examination. 35 students failed in MHTCET, 40 in AIEEE, 40 in IIT, 20 failed in MHTCET and AIEEE, 17 in AIEEE and IIT, 15 in MHTCET and IIT and 5 failed in all three examinations. Find how many students

(i) Did not fail in any examination.

(ii) Failed in AIEEE or IIT.

Sol.



$n(M) = 35, n(A) = 40, n(I) = 40$

$n(M \cap A) = 20, n(A \cap I) = 17,$

$n(I \cap M) = 15, n(M \cap A \cap I) = 5$

$n(X) = 200$

$n(M \cup A \cup I) = n(M) + n(A) + n(I) -$

$n(M \cap A) - n(A \cap I) - n(M \cap I) + n(M \cap A \cap I)$

$= 35 + 40 + 40 - 20 - 17 - 15 + 5 = 68$

(i) Number of students passed in all three examination

$= 200 - 68 = 132$

(ii) Number of students failed in IIT or AIEEE

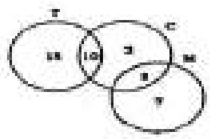
$= n(I \cup A) = n(I) + n(A) - n(I \cap A)$

$= 40 + 40 - 17 = 63$

Example – 21

In a hostel, 25 students take tea, 20 students take coffee, 15 students take milk, 10 students take both tea and coffee, 8 students take both milk and coffee. None of the them take tea and milk both and everyone takes atleast one beverage, find the number of students in the hostel.

Sol.



Let the sets, T and C and set M are the students who drink tea, coffee and milk respectively. This problem can be solved by Venn diagram.

$n(T) = 25; n(C) = 20; n(M) = 15$

$n(T \cap C) = 10; n(M \cap C) = 8$

Number of students in hostel

$= n(T \cup C \cup M)$

$\therefore n(T \cup C \cup M) = 15 + 10 + 2 + 8 + 7 = 42$

Some standard notations to represent sets :

N :	the set of natural numbers
W :	the set of whole numbers
Z :	the set of integers
Z^+ :	the set of positve integers
Z^- :	the set of negative integers
Q :	the set of rational numbers
I :	the set of irrational numbers
R :	the set of real numbers
C :	the set of complex numbers

Other frequently used symbols are :

$\in$:	'belongs to'
$\notin$:	'does not belong to'

$\exists$: There exists, $\nexists$: There does not exist.

INTERVALS AS SUBSETS OF REAL NUMBERS

An interval I is a subset of R such that if $x, y \in$ I and z is any real numbers between x and y then $z \in$ I.

> Any real number lying between two different elements of an interval must be contained in the interval.

If a, $b \in$R and $a < b$, then we have the following types of intervals :

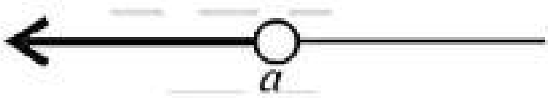
(i) The set $\{x \in \mathrm{R} : a < x < b\}$ is called an <u>open interval</u> and is denoted by (a, b). On the number line it is shown as :

(ii) The set $\{x \in \mathrm{R} : a \leq x \leq b\}$ is called a <u>closed interval</u> and is denoted by $[a, b]$. On the number line it is shown as :

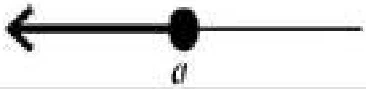
(iii) The set $\{x \in R : a < x \le b\}$ is an interval, open on left and closed on right. It is denoted by $(a, b]$. On the number line it is shown as :

(iv) The set $\{x \in R : a \le x < b\}$ is an interval, closed on left and open on right. It is denoted by $[a, b)$. On the number line it is shown as :

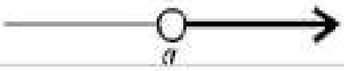
(v) The set $\{x \in R : x < a\}$ is an interval, which is dentoed by $(-\infty, a)$. It is open on both sides. On the number line it is shown as :



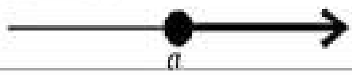
(vi) The set $\{x \in R : x \le a\}$ is an interval which is denoted by $(-\infty, a]$. It is closed on the right. On the number line it is shown as :



(vii) The set $\{x \in R : x > a\}$ is an interval which is denoted by (a, ∞). It is open on the both sides. On the number line it is shown as :



(viii) The set $\{x \in R : x \ge a\}$ is an interval which is denoted by $[a, \infty)$. It is closed on left. On the number line it is shown as :



First four intervals are called finite intervals and the number $b - a$ (which is always positive) is called the length of each of these four intervals (a, b), $[a, b]$, $(a, b]$ and $[a, b)$.

The last four intervals are called infinite intervals and length of these intervals is not defined.

BY ONE MORE WAY, STUDENTS YOU CAN UNDERSTAND THE TOPIC OF

POWER SET

AKS

1.5 POWER SET

Let $A = \{a, b\}$ then, Subset of A are ϕ, $\{a\}$, $\{b\}$ and $\{a, b\}$.

If we consider these subsets as elements of a new set B (say) then, $B = \{\phi, \{a\}, \{b\}, \{a, b\}\}$

B is said to be the power set of A.

Notation : Power set of a set A is denoted by P(A).
and it is the set of all subsets of the given set.

Example 1.11 Write the power set of each of the following sets :

(i) $A = \{x : x \in R \text{ and } x^2 - 7 = 0\}$.

(ii) $B = \{y : y \in N \text{ and } 1 \le y \le 3\}$.

