Std-IX Physics Question Bank-(2022-23)

Ch:1 Measurements And Experimentation

Part 1(A) Systems of Unit

1) **What do you mean by a physical quantity? Give examples of physical quantities.**

   Ans:- A physical quantity is the one which can be measured. For example: mass, weight, length, area, volume, time, temperature, speed, energy, power, current, voltage etc.

2) **What do you mean by measurement?**

   Ans:- Measurement is the process of comparison of a given physical quantity with a known standard quantity of the same nature.

3) **What do you mean by unit of a physical quantity?**

   Ans:- Unit is the quantity of a constant magnitude which is used to measure the magnitudes of other quantities of the same nature by the process of comparison.

4) **What are the requirements for selecting a unit of a physical quantity?**

   Ans:- A unit should have the following properties:

   i. The unit should be of convenient size.
   ii. It should be possible to define the unit without ambiguity.
   iii. The unit should be reproducible.
   iv. The value of unit should not change with space and time.

5) **What do you mean by fundamental quantities and derived quantities? State examples of each.**

   Ans:- Fundamental quantities:- Fundamental quantities are those physical quantities that cannot be expressed in terms of other quantities. It is independent on its own. For example: length, mass, time, temperature, electric current, luminous intensity, amount of substance.

   Derived quantities:- A derived quantity is the one which can be expressed in terms of one or more fundamental quantities.

   For example: Area, speed

   Area = length x breadth = (length) x (length)

   Speed = $\frac{distance}{time} = \frac{(length)}{(time)}$

6) **What do you mean by fundamental and derived units?**

   Ans:- Fundamental unit:- A fundamental unit is that which is independent of any other unit or which can neither be changed nor can be related to any

other fundamental unit. The units of fundamental quantities are the fundamental units.

Derived unit:- Derived units are those which depend on the fundamental units or which can be expressed in terms of the fundamental units. The units of derived quantities are derived units.

7) Name the fundamental quantities in C.G.S. system and their units.

Ans:- length – centimetre (cm)
mass - gram (g)
time - second (s)

8) Name the fundamental quantities in F.P.S. system and their units.

Ans:- length – foot (ft)
mass - pound (lb)
time - second (s)

9) Name the fundamental quantities in M.K.S. system and their units.

Ans:- length – metre (m)
mass - kilogram (kg)
time - second (s)

10) Name the fundamental quantities in S.I. system and their units.

Ans:- length – metre (m)
mass - kilogram (kg)
time - second (s)
electric current – ampere (A)
temperature – kelvin (K)
luminous intensity – candela (cd)
amount of substance- mole (mol)
angle – radian (rd)
solid angle – steradian (st-rd)

11) Name the S.I. units of the following derived quantities and write their symbols.

Force – newton (N)
Work—joule (J)
Power-- watt (W)
Pressure—pascal (Pa)
Frequency—hertz (Hz)
Charge -- coulomb (C)
Potential difference – volt (V)
Electric resistance -- ohm (Ω)

Magnetic field intensity – tesla (T)

12) What do the following prefixes written with a unit represent?

centi- = 10^{-2}
milli- = 10^{-3}
micro- = 10^{-6}
nano- = 10^{-9}
pico- = 10^{-12}
hecto- = 10^{2}
kilo- = 10^{3}
mega- = 10^{6}
giga- = 10^{9}
tera- = 10^{12}

13) Name and define the S.I. unit of length.

Ans:- The S.I. unit of length is 'metre'.

One metre is defined as the distance between two marks drawn on a platinum-iridium alloy rod kept at 0^0 C in the International Bureau of Weights and Measures at Sevres near Paris.

OR

One metre is defined as the distance travelled by light in $\frac{1}{299,792,458}$ of a second in air/vacuum.

14) Name and define the S.I. unit of mass.

Ans:- The S.I. unit of mass is 'kilogram'.

One kilogram is defined as the mass of a cylindrical piece platinum-iridium alloy rod kept at International Bureau of Weights and Measures at Sevres near Paris.

15) Name and define the S.I. unit of time.

Ans:- The S.I. unit of time is 'second'.

A second is defined as $\frac{1}{86400}$ part of a mean solar day.

16) Name two very small units and two very big units of length and express their values in S.I.

Ans:-

<u>Small units of length</u>

micron, angstrom

1 micron = 10^{-6} metre

1 angstrom = 10^{-10} metre

Bigger units of length

astronomical unit , light year

1 astronomical unit = 1.496 X 10^{11} metre

1 light year = 9.46 X 10^{15} metre

17) What do you mean by astronomical unit? Write its S.I. equivalent.

Ans:- Astronomical unit (A.U.) is a big unit of length used to express the distance between heavenly bodies. It is equal to the mean distance between the earth and the sun. Its S.I. equivalent value is 1 A.U. = 1.496 X 10^{11} m

18) What is a light year? Write its S.I. equivalent value.

Ans:- Light Year (ly) is a very big unit of length used to express the distance between heavenly bodies. It is equal to the distance travelled by light in vacuum in one mean solar year.

Its S.I. equivalent value is 1 light year = 9.46 X 10^{15} m

19) Which physical quantity does the unit 'parsec' measure? Write the S.I. equivalent of this unit.

Ans:- 'Parsec' is the unit used to measure length. It is particularly used to measure very long distances such as the distance between heavenly bodies.

Its S.I. equivalent value is 1 parsec = 3.08 X 10^{16} m

20) Write down the S.I. equivalent of the following units and also state their uses.

micron, nanometer, angstrom, fermi

Ans:- 1 micron = (1 micro metre)=1μ = 10^{-6}m

1 nanometre = 10^{-9} m

1 angstrom = 1Å = 10^{-10} m

1 fermi = (1 femto metre) = 1 f = 10^{-15} m

- micron is used to express the size of micro-organisms e.g bacteria, virus, parasites etc.
- nanometer and angstrom are used to express the inter-atomic and inter—molecular separations, wavelength of light and other electromagnetic waves etc.
- fermi is used to express nuclear dimensions.

21) Name two very small units and two very big units of mass and express their values in S.I.

Ans:-

Small units of mass

gram, milligram

1 gram = 10^{-3} kg

1 milligram = 10^{-6} kg

Bigger units of mass

quintal, metric tonne

1 quintal = 100 kg

1 metric tonne = 1000 kg

22) What do you mean by atomic mass unit? Write its S.I. equivalent value.

Ans:- Atomic mass unit or a.m.u. is a unit used to express the mass of atoms. One atomic mass unit is equivalent to $1/12^{th}$ of the mass of a carbon-12 atom. Its value in S.I. is 1 a.m.u. = 1.66 X 10^{-27} kg

23) What is solar mass?

Ans:- The mass of large heavenly bodies is measured in terms of solar mass where 1 solar mass is the mass of the sun.

1 solar mass = 2 X 10^{30} kg

24) Name the physical quantities measured in the following units.

light year----------length
quintal----------mass
astronomical unit----------length
kelvin----------temperature
ampere----------electric current
angstrom----------length
micron----------length
shake----------time
fermi----------length
pound----------mass
foot----------length
millennium ----------time
metric tonne----------mass
candela----------luminous intensity

Part: 1(B) Measurement of length: Vernier Calipers and Screw Gauge

1) **What do you mean by least count of an instrument? Give few examples of the same.**

   Ans:- The least count of an instrument is the smallest measurement that can be taken accurately with it.

   e.g. (1) the least count of an ordinary metre scale is 1mm.
   (2) the least count of a vernier calipers is 0.1 mm.
   (3) the least count of a screw gauge is 0.01mm.
   (4) the least count of a wall clock is 1 second.
   (5) the least count of a stop watch is 0.01 second.

2) **How does the accuracy of a measuring device depend on its least count? Give a suitable example.**

   Ans:- Lesser the value of least count of a measuring device, greater is the accuracy of measurement of that device. For example; the least count of vernier calipers is 0.1 mm whereas that of a screw gauge is 0.01 mm. Thus a screw gauge is more accurate in measuring a length than vernier calipers.

3) **What is a vernier calipers?**

   Ans:- A vernier calipers is a length measuring device having a least count of the order of 0.1 mm (or 0.01 cm). This device is mainly used to measure the dimensions of round shaped objects such as:

   1. diameter of a small sphere,
   2. length and diameter of a small cylindrical rod,
   3. internal and external diameters of a hollow cylinder,
   4. depth of a bottle/beaker etc.

4) **How many scales does a vernier calipers consist of? Name these scales.**

   Ans:- A vernier calipers consists of two scales namely (1) the main scale or pitch scale and (2) the vernier scale.

   The length measured by a vernier calipers is the sum total of main scale reading and vernier scale reading.

5) **Name the main parts of a vernier calipers and state their functions.**

   Ans:- The main parts of a vernier calipers are as follows.

   1. Outside jaws – Used to measure the length of a rod, diameter of a sphere, external diameter of a hollow cylinder.

2. Inside jaws – Used to measure the internal diameter of a hollow cylinder or pipe.
3. Strip – Used to measure the depth of a beaker or a bottle.
4. Main scale – Used to measure length correct up to 1 mm
5. Vernier scale – Used to measure length correct up to 0.1 mm.

6) What is the principle of vernier? Explain by giving an example.

Ans:- In a vernier calipers, if there are 'n' number of divisions in the vernier scale then it is equal in length to 'n-1' number of divisions of the main scale. This is known as principle of vernier. For example; if the vernier scale of a vernier calipers has 10 divisions then that is equal in length to 9 divisions of main scale.

7) Define vernier constant. What is its significance?

Ans:- The difference between the value of one main scale division and one vernier scale division is known as vernier constant. The significance of Vernier constant is that it is equal to the least count of the vernier calipers.

Vernier constant= Least count of vernier calipers

= (one main scale division) – (one vernier scale division)

8) Write down the formula to calculate the least count of a vernier calipers.

Ans:- $L.C.of\ vernier\ calipers = \frac{Value\ of\ one\ main\ scale\ division}{Total\ number\ of\ divisions\ on\ vernier\ scale}$

9) What do you mean by zero error in vernier calipers? What are its two types?

Ans:- When the fixed and the movable jaws of a vernier calipers are in contact but the zero mark of vernier scale does not lie in one line with the main scale zero mark then the vernier calipers is said to have a zero error.

This can be of two types namely (1) positive zero error, (2) negative zero error.

10) What do you mean by positive zero error in vernier calipers? How to determine its value?

Ans:- When the fixed and the movable jaws of a vernier calipers are in contact but the zero mark of vernier scale lies on the right side of the main scale zero mark then the vernier calipers is said to have a positive zero error.

Positive zero error = (+ Least count) X (vernier coincidence mark when the fixed and movable jaws are in contact)

11) What do you mean by negative zero error in vernier calipers? How to determine its value?

Ans:- When the fixed and the movable jaws of a vernier calipers are in contact but the zero mark of vernier scale lies on the left side of the main scale zero mark then the vernier calipers is said to have a negative zero error.

Negative zero error =
(- Least count) X [(Total number of vernier divisions) -- (vernier coincidence mark when the fixed and movable jaws are in contact)]

12) <u>Steps to measure length by a vernier calipers</u>.

1. Value of one main scale division
2. Number of divisions in vernier scale
3. $L.C.of\ vernier\ calipers = \frac{Value\ of\ one\ main\ scale\ division}{Total\ number\ of\ divisions\ on\ vernier\ scale}$
4. Main scale reading
5. Vernier coincidence mark
6. Vernier scale reading = (Least count) X (vernier coincidence mark)
7. Observed length = Main scale reading + Vernier scale reading
8. Zero error
9. Correct length/ True length = Observed length – zero error with sign

13) What is a screw gauge?

Ans:- A screw gauge is a length measuring device having a least count of the order of 0.01 mm (or 0.001 cm). This device is mainly used to measure the diameter of thin wires, thickness of plates and laminas etc.

14) Name the instrument which has the least count:
(a) 0.1 mm, (b) 1 mm, (c) 0.01 mm

Ans:- (a) vernier calipers (0.1 mm)
(b) meter scale (1 mm)
(c) screw gauge (0.01 mm)

15) Which of the following measures a small length to a high accuracy: meter rule, vernier calipers, screw gauge? Give reason for your answer.

Ans:- Screw gauge measures to the highest accuracy as its least count is the smallest among those of three.

16) Arrange the instruments namely vernier calipers, screw gauge, meter scale in the ascending order according to their (a) least count (b) degree of accuracy.

Ans:- (a) According to ascending order of least count

Screw gauge < vernier calipers < meter scale

(b) According to degree of accuracy

Meter scale < vernier calipers < screw gauge

17) Name the instrument which can measure accurately the following:

a) the diameter of a needle

b) the thickness of a paper

c) the internal diameter of the neck of a water bottle

d) the diameter of a pencil

Ans:- a) Screw gauge for the diameter of a needle

b) Screw gauge for the thickness of a paper

c) Vernier calipers the internal diameter of the neck of a water bottle

d) Screw gauge the diameter of a pencil

18) How many scales does a screw gauge consist of? Name these scales.

Ans:- A screw gauge consists of two scales namely (1) the main scale or pitch scale and (2) the circular scale.

The length measured by a screw gauge is the sum total of main scale reading and circular scale reading.

19) Name the main parts of a screw gauge and state their functions.

