ACADEMIC SESSION 2021-22

PHYSICS SMART SKILLS

CLASS IX

KEY FEATURES OF SCIENCE SMART SKILLS

- This edition is enriched with multiple choice questions, in-text questions, application based questions, very short answer type questions, short answer type questions, practice questions, figure based questions, etc. to check the child's grasp of the concept.

- The assignments will help to focus child's attention on the concept to follow and explain and reinforce the scientific concepts.

- The FACTOPAEDIA contains amazing scientific facts. This will help in creating awareness among the students about the world of science.

- Last but not the least – This smart skill has been prepared to help the children develop a scientific aptitude by
  - ✓ Reinforcing concepts
  - ✓ Strengthening expression
  - ✓ Developing independent thinking
  - ✓ Understanding the reasoning of day to day phenomena

INDEX

SYLLABUS

Theme: Moving Things, People and Ideas

Unit III : Motion, Force and Work

Motion: Distance and displacement, velocity; uniform and non-uniform motion along a straight line; acceleration, distance-time and velocity-time graphs for uniform motion and uniformly accelerated motion, derivation of equations of motion by graphical method; elementary idea of uniform circular motion.

Force and Newton's laws : Force and Motion, Newton's Laws of Motion, Action and Reaction forces, Inertia of a body, Inertia and mass, Momentum, Force and Acceleration. Elementary idea of conservation of Momentum

Gravitation: Gravitation; Universal Law of Gravitation, Force of Gravitation of the earth (gravity), Acceleration due to Gravity; Mass and Weight; Free fall. Floatation: Thrust and Pressure. Archimedes' Principle; Buoyancy; Elementary idea of Relative Density.

Work, energy and power: Work done by a Force, Energy, power; Kinetic and Potential energy; Law of conservation of energy.

Sound: Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and SONAR. Structure of the Human Ear (Auditory aspect only).

LIST OF EXPERIMENTS

1. Determination of the density of solid (denser than water) by using a spring balance and a measuring cylinder.
2. Establishing the relation between the loss in weight of a solid when fully immersed in
   a) tap water
   b) strongly salty water, with the weight of water displaced by it by taking at least two different solids.
3. Determination of the speed of a pulse propagated through a stretched string/slinky(helical spring).
4. Verification of the Laws of reflection of sound.

MOTION

LEARNING OUTCOMES

The student is able to

- differentiate materials, objects, phenomena, and processes, based on properties or characteristics
- plans and conducts investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own.
- calculates using the data given, draws labelled diagrams, flow charts, concept maps, graphs,
- analyses and interprets graphs and figures.
- uses scientific conventions, symbols, and equations to represent various quantities, elements, and units.
- derives formulae, equations.

CHAPTER 8

DESCRIBING MOTION

Assignment 8.1

1. Motion – An object is said to be in motion when its _____ changes continuously with respect to a stationary object with the passage of _____.

2. Rest – An object is said to be at rest when its _____ with respect to its surroundings does not change with the passage of _____.

3. (a) Distance – It is the length of the actual path between the _____ position and the _____ position of a moving object.

   (b) It is a _____ quantity.

   (c) The SI unit of distance is _____(m).

4. (a) Displacement – It is the _____ distance from the _____ position to the _____ position of a moving object.

   (b) It is a _____ quantity.

   (c) The SI unit of displacement is _____ (m).

5. Scalar quantities – The physical quantities which can be completely described with the help of their _____ alone are called _____ quantities.

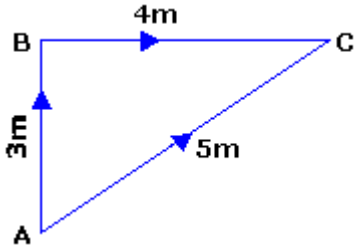
6. Vector quantities – The physical quantities which can be completely described with the help of their _____ and _____ are called _____ quantities.

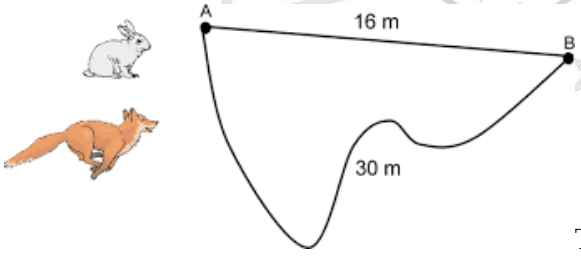
7. Distinguish between distance and displacement.

Distance	Displacement

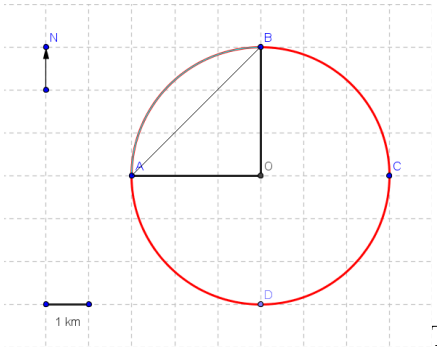
NUMERICALS

Note : 1. Distance – measurement of actual path travelled
2. Displacement – The straight line distance between two points

1. A ball is thrown upwards. It goes to the height of 100m and comes down. What is the net distance travelled by the ball and its net displacement?
2. Jose buys a new bicycle. He travels 3km south and then 4km east. How far does he need to go to get back to where he started if
   a. He chooses the shortest path?
   b. He chooses the same path?
3. 

In the above figure, an object moves from A to C along the path ABC. Find the distance travelled and displacement.
4. 

The rabbit takes the straight path from A to B whereas the fox takes the zig-zag path along AB.
   (i) Find the distance and displacement of the rabbit.
   (ii) Find the distance and displacement of the fox.
   (iii) Who covers larger distance?
   (iv) For whom , distance is same as displacement?



5. The diameter of the circular path is 14cm. If an object travels from A and completes one round, find its distance and displacement.
If the object travels from A to B along ADCB, find the distance travelled and displacement.

6. An object travels 20m towards east, turns and moves 15m towards north. Calculate the distance travelled and the displacement.

7. A boy takes one complete round of a circular track of radius 21m while a girl walks along the diameter of the same track. Calculate the distance travelled and the displacement by the boy and the girl.

8. A boy swims along the length of 60m in swimming pool and comes back in 100s. Find the distance covered by him and his displacement.

9. A particle is travelling along a circular path of diameter 15cm. Calculate the distance travelled and displacement at the end of half a round and on completing one round.

Study the following paragraph and answer the following questions:-

Two passengers A and B are sitting in a train which starts from the station. Some passengers are waiting at the platform. Observe the figure and answer the following questions:-

(i) What is the position of the passengers A and B with respect to each other?
(ii) What is the position of the passengers on the platform with respect to B?
(iii) What is the position of the platform with respect to passengers A and B?
(iv) What is the position of the platform with respect to the passengers waiting on the platform?
(v) Which scientific concept is learnt from the situation?

Assignment 8.2

1. (a) Speed – Speed of an object is defined as _____ travelled by the object per unit _____.

   (b) It is a _____ quantity.

   (c) The SI unit of speed is _____(m/s).

2. (a) Velocity – Velocity of an object is defined as _____ of an object per unit time.

   (b) It is a _____ quantity.

   (c) The SI unit of velocity is _____ (m/s).

3. Uniform / constant speed – If an object covers equal _____in equal intervals of _____, however small the time interval may be, the object is said to travel with uniform speed.

4. Non-uniform / variable speed – If an object travels unequal distances in equal intervals of time or vice versa, however small the time intervals may be, the object is said to travel with non-uniform speed.

5. Uniform / constant velocity – An object is said to move with uniform velocity, if it covers equal _____ [equal distances in a particular direction in equal intervals of time] or if it moves with uniform speed along the same direction.

6. Non-uniform / variable velocity – An object is said to move with non-uniform velocity, if the object changes either its _____ or direction of motion with the passage of time.

7. Velocity of an object can be changed by

   i. changing the _____ of the object keeping direction of motion same.

   ii. changing the _____ of motion keeping the speed same

   iii. changing both _____ and _____ of motion.

8. Distinguish between speed and velocity.

Speed	Velocity

NUMERICALS

1. Convert (a) 108km/h into m/s.
   (b) 1km/min into m/s
   (c) 15m/s into km/h

2. Priyanka takes 30 minutes to cover a distance of 3km on a bicycle. Calculate her velocity in km/min, m/s and km/h.

3. A car covers a distance of 36 km in one hour. Calculate its speed in m/s.

4. A football field is 100m long. If it takes a person 20s to run its length, how fast was the person running?

5. If you drive at 100km/h for 6 hours, how far will you go?

6. A bullet travels at 850m/s. How long will it take the bullet to go 1km?

7. A man walks 60m in 30s. Calculate his speed in m/s. If he maintains this speed, calculate the distance covered by him in 5minutes and 10 seconds.

8. Which of the following is moving faster – a bike moving at a speed of 300m/min or a car moving at a speed of 72km/h?

9. A biker travels 60km in 2 hours towards north. Calculate his velocity.

10. A boy starts from one corner of a square field, moves along the edge of the field of side 50m and stops after completing two and half rounds in 250s. Calculate
    (a) The distance covered the boy
    (b) The displacement of the boy
    (c) Speed with which he walked/ran
    (d) Velocity at the end point

ASSIGNMENT 8.3

1. Average speed – Average speed of a moving object is the ratio of the total _____ by the object to the total _____ taken by it.

   $$\text{Average speed} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

2. (a) Average velocity – Average velocity of a moving object is the _____ of the net displacement of the object to the total time taken.

   $$\text{Average velocity} = \frac{\text{net displacement}}{\text{total time}}$$

   (b) When the velocity of a object is changing at a uniform rate over a period of time, then the average velocity of the object is the arithmetic mean of the initial and final velocity of the object.

   $$\text{average velocity} = \frac{\text{initial velocity} + \text{final velocity}}{2}$$

   $$v_{av} = \frac{u + v}{2}$$

NUMERICALS

1. An object covers first 12m in 5s, next 20m in 8s and final 13m in 2s. Calculate his average speed.

2. John drove for 3 hours at a rate of 50km/h and for 2 hours at a rate of 60km/h. What was his average speed for the whole journey?

3. A bus travels a distance of 240km with a speed of 30km/h and returns with a speed of 60km/h. Calculate the average speed of the bus.

4. Mary drives her car at a speed of 30km/h for first half an hour, at 45km/h for the next one hour and at 40km/h for the next 2 hours. What is her average speed?

5. A boy goes to buy sweets from a shop 180m away from his house. He takes a minute to go and another minute to come back. Calculate his average speed and average velocity.

6. Arhan took a non-stop flight to visit his grandmother. The 750 km trip took 3hours and 45 minutes . Because of bad weather, the return trip took 4 hours and 45 minutes. What was his average speed for the round trip?

7. An object travels 16m in 6s and then another 16m in 2s. What is the average speed of the object?

8. A car travels 40 km at a uniform speed of 40km/h. What should be its speed for the next 80km if the average speed of the entire journey is 60km/h?

9. Ajay travels 30km daily to his office by car. While going one day, he covers 10km at a uniform speed of 30km/h and the rest 20km at a uniform speed of 40km/h. What is the average speed of his car?

10. A train travels some distance with a speed of 30km/h and returns with a speed of 45km/h. Calculate the average speed of the train.

ASSIGNMENT 8.4

1. Uniform motion – An object is said to have uniform motion if it moves along a _____ and covers equal distances in equal intervals of time, howsoever, small these intervals may be.

2. Non-uniform motion - An object is said to have non-uniform motion if it covers unequal distances in _____, howsoever, small these intervals may be or moves with non-uniform velocity.

3. (a) Acceleration – Acceleration of an object is defined as rate of change of _____ of an object.

   (b) It is a _____ quantity.

   (c) The SI unit of acceleration is _____

   (d) acceleration = $\frac{\text{change in velocity}}{\text{Time}}$

   acceleration = $\frac{\text{_____}}{\text{time}}$

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

4. Positive acceleration – If the velocity of an object _____ with time in the direction of the motion of the object, the acceleration of the object is positive.

   Negative acceleration – If the velocity of an object _____ with time, the acceleration of the object is negative. It is also called deceleration or retardation.

5. Uniform/_____ acceleration – If the velocity of an object changes by equal amounts in equal intervals of time, then the object is said to move with uniform acceleration.

6. Non-uniform/_____ acceleration – If the velocity of an object changes by unequal amounts in equal intervals of time, then the object is said to move with non-uniform acceleration.

7. (a) Uniform circular motion – When an object travels equal distances in equal intervals of time over a circular path so that _____ remains constant and _____ changes continuously, the motion of the object is said to be uniform circular motion.

   (b) It is an accelerated motion.

NUMERICALS

1. A train accelerates from 36km/h to 54km/h in 10 seconds. Find its acceleration.

2. A truck travelling at 54km/h slows down to 36km/h on applying brakes in 10 seconds. Find its retardation.
3. A car starts from rest and acquires a velocity of 54km/h in 2seconds. Find the acceleration of the car.

4. A bicycle increases its velocity from 10km/h to 15km/h in 6s. Calculate its acceleration.

Assignment 8.5

DERIVATION OF THE EQUATIONS OF MOTION BY THE GRAPHICAL METHOD

FIRST EQUATION OF MOTION

INTRODUCTION

Consider an object that starts moving with initial velocity 'u' shown by point A on the graph. It attains final velocity 'v' by accelerating uniformly at the rate of 'a' m/s^2 within a time 't'. In the graph drop 2 perpendiculars from point B to the time axis and the velocity axis shown as BC and BE respectively. Draw AD parallel to OC.

GRAPH (To be drawn in class)

From the graph, acceleration, a = slope of line AB,

$$a = \frac{BD}{AD}$$

$$a = \frac{BD}{t}$$

This implies , BD = at

BC = BD + DC

v = u + at [BC=v , DC=u]

v = u+at ---------- First equation of motion

SECOND EQUATION OF MOTION

(Draw the graph and repeat the above introduction)

In the graph we can calculate the distance travelled by the object in the time 't' as follows.

Distance, s = Area of the quadrilateral OABC

s = Area of triangle ABD+ Area of OADC

s = ½ AD BD + OC OA

Substituting AD= OC ='t' , BD=at and OA =u ,

s = ½ t at +ut

$s = ut + \frac{1}{2} at^2$ ----------Second equation of motion

THIRD EQUATION OF MOTION

(Repeat the introduction and draw the graph)

Distance covered by the object in time 't', s = Area of quadrilateral OABC

$s = 1/2 (OA + BC) OC$

Since OC=t , OA= u , BC=v

$s = 1/2 (u +v) t$

Since t=v-u/a , $s = 1/2(u+v) (v-u/a)$

$s = 1/2(v^2-u^2)/a$

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

$v^2 = u^2+2as$ ----------Third equation of motion

EQUATIONS OF MOTION FOR FREELY FALLING BODIES

v=u+gt

$h=ut+1/2gt^2$

$v^2=u^2+2gh$

where h= vertical distance covered ,g= acceleration due to gravity =9.8m/s^2

NUMERICALS

1. A trolley bag slides on an inclined plane with an acceleration of $0.2m/s^2$. What will be its velocity 3s after the start?

2. A bus starts from the bus depot, moves with an acceleration of $0.5m/s^2$ for 2 minutes. Find the speed acquired.

3. An object moves along a straight line with an acceleration of $2m/s^2$. If its initial speed is 10m/s, what will be its speed after 5s?

4. A ball hits a wall horizontally at 6m/s. It rebounds horizontally at 4.4m/s. The ball is in contact with the wall for 0.04s. What is the acceleration of the ball?

5. A car travelled at a velocity of 54km/h is brought to rest by applying brakes in 3s. Calculate its retardation.

6. A bullet hits a wall with a velocity of 20m/s and penetrates up to a distance of 5cm. Find the deceleration of the bullet in the wall.

7. A ship moving with a constant acceleration of $36km/h^2$ in a fixed direction speeds up from 12 to 18 km/h. Find the distance travelled by the ship in this period.

8. A train starts from a station and moves with a constant acceleration for 2 minutes. If it covers a distance of 400m within this period, calculate its acceleration.

9. A car accelerates uniformly from 18 km/h to 36 km/h in 5s. Calculate the acceleration and the distance covered by the car.

10. A truck moves with a velocity of 36km/h. How much distance will it cover in 1 minute if it moves with a uniform acceleration of $1m/s^2$?

11. How much distance will a vehicle moving with uniform acceleration of $4m/s^2$ cover in 5 seconds if the initial velocity of the vehicle is 5m/s.

Assignment 8.6

MULTIPLE CHOICE QUESTIONS

1. For a moving body,
   a. displacement = distance
   b. displacement ≤ distance
   c. displacement ≠ distance.
   d. distance ≤ displacement.

2. A body whose speed is constant
   a. must be accelerated
   b. might be accelerated
   c. has a constant velocity
   d. cannot be accelerated

3. A particle is moving in a circular path of radius r. The displacement after half a circle would be
   a. zero
   b. лr
   c. 2r
   d. 2лr

4. A child runs along a circular path. On completing 4 rounds, distance travelled is-
   a. the circumference
   b. twice the circumference
   c. four times the circumference
   d. twice the radius

5. The rate of change of displacement is-
   a. retardation
   b. velocity
   c. acceleration
   d. speed

6. When the distance covered by a body is directly proportional to time, the body is said to have-
   a. zero velocity
   b. zero speed
   c. uniform acceleration
   d. uniform speed

7. The distance time graph of a body is a straight line inclined to the time axis. The body is in-
   a. uniform motion
   b. rest position
   c. uniform acceleration
   d. uniform retardation

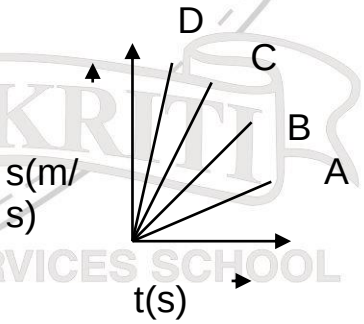
8. Which of the following is not a vector-
   a. displacement
   b. velocity
   c. acceleration
   d. speed

9. The average velocity of a body is equal to the mean of the initial and final velocity. The acceleration of the body is –
   a. variable
   b. 0
   c. negative
   d. uniform

10. Which of the following is not a unit of acceleration?
   a. km/s^2
   b. cms^{-2}
   c. km/s
   d. m/s^2

11. When a car runs on a circular track with uniform speed, its velocity is said to be changing because
   a. car has a uniform acceleration
   b. direction of car varies continuously
   c. car travels unequal distances in equal time intervals
   d. car travels equal distances in equal time intervals

12. Four cars A, B, C and D are moving on a leveled road. Their distance- time graphs are shown in the figure. Choose the correct statement.



   a. A is faster than D
   b. B is slowest
   c. D is faster than C
   d. C is slowest

13. The numerical ratio of displacement to distance for a moving object is
   a. always less than 1
   b. always equal to 1
   c. always more than 1
   d. equal to or less than 1

14. In which case, the distance moved and magnitude of displacement are equal?
    a. pendulum is moving to and fro
    b. car is moving on a straight road
    c. car is moving on a circular track
    d. earth revolving around the sun

15. A physical quantity which cannot be negative is
    a. displacement
    b. distance
    c. velocity
    d. acceleration

16. For a v-t graph with a straight line parallel to time axis, it can be inferred that the object is
    a. in uniform motion
    b. at rest
    c. in non-uniform motion
    d. moving with uniform acceleration

17. Area under a v-t graph represents a physical quantity which has the unit
    a. m^2
    b. m
    c. m^3
    d. ms^{-1}

18. In which of the following cases of motions, the distance moved and the magnitude of displacement are equal?
    a. If the car is moving on straight road
    b. If the car is moving in circular path
    c. The pendulum is moving to and fro
    d. The earth is revolving around the Sun

Assignment 8.7

SHORT ANSWER QUESTIONS

1. A body continues to move with the constant velocity. Name the physical quantity that becomes zero?

2. The displacement of a moving object in a given interval of time is zero. Would the distance travelled by the object also be zero? Justify your answer.