Solution :

(i) Clearly A = ϕ (Null set), $\therefore$ ϕ is the only subset of given set, $\therefore$ P(A)={ ϕ }

(ii) The set B can be written as {1, 2, 3}

Subsets of B are ϕ, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}, {1, 2, 3}.

$\therefore$ P(B) = { ϕ, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}, {1, 2, 3} }.

Example 1.12 Write each of the following sets as intervals :

(i) $\{x \in R : -1 < x \leq 2\}$ (ii) $\{x \in R : 1 \geq 2x - 3 \geq 0\}$

Solution : (i) The given set = $\{x \in R : -1 < x \leq 2\}$

Hence, Interval of the given set = $(-1, 2]$

(ii) The given set = $\{x \in R : 1 \geq 2x - 3 \geq 0\}$

$\Rightarrow \{x \in R : 4 \geq 2x \geq 3\}$, $\Rightarrow \left\{x \in R : 2 \geq x \geq \frac{3}{2}\right\}$

$\Rightarrow \left\{x \in R : \frac{3}{2} \leq x \leq 2\right\}$, Hence, Interval of the given set = $\left[\frac{3}{2}, 2\right]$

FEW MORE EXAMPLES

EXAMPLE: 1.13

Which of the following sets can be considered as a universal set ?

X = {x : x is a real number}

Y = {y : y is a negative integer}

Z = {z : z is a natural number}

Solution : As it is clear that both sets **Y** and **Z** are subset of **X**.

$\therefore$ **X** is the universal set for this problem.

EXAMPLE: 1.14

- Given that

$A = \{x : x$ is a even natural number less than or equal to $10\}$

and $B = \{x : x$ is an odd natural number less than or equal to $10\}$

Find (i) $A - B$ (ii) $B - A$ (iii) is $A - B = B - A$?

Solution : It is given that

$A = \{2, 4, 6, 8, 10\}, B = \{1, 3, 5, 7, 9\}$

Therefore, (i) $A - B = \{2, 4, 6, 8, 10\}$, (ii) $B - A = \{1, 3, 5, 7, 9\}$

(iii) Clearly from (i) and (ii) $A - B \neq B - A$.

EXAMPLE: 1.15

Let U be the universal set and A its subset where

$U = \{x : x \in N$ and $x \leq 10\}$

$A = \{y : y$ is a prime number less than $10\}$

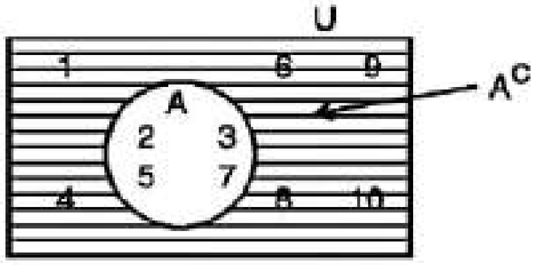
Find (i) A^c (ii) Represent A^c in Venn diagram.

Solution : It is given

$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. and $A = \{2, 3, 5, 7\}$

(i) $A^c = U - A = \{1, 4, 6, 8, 9, 10\}$

(ii)



Example 1.16 Given that

A {x : x is a king out of 52 playing cards}

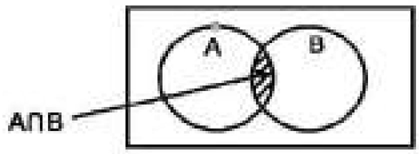
and B = { y : y is a spade out of 52 playing cards}

Find (i) $A \cap B$ (ii) Represent $A \cap B$ using Venn diagram

Solution : (i) As there are only four kings out of 52 playing cards, therefore the set A has only four elements. The set B has 13 elements as there are 13 spade cards but out of these 13 spade cards there is one king also. Therefore there is one common element in A and B.

$\therefore A \cap B$ = { King of spade}.

(ii)



LET US SUM UP

- A set is a collection of well-defined distinct (different) objects.

- To represent a set in Roster form all elements are to be written but in set builder form a set is represented by the common property of its elements.

- If the elements of a set can be counted then it is called a finite set and if the elements cannot be counted, it is infinite.
- If each element of set A is an element of set B, then A is called sub set of B.
- For two sets A and B, $A - B$ is a set of those elements which are in A but not in B.
- Complement of a set A is a set of those elements which are in the universal set but not in A. i.e. $A^c = U - A$
- Intersection of two sets is a set of those elements which belong to both the sets.
- Union of two sets is a set of those elements which belong to either of the two sets.

- Any set 'A' is said to be a subset of a set 'B' if every element of A is contained in B.
- Empty set is a subset of every set.
- Every set is a subset of itself.
- The set 'A' is a proper subset of set 'B' iff $A \subseteq B$ and $A \neq B$
- The set of all subsets of a given set 'A' is called power set of A.
- Two sets A and B are equal iff $A \subseteq B$ and $B \subseteq A$
- If $n(A) = p$ then number of subsets of $A = (2)^p$

- (a, b), $[a, b]$, $(a, b]$ and $[a, b)$ are finite intervals as their length b – a is real and finite.
- Complement of a set A with respect to U is denoted by A′ and defined as $A' = \{x : x \in U \text{ and } x \notin A\}$
- $A' = U - A$
- If $A \subset U$, then $A' \subset U$

****

WRITE ALL BASICS/ EXAMPLES AS GIVEN ABOVE

&

Do

Ex.1.1 TO Ex. 1.6

WITH ALL

N.C.E.R.T EXAMPLES

from

N.C.E.R.T. MATHS BOOK

ALL WORK IS TO BE DONE IN

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THANKS