Ans:- The main parts of a screw gauge are as follows.

1. Sleeve – To mark main scale
2. Thimble– To mark circular scale
3. Ratchet – Used to advance the screw by turning it till the object is gently held between the stud and spindle of the screw.
4. Main scale – Used to measure length correct up to 1 mm
5. Circular scale – Used to measure length correct up to 0.01 mm.

20) Name and state the principle on which a screw gauge works.

Ans:- A screw gauge works on the ‘principle of screw’.

The principle of screw states that when a screw is given one complete rotation then its spindle advances linearly by a distance equal to the distance between its two consecutive threads.

21) Define pitch of a screw and write its formula.

Ans:- The pitch of a screw is defined as the linear distance moved by the screw along its axis when its circular head is given one complete rotation.

$$pitch\ of\ a\ screw = \frac{total\ linear\ distance\ moved\ by\ the\ screw}{total\ number\ of\ rotations\ of\ circular\ head}$$

22) Define least count of a screw gauge and write its formula..

Ans:-Least count of a screw gauge is the linear distance moved by the screw along its axis by rotating the circular scale by one division.

$$L.C.of\ screw\ gauge = \frac{pitch\ of\ the\ screw}{Total\ number\ of\ divisions\ on\ circular\ scale}$$

23) What do you mean by zero error in a screw gauge? What are its two types?

Ans:- When the stud and the screw of a screw gauge are in contact but the zero mark of circular scale does not lie in one line with the base line of the main scale then the screw gauge is said to have a zero error.

This can be of two types namely (1) positive zero error, (2) negative zero error.

24) What do you mean by positive zero error in screw gauge? How to determine its value?

Ans:- When the stud and the screw of a screw gauge are in contact but the zero mark of the circular scale lies below the base line of the main scale then the screw gauge is said to have a positive zero error.

Positive zero error = (+ Least count) X (circular scale coincidence mark when the fixed and movable jaws are in contact)

25) What do you mean by negative zero error in screw gauge? How to determine its value?

Ans:- When the stud and the screw of a screw gauge are in contact but the zero mark of the circular scale lies above the base line of the main scale then the screw gauge is said to have a negative zero error.

Negative zero error = (– Least count) X
[(Total number of circular scale divisions) – (circular scale coincidence mark when the fixed and movable jaws are in contact)]

26) <u>Steps to measure length by a screw gauge</u>.

1. $pitch\ of\ a\ screw = \frac{total\ linear\ distance\ moved\ by\ the\ screw}{total\ number\ of\ rotations\ of\ circular\ head}$
2. Number of divisions in circular scale
3. $L.C.of\ screw\ gauge = \frac{pitch\ of\ the\ screw}{Total\ number\ of\ divisions\ on\ circular\ scale}$
4. Main scale reading
5. Circular scale coincidence mark
6. Circular scale reading = (Least count) X (circular scale coincidence mark)
7. Observed length = Main scale reading + circular scale reading
8. Zero error
9. Correct length/ True length = Observed length – zero error with sign

27) What is backlash error in a screw gauge? How to avoid it?

Ans:- Sometimes due to wear and tear of threads of screw, it is observed that on reversing the direction of rotation of the thimble, the tip of the screw does not start moving in the opposite direction at once, but it remains stationary for a part of rotation. This causes error in the observation which is called the backlash error.

It can be avoided by rotating the screw in one direction only.

Part: 1(C) Measurement of Time: Simple Pendulum

1) **Define the following terms with respect to a simple pendulum.**
   a) **Simple pendulum**: A simple pendulum is a device which contains a heavy point mass called bob, suspended from a rigid support by an inextensible and mass less string.
   b) **One complete oscillation**: A complete to and fro motion of the bob of a pendulum is called one oscillation. The bob moves from one extreme position to other extreme position and comes back to the previous extreme position constitute one oscillation.
   c) **Amplitude**: The maximum displacement of the bob of a pendulum from its mean position on either side is called amplitude. It is the displacement of the bob from mean position to any one extreme position.
   d) **Time period**: The time taken by a pendulum to complete one oscillation is called time period.
   e) **Frequency**: The number of oscillations made by a simple pendulum per second is called frequency.
   f) **Effective length of a simple pendulum**: The distance between the point of suspension to the centre of mass of the bob is called effective length of a pendulum.
2) **State the S.I. units of the following.**
   a) Amplitude-- metre
   b) Time period—second
   c) Frequency—hertz
3) **State the relation between frequency and time period.**

   Ans:- $f = \frac{1}{T}$ where f = frequency and T= time period
4) **Derive a mathematical relation between the frequency and the time period of a simple pendulum.**

   Ans: Let Time period = T seconds

   => time taken to complete one vibration = T second

   => number of vibration in T second = 1

   => number of vibration in 1 second = 1/T

   But number of vibrations in one second is frequency =f

   Hence f=1/T or T= 1/f

5) **Name and explain the factors on which the time period of a simple pendulum depends. Hence write an expression for time period of a simple pendulum in terms of those factors.**

Ans:- Time period of a simple pendulum depends on the following two factors.
(1) Effective length of the pendulum: Time period of a simple pendulum is directly proportional to the square root of its effective length.
(2) Acceleration due to gravity: Time period of a simple pendulum is inversely proportional to acceleration due to gravity.

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

Where T= time period, l = effective length, g= acceleration due to gravity

6) **State the factors on which time period of a simple pendulum does not depend.**

Ans:- (i) mass and material of the bob
(ii) amplitude of oscillation

7) **What happens to the time period of a simple pendulum, if at all, in the following situations?**
   a) Effective length is increased four times--- Time period becomes doubled
   b) Effective length is decreased to one- fourth --- Time period becomes halved
   c) Acceleration due to gravity is increased four times--- Time period becomes halved
   d) Acceleration due to gravity is decreased to one- fourth --- Time period becomes doubled
   e) Mass of the bob is doubled--- No change in time period
   f) Amplitude of oscillation is doubled--- No change in time period

8) **Explain how a simple pendulum is a time measuring device?**

Ans:- The time period of a simple pendulum of a fixed effective length is a constant quantity at a given place. So this constant time period can be used as a unit to measure unknown time intervals.

9) **What is the effect of change in time period of a pendulum on the speed of its oscillation?**

Ans:- (1) If the time period increases then frequency of oscillation decreases. This causes the speed of oscillation to decrease.

(2) If the time period decreases then frequency of oscillation increases. This causes the speed of oscillation to increase.

10) A pendulum clock becomes fast in winter and slow in summer. Explain the reason.

Ans:- The pendulum of a clock is made from metal which expands in summer and contracts in winter with the change of atmospheric temperature. In winter, the effective length of the pendulum of a clock decreases and so also its time period of oscillation decreases. Therefore the pendulum oscillates faster and consequently the clock becomes fast in winter. Similarly in summer, the effective length of the pendulum of a clock increases and so also its time period of oscillation increases. Therefore the pendulum oscillates slowly and consequently the clock becomes slow in summer.

11) While swinging, if we stand on the swing then what will be its effect on the speed of oscillation? Explain the answer with reason.

Ans:- The speed of oscillation of the swing increases if we stand on the swing while swinging. As a person stands on the swing, the position of centre of gravity gets elevated up. So the effective length of the swing decreases and hence the time period of oscillation also decreases. Thus the swing starts oscillating faster.

12) A simple pendulum is taken from equator towards the pole. What will be the effect on the time period and speed of oscillation of the pendulum? Give reason for your answer.

Ans:- Time period of pendulum decreases and the speed of oscillation increases.

Time period of a simple pendulum varies inversely as the square root of acceleration due to gravity. The acceleration due to gravity on earth increases from equator towards the pole. So if a simple pendulum is taken from equator towards a pole then the time period of its oscillation decreases.

13) A simple pendulum is taken from foot of a mountain to the top. What will be the effect on the time period and speed of oscillation of the pendulum? Give reason for your answer.

Ans:- Time period of pendulum increases and the speed of oscillation decreases.

Time period of a simple pendulum varies inversely as the square root of acceleration due to gravity. The acceleration due to gravity on earth decreases with increase in altitude. So if a simple pendulum is taken from foot

of a mountain to its top then the time period of oscillation of pendulum increases.

14) If a simple pendulum is taken from earth to moon then what would be the effect on the time period and speed of oscillation of the pendulum? Give reason for your answer.

Ans:- Time period of pendulum would increase thereby causing the speed of oscillation to decrease.

Time period of a simple pendulum varies inversely as the square root of acceleration due to gravity. The acceleration due to gravity on moon is one-sixth of that on earth i.e lesser. So if a simple pendulum is taken from the earth to the moon then the time period of oscillation of pendulum would increase.

15) Two simple pendulums A and B have equal lengths, but their bobs weigh 50 gf and 100 gf respectively. What would be the ratio of their time periods? Give reason for your answer.

Ans:- The ratio of time periods of pendulum A to pendulum B would be 1:1.

This is because the time period of a pendulum depends on the effective length of the pendulum and not on the mass/weight of the bob. In this case even though the weights of the two pendulums are different but their effective lengths are equal. Therefore their time periods are also equal. Hence the ratio of their time periods is 1:1.

16) Two simple pendulums A and B have lengths 1.0 m and 4.0 m respectively at a certain place. Which pendulum will make more oscillations in 1 minute? Explain your answer.

Ans:- Pendulum A will make more oscillations per minute.

Time period of a simple pendulum varies directly as the square root of effective length of the pendulum. So between the pendulums A and B, A has less time period as its effective length is short. Hence the frequency of oscillations of A is more as frequency is reciprocal of time period. Thus the pendulum A will make more oscillations per minute.

17) Formula

$$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$$

where T_1 and T_2 are the time periods of two pendulums of effective length l_1 and l_2 respectively at the same place.

18) Formula

$$\frac{T_1}{T_2} = \sqrt{\frac{g_2}{g_1}}$$

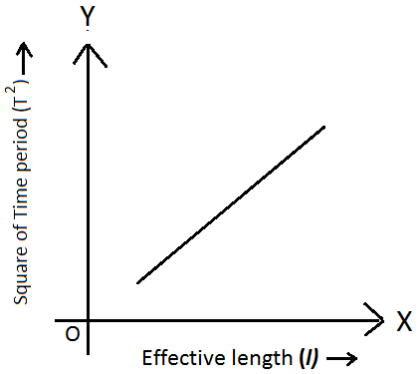
where T_1 and T_2 are the time periods of a pendulum at two different places with acceleration due to gravity g_1 and g_2 respectively.

19) What is a second's pendulum? What is time period and frequency of oscillation? What is the approximate effective length of such a pendulum?

Ans:- A pendulum which takes a time of 1 second to oscillate from one extreme position to the other is called a second's pendulum. It has a time period of 2 second and frequency equal to 0.5 Hz. The effective length of this pendulum is 1 metre approximately.

20) Draw a graph showing the variation of T^2 *with* l for a simple pendulum. What is the value of slope of this graph?

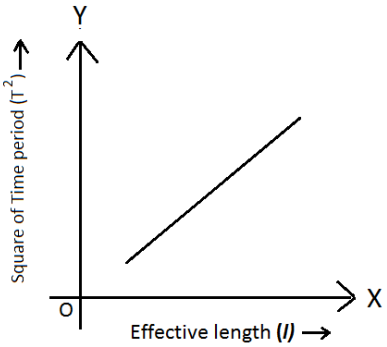
Ans:-



Slope of $T^2 \; vs \; l \; graph = \frac{4\pi^2}{g}$ where g=acceleration due to gravity

21) Draw a graph showing the variation of T^2 *with* l for a simple pendulum. How will you use this graph to determine the value of g (acceleration due to gravity)?

Ans:-



$$g = \frac{4\pi^2}{slope \; of \; T^2 \; vs \; l \; graph}$$

Ch:1 Multiple Choice Questions

1) Which of the following is a fundamental unit:
(a) newton (b) pascal (c) hertz (d) second

2) Which of the following is not a fundamental unit:
(a) metre (b) litre (c) second (d) kilogram

3) Which of the following is not an S.I. unit:
(a) kelvin (b) candela (c) mole (d) angstrom

4) Which of the following is an S.I. unit:
(a) hour (b) minute (c) second (d) milli-second

5) Which of the following is a unit of time:
(a) light year (b) parsec (c) leap year (d) angstrom

6) 1 Å is equal to:
(a) 0.1 nm (b) 10^{-10} cm (c) 10^{-8} m (d) $10^{4}\mu$

7) Light year is the unit of
(a) time (b) length (c) mass (d) velocity

8) The least count of vernier calipers is:
(a) 1 cm (b) 0.001 cm (c) 0.1 cm (d) 0.01 cm

9) A microscope has its main scale with 20 divisions in 1 cm and vernier scale with 25 divisions, the length of which is equal to the length of 24 divisions of main scale. The least count of microscope is:
(a) 0.002 cm (b) 0.001 cm (c) 0.02 cm (d) 0.01 cm

10) The diameter of a thin wire can be measured by:
(a) A vernier calipers (b) a metre rule (c) a screw gauge (d)none of these

11) The maximum displacement of a pendulum bob to either side of the mean position is called:
(a) effective length (b) frequency (c) amplitude (d) wavelength

12) The length of a simple pendulum is made one-fourth. Its time period becomes:
(a) Four times (b) one-fourth (c) double (d) half

13) The time period of a seconds' pendulum clock is:
(a) 1 s (b) 2 s (c) 1 min (d) 12 h

14) The length of seconds' pendulum is nearly:
(a) 0.5 m (b) 9.8 m (c) 1.0 m (d) 2.0 m

15) A simple pendulum is taken from the sea level to the top of a mountain. Its time period will:

(a) increase (b) decrease (c) remain unchanged (d) data insufficient to answer

ANSWERS

1) (d)	2) (b)	3) (d)	4) (c)	5) (c)
6) (a)	7) (b)	8) (d)	9) (a)	10) (c)
11) (c)	12) (d)	13) (b)	14) (c)	15) (a)

Chapter-2

Motion in One Dimension

1) **What do you mean by scalar and vector quantities?**
   Ans:- A scalar quantity is the one which has only magnitude and no direction but a vector quantity is the one which has both magnitude and direction.
2) **Differentiate between scalars and vectors giving examples of each.**
   Ans:

Scalar quantities	Vector quantities
i. A scalar quantity is the one which has only magnitude and no direction. e.g. mass, time, temperature, length, volume, distance, speed, frequency, pressure etc.	i. A vector quantity is the one which has both magnitude and direction. e.g. force, weight, displacement, velocity, acceleration, momentum, moment of force, electric and magnetic field
ii. Scalar quantities can be added, subtracted, multiplied and divided by simple arithmetic methods.	ii. Vector quantities follow different algebra for their addition, subtraction and multiplication.