3. Displacement of a body is 3m when distance travelled by it is 2m.Can it be true?

4. What is the nature of the distance time graph of an object that is in a state of rest ?Write your answer in words.

5. A body falls freely. Which physical quantity is constant?

6. What is the name given to speed in a specific direction?

7. What do the speedometer and odometer of a car measure?

8. Under which condition, the magnitude of average velocity equal to average speed?

9. What is the acceleration of a body moving with uniform velocity?

10. What type of motion is exhibited by a freely falling body?

11. What remains constant and what changes continuously in uniform circular motion?

12. Name the quantity which is measured by area occupied under velocity-time graph?

13. What does the slope of speed-time graph and distance-time graph indicate?

14. What can you say about the motion of a body if its speed-time graph is a straight line parallel to the time axis?

15. A train is moving out of a railway station. Is the platform at rest or in motion with respect to the train?

16. Two moving objects appear to be stationary to each other. When is this possible?

17. What is the other term for negative acceleration?

18. Why is uniform circular motion called accelerated motion?

19. What are the SI and CGS units of speed?

20. How will the equations of motion for an object moving with uniform velocity change?

21. Draw a velocity versus time graph of a stone thrown vertically upwards and then coming downwards after attaining the maximum height.

22. What are the SI and CGS units of acceleration?

23. What does the area enclosed by a speed - time and velocity –time graph signify?

Assignment 8.8

Plot the graph for the following data:-

1.

Distance(km)	0	5	10	15	20	25	30
Time(h)	0	2	4	6	8	10	12

2.

Distance (m)	3	3	3	3	3	3	3
Time(s)	0	1	2	3	4	5	6

3.

Distance(m)	0	3	6	12	21	30	39	54
Time(min)	0	5	10	15	20	25	30	35

4.

Displacement (km)	0	3	6	9	12	12	12	12
Time(s)	0	5	10	15	20	25	30	35

5.

Speed(m/s)	12	10	8	6	4	2	0
Time(s)	0	3	6	9	12	15	18

6.

Speed(km/h)	0	5	10	15	20	25	30
Time(h)	0	2	4	6	8	10	12

7.

Velocity(m/s)	0	2	4	6	8	10	12
Time(s)	0	1	2	3	4	5	6

8.

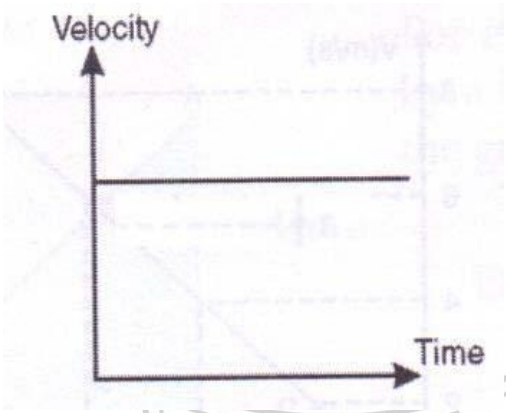
Velocity(km/h	0	2	4	6	8	6	4	2	0
Time(h)	0	3	6	9	12	15	18	21	24

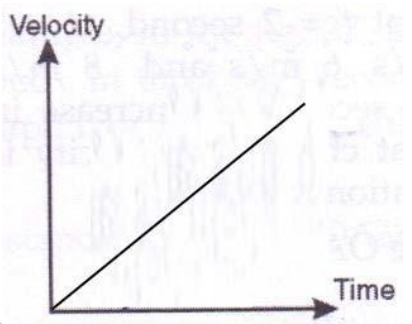
9.

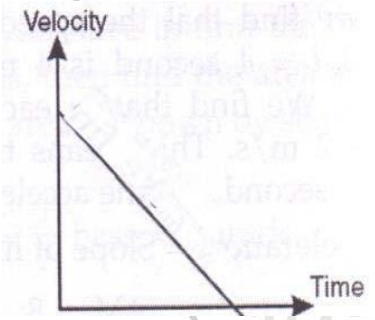
Velocity(m/s)	0	2	6	12	22	36	56	80
Time(s)	0	5	10	15	20	25	30	35

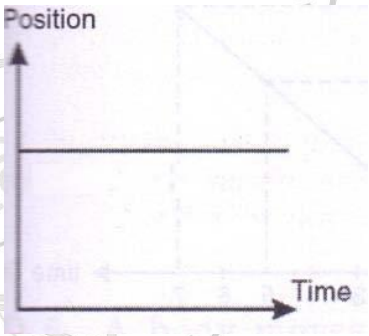
ASSIGNMENT 8.9

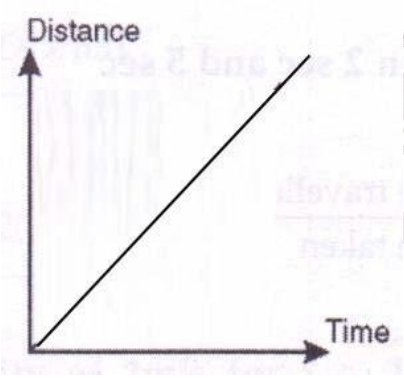
What is the nature of the graph in the following figures?

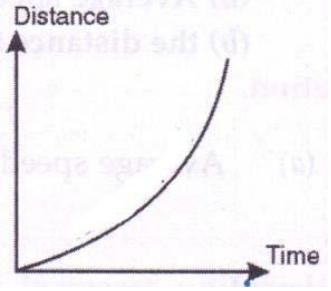


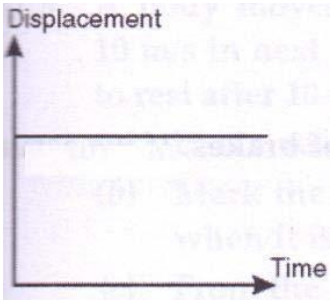


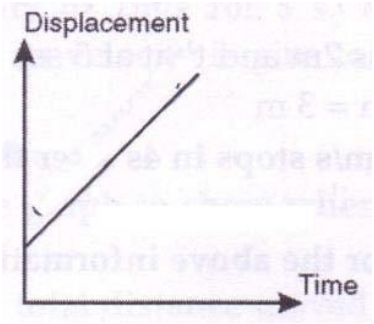


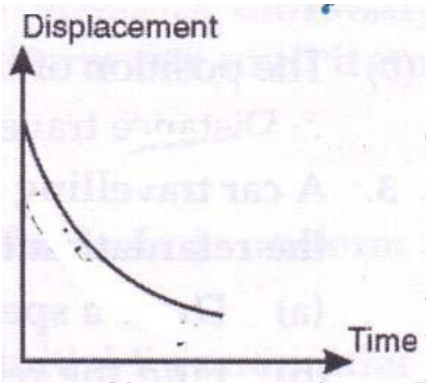


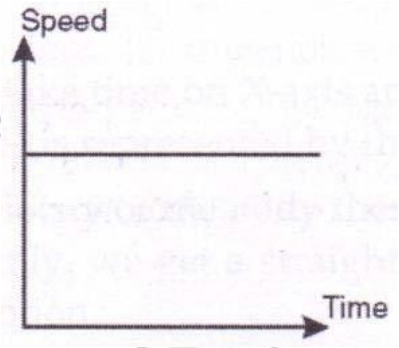


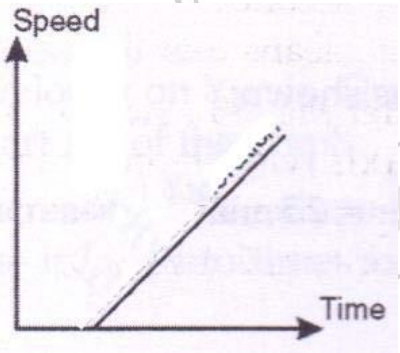


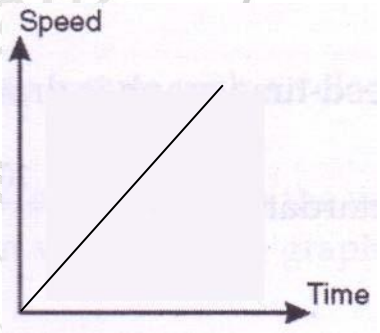






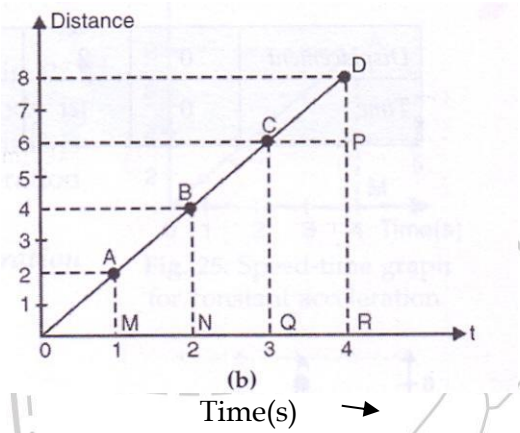




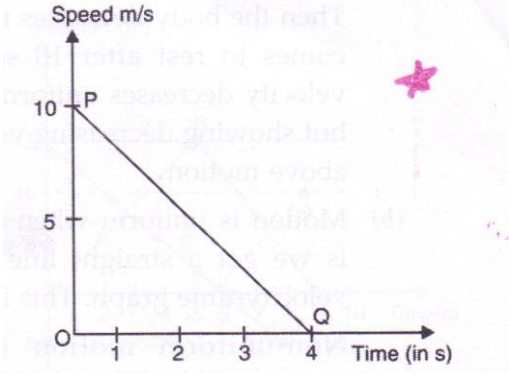


ASSIGNMENT 8.10

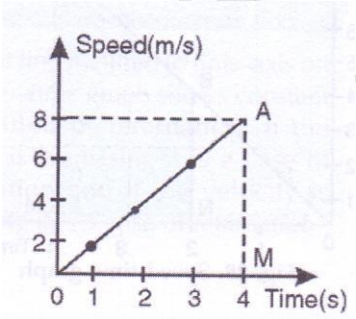
1. Calculate speed from the given distance-time graph during (a) 0-2s (b) 3s-4s.



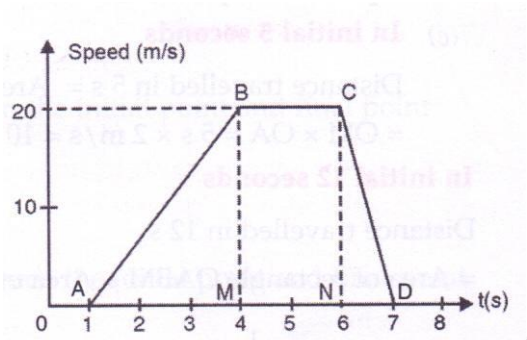
2. Calculate retardation between 0-4s from the given speed-time graph.

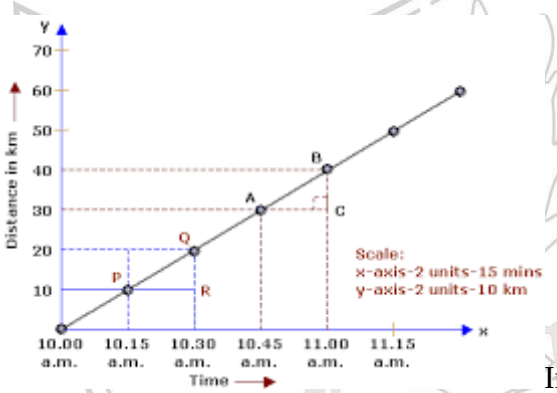


3. Calculate the acceleration and distance travelled between 0-4s from the given speed-time graph.

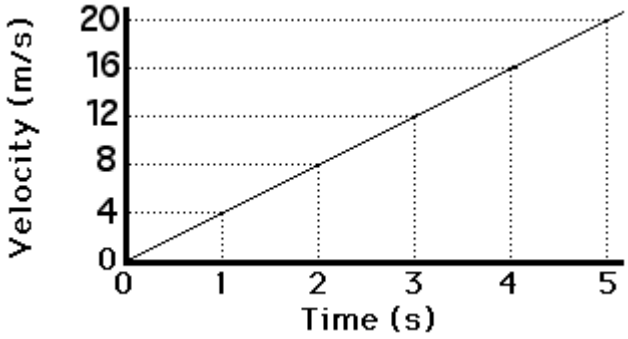


4. Calculate the acceleration during AB and the displacement between1s-6s from the given velocity-time graph.



5. 

In the given figure, find the speed between 10.30am and 11.00am.

6. 

In the given velocity-time graph, interprete the nature of the object's motion and calculate the acceleration and displacement between time interval 2 to 4s.

Assignment 8.11

1. What do the slopes of the following graphs give?

(a) distance-time graph - _____

(b) displacement-time graph - _____

(c) speed-time graph - _____

(d) velocity-time graph - _____

2. Name the physical quantity, the slope of whose graph against time gives

(a) speed - _____

(b) acceleration – _____

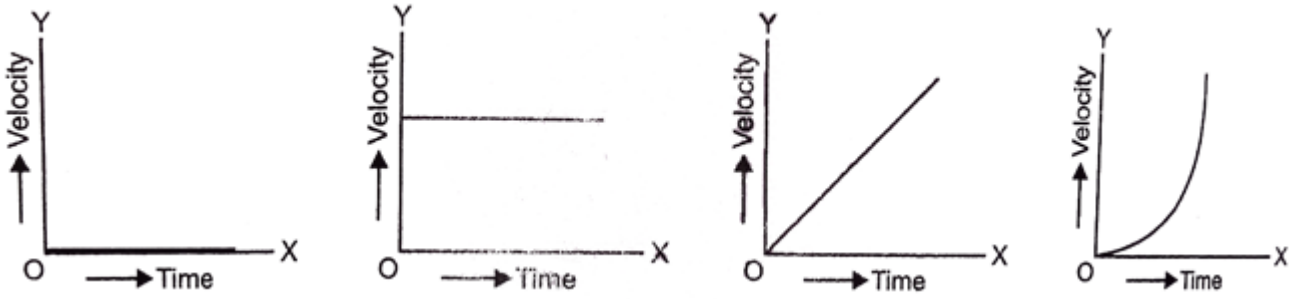
(c) velocity - _____

3. A passenger lift starts from rest, accelerates uniformly and attains a speed of 4.6m/s in 2s. This speed is maintained for the next 6s. Then the lift undergoes uniform deceleration and stops in the next 2s. Draw the velocity-time graph of the lift and calculate the total distance covered by the lift in 10s.

Assignment 8.12

CASE STUDY QUESTIONS

1. Observe the given velocity-time graph and answer the following questions:-

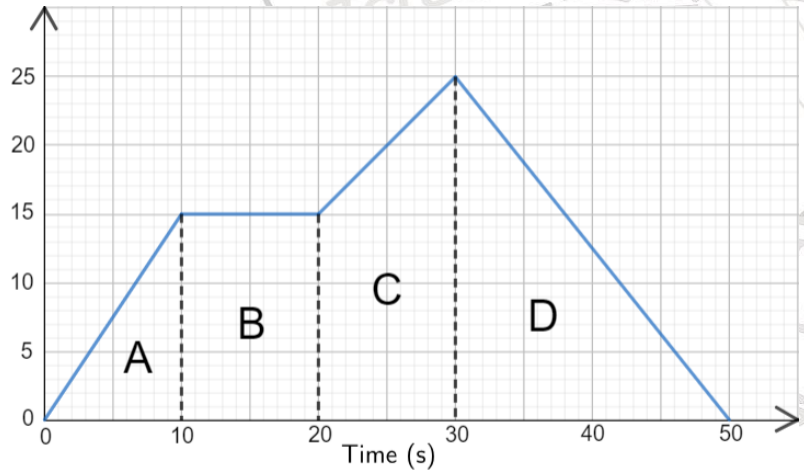


(a) **(b)** **(c)** **(d)**

(i) Interpret the changing trend of velocity from (a) to (d).

(ii) What kind of acceleration is shown in (b), (c) and (d)?
(iii) In which case is the displacement zero?
(iv) In which case there is uniform motion?

2. Observe the speed-time graph of an object in motion and answer the following questions:-



(a) Which part of the graph represents uniform motion?
(b) Find the acceleration of the body during 20-30 s.
(c) What is the displacement of the body during 0-20 s?
(d) When does the body show uniform retardation?

3. **Relative motion** is all about motion in relation to a **frame of reference**. For example, you may be sitting by your window observing a taxi driving past your house. From your perspective, you are at rest and the taxi is moving. However, a passenger in the taxi would see you as moving.

An observer at a train station would see a fast train that does not stop at that station move past them at a speed of 100 km/h. If the observer can see inside the train, a cup of coffee on a train table would be seen as moving at the same speed as the train. A passenger on the train, though, would perceive the same cup of coffee being at rest on the table.
If you have travelled in a car on the motorway, you may have noticed that other cars passing by appear to move slowly past you, even though you know the actual speeds of the cars are very high. This is because of their relative motion to each other.

(a) When is an object said to be in motion?
(b) Why do we say that "motion is relative"?
(c) When can we infer that two men in motion are at rest with respect to each other?

ASSERTION – REASON QUESTIONS

Directions : In the following questions, the Assertions (A) and Reasons ® have been put forward. Read both the statements carefully and choose the correct alternative from the following:

(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion
(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion
(C) Our Assertion is true but the Reason is false
(D) The statement of the Assertion is false but the Reason is true

1. **Assertion** : The accelerated motion of an object may be due to change in magnitude of velocity or direction or both of them.

Reason : Acceleration can be produced only by change in magnitude of the velocity. It does not depend on the direction

2. **Assertion** : The speedometer of a car measures the average speed of the car.

Reason : Average speed is equal to the total distance travelled by the car divided by the total time taken.

3. **Assertion** : Displacement of a body may be zero when the distance travelled by it is not zero.

Reason : The displacement is the shortest distance between the initial and final position whereas distance is the total length of the actual path traversed.

4. **Assertion** : A body can have acceleration even if its velocity is zero at a given instant of time.

Reason : When a body is thrown vertically upwards, it is momentarily at rest at the maximum height and when it reverses its direction of motion.

NOTES

FACTOPAEDIA

- **The longest recorded flight of a chicken was 13 seconds**
- **The longest street in the world is Yonge street in Toronto Canada measuring 1,896 km (1,178 miles)**
- **The Great Wall of China is approximately 6,430 Km long (3,995 miles)**
- **If your DNA was stretched out it would reach to the moon 6,000 times**
- **The human body contains 96,000km(59,650miles) of blood vessels**
- **The average person walks the equivalent of twice around the world in a lifetime**
- **Sun light can penetrate clean ocean water up to a depth of 73m (240 feet)**
- **Your tongue is the fastest healing part of your body**
- **The first train reached a top speed of only 8 kmh (5 mph)**
- **A car travelling at 80kph (50mph) uses half its fuel to overcome wind resistance**
- **Squirrels can climb trees faster than they can run on the ground**
- **The greyhound is the fastest dog and can reach speeds of up to 72kph (45mph)**
- **The fastest fish in the sea is the swordfish and can reach up to speeds of 108kph (68mph, 59knots)**
- **Flies can react to an object it sees and change direction in less than 30 milliseconds**
- **A woodpecker can peck 20 times a second**
- **Fingernails grow faster than toenails**
- **Tachophobia is the fear of speed**

FORCE AND NEWTON'S LAWS OF MOTION

LEARNING OUTCOMES

The student is able to

- differentiate phenomena and processes based on properties or characteristics
- plan and conduct investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,
- calculates using the data given, draw concept maps,analyse and interpret graphs and figures
- uses scientific conventions, symbols, and equations to represent various quantities, elements, and units,
- derives formulae and equations
- draw conclusions and communicate the findings and conclusions effectively,
- apply scientific concepts in daily life and solving problems,
- measures physical quantities using appropriate apparatus, instruments and devices,

ISAAC NEWTON

In 1642, the year that Galileo Galilei died, Isaac Newton was born prematurely on Christmas Day.