3) **Classify the following physical quantities as scalar or vector quantities-**
   Pressure, Acceleration, Speed and Force *[2 marks, 2019 Annual]*
   Ans:- Scalar quantities- Pressure, Speed
   Vector quantities- Acceleration, Force
4) **What do you mean by 'rest' and 'motion'? Give suitable examples to explain how rest and motions are relative but not absolute.**
   Ans:- **Rest**:- If the position of a body does not change with respect to its immediate surroundings then the body is said to be at rest.
   Motion:- If the position of a body changes with respect to its immediate surroundings then the body is said to be in motion.
   Rest and motion are relative:-
   Ex-1 A stone lying on the ground is considered to be at rest since its position does not change with respect to its immediate surroundings. However the same stone is found to be in motion if seen from the outer space since the earth on which it is lying is in motion.
   Ex-2 A person sitting inside a moving train is said to be in motion with respect to another person standing on the platform but the same person inside the moving train is thought be at rest with respect to his co-passengers.

5) **What do you mean by 'one dimensional motion'? Give few examples of this type of motion.**

Ans:- When a body moves along a straight line path, its motion is said to be a rectilinear motion or one dimensional motion.

For example:- a body falling down vertically, a train moving on a straight track, motion of a bullet fired from a gun etc.

6) **Define the terms 'Distance' and 'Displacement'. State their S.I. and C.G.S. units. Between the two which is a vector quantity?**

Ans:- **Distance**:- The length of the path traversed by a body in a certain time is known as the distance travelled by the body.

Displacement:- The shortest distance from initial to final position of a body is known as the displacement of the body.

Both are expressed in same units.

S.I. unit—metre (m) C.G.S. unit – centimetre (cm)

Displacement is the vector quantity.

7) **Differentiate between 'Distance' and 'Displacement'.** (maximum four points)

Ans:-

Distance	Displacement
i. The length of the path traversed by a body in a certain time is known as the distance travelled by the body.	i. The shortest distance from initial to final position of a body is known as the displacement of the body.
ii. It is a scalar quantity.	ii. It is a vector quantity.
iii. It is always positive.	iii. It can be positive or negative or zero.
iv. It depends on the path followed by the body. Longer the path followed, more is the distance travelled.	iv. It depends on the end points of the path but not on the entire path followed by the body. More the separation between the initial and final positions, greater is the displacement.

8) **What do you mean by 'negative displacement'?**

Ans:- The displacement of a body from its final position to the initial position is known as negative displacement.

9) **What is 'zero displacement'? Give an example.**

Ans:- When the initial position and final position of a body coincide after the motion then the displacement of the body is said be zero. For example a train

goes from station-A to station–B and returns to station-A then its net displacement is zero.

10) State the condition when the distance travelled by a body is equal to the magnitude of its displacement.

Ans:- If a body goes from its initial position to the final position along a straight path then the distance travelled by this body is equal to the magnitude of its displacement.

11) Define the terms 'Speed' and 'Velocity'. State their S.I. and C.G.S. units. Between the two which is a vector quantity?

Ans:- **Speed**:- The distance travelled by a body in unit time is called speed of the body.

Velocity:- The distance travelled by a body in unit time in a specific direction is called velocity of the body.

Both are expressed in same units.

S.I. unit—metre per second (ms^{-1}) C.G.S. unit – centimetre per second (cms^{-1})

Velocity is the vector quantity.

12) Differentiate between 'Speed' and 'Velocity'. (maximum four points)

Ans:-

Speed	Velocity
i. The distance travelled by a body in unit time is called speed of the body.	i. The distance travelled by a body in unit time in a specific direction is called velocity of the body.
ii. It is a scalar quantity.	ii. It is a vector quantity.
iii. It is always positive.	iii. It can be positive or negative or zero.
iv. Average speed cannot be zero when average velocity is zero.	iv. Average velocity can be zero when average velocity is not zero.

13) Define the following terms:-

(i) Uniform speed, (ii) non-uniform speed

(iii) Uniform velocity, (iv) non-uniform velocity

Ans:-

(i) **Uniform speed**:- When a body travels equal distances in equal intervals of time then the speed of the body is said to be a uniform speed.

(ii) **non-uniform speed**:- When a body travels unequal distances in equal intervals of time then the speed of the body is said to be a non-uniform or variable speed.

(iii) **Uniform velocity**:- When a body travels equal distances in equal intervals of time in a specific direction then the velocity of the body is said to be a uniform velocity.

(iv) **non-uniform velocity**:- When a body travels unequal distances in equal intervals of time and/or in a variable direction then the velocity of the body is said to be a non-uniform or variable velocity.

14) Give examples of the motion with following characteristics.

(i) Uniform speed, (ii) non-uniform speed

(iii) Uniform velocity, (iv) non-uniform velocity

Ans:-

(i) **Uniform speed**:-

- Motion of a ball rolling on a frictionless surface
- Motion oh hands of a clock
- Motion of a stone tied to one end of a string and whirled in a circular path

(ii) **non-uniform speed**:-

- Motion of a ball rolling on a rough surface
- Motion of a vehicle in a busy road
- Motion of a body falling down under gravity/ thrown upwards

(iii) **Uniform velocity**:-

- Motion of a ball rolling along a straight path on a frictionless surface
- Motion of a car at a constant speed in a perfectly straight track

(iv) **non-uniform velocity**:-

- Motion of a ball rolling on a rough surface
- Motion of a vehicle in a busy road
- Motion of a body falling down under gravity/ thrown upwards
- Motion of a stone tied to one end of a string and whirled in a circular path

15) What do you mean by uniform motion? Give example.

Ans:- The motion of a body taking place at a constant speed and also in a specific direction (straight line path) is said to be a uniform motion.

For example:-

- Motion of a ball rolling along a straight path on a frictionless surface
- Motion of a car at a constant speed in a perfectly straight track

16) What do you mean by an accelerated motion?

Ans:- The motion of a body taking place with a changing speed or changing velocity is said to be an accelerated motion.

17) What do you mean by a uniform circular motion? Give examples.

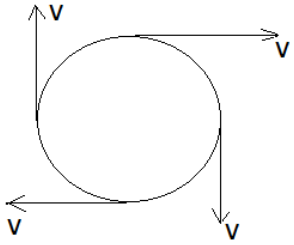
Ans:- When a body moves at a constant Speed in a circular path then the motion is called a uniform circular motion.

For example:-

- Motion of a stone tied to one end of a string and whirled in a circular path
- Motion of a merry-go-round
- Planetary motion

18) With the aid of a diagram state the direction of velocity of a body at any instant in circular path.

Ans:- The instantaneous direction of velocity of a body in the state of circular motion is tangential to the circular path.



19) Explain how a uniform circular motion is an accelerated motion.

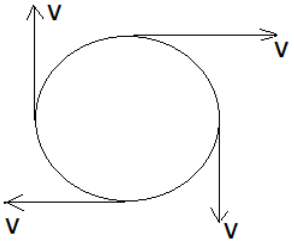
Ans:- The direction of motion of a body in the state of uniform circular motion changes at every instant of time. Therefore the velocity of the body changes although its speed remains constant. So due to variable velocity of the body, uniform circular motion is an accelerated motion.

20) Give an example of motion of a body which takes place at a constant speed but variable velocity.

Ans:- Uniform circular motion is a motion that takes place at a constant speed but variable velocity.

21) Give an example of motion of a body moving with a constant speed but with a variable velocity. Draw a diagram to represent such motion.

Ans:- A body moving in a circular path at a constant speed has a variable velocity.



22) Define 'Average speed' and 'Average velocity' of a moving body.

Ans:- **Average Speed**:- The ratio of total distance travelled by a body to the total time taken is called average speed of the body.

$$average\ speed = \frac{total\ distance}{total\ time}$$

Average velocity:- The ratio of total displacement of a body to the total time taken is called average velocity of the body.

$$average\ velocity = \frac{total\ displacement}{total\ time}$$

23) Give an example of motion in which average speed is not zero but average velocity is zero.

Ans:- When a body moving in a circular path at a constant speed completes one round of motion, its average speed is not zero but average velocity is zero.

24) Define 'instantaneous speed' and 'instantaneous velocity'.

Ans:- **Instantaneous speed:-** When the speed of a body keeps on changing, then its speed at any instant is called instantaneous speed. It is measured by finding the ratio of the distance travelled by the body in a very short interval to the time interval at that particular instant.

Instantaneous velocity:- When a body moves at a variable velocity then its velocity at any instant is called instantaneous velocity. It is measured by finding the ratio of the distance travelled by the body in a sufficiently short time interval to that time interval such that the direction of motion does not change in this time interval.

25) What does the speedometer of a vehicle measure?

Ans:- Instantaneous speed of the vehicle

26) When is the instantaneous speed same as the average speed?

Ans:- When a body moves at a uniform speed then the instantaneous speed is same as the average speed of the body.

27) Define acceleration. State its S.I. and C.G.S. units.

Ans:- The rate of increase of velocity of a body is known as acceleration.

OR The increase in velocity of a body in unit time is known as acceleration.

$$a = \frac{v-u}{t}$$

where u= initial velocity, v = final velocity, t= time interval

S.I. unit of acceleration= ms^{-2}

C.G.S. unit of acceleration= cms^{-2}

28) Classify the following physical quantities as scalar or vector quantities- Distance, Displacement, Speed, Velocity, Acceleration

Ans:- Scalar quantities- Distance, Speed
Vector quantities- Displacement, Velocity, Acceleration

29) Both velocity and acceleration are vector quantities. Which of these two determines the direction of motion (displacement)?

Ans:- Velocity has the same direction as the direction of motion (displacement).

30) Distinguish between acceleration and retardation.

Ans:-

Acceleration	Retardation
The rate of increase of velocity of a body is known as acceleration. $$acceleration = \frac{v-u}{t}$$	The rate of decrease of velocity of a body is known as retardation. $$retardation = \frac{u-v}{t}$$

31) Define: (a) uniform acceleration, (b) uniform retardation, (iii) variable acceleration

Ans:- (a) Uniform acceleration:- When velocity of a body increases equally in equal intervals of time then the acceleration of the body is said to be a uniform acceleration.

(b) Uniform retardation:- When velocity of a body decreases equally in equal intervals of time then the retardation of the body is said to be a uniform retardation.

(c) Non- Uniform acceleration:- When velocity of a body increases unequally in equal intervals of time then the acceleration of the body is said to be a non-uniform acceleration.

32) Give examples of motion of a body having: (a) uniform acceleration, (b) uniform retardation.

Ans:- (a) Uniform acceleration:- A body falling downwards under gravity
(b) Uniform retardation:- A body thrown upwards against gravity

33) What is acceleration due to gravity? State its average value in S.I.

Ans:- When a body falls freely under gravity, the acceleration produced in the body due to earth's gravitational attraction is called acceleration due to gravity. Its average value is 9.8 ms^{-2}.

34) Why the acceleration due to gravity is not same everywhere on earth? How does its value vary on earth?

Ans:- The value of acceleration due to gravity varies inversely as the square of radius of earth. As the radius of earth is not same everywhere so also the value of acceleration due to gravity.

The value of acceleration due to gravity is minimum at equator and maximum at the poles. This value increases in the direction from equator towards the poles.

35) If a stone and a pencil are dropped simultaneously in vacuum from the top of a tower, which of the two will reach the ground first? Give reason.

Ans:- Both will reach the ground simultaneously. This is so because the acceleration due to gravity produced in both is same and they travel equal distances. Acceleration due to gravity does not depend on the mass of the body. Also the air resistance and upthrust is absent in vacuum.

36) How is the distance related to time for the motion under
(i) uniform velocity , (ii) uniform acceleration ?