Newton was born into a farming family. When he was 17, his mother insisted that he returned from school to run the family farm! Thankfully, Newton was a bad farmer and not long afterwards, his uncle successfully persuaded his mother to let him attend Trinity College in Cambridge instead.

- Newton's discoveries about light and movement of planets were used to make the first flights to the moon possible.
- Newton at only age 26 became a professor of math.
- Newton believed God was invisible but influenced every part of people's lives.
- Newton was an Arian, or a follower of a secret religion that didn't believe in the Holy Trinity.
- Newton practiced Alchemy. Alchemy is an ancient practice banned in England in 1404.
- Newton was elected as a member of parliament. His membership lasted only a year.
- Newton earned the title of Warden of the Royal Mint.
- Newton oversaw the recoinage of the whole country.
- Newton was knighted because of his political activities.
- Isaac was named after his father who died three months before Isaac was born.
- Isaac was born early. He was so small he could have put him in a quart jug.

- Isaac's father could hardly write his name.
- Isaac was one of the worst in his class until a bully at school kicked him. Isaac challenged him to a fight even though he was smaller. He won. That wasn't enough for him, he decided to be better than the bully at school as well.
- Isaac liked to draw, his room was even coloured on the ceilings and walls.

CHAPTER – 9

FORCE AND NEWTON'S LAWS OF MOTION

Assignment 9.1

1. (a) **Force [F]–** It is a _____ or _____ which changes or tends to change the state of rest or of uniform motion, direction of motion or the shape and size of an object.

   (b) It is a _____ quantity.

   (c) The SI unit of force is _____ (**N**).

   (d) SI unit of force - **Newton** [its definition]**–** One newton is the amount of force which produces an acceleration of 1m/s2 in a body of mass 1kg.
   $1N = 1kg \cdot 1m/s^2$

   (e) CGS unit of force - **Dyne**
   $1 \text{ dyne} = 1g \cdot 1cm/s^2 = 10^{-5}N$

2. **Balanced forces –** When a number of forces acting on a body do not cause any change in its state of _____ or of _____ _____ in a straight line, then the forces are said to be balanced forces.

   i. They cannot set a stationary body into motion.

   ii. They cannot change the speed or velocity of a moving body.

   iii. They may change the shape and size of a soft object

   iv. The resultant force acting on the body is zero.

3. **Unbalanced forces –** When the resultant of all the forces acting on a body is _____ _____, the forces are called unbalanced forces.

   i. They can set a stationary body into motion.

   ii. They can bring a moving body to rest.

   iii. They can change the direction of motion.

4. **Newton's first law of motion** [Law of _____] – It states that "An object continues to remain in its position of rest or of uniform motion in a straight line unless an external unbalanced force acts on it".

5. **Inertia** – It is the tendency of undisturbed objects to stay _____ or to keep moving with _____ velocity.

OR

It is the property of an object to resist any change in its state of rest or of uniform motion.

6. **Mass is the measure of inertia**. Or in other words Inertia is _____ to mass of an object. The larger is the mass, larger is the inertia and vice-versa.

7. **Types of inertia –**

   i. **Inertia of rest –** It is the tendency of an object to oppose any change in its state of _____.

Eg 1. When a bus starts stars suddenly, passengers tend to fall backward.
2. When a carpet is shaken, dust particles get separated from the carpet.

   ii. **Inertia of motion –** It is the tendency of an object to oppose any change in its state of _____.

Eg 1. When a moving bus stops suddenly, passengers tend to fall forward.
2. An athlete runs a certain distance beyond the finishing line before stopping.

   iii. **Inertia of direction –** It is the tendency of an object to oppose any change in its _____ of motion.

Eg 1. When a moving bus takes a sudden turn, passengers tend to fall sideways.
2. When a vehicle moves on wet road, the water and dust particles fly off tangentially to the moving wheels.

Explain giving scientific reason :-

1. When a bus starts suddenly, a standing passenger tends to fall backwards.

2. A luggage is usually tied with a rope on the roof of buses.

3. When a tree is given a jerk, ripe fruits and dried leaves fall.

4. When the striker hits the lowest coin of the vertical pile of carom coins, the pile remains intact although that coin moves from its place.

ASSIGNMENT 9.2

1. **Momentum** [p] – The _____ possessed by a moving body is known as the momentum of the body.

    i. It is equal to the product of mass [m] and velocity[v] of the body.

    ii. Hence, $p = m v$

    iii. It is a _____ quantity.

    iv. The SI unit of momentum is kilogram metre per second [_____]

2. **Newton's second law of motion** – It states that " the rate of change of momentum of an object is directly proportional to the applied unbalanced force in the direction of force".

Derivation of mathematical form of Newton's second law

We consider an object of mass m moving with initial velocity u. A force F is applied on the object for time t so that the velocity of the object after time t is v [final velocity].

Diagram

Initial momentum of the object, p_i =

Final momentum of the object, p_f =

Change in momentum =

Rate of change of momentum =

By Newton's second law, Rate of change in momentum _____ Force applied

Hence, force acting on an object is directly proportional to its mass and its acceleration.

Explain giving scientific reason :

1. A karate player breaks a pile of tiles in a single blow.

2. A cricket player lowers his hands while catching a ball.

3. After taking a high jump, the athlete lands on a cushioned surface.

NUMERICALS

1. What is the momentum of a body of mass 5kg moving with a velocity of 0.2 m/s?

2. A body of mass 25kg has a momentum of 125kgm/s. Calculate the velocity of the body.

3. Find the acceleration produced by a force of 20 N acting on a body of mass 5kg.

4. Find the magnitude of net force on a 20kg mass if it accelerates uniformly from 2.5m/s to 5.8 m/s in 3s.

5. A ball of mass 200g moving with a velocity of 20m/s is stopped by a player on 0.25s. Calculate the force applied by the player to stop the ball.

6. A body A of mass 1kg has acceleration $2m/s^2$. Another body B of mass 0.5kg has acceleration $5m/s^2$. On which body greater force acts.

7. Calculate the momentum of a ball of mass 450g moving with a velocity of 120 km/h.

8. For how much time should a force of 500N be exerted on a body of mass 10kg to increase its velocity from 100m/s to 300m/s?

3. **Newton's third law of motion –** It states that "To every action there is an equal and opposite reaction".

Eg. When a player kicks a football, the football moves forward and the foot of the player moves backward.

Action – Force with which the football is kicked by the player

Effect of action force – football moves forward

Action force acts on the football.

Reaction – Force exerted by the football on the foot of the player.

Effect of reaction force – foot of the player moves backward.

Reaction force acts on the foot of the player.

Hence we see that action and reaction forces are equal in magnitude and opposite in direction.
Yet they are not balanced forces as they act on two different objects.

Explain giving scientific reason :-

1. We are able to swim.
2. When an inflated balloon is untied, the balloon rises up.
3. Before a person jumps out of a boat in the shore, the boat is tied with a hook on the shore.
4. Glass or bone china crockery is wrapped in newspaper or straw during transportation.
5. A fireman struggles to hold a hose pipe.

ASSIGNMENT 9.3

1. **Law of conservation of momentum –** According to the law of conservation of momentum, the total momentum of a system [or an object] remains constant if no net external unbalanced force acts on the system.

Proof:

2. Recoil velocity of a gun

Let the mass and velocity [after firing] of the bullet be m_b and v_b

And the mass and velocity [after firing] of the gun be m_g and v_g respectively.

Total momentum of gun and bullet before firing =

Total momentum of the gun and bullet after firing =

According to law of conservation of momentum,

Explain giving scientific reason :-

1. Propulsion of a rocket as it it is launched.
2. Recoiling of a gun when a bullet is fired.

NUMERICALS

1. A bullet leaves a rifle with a velocity of 100m/s and the rifle of mass 2.5kg recoils with a velocity of 1m/s. Find the mass of the bullet.
2. A bullet of mass 10g is fired at a speed of 400m/s. from a gun of mass 4kg. What is the recoil velocity of the gun?
3. A shell of mass 100kg is fired with a velocity of 300m/s. If the cannon has a mass 1000kg, what is the velocity of recoil of cannon?
4. Two small glass spheres of masses 10g and 20g are moving in a straight line in the same direction with velocities of 3m/s and 2m/s respectively. They collide with each other and after collision, glass sphere of mass 10g moves with a velocity of 2.5m/s. Find the velocity of the second ball after collision.

ASSIGNMENT 9.4

Identify the law / theory applicable in each of the following :-

1. When a branch of a tree is shaken, dried leaves and ripe fruits leaves from the branches fall down.

2. A standing passenger in a bus falls forward when sudden brakes are applied.

3. When a bus takes a sharp turn, passengers tend to fall sideways / in the outward direction.

4. An athlete runs some distance before taking a long jump.

5. A boxer moves his head backward to minimize the effect of the coming punch.

6. A passenger jumping out of a fast moving bus runs forward after he steps on ground.

7. An athlete running a 100m race never stops at the finishing line.

8. A rubber ball bounces off after hitting a concrete floor.

9. Glass or bone china crockery is wrapped in newspaper or straw during transportation.

10. When a dog chases a hare, the hare takes a zigzag path.

11. A book can be easily pulled out from the bottom of a pile without disturbing the pile.

12. A stone tied to a string if whirled around, the stone flies off tangentially if the string breaks.

13. It is difficult for a fireman to hold a hose pipe which ejects large amounts of water at a high velocity.

14. On firing a bullet from a gun, the gun recoils.

15. It is advised to tie any luggage kept on the roof of a bus with a rope.

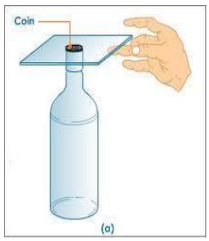
16. When a carpet is beaten with a stick, dust comes out of it.

17. A boat moves backward when a person jumps out of it.

18. An athlete taking a high jump is made to fall on a cushioned bed.
19. It is advised to wear seat belt while driving.
20. Automobiles are provided with shock absorbers or shockers.
21. Mudguards are provided in motorcycles.
22. A person suffer severe injuries when he falls on a concrete floor than on sandy surface.
23. Rowing of a boat possible
24. A karate player can break a slab of ice with a single blow.
25. Sparks coming out of a grinding stone move tangentially.
26. Water droplets come out when a wet cloth is given a jerk.
27. Launching of a rocket.
28. A fielder lowers his hands while catching a ball.

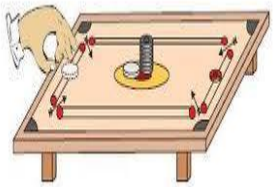
Assignment 9.5

For each of the given identify the law/theory applicable for explanation:-

1. 

2. 

3. 

4. 

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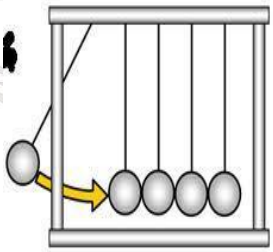
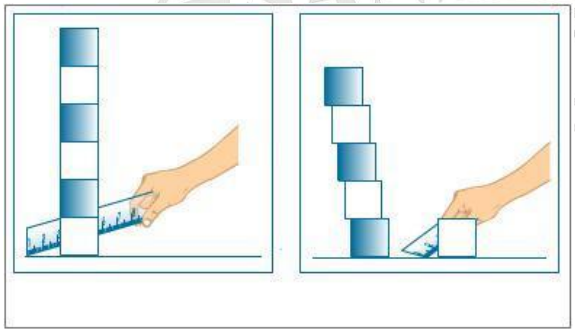
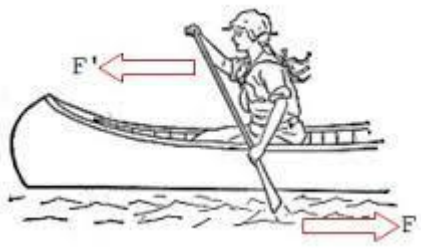
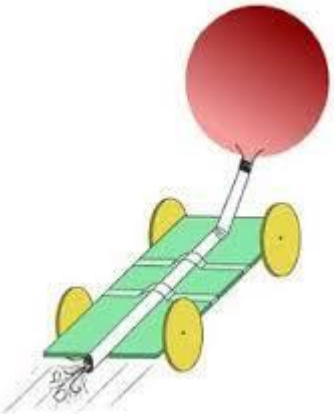
6. 

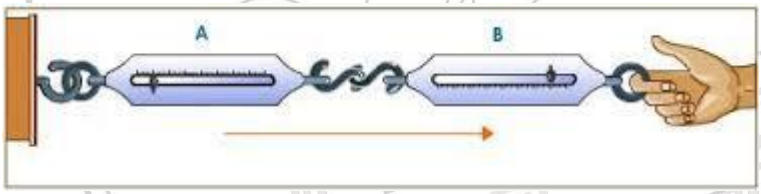
9. 

8. 

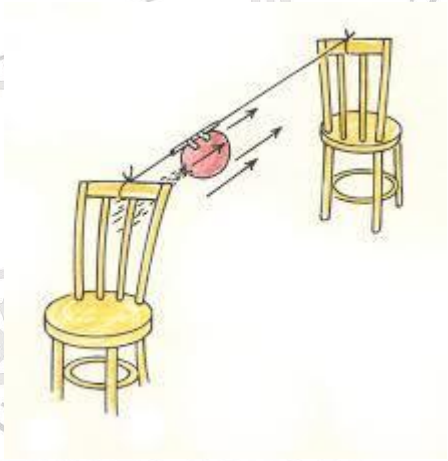


9. _____

10. _____



11. _____



12. _____

Assignment 9.6

MULTIPLE CHOICE QUESTIONS

1. A football and a stone have same mass. Both have
   i. Same inertia
   ii. Same momentum
   iii. Different inertia
   iv. Different momentum

2. The inertia of an object tends to cause the object
   i. to increase its speed
   ii. to decrease its speed
   iii. to resist any change in its state of motion
   iv. to decelerate due to friction

3. A passenger in a moving train tosses a coin which falls behind him. It means that motion of the train is
   i. accelerated
   ii. uniform
   iii. retarded
   iv. along circular tracks

4. Action and reaction forces
   i. Act on same body
   ii. Act on different bodies
   iii. Act in the same direction
   iv. Unequal in magnitude

5. In the game of football, the goalkeeper pulls his hands backwards while holding the ball shot at the goal . This enables the goalkeeper to
   i. Exert larger force on the ball
   ii. Reduce the force exerted by the ball on his hands
   iii. Increase the rate of change of momentum
   iv. Decrease the rate of change of momentum

6. The inertia of an object tends to cause the object to
   i. Decelerate due to friction
   ii. Resist any change in its state of rest or motion
   iii. Increase its speed
   iv. Decrease its speed

7. An object of mass 2kg is sliding with constant velocity of 4m/s on a frictionless horizontal table. The force required to keep the object moving with the same velocity is
   i. 32N

ii. 8N
iii. 2N
iv. 0N

8. If A and B are two objects with masses 6kg and 34kg respectively

i. A has more inertia than B
ii. B has more inertia than A
iii. A and B have the same inertia
iv. None have inertia

9. Unbalanced forces act on a body. The body

i. must remain at rest
ii. must be accelerated / decelerated
iii. must move with uniform velocity
iv. moves in a zigzag manner

10. Balanced forces act on a body. The body

i. must remain at rest
ii. must be accelerated
iii. must move with uniform velocity
iv. moves in a zigzag manner

11. Force measures rate of change of

i. mass
ii. momentum
iii. velocity
iv. acceleration

12. Acceleration measures rate of change of

i. mass
ii. momentum
iii. velocity
iv. acceleration

13. Inertia of an object tends to cause the object to

i. resist any change in its state of motion
ii. decrease its speed
iii. increase its speed
iv. decelerate due to friction

14. Relation between force, mass and acceleration is given by

i. Newton's first law of motion
ii. Newton's second law of motion
iii. Newton's third law of motion
iv. Newton's universal law of gravitation

15. Four iron balls A, B, C and D have mass 1kg, 3kg, 2kg and 5kg respectively. They move with same velocity. Which of them will have largest momentum?

i. A
ii. B
iii. C
iv. D

16. Same force acts on four objects P,Q,R and S of masses 4kg, 3kg, 2kg and 1kg respectively. Which object will have least acceleration?

i. P
ii. Q
iii. R
iv. S

17. A father and the son have masses 60kg and 30kg respectively. The ratio of inertia of the father to inertia of the son is

i. 1:1
ii. 1:2
iii. 2:1
iv. 1:3

18. The earth attracts a stone towards itself with a force of 10N. The force with which the stone attracts the earth is

i. 20N
ii. Infinite
iii. Zero
iv. 10N

Assignment 9.7

SHORT ANSWER QUESTIONS

1. There are three solids made up of aluminium, steel and wood, of the same shape and same volume. Which of them would have highest inertia?

2. Two balls of the same size but of different materials, rubber and iron are kept on the smooth floor of a moving train. The brakes are applied suddenly to stop the train. Will the balls start rolling? If so, in which direction? Will they move with the same speed? Justify.

3. A truck of mass M is moved under a force F. If the truck is then loaded with an object equal to the mass of the truck and the driving force is halved, then how does the acceleration change?

4. Two friends on roller-skates are standing 5m apart facing each other. One of them throws a ball of 2kg towards the other, whoc catches it. How will this activity affect the position of the two?

5. Name the physical quantity that measures inertia. State its SI unit.

6. A runner presses the ground with his feet before he starts his run. Identify the action and reaction forces in this situation.

7. Three solids made up of aluminium, steel and wood have the same shape and volume. Which of them would have highest inertia?

8. Which of the Newton's laws explains 'water sprinklers used for grass lawns begin to rotate as soon as the water is supplied'?

9. While riding a bicycle, if we stop pedaling, why does the bicycle begin to slow down?

10. Name the two forces acting on a toy car being pulled by a child.

11. Why is the recoil velocity of a gun much less than the velocity of bullet?

12. Can balanced forces stop a moving body? Can it change the shape and size of a body?

13. Name the physical quantity whose SI unit is $kgms^{-1}$.

14. What is the product of mass and acceleration of a body equal to?

15. A ball is thrown vertically upwards. What is its momentum at the highest point?

16. What is the relationship between acceleration and mass of a body?

17. A force acting on a body does not produce motion in it but causes a change in its shape. What kind of force is it?

18. Which has more inertia – a cricket ball or a sponge ball of the same size?

19. A ball is moving over a horizontal smooth surface with a constant velocity. Name the type of force acting on the ball.

20. On what factor does inertia of an object depend?

21. Which of the following works on the principle of conservation of momentum?
    (a) Propulsion of rocket
    (b) Wearing of seat belt while driving
    (c) Recoil of gun

22. A fast moving truck loses momentum of 2 kgm/s after colliding with a stationary car. Will the car lose or gain momentum? What is the magnitude of momentum of car after the truck comes to rest?

23. A ball is suspended by a cord from the ceiling of a car. What will be the effect on the position of the ball when

    (a) the car is moving with constant velocity.
    (b) The car is in accelerated motion.
    (c) The car turns towards right.
    (d) The brakes of the car are applied

24. A force of 20N towards east is balanced by an unknown force . What will be the magnitude and direction of the unknown force?

25. Interpret force in terms of momentum. Represent the following graphically:
    (i) momentum versus velocity when mass is fixed
    (ii) momentum versus mass when velocity is constant

Assignment 9.8

NUMERICALS

1. A driver accelerates his car first at the rate of $4m/s^2$ and then at the rate of $8\ m/s^2$. Calculate the ratio of the forces exerted by the engines.

2. Two balls identical in shape and size are acted upon by equal forces which cause them to move on a horizontal surface. The acceleration of the second ball is thrice of that of the first. What is the ratio of the mass of the second to the first.

3. A motorcycle of mass 200kg moves with uniform velocity. Brakes are applied so that the motorcycle undergoes retardation of $1.5m/s^2$. What is the force of friction between the tyres of the motorcycle and the road?

4. Two blocks of different metals identical in shape and size are acted upon by equal forces. The acceleration of the second block is 5 times of that of the first. What is the ratio of the mass of the first to the second?

5. A car starts from rest and acquire a velocity of 54km/h in 2s. Find
   (a) The acceleration
   (b) Distance travelled by car
   (c) Force acting on the car if its mass is 1000kg.

Assignment 9.9

CASE STUDY QUESTIONS

1. Observe the figure and answer the following questions:-

(i) Which trolley is easier to move?
(ii) Why is the other trolley difficult to move? Explain scientifically
(iii) What is meant by 'inertia'?
(iv) What is the relationship between mass and inertia?

2. Newton presented three fundamental laws that govern the motion of objects. These three laws are known as Newton's laws of motion. The first law of motion is stated as: An object remains in a state of rest or of uniform motion in a straight line unless compelled to change that state by an applied force. The second law of motion states that the rate of change of momentum of an object is directly proportional to the applied unbalanced force in the direction of force. The third law of motion states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction.

(i) Although action and reaction forces are equal and opposite, yet they do not cancel each other. Explain why?
(ii) Which law gives mathematical expression for force and write the mathematical expression.
(iii) Why do the dried leaves fall from a tree when the tree is given a jerk?
(iv) Why is a sand bed or cushion provided in a high jump event?

ASSERTION – REASON QUESTIONS

Directions : In the following questions, the Assertions (A) and Reasons (R) have been put forward. Read both the statements carefully and choose the correct alternative from the following:

(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion

(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion

(C) Our Assertion is true but the Reason is false

(D) The statement of the Assertion is false but the Reason is true

1. **Assertion** : Inertia is the property by virtue of which the body is unable to change by itselfthe state of rest only.

Reason : The bodies do not change their state unless acted upon by an unbalanced external force.

2. **Assertion**: If the net external force on the body is zero, then its acceleration is zero.

Reason : Acceleration does not depend on force

3. **Assertion** : If two objects of different masses have same momentum, the lighter body possess greater velocity.

Reason : For all bodies, momentum always remains same.

4. **Assertion** : Aeroplanes always fly at low altitudes.

Reason : According to Newton's third law of motion, for every action there is an equal and opposite reaction.

NOTES

FACTOPAEDIA

- **The wheelbarrow is invented in China**
- **The electric toothbrush was invented in 1939**
- **Isaac Newton invented the cat door**
- **The doorbell was invented in 1831**
- **The revolving door was invented in 1888**
- **Leonardo Da Vinci invented scissors**
- **Bulletproof vests, fire escapes, windshield wipers, and laser printers were all all invented by women**
- **The elevator was invented in 1850**
- **The corkscrew was invented in 1890**
- **The typewriter was invented in 1829**
- **The wristwatch was invented in 1904**

GRAVITATION

LEARNING OUTCOMES

The student is able to

- differentiate materials, objects, phenomena, and processes, based on properties or characteristics,
- plans and conducts investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,
- applies learning to hypothetical situations,
- apply scientific concepts in daily life and solving problems
- describe scientific discoveries and inventions
- calculate using the data given, draw labelled diagrams, flow charts, concept maps and graphs,
- analyse and interpret graphs and figures
- use scientific conventions, symbols, and equations to represent various quantities and units
- derive formulae and equations

Assignment 10.1

1. Newton's law of gravitation [Universal law of gravitation]

"Every object in the universe attracts every other object with a force which is _____ to the product of their masses and _____ to the square of the distance between them. The direction of force is along the line joining the two objects."

If we consider two objects of masses m_1 and m_2 separated by a distance r, then the force of gravitation F between them is given by

F

F

F

$F = G \frac{m_1 m_2}{r^2}$ where G = universal gravitational constant

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

Note : Gravitational force - It is action-at-a-distance force. i.e. the gravitational force always exists between two objects irrespective of the medium which separates them.

So, SI unit of G = $\frac{\text{SI unit of F x SI unit of } r^2}{}$

SI unit of m_1m_2

$$= \frac{\text{newton x metre}^2}{\text{kilogram}^2}$$

$$= \frac{N\ m^2}{kg^2}$$

Definition of G

If $m_1 = 1kg$, $m_2 = 1kg$ and $r = 1m$

Then $F = G$

Universal gravitational constant G is equal to the gravitational force which acts between two bodies of _____ separated by a distance of _____.

$G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$

Note : The value of G was measured by Sir Henry Cavendish in 1798.

2. Importance of universal law of gravitation

It successfully explains

i. The force that binds us to the earth
ii. The motion of the moon around the earth
iii. The motion of the planets around the sun
iv. The tides due to the moon and the sun

3. Why is Newton's law of gravitation known as universal law of gravitation?

Newton's law of gravitation holds good

i. For all bodies of any size and shape
ii. At all places in the universe
iii. At all times

Assignment 10.2

$G = 6.67 \times 10^{-11}\ Nm^2 / kg^2$

Mass of earth, $M_e = 6 \times 10^{24}$ kg

Mass of the sun, $M_{sun} = 2 \times 10^{30}$ kg

Radius of earth, $R_e = 6.4 \times 10^{6}$ m

Mass of moon, $M_{moon} = 7.4 \times 10^{22}$kg

Distance between moon and earth, $R_{moon\ \&\ earth} = 3.84 \times 10^{8}$m

Distance between sun and earth , $R_{sun\&earth} = 1.5 \times 10^{11}$m

Calculate

1. Gravitational force between sun and earth.

2. Gravitational force between moon and the earth.

3. Gravitational force between a body of mass 1kg and the earth .

4. Gravitational force between a man of mass 60 kg and the earth

5. Gravitational force between two objects of mass 1 kg each separated by 1 m distance.

Comparison between the forces

S No	Objects considered	Force acting between 2 objects
1.	Sun and earth	
2.	Moon and earth	
3.	Object of mass 1 kg and earth	
4.	Object of mass 60 kg and earth	
5.	Both objects of masses 1 kg	

- **Because of differences in gravity, a 100kg (220 pound) person would only weigh 38kg (84 pounds) on Mars.**

4. Acceleration due to gravity –

1. It is the acceleration produced in a freely falling body due to the gravitational force of the earth.
2. It is denoted by _____.
3. The SI unit of 'g' is _____.

5. **Estimating value of 'g'**

If Me is mass of the earth, Re is radius of the earth and m is the mass of the object near the surface of the earth falling freely towards the earth,

Then by Newton's law of gravitation

$$F = G \frac{mM_e}{R_e^2} \text{ ---------- (1)}$$

Also by Newton's second law of motion, $F = mg$ ---------- (2)

From (1) and (2), $mg =$

$g =$ where, G= = $6.67 \times 10^{-11} Nm^2/kg^2$; $M_e = 6 \times 10^{24} kg$; $R_e = 6.4 \times 10^6 m$

$g =$

$g =$ m/s^2

Interpretation – The acceleration of an object falling freely towards earth is 9.8 m/s^2. This means that when an object falls freely towards earth, its velocity increases by 9.8 m/s every one second during its motion.

5. Difference between acceleration due to gravity (g) and universal gravitational constant (G)

Acceleration due to gravity(g)	**Universal gravitational constant(G)**
1. It is the acceleration produced in a freely falling object under the action of the earth's gravitational force.	1. It is the gravitational force of attraction between two objects of unit masses separated by a unit distance.
2. The value of g is different at different places on the earth as well as other planets.	2. The value of G remains same everywhere in the universe.

6. How does g vary as one goes from equator to the poles?

7. How does g vary with altitude above the surface of the earth?

8. Differences between mass and weight

Mass	**Weight**
It is the amount of matter contained in an object	Weight of an object is the force of attraction exerted by the earth on an object.
Mass of an object remains constant everywhere and can never be zero.	The weight of an object changes on different planets and also on the earth with the latitude, altitude and the depth and becomes zero at the centre of the earth.
Mass is a scalar quantity	Weight is a vector quantity
Mass is measured using a beam balance and its SI unit is kg.	It is measured using a spring balance and its SI unit is Newton (N).

- **Due to gravitational effects, you weigh slightly less when the moon is directly overhead.**

Assignment 10.3

Short answer questions

1. What is the source of centripetal force that a planet requires to revolve around the sun? On what factors does that force depend?

2. An object weighs 60N on the surface of the earth. How much will it weigh on the surface of moon if 'g' on moon is one-sixth of that on the earth?

3. On the earth, a stone is thrown from a height in a direction parallel to the earth's surface while another stone is simultaneously dropped from the same height. Which stone would reach the ground first and why?

4. Suppose gravity of the earth suddenly becomes zero, then in which direction will the moon begin to move if no other celestial body affects it?

5. The weight of any person on the moon is about 1/6 times that on the earth. He can lift a mass of 15kg on the earth. What will be the maximum mass, which can be lifted by the same force applied by the person on the moon?

6. An object weighs 200N on earth, find its mass and weight on moon?

7. Where is the acceleration due to gravity maximum – on or above the earth?

8. How would the weight of an object bought in Delhi change if it is taken to (a) Poles and then to the (b) equator?

9. You buy a bag of sugar of weight W at a place on the equator. You take it to Antarctica. Would it weigh more or less or same? Why?

10. What is the acceleration of (a) a free falling body (b) a body thrown vertically upwards?

11. Name the force responsible for the tides in the sea.

12. Which of these is a scalar quantity – mass or weight?

13. A body has mass m kg.

    (a) What is its weight on the earth?

    (b) What is its mass on moon?

    (c) What is its weight on moon?

Assignment 10.4

Multiple Choice Questions

1. Two objects of different masses falling freely near the surface of the moon would

   (i) have same velocities at any instant
   (ii) have different accelerations
   (iii) experience forces of same magnitude
   (iv) undergo a change in their inertia

2. The value of acceleration due to gravity

   (i) Is same at the equator and poles
   (ii) Is least at poles
   (iii) Is least at equator
   (iv) Increases from pole to equator

3. Two iron balls are kept at the some distance. If the mass of both the balls are doubled keeping the distance between them unchanged, the value of gravitational force would be

   (i) Unchanged
   (ii) Half times
   (iii) One-fourth times
   (iv) Four times

4. Force of attraction between two unit point masses separated by unit distance is called

   (i) Gravitational force
   (ii) Acceleration due to gravity
   (iii) Universal gravitational constant
   (iv) Universal law of gravitation

5. An apple falls from a tree on the ground. If F_1 be the force exerted by the earth on the apple and F_2 be the force exerted by the apple on the earth, then

   (i) $F_1 = F_2$
   (ii) F_1 is slightly greater than F_2
   (iii) F_1 is much greater than F_2
   (iv) F_1 is less than F_2

6. When a stone falls from the roof of a house,

   (a) Only stone attracts the earth
   (b) Only earth attracts the stone
   (c) Both earth and stone attract each other
   (d) They do not attract each other

7. The ratio of the value of 'g' on the earth's surface to that on the moon 's surface is

   (a) 1/6

(b) 6
(c) √6
(d) 1/√6

8. The force of gravitation between two bodies does not depend upon

(a) Their separation
(b) The product of their masses
(c) The sum of their masses
(d) The gravitational constant

9. If the distance between two objects is doubled, the gravitational force between them

(a) Remains the same
(b) Gets doubled
(c) Gets halved
(d) Becomes one fourth

10. The gravitational force between two objcets is F. If masses of both objects are halved without changing distance between them, the the gravitational force would become

(i) F/4
(ii) F/2
(iii) F
(iv) 2F

11. Acceleration due to gravity

(a) has the same value everywhere in space
(b) has the same value everywhere on earth
(c) is greater on moon than on earth
(d) varies with the latitude of the earth

12. The weight of an object

(a) is the mass of the matter it contains
(b) refers to its inertia
(c) is same as the mass but expressed in different units
(d) is the force with which it is attracted to the earth

13. In free fall, when a heavy object and a light object are dropped simultaneously,

(a) The lighter object accelerates more
(b) The heavier object accelerates more
(c) Both move with same velocity
(d) Both undergo same acceleration

14. If masses of two objects are halved without changing the distance, the gravitational force, F between two objects would become

(i) F/4
(ii) F/2
(iii) F
(iv) 2F

15. The force of attraction between two unit point masses separated by a unit distance is called

(i) Gravitational potential
(ii) Acceleration due to gravity
(iii) Gravitational field
(iv) Universal gravitational constant

Assignment 10.5

Equations of motion for objects under free fall

a → g, acceleration due to gravity

s → h, vertical distance covered

$$v=u+gt$$

$$h=ut+\frac{1}{2}gt^2$$

$$v^2=u^2+2gh$$

1. A boy drops a coin from a height of 1.85m. With what speed will the coin strike the ground?

2. An object is released from a height. Find the distance travelled by the object after (i) 1s (ii) 2s.

3. Find the speed of an object 2s after its release from a certain height.

4. An object is thrown up with a speed of 19.6m/s. What is its speed after 2s ?

5. An object is thrown up with a speed of 40m/s. Find the time for which it goes in the upward direction and the maximum height attained. [Take g = 10m/s^2]

Assignment 10.6

CASE STUDY QUESTIONS

1. Mass (measured in kilogram, kg) is related to the amount of matter in an object. Weight (measured in newton, N) is the force of gravity with which an object is attracted towards the centre of the celestial object. The acceleration due to gravity on a celestial object is directly proportional to G [universal gravitational constant], directly proportional to the mass of the celestial object and inversely proportional to the square of the radius of the celestial object. The weight of an object of mass 25kg is found to be 245N on the earth, 40.8 N on the moon and 612.5 N on Jupiter.

   (i) Find the ratio of 'g' on earth to Jupiter.
   (ii) Find the value of 'g' on moon and relate it to 'g' on earth
   (iii) What is the mass of the object on moon and Jupiter?
   (iv) Why is the weight of the object maximum on Jupiter?
   (v) How does the value of 'g' change as we move from equator to the poles of the earth?

ASSERTION – REASON QUESTIONS

Directions : In the following questions, the Assertions (A) and Reasons ® have been put forward. Read both the statements carefully and choose the correct alternative from the following:

(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion
(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion
(C) Our Assertion is true but the Reason is false
(D) The statement of the Assertion is false but the Reason is true

1. **Assertion** : The value of acceleration due to gravity does not depend upon the mass of the body on which force is applied.
Reason : Acceleration due to gravity is a constant quantity.

2. **Assertion** : When distance between two bodies is doubled and also mass of each body is also doubled, gravitational force between them remains same.
Reason : According to Newton's law of gravitation, force is directly proportional to the product of the masses and inversely proportional to the square of the distance between them

3. **Assertion:** The mass and weight of an object differs from planet to planet.
Reason: Mass is independent of the location of the object and weight depends on "g".

- **Water can work against gravity, moving up narrow tubes in a process called capillary action**

Assignment 10.7

1. Compare the gravitational forces exerted by the sun and the moon on the earth and find their ratio.

2. Two objects of masses 50kg and 90kg, separated by a distance, exert a force of 5N on each other. What will be the gravitational force between them if
   (a) Mass of one object is doubled?
   (b) Mass of both objects are halved?
   (c) Distance of separation between the objects is doubled?

3. What will be the acceleration due to gravity of an object on a planet whose mass is one-ninth of the mass of the earth and whose radius is half of that of the earth?

4. A toy car falls on the ground in 0.5s. What is its speed just before striking the ground? [g = $10m/s^2$]

5. A boy throws a ball upwards which comes back in 10s. Find the velocity with which it was thrown and height to which the ball rises up? [g = $10m/s^2$]

6. Calculate the acceleration due to gravity on a planet whose mass is double and radius is three times that of the earth.[take g = $9.8m/s^2$]

FACTOPAEDIA

- **Switzerland eats the most chocolate equating to 10 kilos per person per year**
- **The human body of a 70 kg person contains 0.2mg of gold**
- **Crocodiles swallow rocks to help them dive deeper**
- **The bones of a pigeon weigh less than its feathers**
- **Your brain weights 2% of your body weight though uses 20% of all oxygen you breathe and 15% of the body's blood supply**
- **8.5 million tons of water evaporates from the Dead Sea every day**
- **The Statue of Liberty weighs over 225 tons**
- **The average person sheds .7kg (1.5 pounds) of skin each year**
- **Due to gravitational effects you weigh is slightly less when the moon is directly overhead**

ACTIVITY

Aim : To observe and compare the pressure exerted by a glass slab on refined flour while resting on its three different faces and to find a relation between pressure, force and area.

Materials : Refined flour, 2-3 glass slabs, measuring scale, glass rod, tray

Observation :

Length of the glass slab, **l** = _____ cm

Breadth of the glass slab, **b** = _____ cm

Height of the glass slab, **h** = _____ cm

Weight of the glass slab, **F** = _____ gwt

Observation table:

S No	Faces	Area, **A (cm^2)**	Depression measured **(cm)**	Pressure, **P = $\frac{F}{A}$ (gwt/cm^2)**
1.	l x b			
2.	b x h			
3.	l x h			

Result :

1. When _____ face is kept on refined flour, depression measured is maximum.
2. When _____ face is kept on refined flour, depression measured is minimum.
3. Pressure exerted by the glass slab on refined flour is maximum when it is placed with _____ face and minimum when it is placed with _____ face.
4. Hence , pressure = force / area

Assignment 10.7

1. Thrust – The total force acting in _____ direction [perpendicular to] over a given surface area is called thrust.

2. Pressure - _____ acting per unit _____ of a surface is called pressure.

3. Pressure = Force / Area

4. SI unit of pressure =

5. Definition of SI unit of pressure – Pressure exerted on an object is _____ when a thrust / perpendicular force of _____ acts on a surface of area _____.

REASONING QUESTIONS

(a) It is easier to cut a tomato with a sharp edge of knife than the blunt edge.

(b) School bags are provided with wide straps.

(c) Tyres of big buses and trucks are broader.

NUMERICALS

1. Calculate the pressure exerted by an object of weight 600N having a surface area of 15cm^2.

2. The pressure exerted by the weight of a cubical block of side 3 cm on the surface is 5 Pa. Calculate the weight of the block.

3. A drawing pin is pushed against a wooden table with a force of 10 N. Calculate the pressure exerted by the pin at a point on the table if the area of the point is 0.01 mm^2.

4. A man weighs 600 N. The total area of his shoes is 200 cm^2. What is the pressure exerted by him on the ground in SI units?

5. A force of 12 N is uniformly distributed over an area of 120cm^2. Find the pressure in pascal.

6. A cuboidal metal block has dimensions 15cm x 20cm x 25cm. Find the maximum and minimum pressure exerted by the block on a horizontal surface when it exerts a perpendicular force of 100N. [SI units]

ASSIGNMENT 10.8

1. Buoyant force / _____ - It is the upward force experienced by an object when it is _____ or _____ immersed in a fluid.