Ans:- (i) In case of motion under uniform velocity, distance is directly proportional to time. $S \alpha t$

(ii) In case of motion under uniform acceleration, distance is directly proportional to square of time. $S \alpha t^2$

Equations of Motion / Kinematic Equations

1) Write down the equations of uniformly accelerated motion.

Ans:- 1) $v = u + at$

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

3) $v^2 - u^2 = 2as$

where u = initial velocity

v = final velocity

a = acceleration

t = time interval

s = distance travelled/ displacement

2) Derive the equation of motion $\boldsymbol{v = u + at}$ by definition method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'.

By definition, $acceleration = \frac{final\ velocity - initial\ velocity}{time}$

$$=> \ a = \frac{v-u}{t}$$
$$=> \ v - u = at$$
$$=> \ v = u + at$$

3) Derive the equation of motion $\boldsymbol{s = ut + \frac{1}{2}at^2}$ by definition method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'.

For a uniformly accelerating body,

displacement= average velocity x time

$$=> \ displacement = \left(\frac{initial\ velocity + final\ velocity}{2}\right) x \ time$$
$$=> \ s = \left(\frac{u+v}{2}\right) t$$

$$=> s = \left(\frac{u+u+at}{2}\right) t \qquad (since \quad v = u+at)$$

$$=> s = \frac{2ut}{2} + \frac{at^2}{2}$$

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

4) Derive the equation of motion $\boldsymbol{v^2 - u^2 = 2as}$ by definition method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'.

For a uniformly accelerating body,

displacement= average velocity x time

$$\Rightarrow \quad displacement = \left(\frac{initial\ velocity + final\ velocity}{2}\right) x\ \ time$$

$$\Rightarrow \quad s = \left(\frac{u+v}{2}\right) t$$

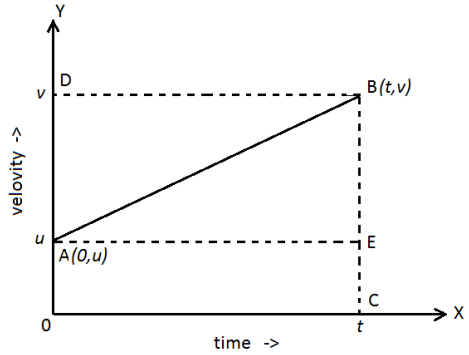
$$\Rightarrow \quad s = \left(\frac{v+u}{2}\right)\left(\frac{v-u}{a}\right) \qquad (since \quad v = u+at \quad \Rightarrow t = \frac{v-u}{a})$$

$$\Rightarrow \quad s = \frac{v^2-u^2}{2a}$$

$$\Rightarrow \quad v^2 - u^2 = 2as$$

5) Derive the equation of motion $v = u + at$ by graphical method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'. The following diagram shows the sketch of velocity-time graph of the body.



AB = Velocity- time graph
OA= u =initial velocity
OD = v = final velocity
OC = t = time interval

Acceleration = slope of AB = $\frac{BE}{AE} = \frac{BC-EC}{AE} = \frac{OD-OA}{OC}$

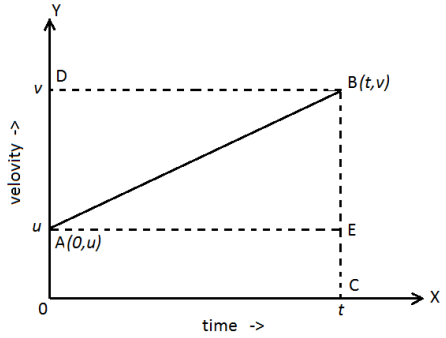
$$\Rightarrow \quad a = \frac{v-u}{t}$$

$$\Rightarrow \quad v - u = at$$

$$\Rightarrow \quad v = u + at$$

6) Derive the equation of motion $s = ut + \frac{1}{2}at^2$ by graphical method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'. The following diagram shows the sketch of velocity-time graph of the body.



AB = Velocity- time graph
OA= u =initial velocity
OD = v = final velocity
OC = t = time interval

Displacement = Area of trapezium OABC
= Area of rectangle OAEC + Area of right triangle AEB
= (OA X OC) + (1/2 X AE X BE)
=(OA X OC) + [1/2 X OC X (OD-OA)]

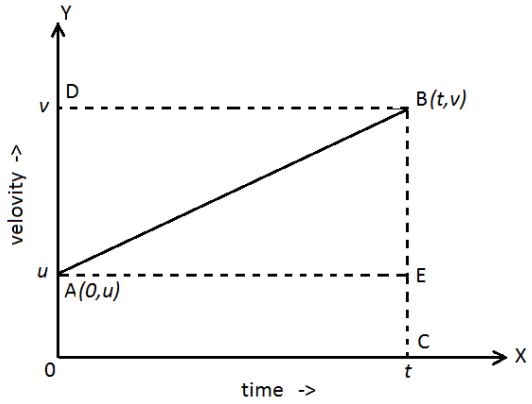
=> $s = ut + \frac{1}{2}.t.(v-u)$

=> $s = ut + \frac{1}{2}.t.at$ *(since v = u+at => v-u = at)*

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

7) Derive the equation of motion $v^2 - u^2 = 2as$ by graphical method.

Ans:- Let us consider a body accelerating at a uniform rate '*a*'. Suppose its velocity changes from '*u*' to '*v*' in a time interval 't'. The distance moved by the body during this time interval is 's'. The following diagram shows the sketch of velocity-time graph of the body.



AB = Velocity- time graph
OA= u =initial velocity
OD = v = final velocity
OC = t = time interval
Displacement = Area of trapezium OABC
= ½ x OC X (OA + BC)

$$\Rightarrow \quad s = \frac{1}{2} \times t \times (u + v)$$

$$\Rightarrow \quad s = \left(\frac{u+v}{2}\right) t$$

$$\Rightarrow \quad s = \left(\frac{v+u}{2}\right)\left(\frac{v-u}{a}\right) \qquad (\text{since } v = u+at \Rightarrow t = \frac{v-u}{a})$$

$$\Rightarrow \quad s = \frac{v^2-u^2}{2a}$$

$$\Rightarrow \quad v^2 - u^2 = 2as$$

Ch:2 Multiple Choice Questions

1) Which of the following is a vector quantity:
(a) mass (b) weight (c) volume (d) density

2) Which of the following is a scalar quantity:
(a) velocity (b) acceleration (c) momentum (d) speed

3) The distance travelled by a body in unit time is its:
(a) displacement (b) velocity (c) speed (d) acceleration

4) The S.I. unit of retardation is:
(a) kms^{-2} (b) ms^{-2} (c) cms^{-2} (d) m/s^{-2}

5) 18 kmh^{-1} is equal to:
(a) 10 ms^{-1} (b) 18 ms^{-1} (c) 5 ms^{-1} (d) 1.8 ms^{-1}

6) A man runs on a circular track of radius R. The distance ran by him on completing one round will be:
(a) $2\pi R$ (b) πR (c) $\pi R/2$ (d) 0

7) If a body moves with a uniform acceleration then which of the following shows a correct relation between the displacement (s) of the body and time (t):
(a) $S \alpha t$ (b) $S \alpha 1/t$ (c) $S \alpha 1/t^2$ (d) $S \alpha t^2$

8) The slope of a displacement-time graph of a body is equal to its:
(a) velocity (b) acceleration (c) displacement (d) momentum

9) The slope of a velocity-time graph of a body is equal to its:
(a) velocity (b) acceleration (c) displacement (d) momentum

10) The area enclosed in between velocity-time graph of a body and the time-axis is equal to its:
(a) velocity (b) acceleration (c) displacement (d) momentum

11) The average velocity of a body is zero. Which of the following statements is true about this body:
(a) It travelled from initial to final position along a straight path.
(b) It travelled from initial to final position along a curved path.
(c) It stopped on the way and couldn't reach the final position.
(d) It returned to the same position from where it had started its journey.

12) A body is said to be in a state of uniform motion if:
(a) it moves at a constant speed
(b) it moves in a specific direction
(c) it moves at a constant speed but in variable direction
(d) it moves at a constant speed and in a specific direction

13) Speedometer of an automobile measures the:
(a) Instantaneous speed of the automobile
(b) Average speed of the automobile
(c) Instantaneous velocity of the automobile
(d) Average velocity of the automobile

14) Acceleration of a moving body is said to be negative if:
(a) its velocity increases with increase in time
(b) its velocity decreases with increase in time
(c) its velocity increases while travelling in the opposite direction
(d) its velocity remains unchanged

15) A body falling freely has a:
(a) uniform speed
(b) uniform velocity
(c) uniform acceleration
(d) uniform retardation

ANSWERS

1) (b)	2) (d)	3) (c)	4) (b)	5) (c)
6) (a)	7) (d)	8) (a)	9) (b)	10) (c)
11) (d)	12) (d)	13) (a)	14) (b)	15) (c)

Chapter-3 Laws of Motion

(A) Effect of Force & Kinds of Force

1) What is force?

Ans:- A force is that physical cause which changes or tends to change either the size or the shape or the state of rest or the state of motion of a body.

2) State the effects of force.

Ans:- Following are the effects of a force:

(i) To start or to stop motion in a body
(ii) To increase or to decrease the speed of a moving body
(iii) To change the direction of a moving body
(iv) To change the shape or size of a non-rigid body

3) Give one example in each of the following cases where a force:

i. Stops a moving body – to stop a moving car by applying brakes
ii. Moves a stationary body – to move a table by pushing it
iii. Changes the size of a body – to stretch a rubber string by pulling from both its ends
iv. Changes the shape of a body – to squeeze a piece of sponge

4) State the effects of force applied on a rigid body.

Ans:- Following are the effects of a force applied on a rigid body:

(i) To start or to stop motion in a body
(ii) To increase or to decrease the speed of a moving body
(iii) To change the direction of a moving body

5) State the effects of force applied on a non-rigid body.

Ans:- The effect of force applied on a non-rigid body is to change the shape or size of the body.

6) Why does the effect of force applied on a non-rigid body differ from that on a rigid body?

Ans:- A force when applied on a rigid body does not change the inter-spacing between its constituent particles and therefore it does not change the dimensions of the object, but causes only the state of rest or motion to change in it.

On the other hand, a force when applied on a non-rigid body, changes the inter-spacing between its constituent particles and therefore causes a change in its dimensions and can also produce motion in it.

7) What do you mean by contact force? Give examples of these forces.

Ans:- A force which acts between two bodies when they are in actual physical contact with each other is called a contact force.

For example: (1) Force applied to push or pull any object
(2) Force of friction
(3) Normal reaction force
(4) Tension force in a stretched string

8) What do you mean by non-contact force? Give examples of these forces.

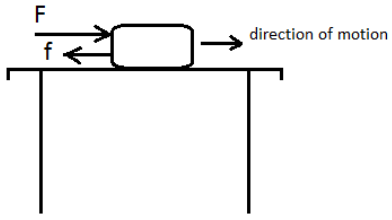
Ans:- A force which acts between two bodies when they are not in actual physical contact with each other is called a non-contact force or force at a distance.

For example: Gravitational force, Magnetic force, Electrostatic force

9) A block is pushed to slide on the surface of a table top.

i. Name the force which the block now experiences opposite to the applied force.
ii. What is the effect of this force on the motion of the block?
iii. Is this force a contact force?
iv. Draw a schematic diagram to show the directions of the applied force and the force named by you in (i).

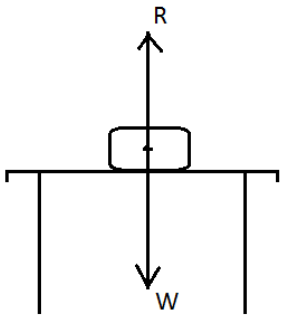
Ans:- i. Force of friction
ii. To oppose the motion
iii. Yes, it is a contact force
iv.



F = the applied force
f = the force of friction

10) A wooden block is placed on a table top. Name the forces acting on the block. Draw a neat and labeled diagram to show the point of application and direction of these forces.

Ans:-



W = weight of the block acting on the table surface in downward direction

R = force of normal reaction given by the table surface to the block in upward direction.

11) A wooden block is placed on a table top. Name the force that (i) the block exerts on the table top, (ii) the table top exerts on the block.

Ans:- (i) The block exerts its own weight on the table top.

(ii) The table top exerts normal reaction on the block.

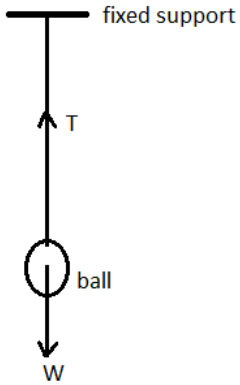
12) A ball is hanging by a string from the ceiling of the roof.

i. Name the forces acting on the ball and the string.

ii. Draw a neat labeled diagram showing the above forces and indicate their directions by arrow marks.

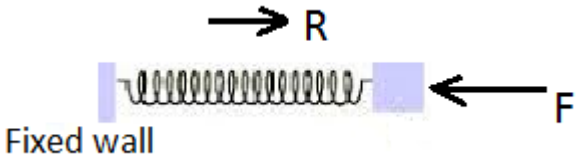
Ans:- W = The weight of the ball acting in downward direction

T = The force of tension in the string acting towards the fixed point of suspension



13) A spring is compressed against a rigid wall. Draw a neat diagram showing the forces acting on the spring. Name these forces and mark their directions in the diagram.

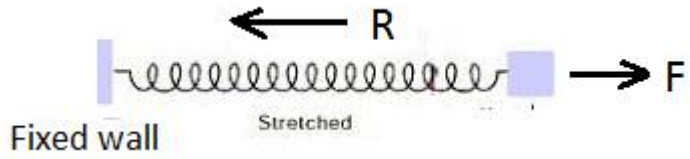
Ans:-



F = Force applied to compress the spring
R = Restoring force acting in the spring

14) A spring fixed to a rigid wall at one end is pulled from the other end. Draw a neat diagram showing the forces acting on the spring. Name these forces and mark their directions in the diagram.

Ans:-

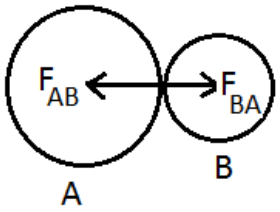


F = Force applied to stretch the spring
R = Restoring force acting in the spring

15) Two bodies A and B moving towards each other on same straight path undergo a head-on collision between them. If F_{AB} and F_{BA} are the forces acted on them during the collision then draw a diagram to show the directions of these forces.

What is the ratio of magnitudes of these two forces?

Ans:-



F_{AB} = Force acting on A due to B
F_{BA} = Force acting on B due to A

16) Write any two characteristics of non-contact forces.

Ans:- (1) The gravitational force is always of attractive nature, while the electrostatic force and the magnetic force can be either attractive or repulsive.
(2) The magnitude of a non-contact force between two bodies varies inversely as the square of distance of separation between them.

17) Name and explain the factor on which the magnitude of a non-contact force between two bodies depends.

Ans:- The magnitude of a non-contact force between two bodies depends on the distance of separation between them. It varies inversely as the square of distance of separation between them.

18) How is the magnitude of gravitational force between two bodies affected when the separation between them is (i) reduced to half, (ii) doubled?

Ans:- (i) If the distance of separation between the two bodies is reduced to half then the magnitude of non-contact force between them increases to four times.
(ii) If the distance of separation between the two bodies is doubled then the magnitude of non-contact force between them decreases to one-fourth.

(B) Newton's First law of Motion

1) State Newton's first law of motion.

Ans:- Newton's first law of motion states that if a body is in the state of rest then it continues to remain in the same state of rest and if a body is in the state of uniform motion then it continues to move at the same speed and along the same straight path unless an external unbalanced force acts on it.

2) Is a force required to keep a body in motion?

Ans:- No, a force is not required to keep a body moving. A body can move at a constant speed and along a straight path even though no force acts on it.

3) Two equal and opposite forces act on a stationary body. What will be the effect on the state of rest of the given body? Give a reason for your answer. Which law of motion explains this?

Ans:- No change takes place in the state of rest of a stationary body if two equal and opposite forces act on it, i.e. the body continues to remain in the same state of rest. This is so because the resultant force acting on the body is zero. Newton's first law of motion explains the above fact.

4) **Two equal and opposite forces act on a uniformly moving body. What will be the effect on the state of motion of the given body? Give a reason for your answer. Which law of motion explains this?**

Ans:- No change takes place in the state of motion of a uniformly moving body if two equal and opposite forces act on it, i.e. the body continues to move at the same speed and along the same straight path. This is so because the resultant force acting on the body is zero. Newton's first law of motion explains the above fact.

5) **Write the two significance of Newton's first law of motion.**

Ans:- Following are the two significance of Newton's first law of motion:

(1) It gives a qualitative definition of force.

(2) It explains about the concept of inertia.

6) **Which law of motion is known as the *law of inertia* and why? State this law.**

Ans:- Newton's first law of motion is known as the Law of inertia as it explains about the property of inertia of a body. It states that if a body is in the state of rest then it continues to remain in the same state of rest and if a body is in the state of uniform motion then it continues to move at the same speed and along the same straight path unless an external unbalanced force acts on it.

7) **Define the term '*inertia*' of a body. Name and explain the factor on which it depends.**

Ans:- Inertia is an inherent property of a body by virtue of which the body tends to resist any change in its present state of rest or that of motion. The property of inertia of a body depends on mass of the body. More the mass, more is the property of inertia and vice-versa.

8) **Why it is difficult to stop a loaded trolley than an unloaded one while in motion?**

Ans: - A loaded trolley has a greater inertia due to its more mass whereas the inertia is less in an unloaded trolley. So a greater force is required to stop a loaded trolley than that in case of an unloaded one while in motion. That is why it is difficult to stop a loaded trolley than an unloaded one while in motion.

9) **Name the inertia of different kind and define them.**

Ans: - There are three types of inertia namely: inertia of rest, inertia of motion and inertia of direction.

Inertia of rest: - The property of a stationary body by virtue of which it tends to oppose any change in its state of rest is called inertia of rest.

Inertia of motion: - The property of a uniformly moving body by virtue of which it tends to oppose any change in its state of motion is called inertia of motion.

Inertia of direction: - The property by virtue of which a body moving along a straight path (/fixed direction) tends to oppose any change in its direction of motion is called inertia of direction.

10) Why does a passenger standing inside a stationary train tend to fall backward as the train suddenly starts moving?

Ans: - Inside a stationary train, the whole body of the passenger remains at rest. But as the train starts moving suddenly, the lower part of the passengers body being in contact with the train tends move in the direction of the moving train. But the upper part of his body maintains the inertia of rest and stays at its place. So as lower part is dragged forward leaving behind the upper part, the passenger tends to fall opposite to the direction of moving train.

11) Why it is advised to fasten seat belts in a moving car?

Ans: - Inside a moving car, the whole body of the passenger has the tendency to move in the direction of the car. But if the car is stopped suddenly by applying the brakes, the lower part of the passengers body being in contact with the car comes to rest at once with the car. But the upper part of his body tends to move forward due to inertia of motion. So the passenger gets a forward jerk and may hit against something and gets injured. Therefore as a safety measure, it is advised to fasten the seat belts in a moving car.

12) A hanging carpet is beaten with a cane to remove dust from it. Give reason for this.

Ans: - Initially both the carpet and the dust particles settled on it are at rest. But when the carpet is beaten with a cane by hanging it, the carpet tends to move in the direction of the moving cane whereas the dust particles settled on the carpet stay behind due to inertia of rest. By this the dust particles get separated from the carpet and fall off due to pull of gravity.

13) The branch of a tree laden with ripe fruits is to be shaken to get down the fruits. Give reason.

Ans: - Initially the branch of the tree and the fruits hanging from it are at rest. By shaking the branch, it comes to motion whereas the fruits remain unmoved due to inertia of rest. This causes the ripe fruits with weak stem to get detached from the branch and fall off due to pull of gravity.

14) Why does a coin placed on a card, drop into the tumbler when the card is rapidly flicked with the finger?

Ans: - When the card is flicked, a momentary force acts on the card for which the card moves away. But the coin kept on it does not share the motion at once and it remains at its place due to inertia of rest. The coin then falls down into the tumbler due to the pull of gravity.

15) Why does a person fall when he jumps out from a moving train?

Ans: - Inside a moving train, the whole body of the passenger was in a state of motion with the train. On jumping out of the moving train, as soon as his feet touch the ground, the lower part of his body comes to rest, while the upper part still remains in motion due to inertia of motion. As a result, he falls in the direction of motion of the train.

16) Why does a ball thrown vertically upwards in a moving train, come back to the thrower's hand?

Ans: - The moment the ball was thrown upwards inside the moving train, it was in motion along with the person and the train. It remains in the same state of forward motion even during the time the ball remains in air. The person, the inside air and the ball, all move ahead by the same distance due to inertia of motion for which the ball falls back into his palm on its return.

17) When a corridor train suddenly moves forward, the passenger standing in the compartment tends to fall backwards. Give reason.

Ans: - In a corridor train, the frame of the sliding door being fixed on the floor of the train also comes in motion on start of the train. But the sliding door remains in its position due to inertia of rest. Thus the frame moves ahead with the train while door slides opposite to the direction of motion of the train. Thus the door may open.

18) After alighting from a moving bus, one should run for some distance in the direction of bus. Explain why this is so.

Ans: - Inside a moving bus, the whole body of the passenger was in a state of motion with the bus. On jumping out of the moving bus, as soon as his feet touch the ground, the lower part of his body comes to rest, while the upper part still remains in motion due to inertia of motion. As a result, he tends fall in the direction of motion of the bus and gets hurt. Therefore to avoid falling he should run some distance in the direction of the moving bus so that he can continue with his inertia of motion.

19) It is advantageous to run before taking a long jump. Explain the reason.

Ans: - By running, an athlete brings his entire body in the state of motion. By doing so he picks up the inertia of motion, which helps him taking a longer jump. That is why it is advantageous to run before taking a long jump.

20) A bullet fired against a glass window pane makes a neat hole in glass without shattering the glass pane. Explain why?

Ans: - The fast moving bullet on coming in contact with glass pane, immediately shares its velocity with the glass pane and hence both move forward making a neat hole. However, the rest of the glass pane does not share any velocity of bullet and hence due to inertia of rest remains intact. That is why the glass pane does not shatter and only a neat hole is made through it.

(C) Newton's Second law of Motion

1) Define the term 'linear momentum'. Write its S.I. and C.G.S. units. State whether linear momentum is a scalar or vector quantity.

Ans: - Linear momentum of a body is the product of its mass and velocity.

$$\mathbf{p = mv}$$

S.I. unit of momentum = $kgms^{-1}$

C.G.S. unit of momentum = $gcms^{-1}$

Linear momentum is a vector quantity.

2) State the two factors on which momentum of a body depends. / Name two factors on which force needed to stop a moving body in a given time depends.

Ans: - The two factors are:

(1) Mass of the body (2) velocity of the body

3) Write the expression for change in momentum (Δp)

(i) when a body has velocity (v) much lesser than the velocity of light(c) in vacuum.

(ii) when a body has velocity (v) equal/comparable to the velocity of light (c) in vacuum.

Ans: - (i) $\Delta p = m\Delta v$ when $v<<<c$

(ii) $\Delta p = \Delta(mv)$ when $v \rightarrow c$

4) State the S.I. units of the following:

(i) momentum, (ii) change in momentum, (iii) rate of change of momentum

Ans: - (i) S.I. unit of momentum = $kgms^{-1}$ or Ns

(ii) S.I. unit of change in momentum = $kgms^{-1}$ or Ns

(iii) S.I. unit of rate of change of momentum = $kgms^{-2}$ or newton (N)

5) State Newton's second law of motion both in words and in symbolic form.

Ans: - Newton's second law of motion states that the rate of change of momentum of a body is directly proportional to the force applied on it and the change in momentum takes place in the direction in which the force is applied.

In symbolic form; $F \propto \left(\frac{\Delta p}{\Delta t}\right)$

6) Write the mathematical form of Newton's second law of motion.

Ans: - The mathematical form of Newton's second law of motion is:

$$F = ma$$

where $F = force,\ m = mass \ \ and \ \ a = acceleration$

7) Which law of motion gives a quantitative definition of force? What is this quantitative definition of force?

Ans: - Newton's second law of motion gives a quantitative definition of force.

Force acting on a body is quantitatively equal to the product of mass of the body and the acceleration produced in it.

$$F = ma$$

where $F = force,\ m = mass \ \ and \ \ a = acceleration$

8) State the condition when Newton's second law of motion takes its mathematical form.

Ans: - When a body moves at a velocity much lesser than the velocity of light in vacuum (i.e. v <<< c) then mass of the body remains constant. Under this condition, Newton's second law of motion takes its mathematical form.

9) Derive the formula $F = ma$ using Newton's second law of motion.

Ans: - Let us consider a body of mass ***m*** moving at velocity ***u***. A force ***F*** is applied on the body for a time interval ***t*** so that its velocity changes to ***v***.

Initial momentum of the body = *mu*

Final momentum of the body = *mv*

Change in momentum of the body = *mv-mu*

Rate of change of momentum of the body = $\frac{mv-mu}{t}$

According to Newton's second law of motion;

Force α Rate of change of momentum

=> F α $\left(\frac{mv-mu}{t}\right)$

=> F = $k\left(\frac{mv-mu}{t}\right)$ where k is a proportionality constant.

=> F = km $\left(\frac{v-u}{t}\right)$ (since v <<< c so m is constant)

=> F = kma ----------Eq-(1)

where $a = \frac{v-u}{t}$ is the acceleration

If the unit of force is so chosen that a unit force when applied on a body of unit mass produces a unit acceleration then the proportionality constant k takes the value equal to 1.

i.e. if F=1, m=1, a=1 then k=1

Substituting the value of k=1 in Eq(1) we get $F = ma$

Hence derived.

10) Name and define the S.I. unit of force.

Ans: - The S.I. unit of force is *newton* (N).

One newton is the force which can produce an acceleration of 1 ms^{-2} when applied on a body of mass 1 kg.

1 N = 1 kg X 1 ms^{-2} = 1 $kgms^{-2}$

11) Name and define the C.G.S. unit of force.

Ans: - The C.G.S. unit of force is *dyne.*

One dyne is the force which can produce an acceleration of 1 cms^{-2} when applied on a body of mass 1 g.