2. Buoyant force =

3. Density [ρ/D] –

4. SI unit of density =

5. CGS unit of density =

6. Archimedes' Principle –

7. Relative density –

8. Conditions of floatation –

   (a) With respect to density of a substance

   (i) If density of a substance is _____ than the density of water, it _____

   (ii) If density of a substance is _____ than the density of water, it _____

   (iii) If density of a substance is _____ than the density of water, it _____

(b) With respect to weight of a substance

(i) If weight of a substance is _____ than the weight of the displaced liquid, it _____

(ii) If weight of a substance is _____ than the weight of the displaced liquid, it _____

(iii) If weight of a substance is _____ than the weight of the displaced liquid, it _____

REASONING QUESTIONS

(a) Swimmers are provided with inflated rubber jacket/tube.

(b) It is easier to swim in sea water than in river water.

(c) A mug full of water appears lighter inside water.

(d) Base of the dams are thick and broad.

(e) A ship made of iron can float in water whereas a nail made of iron sinks.

PRACTICE QUESTIONS OF REASONING:-

a. When a plastic block is released under water, it bounces back to the surface of water.

b. War tanks can move on soft ground.

c. Eskimos use sledges to travel on snow.

d. Skiers do not sink in snow.

e. Camels can easily walk in deserts.

Assignment 10.9

Multiple Choice Questions

1. When an object is immersed in three different liquids of densities d_1, d_2 and d_3 respectively, it floats with 1/9, 2/11 and 3/7 parts of its volume outside the liquid surfaces. Which of the following statements is correct?
   (i) $d_1 > d_2 > d_3$
   (ii) $d_1 < d_2 < d_3$
   (iii) $d_1 < d_2 > d_3$
   (iv) $d_1 > d_2 < d_3$

2. An object weighs 10N in air. When it is fully immersed in a liquid, it weighs 8N. The weight of the liquid displaced by the object is
   (i) 12N
   (ii) 10N
   (iii) 8N
   (iv) 2N

3. A rectangular brick is placed on a table with different faces in contact. The block exerts
   (i) same thrust and same pressure
   (ii) same thrust and different pressure
   (iii) different thrust and different pressure
   (iv) different thrust and same pressure

4. If a solid copper ball of radius 1cm is placed in water, the upthrust acting on it will be
   (i) more than the weight of the sphere
   (ii) equal to the weight of the sphere
   (iii) less than the weight of the sphere
   (iv) none of these

5. The SI unit of pressure is
   (i) Newton
   (ii) newton metre
   (iii) newton per square metre
   (iv) newton per metre

6. The density of water is 1000 kg/m^3 and relative density of silver is 10.5. The density of silver is
   (v) 105 kg/m^3
   (vi) 1050 kg/m^3
   (vii) 10500 kg/m^3
   (viii) 10.5 kg/m^3

7. If the density of iron is 7900 kg/m^3, its relative density is
   (v) 7900
   (vi) 790
   (vii) 79
   (viii) 7.9

8. By doubling the mass of a solid object, its density becomes
   (i) twice
   (ii) thrice
   (iii) half
   (iv) remains same

9. On immersing a body fully in a liquid, the apparent loss in weight of the object is
   (i) more in denser liquid
   (ii) less in denser liquid
   (iii) more in less dense liquid
   (iv) independent of the density of the liquid

10. When an object is weighed in a liquid, the loss in its weight depends upon

    (i) volume of the object
    (ii) mass of the object
    (iii) shape of the object
    (iv) centre of gravity of the object

11. The upthrust acting on a body completely immersed in a liquid is equal to

    (i) weight of the liquid displaced
    (ii) mass of the liquid displaced
    (iii) volume of the liquid displaced
    (iv) volume of the solid immersed

12. A heavy cylinder of length l is slowly taken out of a dense liquid. The weight felt as it is taken out of the liquid

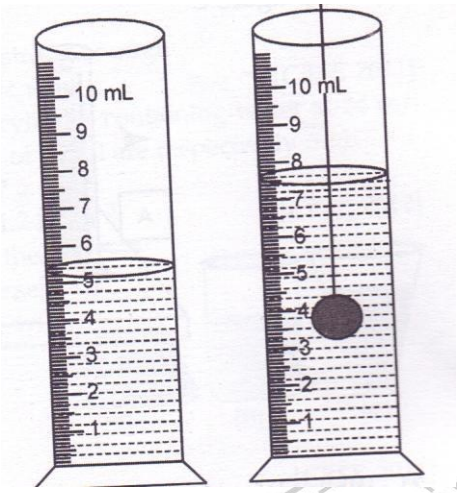
    (i) will remain the same
    (ii) will increase
    (iii) will decrease
    (iv) will increase till it attains the weight in air

13. A girl stands on a box having 60cm length, 40cm breadth and 20cm height in three ways. In which of the following cases, pressure exerted by the brick will be

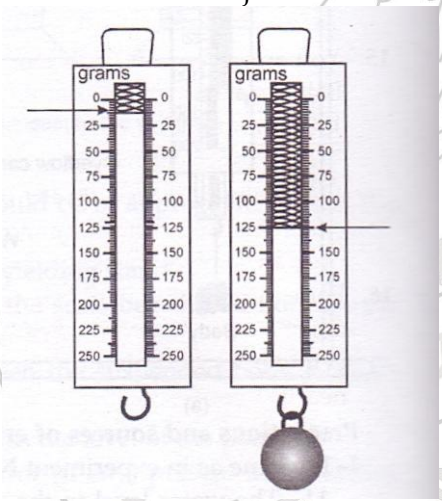
(i) maximum when length and breadth form the base
(ii) maximum when breadth and height form the base
(iii) maximum when height and length form the base
(iv) the same in all the above three cases

13. The level of the water in the two figures are 5.5ml and 7.5 ml respectively. The volume of the object is

(i) 2ml
(ii) $2cm^3$
(iii) 0.2 ml
(iv) $0.2cm^3$



14. There are 10 divisions between 0 and 25 in the given spring balance. The least count and the mass of the object are



(i) 2g and 125 g
(ii) 2.5g and 112.5g
(iii) 12.5g and 125g
(iv) 12.5g and 112.5g

The Dead Sea is so dense with salt, you can easily float on it without drowning

Assignment 10.10

Short answer questions

1. On what principle is lactometer based?

2. State the SI units of thrust and pressure.

3. Which of the two will double the pressure – doubling area and force or making area half?

4. Name the force experienced by an object when immersed in a liquid. What is the direction of this force?

5. What are the factors on which density of a solid depend?

6. What are the factors on which buoyant force acting on an object depend?

7. What are the factors on which weight of an object depend?

8. What are the factors on which pressure exerted by a liquid depend?

9. Where will a body weigh maximum – in air, in vacuum or in water?

10. What is the term for 'thrust per unit area'?

11. Name the force which makes heavy objects appear light when immersed in a liquid?

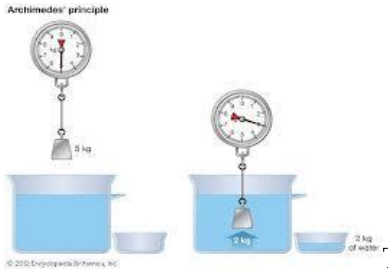
12. A cube of side 5cm is immersed in water and then in saturated salt solution. In which case, will it experience a greater buoyant force? If each side of the cube is reduced to 4cm and then immersed in water, what will be the effect on the buoyant force experienced by the cube as compared to the first case for water?

13. A ball weighing 4kg of density 4000 kg/m^3. Find the force of buoyancy on it. [$g = 10m/s^2$]

- The world's densest wood, the Black Ironwood (Olea laurifolia), does not float on water and therefore sinks.

- **You can convert graphite into diamond by applying a temperature of 3000 Celsius and pressure of 100,000 atm.**

Assignment 10.11

1. 

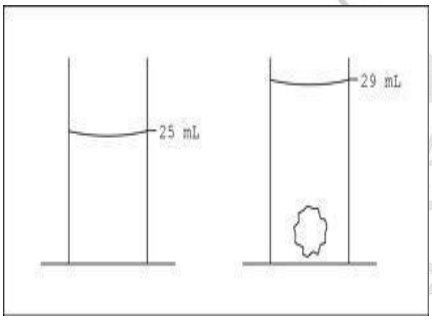
The reading in the spring in the first figure is 5kgf, that in the second figure is 3 kgf and the water collected in the second figure is 2 kg.

(a) What is the weight of the object in air?

(b)What is the loss in weight of the object immersed in water?

(c) What is the weight of the water displaced by the object?

(d) Which scientific principle is verified by this activity?

2. 

What is the volume of the object immersed in water?

- **The bark of the redwood tree is fireproof.**

Assignment 10.12

Numericals

1. A cuboidal metal block of dimensions 2cm x 5cm x 10cm weighs 3kg. Find its density and relative density.

2. A solid object of mass 150g and volume 250cm^3 is placed in water. Will it float or sink in water? [density of water is 1 g/cm^3]

3. A ball weighing 2 kg of density 2000 kg/m^3 is completely immersed in water of density 1000 kg/m^3. What is the buoyant force acting on it?

4. A 400g sealed container has a volume 200 cm^3. What is the density of the container? Will it float or sink in water?

5. If the density of gold is 19320 kg/m^3, what is its relative density?

6. If the density of turpentine is 840 kg/m^3, what will be its relative density?

7. A rectangular block of dimension 5 x 4 x 6 [in cm] is immersed in a liquid of density 1.2g/cm^3. What is the upthrust acting on it?

8. A body of volume 50 cm^3 is completely immersed in water. What is the buoyant force on the body?

Assignment 10.13

CASE STUDY QUESTIONS

Study the following paragraph and answer the following questions:-

1. You received an e-mail from a friend living in a coastal town. He shared an experience with you that recently happened. While swimming on the coastline of the sea in common swimming attire, he thought of going deeper inside the sea. He was asked to abstain from delving deeper into the sea by the rescue personnel.

   (a) Why was he asked not to go deeper into the sea?

   (b) What can happen if a person goes deep in the sea without wearing specialized suits?

   (c) How can a submarine go deep inside the sea?

2. Buoyancy or upthrust, is an upward force exerted by a fluid on a partially or fully immersed object. In a column of fluid, pressure increases with depth of the fluid. Thus the pressure at the bottom of a column of fluid is greater than at the top of the column. If an object has density less than the density of water, it floats. Like, dried leaf of a plant floats on the water because the density of leaf is less than the density of water. A stone thrown in water sinks because the density of stone is more than the density of water. Archimedes principle states that "When a body is immersed partially or wholly in a liquid, there is an apparent loss in the weight of the body which is equal to the weight of liquid displaced by the body".

   (a) Why does a ship made of iron floats in water but a needle made of same iron sinks?

   (b) What happens to a ship when it is taken from fresh water river to sea water?

   (c) What happens to the apparent weight of an object when it is when it is immersed in glycerine as compared to water?

   (d) Why are the base of dams made strong?

Directions : In the following questions, the Assertions (A) and Reasons (R) have been put forward. Read both the statements carefully and choose the correct alternative from the following:

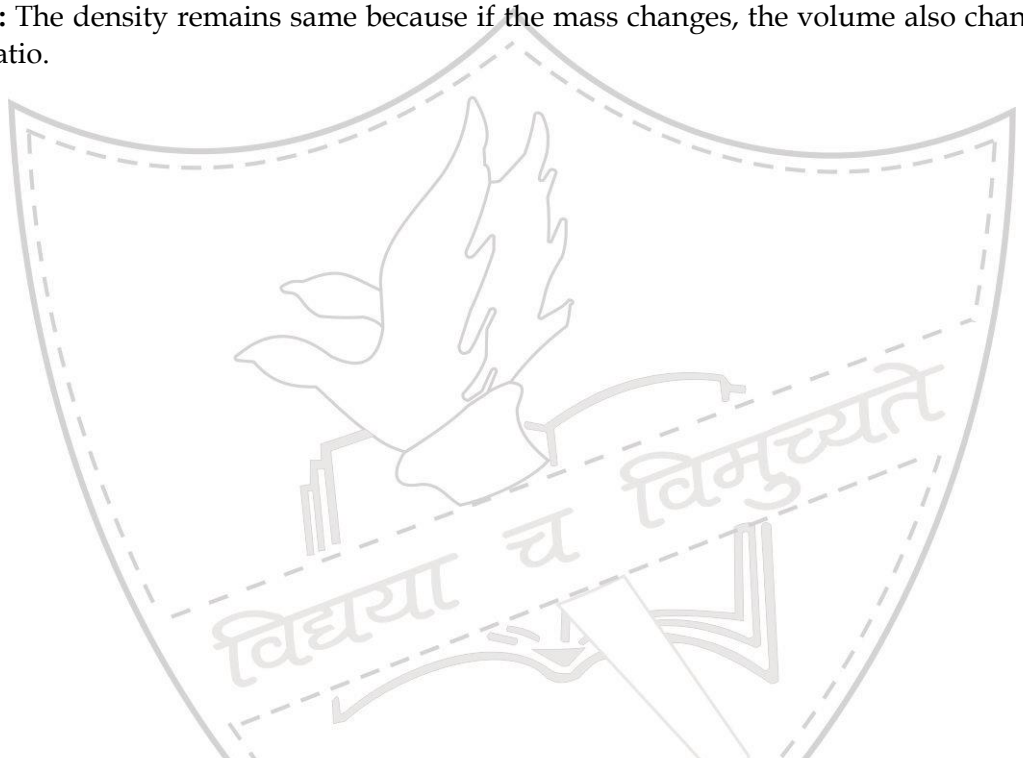
(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion
(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion
(C) Our Assertion is true but the Reason is false

(D) The statement of the Assertion is false but the Reason is true

1. **Assertion:** A cork placed on the surface of water may float, whereas the iron ball will always sink.
   Reason: The buoyancy of an object depends both on the material and shape of the object.

2. **Assertion:** It is comfortable to walk on a beach with flat slippers instead of high heels.
   Reason: Pressure is inversely proportional to area

3. **Assertion:** When the mass of pure gold is doubled, the density of gold also doubles.
   Reason: The density remains same because if the mass changes, the volume also changes at the same ratio.



- **If Mount Everest were placed at the bottom of the deepest part of the ocean, its peak would still be a mile underwater**

NOTES

WORK AND ENERGY

LEARNING OUTCOMES

The student is able to

- differentiate materials, objects, phenomena, and processes, based on properties or characteristics,
- plans and conducts investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,
- calculates using the data given, draws labelled diagrams, flow charts, concept maps, graphs,
- analyses and interprets graphs and figures
- uses scientific conventions, symbols, and equations to represent various quantities, elements, and units,
- derives formulae, equations,

Assignment 11.1

1. The word 'work' means any kind of physical or mental activity. Eg. Reading a book, cooking food, pushing a wall, carrying a heavy bag, etc.
   But in physics 'work' has an entirely different meaning.

2. (a) **Work** is said to be done by an object when a force acting on the object produces displacement in it.

   (b) Work is a _____ quantity.

   (c) The SI unit of work is newton metre (Nm) which is also known as joule(J) in memory of famous physicist Joule.

   (d) If W denotes work, F denotes force applied and s denotes displacement,

   Then, work = force x displacement

   W = F x s

3. (a) **Work done by a force on an object is positive** when the object is displaced in the _____ of the applied force

W = F x s

(b) **Work done by a force on an object is negative** when an object is displaced in a direction _____ to the direction of the applied force.

W = - F x s

(c) **Work done is zero** or no work is done when the force is acting at _____ to the displacement of the object.

W = 0

i.e. Work done is zero if displacement is perpendicular to direction of force.

Eg. 1. When a person carries a load in hand or on head and walks, no work is done.

2. When a man pushes a wall without displacing it from its position, [s=0], no work is done.

4. **SI unit of work** - work = force x displacement

So, SI unit of work = SI unit of force x SI unit of displacement

= newton x metre [N x m]

= joule [J]

1 J = 1 N x 1 m

Definition of SI unit of work – Work done is said to be 1 joule when a force of 1 newton acting on an object displaces the object by 1 metre.

[NOTE : The amount of work (W) done on an object by a given force can be calculated using the formula

$$W = F s \cos \Theta$$

where F is the force and s is the distance over which the force acts and Θ is the angle between F and s]

1. Indicate whether or not the following represent examples of Work Done? Yes or No?
   a. A teacher applies a force on a wall and becomes exhausted.
   b. Force exerted by weightlifter to lift a barbell above his head
   c. Force exerted by gravity on the barbell while being lifted by the weightlifter.
   d. Force exerted by the waiter carries a tray full of meals across a room on the tray
   e. A short putter launches a shot

2. Indicate whether there is positive or negative work being done on the object.
   a. An eastward-moving car skids to a stop across dry pavement.
   b. Work done by the librarian on the book while lifting a World Civilization book to the top shelf of his locker from the table
   c. A roller coaster car is lifted to the peak of the first hill in An Adventure Park with respect to gravity
   d. Work done by air on the falling parachutist when he opens the chute and slows down.

NUMERICALS

1. Calculate the work done when a force of 20N displaces a body through 8m in the direction of the applied force.

2. An object of mass 2kg thrown up reaches a maximum height of 5m. Calculate the work done by the force of gravity on the object

3. A porter lifts a 20kg bag and puts it on his head at a height of 1.5m above the ground. Calculate the work done by the porter on the bag.

4. A person holds a 30kg suitcase and walks on the platform upto 50m.
   (i) Calculate the work done by the person on the suitcase.
   (ii) Calculate the work done by the force of gravity on the suitcase.

5. An elevator lifts 12 occupants up 21 floors (76.8 meters) at a constant speed. The average mass of the occupants is 62.8 kg. What is the work done by the elevator on the occupants?

Assignment 11.2

1. **Energy –** The capacity of doing work by an object is known as the energy of the object
   Some of the forms of energy –

   (i) Mechanical energy – Sum of kinetic and potential energy.

   (ii) Thermal [heat] energy – Energy possessed by an object due to its temperature.

   (iii) Chemical energy – Energy released in chemical reactions.

   (iv) Sound energy – Energy of a vibrating object producing sound.

   (v) Electrical energy – Energy of moving electrons in a conductor connected with a battery.

   (vi) Nuclear energy – Energy released when two or more light nuclei combine to form a heavy nucleus or when a heavy nucleus breaks down into two or more light nuclei.

   (vii) Solar energy – Energy radiated by the sun.

2. **SI unit of energy –** The SI unit of energy is **joule (J)** i.e. same as that of work.

3. **Kinetic energy –** Energy possessed by an object by virtue of its _____.

Eg. A moving car, moving bullet, released arrow, flowing water, moving ball, etc have kinetic energy.

In other words, anything which moves has kinetic energy.

4. Derivation of expression for kinetic energy

We consider an object of mass **m** lying on smooth horizontal surface. Let a force **F** is applied on the object so that the object starts moving, attains velocity v after travelling a distance **s.** As the object start from rest the velocity changes from 0 to v, it undergoes acceleration a.

Work done, $W = F\ s$ [from definition of work]

$W =$ [$F = m\ a$ {from newton's second law of motion}] ---------- (1)

From 3rd equation of motion, $v^2 - u^2 = 2\ a\ s$

---------- (2)

Using (2) in (1),

$W =$

$W =$

This work done is the kinetic energy of the body.

Kinetic energy, E_k = W = ½ mv^2

5. **Special case –** If an object is moving with initial velocity u which undergoes an acceleration a due to an applied force F and attains a final velocity v, then

W = F s

W = m a s

W = m a [v^2 - u^2 / 2a]

W = ½ mv^2 - ½ mu^2

W = final kinetic energy - initial kinetic energy

W = change in kinetic energy of the body

6. **Potential energy** - Energy possessed by an object by virtue of its _____ or _____ or _____.