1 dyne = 1 g X 1 cms^{-2} = 1 $gcms^{-2}$

12) Derive the relation between S.I. and C.G.S. units of force.

Ans: - 1 N = 1 kg X 1 ms^{-2}

= 1000 g X 100 cms^{-2}

= 100000 $gcms^{-2}$

= 10^5 dyne

Thus 1 N = 10^5 dyne

13) Why does a glass vessel break when it falls on a hard floor, but it does not break when it falls on a carpet?

Ans: - When a glass vessel falls from a height on a hard floor, it comes to rest almost instantaneously i.e. in a very short time. So the rate of change of momentum of the vessel is more and it experiences a greater force from the hard floor. Hence it breaks.

But if the same glass vessel falls on a carpet, then the carpet gets compressed and allows a comparatively more time to the vessel to come to rest. So the rate of change of momentum of the vessel is less and it experiences a less force from the carpet. Hence it does not break.

14) Explain why a cricketer pulls his hands back while catching a fast moving cricket ball.

Ans: - As the cricketer pulls his hands back, he allows a comparatively more time to the moving ball to come to rest. So the rate of change of momentum of the ball

is less and it exerts a less resistive force on the hands of the cricketer. Hence the ball does not hurt the hands and he can take the catch easily.

15) Explain why an athlete prefers to land on sand instead of hard floor while taking a high jump.

Ans: - When an athlete lands from a height on a hard floor, his feet come to rest almost instantaneously. So the rate of change of momentum of his body is more due to which he experiences more resistive force from the floor. This may hurt his feet.

On the other hand, when he lands on sand, his feet push the sand for some distance before coming to rest. So the rate of change of momentum of his body is less and he experiences a less resistive force from sand. So he gets saved from getting hurt.

16) Derive Newton's first law of motion from the second law.

Ans: - From Newton's second law of motion we obtain

$$F = ma$$

where $F = force,\ m = mass \ \ and \ \ a = acceleration$

But if F = 0 then $ma = 0$

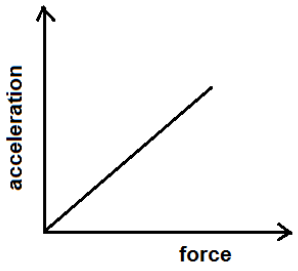
$\Rightarrow a = 0$ (since mass m can't be zero)

=> Either the body is at rest or is moving at a uniform velocity

Thus it is seen that as long as no force acts on the body then its acceleration remains zero i.e. either the body remains at rest or is moves at a uniform velocity. So no change can take place in the state of rest or that of uniform motion unless an external force acts on the body. This is Newton's first law of motion which is obtained from the second law.

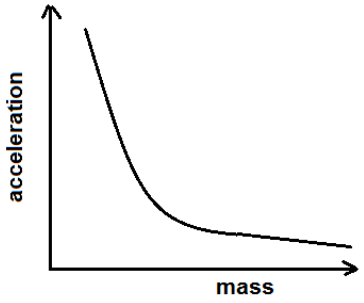
17) How does the acceleration produced on a given mass depend on the force applied on it? Draw the sketch of a graph to show it.

Ans: - Acceleration is directly proportional to the magnitude of force applied on a body of given mass.



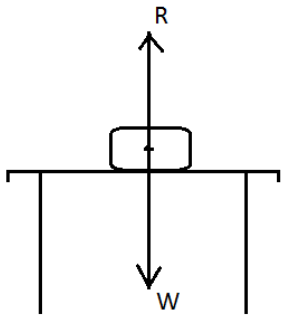
18) How does the acceleration produced by a given force depend on mass of the body? Draw the sketch of a graph to show it.

Ans: - Acceleration is inversely proportional to the mass of a body for a given force applied.



(D) Newton's Third law of Motion

1) **State Newton's third law of motion./ State the law of action-reaction.**
   Ans:- Newton's third law is also called law of action-reaction and states that: "To every action there is an equal and opposite reaction."
2) **State the usefulness of Newton's third law of motion?**
   Ans:- This law tells us about how a force acts on an object. According to this law the forces of interaction are always present in pair that is action-reaction pair.
3) **Action and reaction do not cancel each other. Explain.**
   Ans:- Although action and reaction are equal in magnitude and oppositely directed, they cannot cancel each other. Their resultant is not zero.
   This is because they do not act on the same body. They act on two separate bodies but simultaneously.
4) **When we push a wall then we feel a resistance in our hand. Why?**
   Ans:- If we push a wall by our hand then it is action. So the wall also applies an equal reaction on hand in opposite direction. So we receive a resistance from the wall.
5) **Name the action-reaction forces when a block lies at rest on the surface of a table top.**
   Ans:- The block lying on a table top exerts a force equal to its weight as action on the surface. The surface of the table top exerts an equal reaction force on the block in the direction perpendicular to the surface. This is called normal reaction.



W = weight of the block acting on the table surface in downward direction

R = force of normal reaction given by the table surface to the block in upward direction.

6) **Explain how we can walk on the ground.**

Ans:- While walking, our feet pushes the ground backwards with a force that is action. So the ground pushes our body forward with an equal and opposite reaction force. The horizontal component of this reaction force enables us to move forward.

7) **Explain how a swimmer swims in water.**

Ans:- A swimmer pushes water backwards in order to move forward. By pushing water, he exerts a force on water that is action. So water in return pushes his body forward due to an equal opposite reaction force.

8) **Why does a boatman push the shore with his oar to move the boat away from the shore?**

Ans:- The boatman pushes the shore with his oar thereby applying an action on the ground. So the ground also gives an equal reaction force on the boatman and the boat in opposite direction. This makes the boat to move away from the shore on water.

9) **To move a boat ahead in water, the boatman has to push the water backwards by his oar. Explain.**

Ans:- The boatman pushes water backwards with his oar. This is action. Hence the water also pushes the oar and the boat in forward direction with an equal force. This is reaction. Thus due to the reaction force, the boat can move forward on water.

10) **When you step ashore from a stationary boat, it tends to leave the shore. Explain.**

Ans:- When a man jumps out of (steps ashore from) a boat near the bank of a river, he presses the boat with his foot in the backward direction. This is an action. In turn, the boat exerts an equal and opposite force as reaction on him which enables him to step out of the boat to the shore. Since the boat is

floating on water surface, the backward push or action exerted by the man causes the boat to move back in water.

11) Why does a gun recoil on firing?

Ans:- When a gun is fired, the bullet leaves the gun with a force that is action. The outgoing bullet in turn exerts an equal and opposite reaction force on the gun thereby giving it a backward jerk. This is called the recoiling of the gun.

12) Explain the motion of a rocket on the basis of Newton's third law of motion.

Ans:- In a rocket, fuel burns to produce hot gases and fumes. The engine of the rocket pushes these hot gases and fumes to escape through the outlets of the rocket. The thrust with which these gases escape is the action. So according to Newton's third law, the outgoing gases exert an equal and opposite reaction on the rocket which helps in propelling the rocket opposite to the direction of exhausting gases.

(E) Gravitation

1) What do you mean by gravitational force? Is it a contact force or a non-contact force?

Ans:- The force of attraction between two bodies due to their masses is called as gravitational force. It is a non-contact force.

2) State Newton's universal law of gravitation.

Ans:- Newton's universal law of gravitation states that the gravitational force of attraction between two bodies is (1) directly proportional to the product of their masses, and (2) inversely proportional to the square of distance of separation between them.

3) Write down the expression for the gravitational force of attraction between two bodies.

Ans:- $$F = \frac{G\, m_1 m_2}{r^2}$$

where G = Universal Gravitational constant

m_1m_2 = product of masses of the two bodies

r = distance of separation between the two bodies

4) What do you mean by universal gravitational constant? State its value in S.I. unit.

Ans:- The universal gravitational constant is defined as the gravitational force of attraction between two bodies each of unit mass and separated by a unit distance apart.

$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$

5) How is the magnitude of gravitational force between two bodies affected when the separation between them is (i) reduced to half, (ii) doubled?

Ans:- (i) If the distance of separation between the two bodies is reduced to half then the magnitude of non-contact force between them increases to four times.

(ii) If the distance of separation between the two bodies is doubled then the magnitude of non-contact force between them decreases to one-fourth.

6) Write down the salient features of gravitational force.

Ans:- Following are few salient features of gravitational force.

i. It is an attractive force.
ii. It is a non-contact force.
iii. It is a mutual force.
iv. It acts along the line joining the centre of mass of the two bodies.
v. It is significant in case of very large massive bodies such as heavenly bodies.

7) Why the gravitational force between two bodies with less masses is not significant?

Ans:- It is due to the very small magnitude of the universal gravitational constant G that the gravitational force between two bodies with less masses is not significant.

8) Write the importance of the law of gravitation.

Ans:- Newton's law of gravitation is used (1) to explain the planetary motion, (2) to explain the motion of a freely falling body.

9) What do you mean by force of gravity? Write an expression for it and state its direction. What is this force otherwise known as?

Ans:- The force with which a body gets attracted towards the (centre of) the earth is known as force due to gravity. So it is the gravitational force of attraction of earth acting on anybody.

It is expressed as $F = mg$ where m = mass of the body
and g = acceleration due to gravity

This force acts in vertically downward direction.

This force is also known as the 'weight of the body' on which it acts.

10) What is acceleration due to gravity? State its average value in S.I.

Ans:- When a body falls freely under gravity, the acceleration produced in the body due to earth's gravitational attraction is called acceleration due to gravity. Its average value is 9.8 ms^{-2}.

11) How are *g* and G related?

Ans:- $g = \frac{GM}{R^2}$

Where g = acceleration due to gravity
G = universal gravitational constant
M = mass of the earth
R = radius of the earth

12) Why the acceleration due to gravity is not same everywhere on earth? How does its value vary on earth?

Ans:- $g = \frac{GM}{R^2}$

The value of acceleration due to gravity varies inversely as the square of radius of earth. As the radius of earth is not same everywhere so also the value of acceleration due to gravity.

The value of acceleration due to gravity is minimum at equator and maximum at the poles. This value increases in the direction from equator towards the poles.

13) How does acceleration due to gravity change (i) with the increase of altitude, (ii) below the earth surface?

Ans:- (i) The acceleration due to gravity decreases with the increase of altitude.
(ii) The acceleration due to gravity decreases below the earth surface.

14) What is the relation between the value of acceleration due to gravity on earth and that on moon?

Ans:- $g_{moon} = \frac{1}{6} \times g_{earth}$

$g_{earth} = 9.8\, ms^{-2}$ but $g_{moon} = 1.66\, ms^{-2}$

15) Define the term 'weight' of a body. Write the expression for it. Name its S.I. unit.

Ans:- The weight of a body is defined as the force with which it is attracted towards the (centre of) the earth. In otherwords, weight of a body is the force of gravity acting on the body.

It is expressed as W = mg where m = mass of the body
and g = acceleration due to gravity

The S.I. unit of weight is newton (N).

16) Why does the weight of a body vary from place to place?

Ans:- The weight of a body is the mathematical product of mass of the body and acceleration due to gravity. Although the mass of a body is a constant quantity but the value of acceleration due to gravity changes from place to place. Therefore the weight of a body also changes from place to place.

17) What would be the weight of a body if taken to the centre of the earth?

Ans:- zero

18) Differentiate between mass and weight of a body.

Ans:-

mass	weight
i. The quantity of matter contained in a body is known as mass of the body.	i. The weight of a body is defined as the force with which it is attracted towards the (centre of) the earth.
ii. The mass of a body remains constant everywhere.	ii. The weight of a body changes from place to place.
iii. Its S.I. unit is kilogram (kg).	iii. Its S.I. unit is newton (N).
iv. It is a scalar quantity.	iv. It is a vector quantity.
v. It is measured by a beam balance.	v. It is measured by a spring balance.

19) Name the gravitational units of force in M.K.S. and C.G.S. systems.

Ans:- In M.K.S., the gravitational unit of force is ***kilogram force (kgf).***
In C.G.S., the gravitational unit of force is ***gram force (gf).***

20) What do you mean by *one kilogram force*? Write its value in newton (N).

Ans:- One kilogram force is defined as the force with which a body of mass 1 kilogram gets attracted towards the earth.

OR

One kilogram force is the force due to gravity on a mass of 1 kilogram.

1 kgf = 9.8 N

21) What do you mean by *one gram force*? Write its value in dyne.

Ans:- One gram force is defined as the force with which a body of mass 1 gram gets attracted towards the earth.

OR

One gram force is the force due to gravity on a mass of 1 gram.

1 gf = 980 dyne

22) The mass of a body is 5 kg. What is the weight of this body expressed in (i) newton, (ii) kgf. (Take g = 9.8 ms^{-2})

Ans:- (i) mass = 5 kg

So in newton, weight = 5 kg X 9.8 ms^{-2} = 49 N

(ii) mass = 5 kg

So in kgf, weight = 5 kgf

Chapter-4 PRESSURE

(A) Liquid Pressure

1) Differentiate between thrust and pressure.

Ans:

Thrust	Pressure
1) Thrust is the force acting normally on a surface. 2) S.I. unit of thrust is newton. 3) It is a vector quantity. 4) It does not depend on the area on which it acts.	1) Pressure is the thrust acting per unit area of a surface. 2) S.I. unit of pressure is pascal. 3) It is a scalar quantity. 4) It varies inversely as the area on which it acts.