Examples of objects having potential energy due to position –

(i) Water stored in a dam
(ii) Stone held at a height above the ground
(iii) Hammer which is lifted to a height by hand

Examples of objects having potential energy due to shape / configuration –

(i) A stretched or compressed spring
(ii) A stretched bow and arrow
(iii) A wound spring of a watch

7. Derivation of expression for potential energy of an object at a height

The work done in lifting an object of mass m against force of gravity through a height h is the potential energy of the object at that height.

We consider an object of mass m which is raised to height h. For lifting it to h,

force applied, F = weight of the object =

work done, W =

W =

This work done against gravity is stored in the object as its potential energy or gravitational potential energy.

Hence, **Potential energy, E_p = W = m g h**

Assignment 11.3

1. Read each of the following statements and identify them as having to do with kinetic energy (KE), potential energy (PE) or both (B).

S No	Statement	KE / PE / B
1.	If an object is at rest, it certainly does NOT possess this form of energy.	
2.	Depends upon object mass and object height.	
3.	The energy stored in an object due to its position (or height).	
4.	The energy an object possesses due to its motion.	
5.	Depends upon object mass and object speed.	
6.	If an object is at rest on the ground (zero height), it certainly does NOT possess this form of energy.	
7.	The amount is expressed using the unit joule (J)	

NUMERICALS

1. Five men lift a 250kg box to a height of 1.5m and hold it at that height. What is the work done by them on the box. [$g=10m/s^2$]

2. A magnetic crane lifts a mass of mass 2000 kg through a vertical height of 50 m. Calculate the work done by the crane. [$g=10m/s^2$]

3. A body of mass 10kg is moving with a speed of 50m/s. What is its kinetic energy?

4. In Q 3. Calculate the K.E. if (i) velocity is doubled (ii) mass is doubled.

5. A body of mass 100g slows down from a speed of 5m/s to 3m/s. Find the change in the kinetic energy of the body.

6. A body of mass 5 kg is raised to a height of 50m. Calculate the potential energy of the body.

7. 60000 J of energy is utilized in lifting a mass of 50kg. Calculate the height to which the mass is lifted.

8. A bag of cement weighing 80kg is raised above the ground to acquire a potential energy of 8000J. What is the height attained by the bag of cement? [$g=10m/s^2$]

8. Law of conservation of energy

Statement 1 – Energy can neither be created nor destroyed, but can be changed from one form to another.

Statement 2 – When one form of energy is changed or transformed into other forms of energy, the total energy of an isolated system remains the same.

Assignment 11.4

1. (1) **Power –** It is defined as rate of doing work or work done per unit time by an object.

$$\text{Power , } P = \frac{\text{work done, } W}{\text{time taken, } t}$$

(2) **SI unit of power** = SI unit of W / SI unit of t

= joule, J / second, s

= watt, W

1 W = 1 J / 1 s

Definition of SI unit of power – Power of an object or agent is said to be 1 watt when it does 1 joule of work in 1 second.

2. Some other **expressions of power**

$P = W / t$

$P = F s / t$ [$W = F s$]

$P = F (s/t)$

$P = F v$ [$v = s/t$]

3. Some other **units of power**

horse power :- 1 h.p. = 746 W

kilowatt :- 1 kW = 1000 W

megawatt :- 1 MW = 10^6 W

4. **Commercial unit of energy**: kilowatt – hour (kWh)

Electric energy is required to operate all electrical gadgets such as lamps, heaters, refrigerators, etc.

The department of electricity sells the electric energy to consumers in units called kilowatt hour (kWh).

1 unit = 1 kWh

Definition of 1 kWh – A kilowatt hour is the amount of electric energy used by 1000 W electric appliance when it operates for 1 hour.

5. Relationship between SI unit and commercial unit of power

Relationship between joule (J) and kilowatt-hour (kWh)

1 kWh =

1 kWh = 3.6 x 10^6 J

NUMERICALS

1. Two kids A and B of mass 20kg each climb up a rope to a height of 5m. A takes 15 s and B takes 20s to reach that height. What is the work done by each kid? Who has more power? Who does more work per second?

2. An engine supplies 36000 J of energy in one minute. Calculate its power.

3. A woman weighing 60kg climbs up 15 steps of stairs in half a minute. If each step is 20cm high, calculate the power used in climbing the stairs.

4. A 1000 W electric heater is switched on for 2 hours. Calculate the electric energy consumed by the heater.

5. A 100 W bulb is lit for 6 hours everyday. Calculate the energy consumed in a month of 30 days and cost of electricity consumed at a rate of Rs. 5 per unit.

6. The electric meter shows that a household consumes 500 units in a month. How much is this energy in joules?

7. A cart is pushed along the road with a force of 500N through a distance of 50m in I minute. Calculate its power.

8. The power output of an engine is 5kW. How much work does the engine do in 50 s?

9. Five electric fans of 120 W each are used for 6 hours. Calculate the electrical energy consumed in kWh.

10. An electric iron uses 500kJ in 5 minutes. What is its power rating?

11. An elevator motor lifts 715 kg of mass to the height of the fourth floor of an office building (11.0 meters above ground level) at a constant speed in 25 seconds. Determine the power rating of the motor.

- **The only rock that floats in water is pumice.**

Assignment 11.5

Multiple Choice Questions

1. A stone is tied to a string and whirled around in a circle. The Work done on it by the string is –

(a) positive
(b) negative
(c) undefined
(d) zero

2. When brakes are applied to a moving vehicle, the work done is-

(a) positive
(b) negative
(c) undefined
(d) zero

3. Potential energy of a person is minimum when he is –

(a) lying down
(b) standing on the floor
(c) sitting on a chair
(d) standing on a chair

4. When a stone falls through a height "h" the decrease in potential energy is –

(a) mg/h
(b) mg^2/h
(c) mgh
(d) $mg^2/2$

5. One of the following is a vector quantity-

(a) potential energy
(b) kinetic energy
(c) muscular force
(d) work

6. A wound spring possesses

(a) kinetic energy
(b) potential energy
(c) electric energy
(d) no energy

7. When an object falls freely towards the earth, its total energy
(a) increases
(b) decreases
(c) remains same
(d) first increases and then decreases

8. Which one of the following is not the unit of energy?

(a) joule
(b) kilowatt
(c) kilowatt-hour
(d) newton metre

9. This is a device which converts electric energy into mechanical energy.

(a) electric kettle
(b) electric fan
(c) electric toaster
(d) electric tandoor

10. Which of the following is not a scalar quantity?

(a) force
(b) energy
(c) pressure
(d) work

11. When a body falls freely towards the earth, then its total energy

(a) increases
(b) decreases
(c) remains constant
(d) first increases and then decreases

12. In case of negative work, the angle between force and displacement is

(a) 0^0
(b) 45^0
(c) 90^0
(d) 180^0

13. A car is accelerated ona levelled road and attains a velocity 4 times of its initial velocity. In this process, the potential energy of the car

(a) does not change
(b) becomes twice of the initial
(c) becomes 4 times of the initial
(d) becomes 16 times of the initial

14. In case of negative work, the angle between the force and displacement is

(a) 0^o
(b) 45^o
(c) 90^o
(d) 180^o

15. A girl carrying a school bag of 3kg mass on her back and moves 200 m on a levelled road. The work done against the gravitational force will be [g = 10m/s^2]
    (a) 6x10^3J
    (b) 6J
    (c) 0.6J
    (d) zero

- **The temperature in fahrenheit can be determined by counting the number of cricket chirps in 14 seconds and adding 40.**

Assignment 11.6

Short answer questions

1. A person holding a suitcase is at rest. Is he doing any work?

2. In what form is energy stored in a clock?

3. A car and a bike, both have same kinetic energy. Which one is running faster?

4. Name the two types of mechanical energy.

5. Can a body have energy without momentum?

6. What are the SI unit of power, work and energy?

7. Name the type of energy possessed by water stored in a dam.

8. Name and define the type of energy possessed by a ball , just before it is caught by a fielder?

9. What is the work done on a body by the centripetal force moving in a circular path?

10. Which physical quantity does watt-second represent?

11. Flowing water can rotate a turbine. Which type of energy is used by the turbine?

12. By how much will the kinetic energy of a bicycle change if its speed is doubled?

13. What change would be affected in the velocity of a given body to maintain the same kinetic energy if its mass is increased 4 times?

14. A heavy and a light body have the same momentum. Which one will have more kinetic energy?

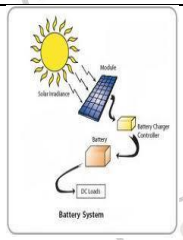
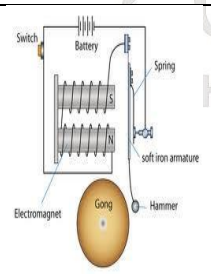
15. Can kinetic energy of an object be negative? Justify.

16. A rocket is moving up with a velocity v. If the velocity of this rocket is suddenly tripled, what will be the ratio of the two kinetic energies?

- The word energy comes from the Greek word energeia.

Assignment 11.7

Mention the energy transformations in the following:-

Figure	Name [object/instrument]	Energy transformation
		
		
		
		
		

The mass of our entire atmosphere is estimated to be some 5.5 quadrillion tons (55 followed by 14 zeros).

Assignment 11.8

1. A force of 100 N acts on a body of mass 5kg at rest for 5 seconds. Find

   (a) initial kinetic energy of the body.

   (b) Acceleration produced in the body

   (c) Final kinetic energy of the body

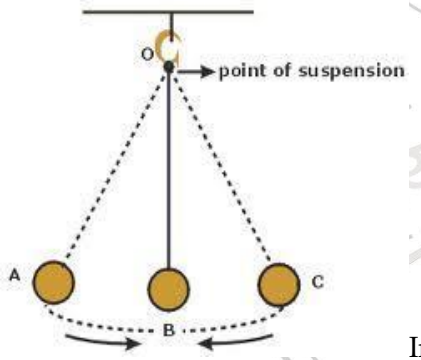
   (d) Velocity before the force is applied

   (e) Velocity after 5 seconds.

   (f) Distance moved by the body in 5 seconds

   (g) Work done by the force

   (h) Power developed by the body



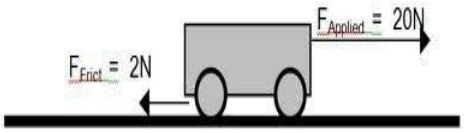
2. In the figure of simple pendulum, mention the position where the bob

   (a) minimum potential energy

   (b) minimum kinetic energy

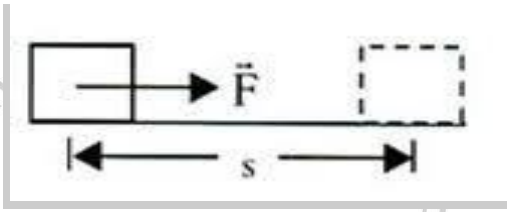
   (c) maximum potential energy

   (d) maximum kinetic energy

4. 

What is the net force?

5. What is the work done? Is it positive or negative?



2. What is the work done by the man on the buckets while walking?

Assignment 11.8

1. Under what conditions is Work done on an object considered to be zero?

2. Find the work done by a player in giving a speed of 10m/s to a ball of mass 250g?

3. Define the commercial unit in which electrical energy is measured and obtain its value in terms of the S.I unit of energy?

4. Name the commercial unit of energy.

5. Define kilowatt hour

6. What is the power of a body which is doing work at the rate of one joule per second?

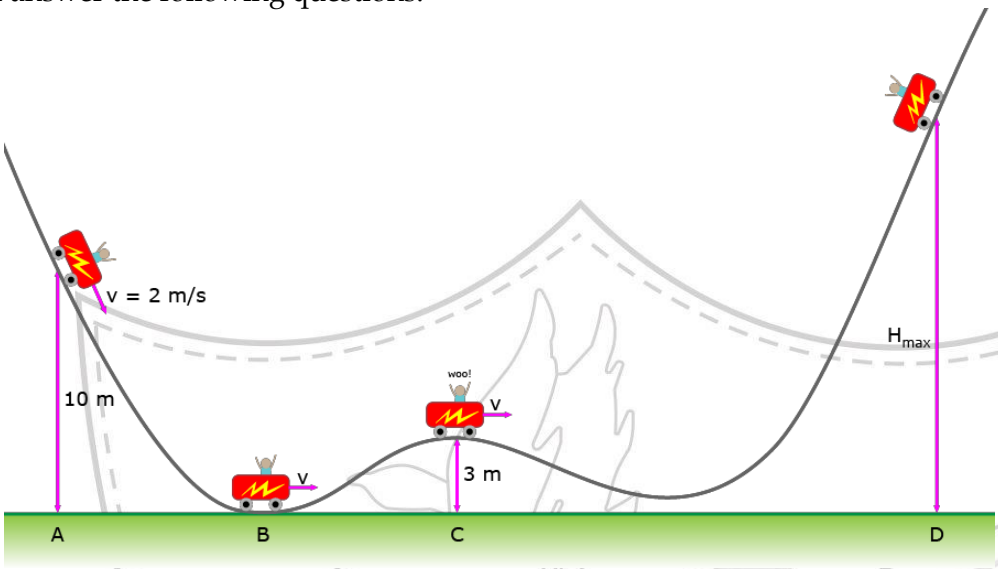
7. In a game of tug of war between teams A and B, A loses and B wins. Which team does positive work and which team does negative work?

8. State the law of Conservation of Energy and mention the series of energy transformations that take place while riding a bicycle, in the form of a schematic figure?

Assignment 9.9

CASE STUDY QUESTIONS

1. A roller coaster ride is taken by the boy. The boy is said to have maximum potential energy at the maximum height and maximum kinetic energy near the surface of the earth. Study the picture and answer the following questions:-



(a) At which position, would the kinetic and potential energy be the maximum?

(b) Find the potential and kinetic energy of the boy at position C.

(c) What is the total mechanical energy of the boy at A and C.

(d) Which law is verified in part (c)? State the law.

2. Observe the following table and answer the following questions:-

S No	DEVICE	No of Devices	Power	Time
1.	Bulb	4	40 W	10 h
2.	Fan	4	50 W	18 h
3.	Television	1	100 W	5 h
4.	Refrigerator	1	350 W	24 h

(a) Find the relationship between the SI and commercial unit of energy.

(b) What is meant by power? State its SI unit.

(c) Find the total units consumed by the devices in a day.

(d) What will be the electric bill for a month of 30 days if the cost per unit is ₹ 5 per unit

ASSERTION – REASON QUESTIONS

Directions : In the following questions, the Assertions (A) and Reasons (R) have been put forward. Read both the statements carefully and choose the correct alternative from the following:

(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion
(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion
(C) Our Assertion is true but the Reason is false
(D) The statement of the Assertion is false but the Reason is true

1. Assertion : A person working on a horizontal road with a load on his head does no work.
Reason : No work is said to be done if force and displacement of the load are perpendicular to each other.

2. Assertion : A light and a heavy body have the same momentum. Then they also have the same kinetic energy
Reason : Kinetic energy does not depend on the mass of the body.

3. Assertion : Water at the foot of the waterfall is always at different temperature than at the top.
Reason : The potential energy of the water at the top is converted into heat energy at the foot of waterfall.

4. Assertion : The power of a pump which raises 100kg of water in 10 seconds to a height of 100m is 10kW.
Reason : The practical unit of power is horse-power.

NOTES

SOUND

LEARNING OUTCOMES

The student is able to

- differentiate materials, objects, phenomena, and processes, based on properties or characteristics,
- plan and conduct investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own
- calculate using the data given, draws labelled diagrams, flow charts, concept maps, graphs
- analyse and interpret graphs and figures
- communicate the findings and conclusions effectively,
- measure physical quantities using appropriate apparatus, instruments and devices
- use scientific conventions, symbols, and equations to represent various quantities, elements, and units
- derive formulae and equations

Assignment 12.1

1. **Sound –** It is a form of _____ which produces the sensation of hearing in our ears.

2. (i) **Wave –** The movement of the _____ through a medium due to the repeated periodic motion of the particles of the medium about their mean position is known as wave.

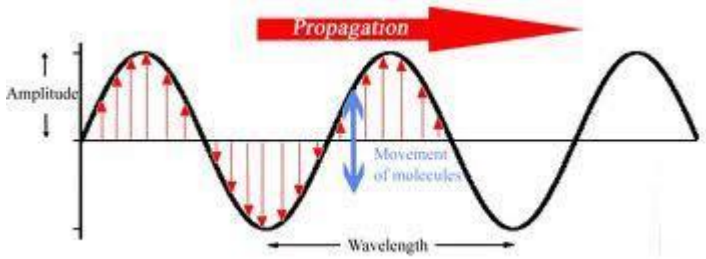
   (ii) Wave transfers energy and not matter.

3. **Mechanical wave –** It is a periodic disturbance which requires a _____ [solid, liquid or gas] for its propagation

   Sound waves, waves produced in water, waves produced due to earthquake, etc are some mechanical waves.

4. Types of mechanical waves - (i) _____(ii) _____

5. (i) **Transverse waves –** If the particles of a medium vibrate or oscillate about their mean position at right angles to the _____ _____, then the waves are transverse waves.



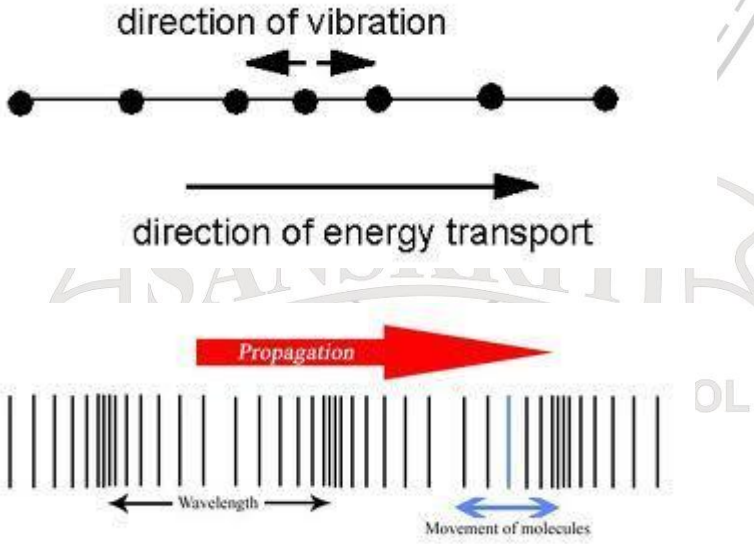
(ii) When transverse waves travel through the medium, the particles of the medium either rise above the mean position or go down below the mean position.

(iii) **Crest –** The point on the elevation of the medium whose distance is maximum from the mean position is called crest.

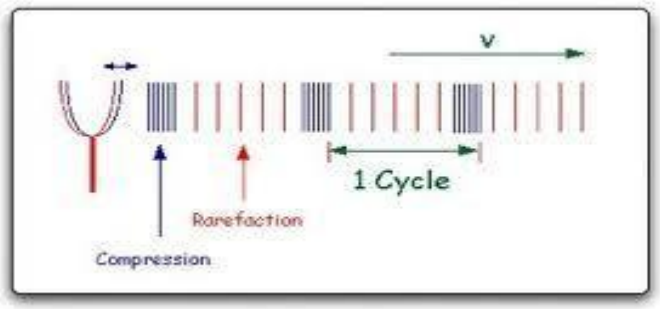
(iv) **Trough –** The point on the depressed part of the medium whose distance is maximum from the mean position is called trough.

(v) The distance between two successive crests or troughs is known as _____. It is represented by λ (lambda).

6. (i) **Longitudinal waves –** If the particles of the medium vibrate or oscillate to and fro about their mean position _____ the direction of the propagation of the disturbance, then the wave is called longitudinal wave.



(ii) When longitudinal waves passes through a medium, the medium is divided into regions of _____ and _____.



(iii) **Compression –** It is the region of the medium where the density of the medium is _____ i.e. the particles of the medium are very close to each other.

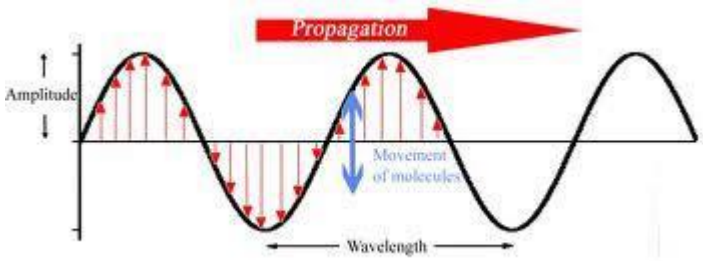
(iv) **Rarefaction –** It is the region of the medium where the density of the medium is _____ i.e. the particles of the medium are far apart from each other.

(v) The distance between two successive compressions or rarefactions is called _____ (λ).

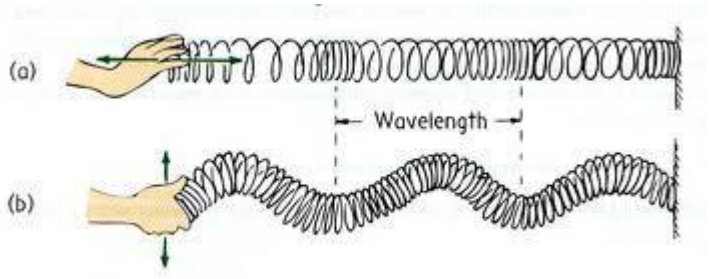
7. Sound waves are longitudinal waves.

8. **Characteristics of sound wave**

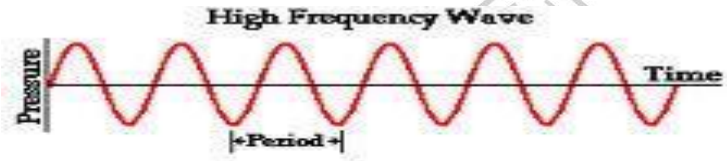
(i) **Amplitude –** It is the maximum displacement of a vibrating body from its _____. It SI unit is **metre (m).**

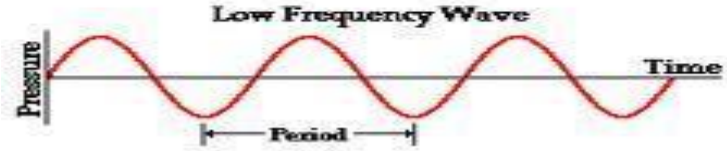


(ii) **Wavelength –** The distance between two successive regions of _____ or rarefactions is called the wavelength of the sound wave. It is denoted by **λ**. Its SI unit is **metre (m).**



(iii) **Frequency** – It is the total number of vibrations made by a vibrating body in _____. It is denoted by f or ν (nu). Its SI unit is **hertz (Hz).**





9. **Time period (T) –** It is the time taken by a vibrating body to complete _____. Its SI unit is **second (s).**

10. **Relationship between frequency and time period**

$$f = 1/T$$

11. **Pitch** – It is the characteristic property of a sound which depends on _____ of the sound wave.

More is the frequency, more is the pitch and vice versa. High pitch is characterized by a shrill voice.

Eg. A woman's voice has high pitch [high frequency and more shrill].

A man's voice has low pitch [low frequency and less shrill]

12. **Loudness –** The loudness of a sound depends upon the _____ of the vibrating body producing sound. More is the amplitude, more is the loudness and vice versa. It is a subjective quantity i.e. it depends on the sensitivity of our ears. Same sound can be loud for one person and feeble for another standing at the same position.

13. **Quality / Timbre –** It is a characteristic feature of sound which enables us to distinguish between the sounds of same _____ and _____. This is so because different sources of sound produce different wave patterns.

14. **Intensity –** Intensity of a sound is the sound energy transferred per unit time through a unit area placed perpendicular to the direction of the propagation of sound.

$$\text{Intensity} = \frac{\text{sound energy}}{\text{time} \times \text{area}}$$

SI unit of intensity = joule second^{-1} metre^{-2} = watt / metre^2

Hence, intensity of sound is an objective physical quantity which does not depend upon the sensitivity of our ears.

15. **Relationship between speed of wave (v), frequency (f) and wavelength (λ)**

$$\text{Speed of wave} = \frac{\text{distance travelled by the wave}}{\text{time taken}}$$

$$= \frac{\text{wavelength}}{\text{time period}}$$

$$= \text{wavelength} \times \text{frequency} \quad [\text{frequency} = 1 / \text{time period}]$$

i.e. $\mathbf{v = \lambda f}$

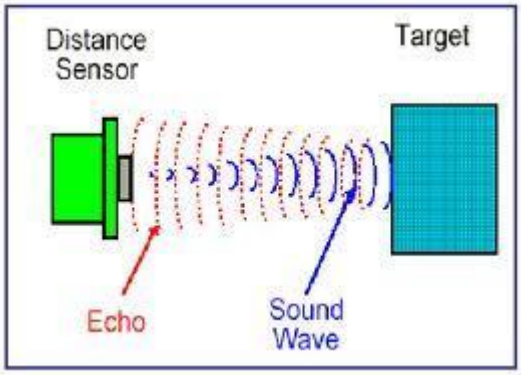
16. Reflection of sound – When a sound wave travelling in a medium bounces back to the same medium after striking the second medium (a solid), reflection of sound wave is said to take place.

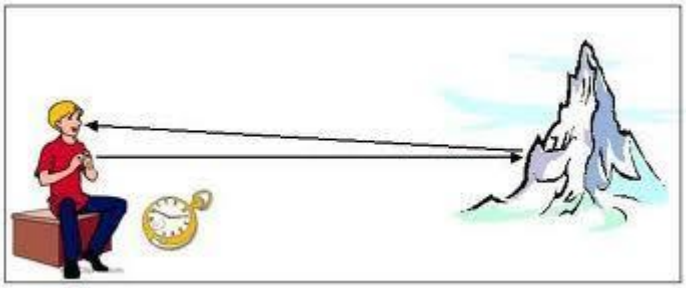
Laws of reflection

(1) The angle of incidence of sound wave is equal to the angle of incidence of the sound wave.

(2) The incident direction of sound, reflected direction of sound and the normal to the point of incidence, all lie in the same plane.

17. Echo – It is the repetition of sound due to the _____ of original sound by a large and hard obstacle.





Conditions for production of echo

(i) Time gap between the original and reflected sound should be more than 0.1 s.

This is because we can hear two sounds distinctly when the time gap between two sound is more than 0.1 s as our persistence of hearing is $1/10^{th}$ of a second i.e. 0.1 s. It means that the impression of a sound remains for 0.1 s in our brain.

(ii) Minimum distance between the source of sound and obstacle should be 17 m.

As the speed of sound in air is 344 m/s approx.,

distance travelled by sound in 0.1 s is = speed x time

=

=

So, the minimum distance between the source and obstacle should be half of this distance i.e.

……

(iii) The nature of the obstacle should be a rigid object like a building, hill or cliff.

(iv) The size of the obstacle reflecting the sound should be quite large.

18. Reverberation – It is the repeated reflection of sound which results in persistence of sound for a long time after the source of sound has stopped producing sound and its gradual fading away until it is no longer audible.

Reverberation time – The time during which the audible sound persists after the production of sound.

A certain amount of reverberation improves the quality of sound.

Excessive reverberation is undesirable as it interferes with the original sound and sound becomes unclear.

Ways of decreasing reverberation time –

Reverberation time can be reduced by using sound absorbing materials in big halls and auditorium like

(i) Covering the walls and ceilings with _____ materials such as fiber board, rough plaster, draperies, perforated cardboard sheets, etc.

(ii) Windows are covered with _____.

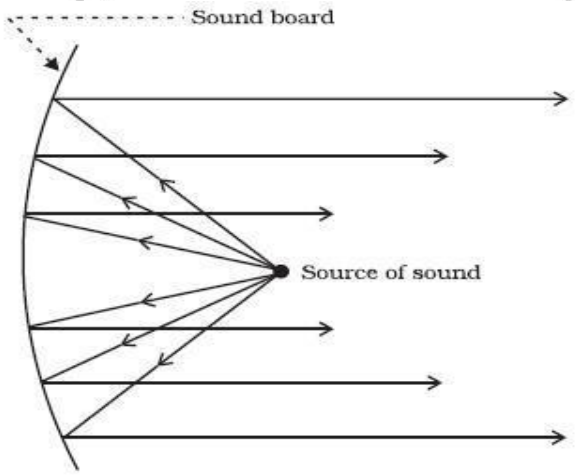
(iii) Special tiles are used for flooring or floors are _____.

(iv) Seats are _____.

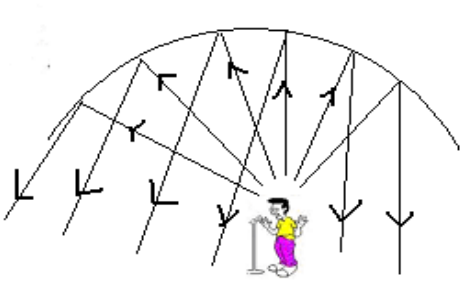
(v) Some potted plants are arranged in the hall.

19. Applications of reflection / multiple reflection of sound

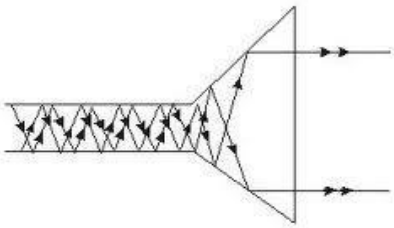
(i) Sound board – These are curved (concave) surfaces used at the back of the stage which directs the sound waves towards the people sitting in a hall / auditorium.



(ii) Curved ceilings – This is done so that sound reaches all parts of the hall after reflecting from the ceiling as shown in the figure.

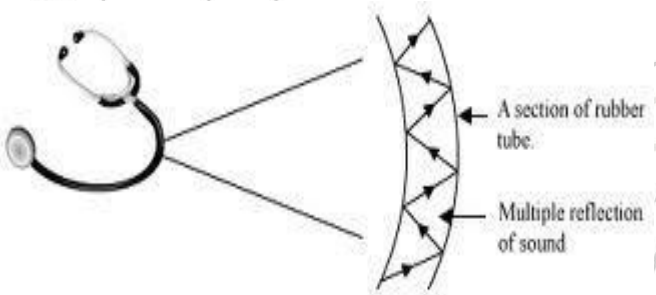


(iii) Megaphone, horns, trumpets, shehnais, etc.



Multiple reflection of sound in a megaphone

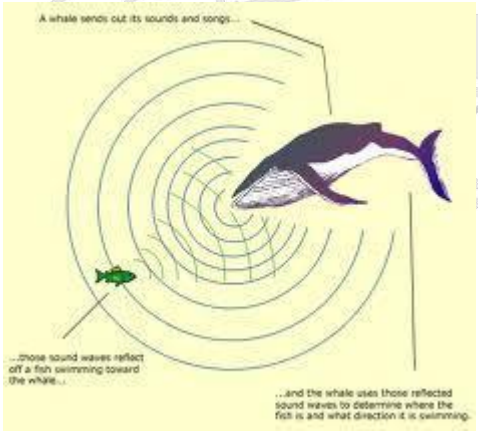
(iv) Stethoscope



(v) Hearing aid

20. Range of hearing - The audible range of frequency for human beings is _____.

Waves of frequency _____ 20 Hz are called infrasonic waves or infrasound. Infrasonic waves are produced by earthquakes, elephants, rhinoceros, whales, etc.

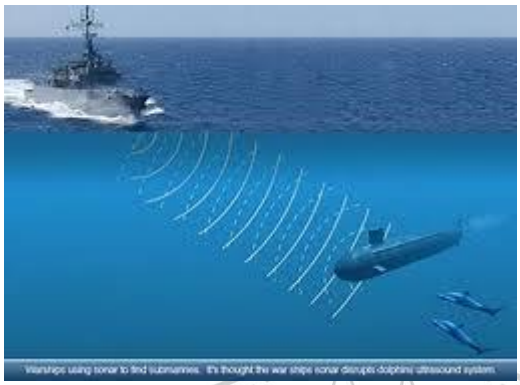


Waves of frequency _____ 20,000 Hz are called ultrasonic waves or ultrasound.

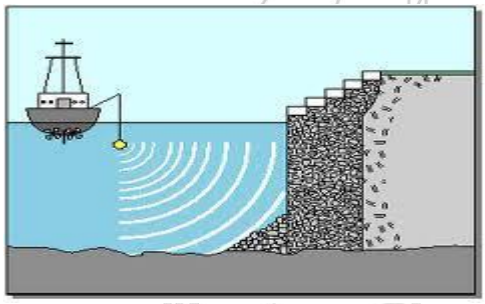
Bats, dogs and dolphins can produce ultrasonic waves.

21. Applications of ultrasound –

(i) To establish ship to ship / submarine communication or location.



(ii) To determine depth of a sea [SONAR]



(iii) For cleaning hidden parts of certain devices

(iv) For welding plastic

(v) For diagnosing diseases in human body

(vi) To kill bacteria in liquids like milk.

(vii) To detect faults and cracks in metals.

(viii) To study the growth of foetus.

22. Uses of Sound Navigation And Ranging [SONAR]

(i) To determine the depth of sea

(ii) To locate underwater hills, valleys, submarine, icebergs, sunken ships, etc.

23. Applications of ultrasound in medicine

(i) Echocardiography – Ultrasonic waves are made to reflect from the parts of heart to form its image.

(ii) Ultrasonography – Ultrasound scanner uses these waves to form images of various internal organs [liver, gall bladder, kidney, etc] of human body and to detect congenial defects and growth abnormalities in foetus during pregnanacy.

(iii) Lithotripsy – The waves are used to break stones formed in the kidney into fine grains which gets flushed out of the body with urine.

- **If you yelled for 8 years, 7 months and 6 days, you would have produced just enough sound energy to heat up one cup of coffee.**

Assignment 12.2

Multiple choice questions

1. Ultrasound waves are those waves which are-
   (a) Audible to man
   (b) Inaudible to man
   (c) Having low frequencies
   (d) Having low amplitudes.

2. When a sound wave goes from air to water, its characteristic property that remains unchanged is-
   (a) velocity
   (b) amplitude
   (c) frequency
   (d) wavelength.

3. Supersonic jets fly with a speed
   (a) less than the speed of sound
   (b) greater than the speed of sound
   (c) equal to that of sound
   (d) equal to that of light

4. A bomb explodes on the moon. How long will it take for the sound of the explosion to reach the earth?
   (a) 10s
   (b) 1day
   (c) 1000s
   (d) None of these

5. The persistence of sound in an auditorium is due to the phenomenon of -
   (a) absorption
   (b) reflection
   (c) reverberation
   (d) interference

6. Air in a room is warmed up. The speed of sound in this room will
   (a) increase
   (b) decrease
   (c) remain unaffected
   (d) fluctuates.

7. When a sound wave moves in a medium,
   (a) density of the medium changes
   (b) pressure of the medium changes
   (c) medium remains unaffected
   (d) Both density and pressure changes.

8. Sound waves can be
   (a) reflected
   (b) absorbed
   (c) reflected multiple times
   (d) all of the above

9. When the source of sound moves towards the listener
   (a) frequency of sound is increased
   (b) velocity of sound is decreased
   (c) wavelength of sound is decreased
   (d) amplitude of sound is increased

10. Which of the following is carried by the waves from one place to another?
   (a) mass
   (b) velocity
   (c) energy
   (d) all the above

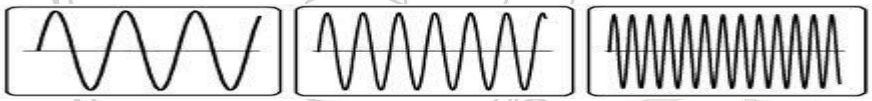
11. 

Fig A Fig B Fig C

For the three figures, with respect to their amplitude and frequency, which of the following statement is correct?
   (a) A, B and C have same amplitude and same frequency
   (b) A, B and C have same amplitude and decreasing frequency from A to C
   (c) A, B and C have different amplitude and different frequency
   (d) A, B and C have same amplitude and increasing frequency from A to C

12. Sound absorbing materials are used in the interiors of an auditorium to
   (a) enhance the appearance of auditorium
   (b) decrease the echo
   (c) decrease the reverberation
   (d) decrease the amount of reflection

13. The instruments such as megaphone, hearing aid, stethoscope and sound board have something in common. What is that?
   (a) all are made of metals
   (b) all cause echo of sound which is inaudible
   (c) all work on the principle of reflection
   (d) None of these

14. Note is a sound of
   (a) mixture of several frequencies
   (b) mixture of two frequencies
   (c) single frequency
   (d) Both (a) and (c)

15. In SONAR, we use
   (a) Audible sound waves

(b) Radio waves
(c) Infrasonic waves
(d) Ultrasonic waves

16. When we change a feeble sound to loud sound, we increase its
(a) frequency
(b) amplitude
(c) quality
(d) wavelength

17. Note is a sound
(a) of mixture of several frequencies
(b) of mixture of two frequencies only
(c) of a single frequency
(d) always unpleasant to listen

- **If Mount Everest were placed at the bottom of the deepest part of the ocean, its peak would still be a mile underwater.**

Assignment 12.3

Short answer questions

1. Why do we hear the sound of a humming bee but not the sound of a pendulum when it is made to oscillate?

2. On what principle is echocardiography based?

3. What is the minimum distance between source of sound and obstacle like cliff to hear an echo?

4. On what principle does a stethoscope work?

5. Name the wave property that determines (a) loudness and (b) pitch

6. What is the nature of sound waves?

7. A sound wave travels from east to west. What is the direction of motion of the particles of the medium?

8. Why is a woman's voice shriller than a man's voice?

9. What is the audible range of frequency of hearing in human beings?

10. Why do astronauts use radios to talk with each other in space?

11. Which characteristic of a sound wave helps us in identifying our friend's voice in a group without seeing them?

12. Name the type of wave produced when

    (a) a stone is dropped in a pond - _____

    (b) a tuning fork is struck on rubber pad - _____

    (c) a slinky kept horizontally is pushed to give a jerk - _____

13. What is the persistence of hearing for a human being?

14. What is the relationship between speed, frequency and wavelength of a wave?

15. Where is the density of particles of medium more for longitudinal waves?

16. What is the distance between two consecutive compressions or rarefactions called?

- **The bark of the redwood tree is fireproof.**

Assignment 12.4

Reasoning questions

1. An approaching train can be felt easily by putting one's ear to the rails.

2. Bats can detect the position of their prey with great accuracy.

3. Carpets and curtains are used in auditoriums.

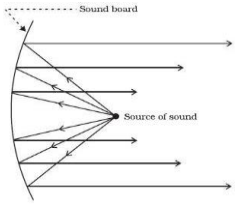
4. The 

figure shows the reflection of sound from a curved sound board in a big hall.

(a) Why are the sound boards curved?

(b) Where should the speaker stand and speak so that all in the hall can hear him clearly?