2) Name and define the S.I. unit of pressure.

Ans:- The S.I. unit of pressure is pascal (Pa). 1 Pa is the pressure exerted on a surface of area 1 m^2 by a force of 1 N acting normally on it.

3) Give reasons for the following:

(i) The ends of nails are made pointed.

Ans:- Pointed end has less area of contact and lesser the area , greater is the pressure produced by applying force. Since the ends of nails are made pointed, large pressure is exerted through the pointed ends and they can be driven into the surface with a less effort.

(ii) It is easier to cut by the sharp edge of a knife than the blunt one.

Ans:- Sharp edge has less area of contact than the blunt edge and lesser the area , greater is the pressure produced by applying force. So a less thrust may cause a greater pressure at the sharp edge and cutting can be done with a less effort. Therefore it is easier to cut by the sharp edge of a knife than the blunt one.

(iii) Wooden sleepers are laid down under a railway track.

Ans:- Broad wooden sleepers are laid down under the iron rails of a railway track to increase the effective surface area of the track. This reduces the pressure due to weight of the running train on the track and prevents the railway track to penetrate into the ground.

(iv) Tall rise buildings have wider foundations.

Ans:- Larger the area, lesser is the pressure exerted due to a force. The foundations of buildings are made wider than the walls so that the pressure exerted by the building on the ground becomes less. So the building is prevented from penetrating into the soil.

4) Write the expression for pressure exerted by a liquid.

Ans:- $P = h\rho g$

where P= liquid pressure

h= height of liquid column

ρ= density of liquid

g= acceleration due to gravity

5) Write the expression for total pressure acting at a point inside a liquid.

Ans:-

Total pressure at any point inside a liquid

= Atmospheric pressure + Pressure due to liquid column above the point

$P = P_a + h\rho g$

6) State the factors affecting pressure exerted by a liquid.

Ans:-

1) It is directly proportional to the depth of the point below the free surface (or height of the liquid column above the point)
2) It is directly proportional to the density of the liquid.
3) It is directly proportional to the acceleration due to gravity.

7) How does the area of cross-section of a liquid column affect, if at all, the pressure exerted by the liquid column?

Ans:- Pressure due to a liquid column does not depend on the area of cross-section of the liquid column.

8) What are the laws of liquid pressure?

Ans:- Following are the laws of liquid pressure.

1) Inside the liquid, pressure increases with the increase in depth from its free surface.
2) In a stationary liquid, pressure is same at all points on a horizontal plane.
3) Pressure is same in all directions about a point inside the liquid.

4) Pressure at same depth is different in different liquids. It increases with the increase in density of liquid.
5) A liquid seeks its own level.

9) How does the liquid pressure on a diver change if:

(i) the diver moves to the greater depth

(ii) the diver moves horizontally?

Ans:- (i) If a diver goes deep inside water then he experiences an increase in pressure due to water column above him. This is so because the height of water column above him increases.

(ii) If he swims horizontally at a particular level of water then he does not feel any change in the pressure acting on him. This is so because the height of water column above him remains unchanged.

10) State whether the pressure at a certain depth in sea water and river water are same or not. Explain the reason.

Ans:- The pressure at a certain depth in sea water is more than that in the river water. This is so because the density of sea water is more than that of river water due to presence of dissolved salt in sea water. Liquid pressure increases with the increase in density of liquid.

11) Give reasons for the following:

(i) The wall of a dam is made thicker at the bottom.

Ans:- The pressure of water in a dam increases with the increase in depth and becomes maximum at the bottom. This pressure acts not only in downward direction but also in sidewise direction on the wall of the dam. So the bottom of the wall experiences enormous pressure and may collapse. Hence to withstand the pressure of water, the bottom of the wall is made thicker.

(ii) Deep sea divers wear special protective suits while in action.

Ans:- The pressure of water increases with the increase of depth. So a deep sea diver experiences an enormous pressure at a greater depth inside water which may become unbearable for him. So to withstand this pressure he wears a special protective suit which is internally pressurized at one atmospheric pressure.

(iii) Water supply tanks are generally placed at a greater height.

Ans:- As greater is the height of tank above the ground level, more will be the pressure of water in the taps of a house. Thus for a good supply

of water, the height of the supply tank must always be a few metre higher than the level at which supply of water is to be made.

(iv) A gas bubble released at the bottom of a water tank grows in size gradually as it rises upwards.

Ans:- As the gas bubble rises upwards gradually, the height of water column above it decreases. So the pressure due to water column acting on the bubble also decreases. Hence according to Boyle's law (PV = constant), a decrease in pressure causes the volume of the bubble to increase. That is why a gas bubble released at the bottom of a water tank grows in size gradually as it rises upwards**.**

12) State Pascal's law. Name some of its applications.

Ans:- Pascal's law states that the pressure exerted anywhere in a confined liquid is transmitted equally and undiminished in all directions throughout the liquid.

This law is applied to hydraulic machines namely hydraulic press, hydraulic jack, hydraulic brakes, hydraulic lifts etc.

(B) Atmospheric Pressure

1) What is atmospheric pressure? What is its value at the sea level?

Ans:- Atmospheric pressure is defined as the force per unit area exerted against a surface by the weight of the air column above that surface. Its value is maximum at the sea level which is nearly 10^5 Pa.

2) Why don't we feel the enormous atmospheric pressure acting on us?

Ans:- We do not feel this enormous atmospheric pressure acting on our body due to the fact that the blood pressure in our body is slightly more than the atmospheric pressure. So the blood pressure and atmospheric pressure counterbalance each other.

3) What happens to the atmospheric pressure as we go to higher altitude and why?

Ans:- Atmospheric pressure decreases with the increase of altitude due to following reasons:

1) The height of atmospheric column decreases with the increase of altitude.
2) The density of air decreases with increase of altitude.

4) Why do some people fall prey to nose bleeding at high altitudes?

Ans:- At a high altitude, the atmospheric pressure falls drastically. So the blood pressure in our body cannot get balanced with the atmospheric pressure and becomes excess of the atmospheric pressure. This causes the fine blood vessels in the nostril to split open and blood oozes out. This is the cause of nose bleeding at high altitudes.

5) Give reasons for the following:

(i) One can drink a soft drink easily using a straw.

Ans:- By sucking the straw, the air inside it passes to the lungs. So the air pressure inside the straw decreases. This makes the atmospheric pressure acting on the surface of the soft drink to become more than air pressure inside the straw. So the atmospheric pressure pusses the drink to enter in the straw and to rise to the mouth.

(ii) A balloon collapses when air is removed from it.

Ans:- The pressure of trapped air inside an inflated balloon remains in equilibrium with the atmospheric pressure outside the balloon. But as the air is removed from the balloon, the pressure inside the balloon decreases. So the atmospheric pressure becomes excess and squeezes the balloon. Hence the balloon gets collapsed.

(iii) Liquid rises in a syringe when its piston is pulled backwards.

Ans:- By pulling the piston backwards, the volume of empty space in the syringe increases. This causes the pressure inside the syringe to decrease. Hence the outside atmospheric pressure acting on the liquid surface becomes excess and pushes the liquid to enter in the syringe through the capillary tube. Hence the liquid rises in the syringe.

(iv) Water does not run out of a dropper unless its rubber bulb is pressed.

Ans:- The air pressure acting at the mouth of the dropper prevents the liquid top flow out spontaneously. But when the rubber bulb of the dropper is pressed, the pressure inside the dropper increases. This makes the pressure of the liquid inside the dropper to become more than the outside air pressure. Hence the liquid flows out of the opening.

(v) Two holes are made in a sealed tin can to take out oil from it.

Ans:- The air pressure acting at the opening prevents the oil to flow out smoothly. So if two holes are made in the sealed tin can then through one hole air enters the tin and applies pressure on the surface of the oil. This makes the oil to flow out smoothly through the other hole.

(vi) Aeroplanes are provided with pressurized cabins for the passengers.

Ans:- As an aeroplane rises to a high altitude, it encounters low atmospheric pressure. So the blood pressure of passengers body exceeds the atmospheric pressure. This would cause health problem in the passengers such as nose bleeding. Hence for the safety of the passengers, the inside of the aeroplane is pressurized such that their blood pressure can be balanced with the outside air pressure.

(vii) Astronauts wear special suits while in spacewalk.

Ans:- In the space there is no atmosphere. So the blood pressure of an astronaut's body cannot be balanced by any external air pressure. This would cause his body to split open due to enormous blood pressure. Hence for the safety, the astronaut has to wear a special protective suit which is pressurized from inside. The pressure of the suit counter balances the blood pressure of astronaut's body and he remains safe inside it.

(viii) A fountain pen leaks at high altitude.

Ans:- Normally a fountain pen filled with ink contains some air which is at a pressure equal to the atmospheric pressure on the earth surface. When the pen is taken at an altitude, the atmospheric pressure at this altitude is low. So the excess pressure due to air inside the rubber tube forces the ink to leak out.

6) What is a simple barometer?

Ans:- A simple barometer is used to measure atmospheric pressure. It consists of a long glass tube containing dry mercury standing vertically erect with its mouth dipped in mercury taken in a trough. The height of the mercury column standing in the glass tube is a function of the atmospheric pressure at that place i.e. as the atmospheric pressure of the place changes, the height of the mercury column also changes proportionally. That is why the atmospheric pressure measured by a simple barometer is expressed as the height of mercury column called the barometric height. It is to be noted that the height of the mercury column is measured from the surface of the mercury in the trough to the surface of mercury in the tube.

7) The atmospheric pressure at the sea level is 76 cm of mercury column. What do you mean by this statement?

Ans:- It means that the atmospheric pressure at the sea level is equal to the pressure exerted by a mercury column of height 76 cm.

8) Write the value of atmospheric pressure at sea level (i) in terms of barometric height, (ii) in S.I. unit.

Ans:- (i) At sea level, atmospheric pressure = 76 cm of mercury column

(ii) In S.I. unit, the atmospheric pressure at sea level =1.01×10^5 Pa or nearly 10^5 Pa

9) Explain why the barometric height decreases with the increase of altitude.

Ans:- If the barometer is taken to a higher altitude then it encounters a decrease in atmospheric pressure. So to counter balance the atmospheric pressure, the pressure due to mercury column in the barometer tube also decreases. This happens due to decrease in the height of mercury column in the barometer tube. Thus a decrease in atmospheric pressure is demonstrated as a decrease in the height of mercury column in the barometer tube.

10) How is the reading of a barometer affected in the following cases?

Barometer is taken to a hill	Barometer reading decreases	Because atmospheric pressure decreases due to decrease in height of atmospheric column
Barometer is taken to a mine	Barometer reading increases	Because atmospheric pressure increases due to increase in height of atmospheric column
A drop of liquid enters in the barometer tube	Barometer reading decreases	Because the liquid drop gets vapourised on coming in contact with torricellian vacuum and then this vapour pressure acting on the mercury column causes it to decrease in height

11) How is the reading of a barometer affected in the following cases?

(i) If the tube is pushed down into the trough:- no change in the reading

(ii) If the tube is lifted up slightly from the trough.:- no change in the reading

(iii) If the tube is tilted slightly from its vertical position:- no change in the reading

(iv) If the area of cross-section of the tube is increased:- no change in the reading

12) Write the advantages of using mercury as barometric liquid.

Ans:-

i. The density of mercury is very high. So a mercury column of less height is good enough to balance with the atmospheric pressure. Accordingly the length of the glass tube required to make a barometer is reduced considerably.

ii. Mercury neither wets nor sticks to the glass tube. So it gives accurate reading.

iii. The surface of mercury is shiny and opaque. So it is seen easily while taking the reading.

iv. Mercury has a negligible vapour pressure. So the reading is not affected due to the presence of mercury vapour above the column of mercury.

13) Write the disadvantages of using water as barometric liquid.

Ans:-

i. The density of water is very low to be used in a barometer. So a water column of height nearly 10.34m would be required to balance with the atmospheric pressure. Accordingly the length of the glass tube required to make a barometer would be very long.

ii. Water sticks to the glass tube. So it cannot give accurate reading.

iii. Water is a transparent liquid. So its surface cannot be seen easily while taking the reading.

iv. Water has a high vapour pressure. So the reading would be greatly affected due to the presence of water vapour above the column of water.

14) Write the demerits of a simple barometer.

Ans:-

i. It is inconvenient to move a simple barometer from one place to another, i.e it is not portable.
ii. There is no protection for the glass tube.
iii. The surface of mercury in the trough is open. Therefore there are chances that the impurities may fall in and get mixed with the mercury.
iv. A scale cannot be fixed with the tube to measure the barometric height since the zero mark of the scale is likely to vary with the variation of atmospheric pressure.

15) Write down the different uses of barometer.

Ans:- Following are the uses of a barometer.

i. To measure the atmospheric pressure.
ii. To forecast weather.
iii. Used as an altimeter to measure height above the sea level.

16) What do the following indicate in a barometer regarding weather?

Sudden fall in the mercury level	Indicates the coming of a storm
Sudden rise in the mercury level	Indicates a very hot and dry weather
Gradual fall in the mercury level	Indicates the possibility of rain
Gradual rise in the mercury level	Indicates a dry weather
No abrupt change in mercury level	Indicates no change in weather

17) What is an altimeter?

Ans:- An altimeter is used to measure altitude i.e. height above the sea level. It is used in aeroplanes and aircrafts to measure the height at which they fly. It is an aneroid barometer in which the scale is calibrated in terms of height of ascent, with height increasing towards left because the atmospheric pressure decreases with increase of height above the sea level.

Chapter:5
Upthrust in Fluids And Archimedes' Principle

(A) Upthrust and Archimedes' principle

1) What do you mean by the term upthrust of a fluid?

Ans:- The upward force exerted on a body by the fluid in which it is submerged, is called the upthrust or buoyant force.

2) What is meant by buoyancy?

Ans:- The property of a of liquid to exert an upward force on a body immersed in it, is called buoyancy.

3) What is the effect of upthrust acting on a body in a fluid?

Ans:- The upthrust acting on a body causes an apparent loss in weight of the body.

Upthrust = Loss in weight of the body

= Actual weight – Apparent weight

Apparent weight = Actual weight - Upthrust

4) What is the cause of upthrust?

Ans:- When a body is immersed in a liquid then it experiences liquid pressure from all directions i.e. upwards, downwards as well as sideways. But the resultant pressure acting on the body from sideways is zero. However the upward pressure acting on bottom surface of the body remains more than the downward pressure acting on top surface. Hence a net upward pressure acts on the body from the liquid. This net upward pressure acting on the surface of the body is held responsible for the upthrust of liquid.

5) Write an expression for upthrust exerted by a fluid.

Ans:- Upthrust $U = V\rho g$

where V = volume of submerged part of the body

ρ = density of fluid

g = acceleration due to gravity

6) State the factors on which upthrust of a fluid depends.

Ans:- Upthrust of a fluid depends on the following.

(1) Upthrust is directly proportional to density of fluid (for the same volume submerged)
(2) Upthrust is directly proportional to the volume of submerged part of the body (in the liquid of same density)

7) State Archimedes' principle.

Ans:- Archimedes' principle states that when a body is immersed partially or completely in a liquid, it experiences an upthrust, which is equal to the weight of the liquid displaced by it.

8) How does the density of a solid and that of a liquid determine whether the solid will sink or float in the liquid?

Ans:- If the density of solid is more than the density of liquid then the solid sinks in the liquid.

But If the density of solid is less than or equal to the density of liquid then the solid floats in the liquid.

Let ρ_S = density of solid and ρ_L = density of liquid

If $\rho_S > \rho_L$ then the solid sinks in the liquid

If $\rho_S = \rho_L$ then the solid floats just under the liquid surface

If $\rho_S < \rho_L$ then the solid floats with some portion of its volume immersed in the liquid

9) It is easier to lift a heavy stone under water than in air. Explain.

Ans:- The upthrust of water acts on the stone opposite to the direction of weight. So the weight of the stone gets apparently reduced by an amount equal to upthrust of water. So the heavy stone feels to be lighter in weight and hence it is easier to lift the stone under water.

10) A piece of wood if left under water, comes to the surface. Explain the reason.

Ans:- Wood has density lesser than the density of water. So when a piece of wood is dipped completely in water then it experiences upthrust greater than its weight. That means a piece of wood experiences a net force in upward direction if taken under the water surface. So if left, it tends to come to the water surface.

11) Why is a force needed to keep a block of wood inside water?

Ans:- Cork has density lesser than the density of water. So when a piece of cork is dipped completely in water then it experiences upthrust greater than its weight. That means a piece of cork experiences a net force in upward direction if taken under the water surface. So if left, it tends to come to the water surface. Therefore a force is needed to apply on it downwards to keep it inside water.

12) Will a body weigh more in air or vacuum when weighed with a spring balance? Give a reason for your answer.

Ans:- A body will weigh more in vacuum than in air.

This is so because in vacuum, no upthrust acts on the body. So the weight measured in vacuum is the true weight of the body. But when weighed in air, the weight of a body remains apparently less because of upthrust of air acting on the body.

13) A metal solid cylinder tied to a thread is hanging from the hook of a spring balance. The cylinder is gradually immersed into water contained in a jar. What changes do you expect in the readings of spring balance? Explain your answer.

Ans:- As the cylinder is gradually immersed in water, volume of submerged part increases and accordingly the upthrust of water acting on the cylinder increases. So the apparent weight of the cylinder gradually decreases which is seen as the decreasing reading of the spring balance.

When the cylinder becomes fully immersed in water then volume of submerged part becomes maximum and so also the upthrust of water acting on it. At this point, the apparent weight of the cylinder becomes constant at a minimum value and does not change by lowering the cylinder further deep in water. Hence the reading of spring balance becomes constant at some minimum value.

14) (i) A bunch of feathers and a stone of the same mass are released simultaneously in air. Which will fall faster and why?

(ii) How will your observation be different if they are released simultaneously in vacuum?

Ans:- (i) The stone falls faster.

Density of feathers is much lesser than that of stone. Therefore the volume of a bunch of feathers is much larger than the volume of a stone of

same mass. Hence a greater upthrust of air acts on the feathers than on the stone. This makes the stone to fall faster than feathers.

(ii) If both are released in vacuum then both will fall at the same speed.

15) A sphere of iron and another of wood of the same radius are held under water. Compare the upthrust on the two spheres. Give reason for your answer.

Ans:- The ratio of upthrust acting on the two spheres is 1:1.

Both the spheres of iron and wood have same volume as they have same radius. If both are held under water then the volume of immersed part is same for both as well as the density of water is same for both. Hence equal upthrust acts on the two. So the ratio of upthrust on them is 1:1.

16) A sphere of iron and another of wood, both of same radius are placed on the surface of water. State which of the two will sink? Give reason to your answer.

Ans:- The sphere of iron will sink in water.

Density of iron is more than density of water but density of wood is less than density of water. So iron sphere sinks in water but wooden sphere floats on water.

(B) Density and Relative Density

1) Define density of a substance. What are its S.I. and CGS unit and state the relation between the two.

Ans:- The ratio of mass to volume of a substance is known as the density of the substance.

$$density = \frac{mass}{volume} \qquad \rho = \frac{m}{V}$$

SI unit of density = kgm^{-3}

CGS unit of density = gcm^{-3}

2) What is the effect of temperature change on the density of a substance?

Ans:- If temperature increases then density decreases and vice-versa.

3) Define relative density of a substance. What is its unit?

Ans:- The ratio of density of a substance to the density of water at 4^0 C is known as relative density or specific gravity of the substance.

R.D. = $\frac{density\ of\ the\ substance}{density\ of\ water\ at\ 4\circ C}$

Relative density has no unit as it is a pure ratio.

4) **Write the relation between density and relative density of a substance.**

Ans:- Relative density = Numerical value of density in gcm^{-3}

= $\frac{1}{1000}$ x Numerical value of density in kgm^{-3}

5) **Write down the formula to find relative density of a solid using Archimedes' principle.**

Ans:- R.D. of a solid = $\frac{W_1}{W_1 - W_2}$

where W_1 = weight of the solid in air

W_2 = weight of the solid in water

6) **Write down the formula to find relative density of a liquid using Archimedes' principle.**

Ans:- R.D. of a liquid = $\frac{W_1 - W_2}{W_1 - W_3}$

where W_1 = weight of the solid in air

W_2 = weight of the solid in liquid

W_3 = weight of the solid in water

(C) <u>Floatation</u>

1) **What is the principle of floatation?**

Ans:- The weight of a floating body is equal to the weight of the liquid displaced by its submerged part. This is the principle of floatation.

2) **What is the apparent weight of a floating body?**

Ans:- Apparent weight of a floating body is zero.

3) **Write the formula of floatation.**

Ans:- $\frac{V'}{V} = \frac{\rho_S}{\rho_L}$

Where V = volume of the body

V' = volume of immersed part of the body

ρ_s = density of solid

ρ_L = density of liquid

4) **A man first swim in sea water and then in river water. In which case the upthrust of water acting on the man is more and why?**

Ans:- The upthrust of water in both the cases remain the same.

When the man swims, his body weight equals to the upthrust of water acting on him. Since the weight of the man remains same whether he swims ion sea water or river water, the upthrust of water is also same in both the cases.

5) **A man first swim in sea water and then in river water. Compare the weight of water displaced by him in each case. Give reason for your answer.**

Ans:- The ratio of weight of sea water displaced to the weight of river water displaced is 1:1.

When the man swims in sea water or in river water, the upthrust of water acting on him remains same in both the cases. Since upthrust is equal to weight of liquid displaced by the submerged part of the body, so the weight of sea water displaced and weight of river water displaced by the same person is same. Hence their ratio is 1:1.

6) **Why it is easier to swim in sea water than in river water?**

Ans:- The density of sea water is comparatively more than the density of river water. So while swimming, the weight of a swimmer's body gets balanced by the weight of a lesser volume of sea water displaced. That means, while swimming, a lesser part of a swimmer's body remains submerged in sea water than that in river water. Hence it is easy to swim in sea water than in river water.

7) **A loaded cargo ship sails from sea water to river water? State and explain your observation.**

Ans:- As a loaded ship sails from sea water to river water, it gets submerged more in river water than that in sea water.

The density of river water is comparatively lesser than the density of sea water. So while sailing, the weight of a loaded ship gets balanced by the weight of a greater volume of river water displaced. That means, while sailing, a greater volume of the ship remains submerged in river water than that in sea water. That is why, as a loaded ship sails from sea water to river water, it gets submerged more in river water.

8) **As a ship in harbor is being unloaded, it slowly rises higher in water.**

Ans:- As a ship is unloaded, the weight of the ship decreases. So according to the principle of floatation, the weight of sea water displaced by the ship (upthrust of sea water) also decreases. That means the volume of the

submerged part of the ship decreases or in other words the ship slowly rises higher in water.

9) An iron nail sinks in water while an iron ship floats on water. Explain the reason.

Ans:- An iron nail is made from solid iron whose density is much higher than the density of water. So the weight of an iron nail is more than the weight of water displaced by it. Hence the iron nail sinks in water.

But an iron-made ship is hollow from inside containing air due to which its average density is less than the density of water. Therefore, even with a small portion of ship submerged in water, the weight of water displaced by the submerged part of ship becomes equal to the total weight of the ship. Hence the ship floats.

10) How it is so that a submarine can be made to dive into water or rise up to the surface of water as and when desired?

Ans:- A submarine is a water-tight boat provided with several ballast or floatation tanks in its front and rear parts. If a submarine is to dive, its ballast tanks are filled with water so that the average density of submarine becomes greater than the density of sea water. This makes the submarine to dive into water.

If the submarine is to rise, water from the ballast tanks is forced out into the sea by allowing the compressed air to enter the tank. This makes the average density of submarine to become less than that of sea water. As a result, the weight of water displaced by its partially small submerged part becomes equal to the weight of submarine and hence it rises up to the surface of water.

11) An egg sinks in fresh water, but floats in a strong salt solution.

Ans:- The density of egg is more than the density of fresh water. So the weight of an egg is more than the weight of water displaced by it. Hence an egg sinks in water. But as salt is added to water, the density of the salt solution increases. When the density of salt solution increases to such an extent that the weight of salt solution displaced by the egg becomes equal to the actual weight of the egg then the egg starts to float in the salt solution.

12) Icebergs floating in sea are dangerous for ships.

Ans:- The relative density of ice is 0.92 while that of sea water is 1.02. Therefore while floating in sea water, an iceberg has nearly 90% of its volume submerged and only 10 % of its body remain visible above the water surface.

So for the sailors of a ship, it becomes very difficult to estimate the actual size of a floating iceberg. So it is dangerous as the iceberg may collide with the ship causing damage to the ship.

13) A piece of ice floating in a glass of water melts, but the level of water does not change. Give reason.

Ans:- The density of ice is slightly lesser than that of water. So a floating piece of ice has nearly whole of its volume submerged in water and only the top surface is visible outside water. So as the piece of ice melts, the water formed occupies the same space inside water. The negligible portion appearing outside the water surface gets adjusted in the same water as ice contracts by volume on melting. Therefore there is no net change in the level of water after the floating piece of ice melts.

14) A toy balloon filled with hydrogen rises to the ceiling, but if filled with carbon dioxide sinks to the floor.

Ans:- The density of hydrogen is less than the average density of air. So a hydrogen filled balloon has weight lesser than the upthrust of air acting on it. Hence a hydrogen filled balloon experiences a net upward force and tends to rise to the ceiling.

In the other hand, the density of carbon dioxide is more than the average density of air. So a balloon filled with carbon dioxide has weight more than the upthrust of air acting on it. Hence a balloon filled with carbon dioxide, experiences a net downward force and sinks to the floor.

15) A balloon filled with hydrogen rises to a certain height and then stops rising further.

Ans:- The density of hydrogen is less than the average density of air. So a hydrogen filled balloon has weight lesser than the upthrust of air acting on it. Hence a hydrogen filled balloon experiences a net upward force and tends to rise upwards.

But as it rises more, it comes across the air of decreasing density. Hence the upthrust of air acting on the balloon decreases. At a certain height, when the upthrust of air becomes equal to the weight of the hydrogen balloon then it stops rising further because the net force acting on the balloon becomes zero.