5. The sound of supernova explosions in space cannot be heard on the surface of the earth.

6. When thunder and lightning are produced simultaneously, thunder is heard after a few seconds after the flash is seen.

7. Sound wave is a longitudinal wave.

8. Astronauts use radios to talk to each other in space.

- **Chewing gum was invented by a dentist, named William Semple - as a way to exercise your jaws.**

Assignment 12.5

1. A violin and a sitar may have the same pitch, yet we can distinguish their notes. Why?

2. State one use of ultrasound in (a) medical (b) industry.

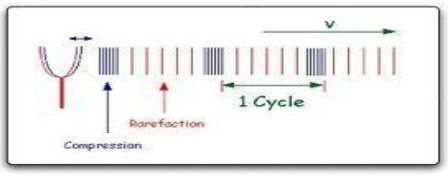
3. A boy strikes one end of an iron pipe. Another boy at the other end of the pipe hears two sounds in a short interval of time. Why?

4. How is a note different from tone?

5. How is an echo different from reverberation?

6. On what factors does speed of sound in a medium depend?

7. Does the sound of a bomb explosion travel faster than that produced by a humming bee?

8. 

A vibrating tuning fork has a frequency of 250 Hz. The distance between two consecutive compressions is 25cm. What is the velocity with which the wave is travelling forward? Name the type of waves produced.

9. 
Fig A

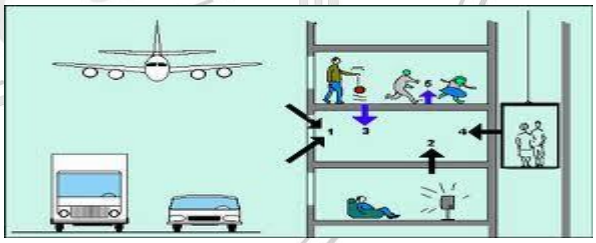
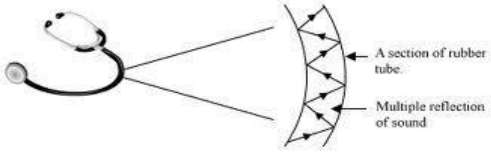



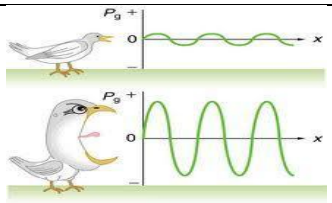
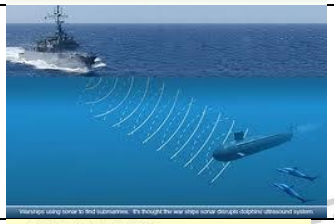
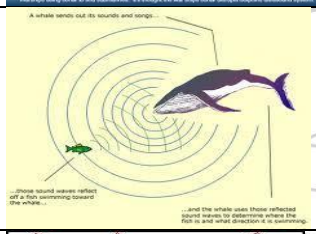
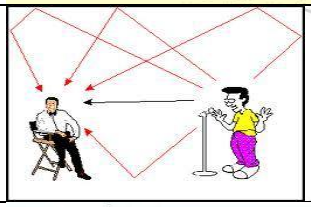
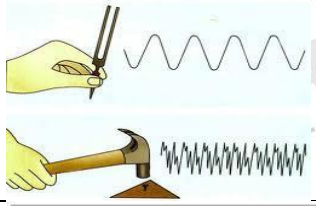
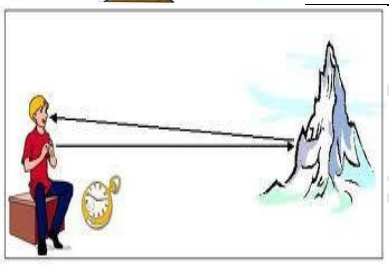
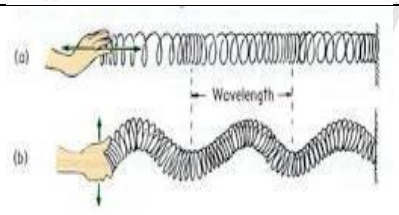
Fig B
The two figures A and B show two different sets of things which produce sound. What is the difference between the two?

10. 

Name the first figure. What is the relation between the first and the second figure?

11. If we hit a wooden table hard, what type of sound wave is produced and what kind of sound is heard?

Assignment 12.6

QNo	Figure	Question
1.		The wave pattern produced by the bird at two different times is shown. Which characteristic of sound wave is shown and what type of sound is produced in each case? Ans.
2.		What is the technique used to find the position of the submarine? Ans.
3.		Name the sound waves used by the whale to locate its prey, the fish. Ans.
4.		How can this room be designed to ensure clarity of the sound produced by the boy and that heard by the man sitting? Ans.
5.		What is the difference in the sound produced by the tuning fork and the hammer? Ans.
6.		What can the boy do/verify/find with the stop watch in the given situation? Ans.
7.		What is the difference between the two slinky on the basis of how the waves are produced? Ans.

The loud noise you create by cracking a whip occurs because the tip is moving so fast it breaks the speed of sound!

Assignment 12.7

NUMERICALS

1. A sound wave has a frequency 3kHz and wavelength 45cm. Find the speed of the wave.

2. Sound produced by a thunderstorm is heard 10s after the lightning is seen. Calculate the approximate distance of thunder cloud. [Speed of sound = 340m/s]

3. A tuning fork has a frequency of 256 Hz. What is the wavelength of the sound wave produced in air if the speed of the sound in air is 340m/s?

4. A boy hears an echo from a cliff 4s after the sound from a powerful cracker is produced. How far is the cliff from the boy?

5. Calculate the wavelength of a sound wave whose frequency is 220Hz and speed is 440m/s in a given medium.

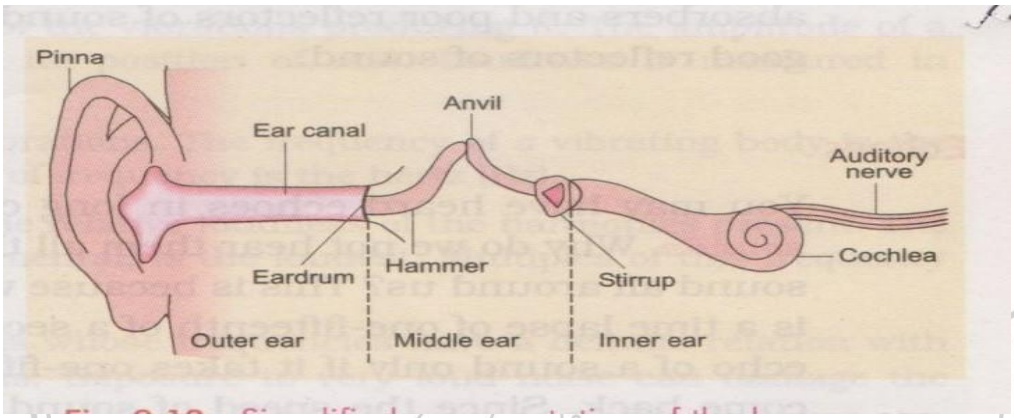
6. A submarine emits a SONAR pulse, which returns from an underwater cliff in 1.02 s. How far is the cliff from the source if the speed of sound in water is 1531m/s?

- **The scientific study of sound waves is known as acoustics.**

Assignment 12.8 [HOME WORK]

Structure of ear and its working

1. Schematic diagram of human ear.



2. How do we hear sound through our ears?

Assignment 12.9

1. Name the type of waves produced when a bell rings in air.

2. Name the sound wave below and above the audible range of human beings.

3. What are the condition(s) necessary for an echo to be heard distinctly?

4. Why are sound waves called mechanical waves?

5. In which form does transverse and longitudinal waves propagate?

6. Mention two medical uses of ultrasonography?

7. Why is the reverberation time larger for an empty hall than a crowded hall?

8. Why do we prefer to use ultrasound instead of X-rays for medical applications?

Assignment 12.10

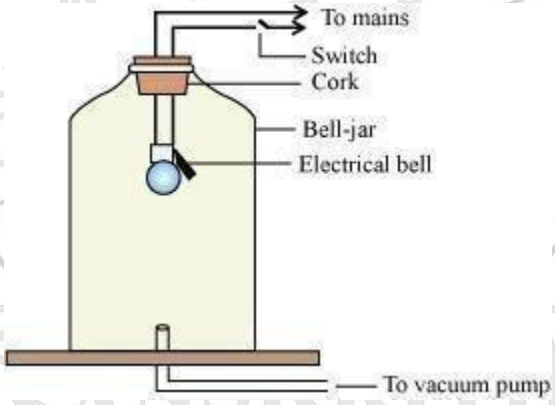
CASE STUDY QUESTIONS

1. Study the following paragraph and answer the following questions:

At the bottom of the ship, transmitters and receivers are fitted. Transmitters emit ultrasonic waves which on striking at the bottom of the water, return, and are received by the receiver. The time taken by a wave to travel down and get received back by the receiver is calculated and using the velocity of ultrasonic waves in water, the time interval and the distance of submarine from surface or depth can be calculated.

a) Name the method used for the above.
b) Name the device used to determine the depth of the sea by the above method.
c) Write an expression which relates the distance of the underwater object, time and the speed of ultrasonic wave.
d) Which scientific principle is used in this process?

2. Observe the diagram and answer the following questions: It is the bell jar experiment where an electric bell is kept in a sealed jar. With the help of vacuum pump, air is slowly sucked out.



a) Which fact about sound is proved by the activity?
b) What happens when the entire air inside the bell jar is sucked out? Why?
c) When does the electric bell ring?
d) How does sound travel in a medium?

ASSERTION – REASON QUESTIONS

Directions : In the following questions, the Assertions (A) and Reasons (R) have been put forward. Read both the statements carefully and choose the correct alternative from the following:

(A) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion

(B) The Assertion and the Reason are correct but the reason is not the correct explanation of the Assertion

(C) Our Assertion is true but the Reason is false

(D) The statement of the Assertion is false but the Reason is true

1. Assertion : Two persons on the surface of the moon cannot talk to each other.
Reason : Sound cannot travel as there is no atmosphere (medium) on moon.

2. Assertion : The speed of sound increases with the increase in temperature.
Reason : The speed of sound does not depend on the medium.

3. Assertion : Compression and rarefaction involve changes in density and pressure.
Reason : When particles are compressed, density of the medium increases and when they are rarefied, the density of the medium decreases.

4. Assertion: Sound would travel faster on a hot summer day than on a cold winter day.
Reason : Sound is directly proportional to the square of its temperature.

NOTES

FACTOPAEDIA

- **If you try to say the alphabet without moving your lips or tongue every letter will sound the same**
- **To crack a whip the tip must be travelling faster than the speed of sound**
- **Dolphins can hear underwater sounds from 24km (15miles) away**
- **Sound travels 10 times faster through granite than air**
- **Dolphin's can detect underwater sounds from 24 km (15 miles) away**
- **When baby polar bear cubs are born they cannot see or hear for their first month**
- **Akousticophobia is the fear of noises**
- **Melophobia is the fear of music**

PRACTICALS

INSTRUCTIONS FOR WRITING PRACTICAL IN FILE

- The sequence as given here must be followed.
- Diagram has to be drawn with pencil.
- What is given in smart skills has to be copied from here to the file and the rest in the given sequence is to be noted down from the laboratory manual.

1. **AIM**
2. **APPARATUS**
3. **THEORY**
4. **DIAGRAM [Left hand side of the file / Blank page]**
5. **OBSERVATION [Left hand side of the file / Blank page]**
6. **OBSERAVTION TABLE [Left hand side of the file / Blank page]**
7. **CALCULATION [If any]**
8. **RESULT**
9. **PRECAUTION**
10. **SOURCES OF ERROR**

EXPERIMENT 1

Aim : To determine the density of a solid by using spring balance and a measuring cylinder.

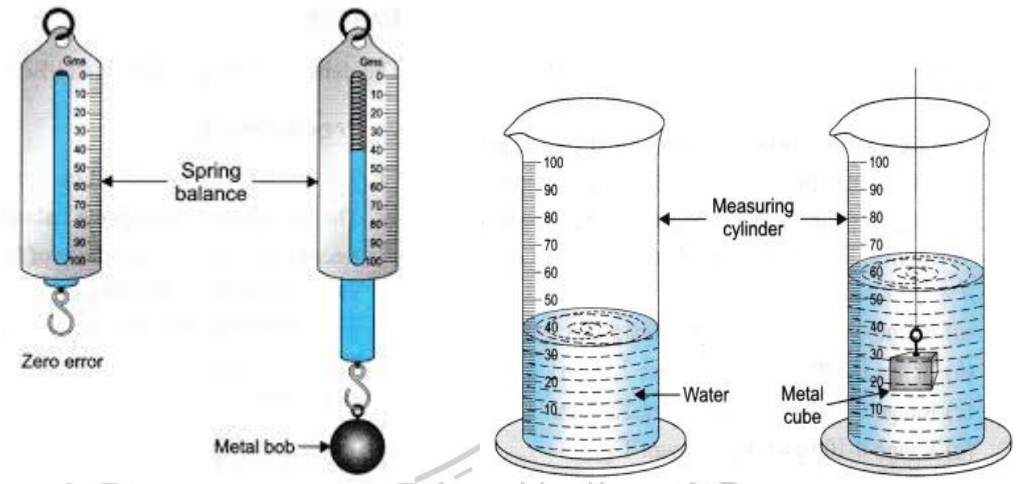
Materials required: Spring balance, measuring cylinder, a piece of thread, water, regular object, irregular object

Theory: The density of a substance is defined as the mass per unit volume.

Density = mass / volume

The SI and CGS unit of density are kg/m^3 and g/cm^3 respectively.

Diagram: [BLANK SIDE]



[Observation and observation tables on BLANK SIDE]

Observation :
Range of the spring balance –

Zero error of the spring balance –

Least count of the spring balance –

Range of the measuring cylinder –

Least count of the measuring cylinder –

1 ml = 1 cm^3 (cc)

Observation Table 1: [Regular object]

S No	Mass of object in air,**M (g)**	Initial volume of water, V_i**(cm^3)**	Final volume of water, V_f**(cm^3)**	Volume of solid **$V = V_f - V_i$ (cm^3)**	Average volume of object, **$V_{av}=\frac{V_1+V_2+V_3}{3}$ (cm^3)**
1.					
2.					
3.					

Observation Table 2: [Irregular object]

S No	Mass of object in air,**M(g)**	Initial volume of water, V_i**(cm^3)**	Final volume of water, V_f **(cm^3)**	Volume of solid **$V=V_f - V_i$ (cm^3)**	Average volume of object, **$V_{av}=\frac{V_1+V_2+V_3}{3}$ (cm^3)**
1.					

2.					
3.					

Calculation : 1. Density [Regular object] = $\frac{\text{mass}}{\text{volume}}$

$= \frac{\mathbf{M}}{\mathbf{V_{av}}}$

= g/cm^3

= g/cm^3

2. Density [Irregular object]= $\frac{\text{mass}}{\text{volume}}$

$= \frac{\mathbf{M}}{\mathbf{V_{av}}}$

= g/cm^3

= g/cm^3

Result : 1. The density of the regular object is _____ g/cm3.
2. The density of the irregular object is _____ g/cm3.

Precautions:

1. The measuring cylinder must be dry and clean.
2. The measuring cylinder should be placed on a horizontal surface while reading the water meniscus.
3. While observing the liquid meniscus, the line of sight should be at the same horizontal level as that of the lowest meniscus.
4. There should be no air bubble in the liquid while measuring its volume.
5. The spring balance should be held vertical while taking measurement.
6. Before making use of spring balance, it must be ensured that its pointer is at the zero mark.
7. The readings of the spring balance should be noted only when its pointer comes to rest.
8. The solid object should be wiped with a dry cloth before repeating the activity.

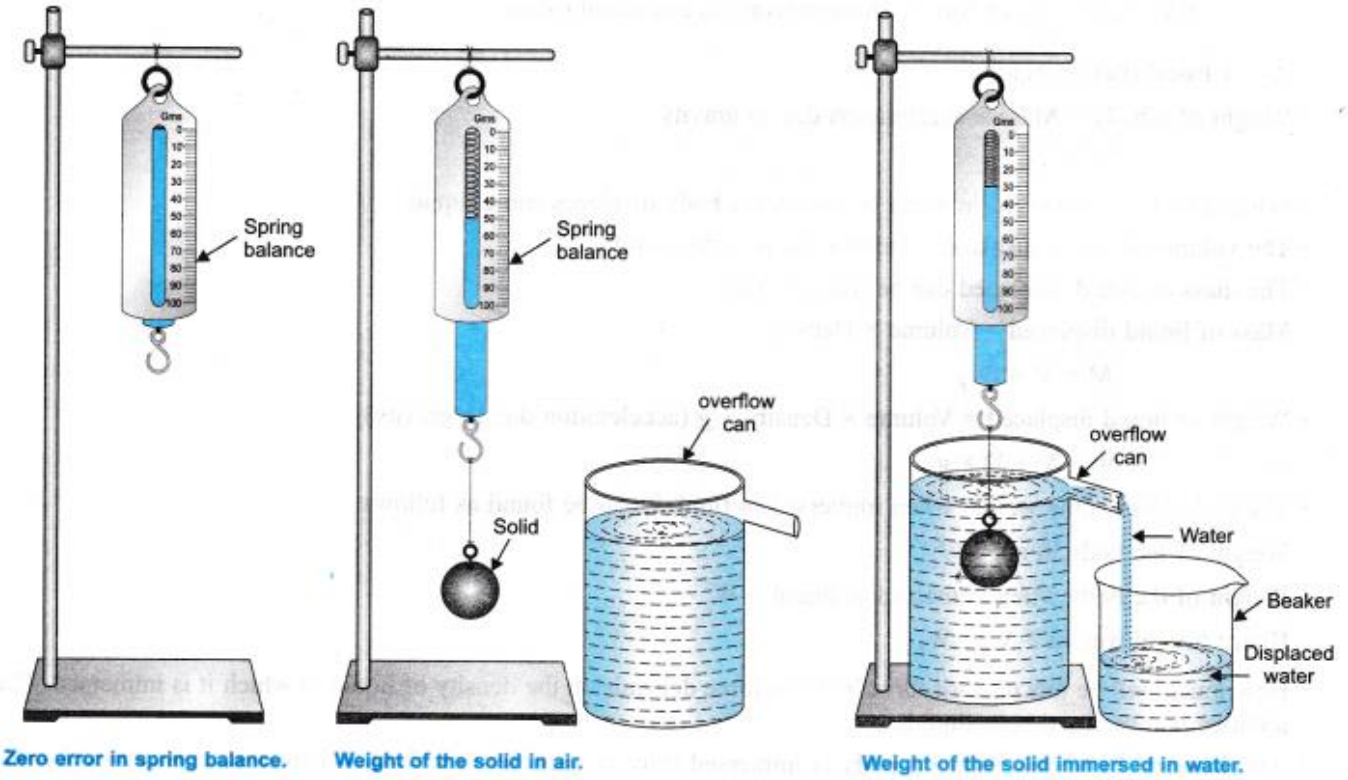
EXPERIMENT 2

Aim : To establish a relation between the loss in weight of a solid when fully immersed in (i) tap water and (ii) saturated salt solution, with the weight of the water displaced by it.

Materials required :

Theory : Archimedes'principle states that when an object is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

Diagram:



Zero error in spring balance. Weight of the solid in air. Weight of the solid immersed in water.

Observation:

Zero error of spring balance = _____ g

Range of the spring balance = _____ g

Least count of the spring balance = _____ g

Weight of the empty beaker, W_3 = _____ gwt

Observation table 1: [Tap water]

S No	Weight of solid in air, W_1 **(gwt)**	Weight of solid in tap water, W_2 **(gwt)**	Loss inweight of solid $W' = W_1 - W_2$ **(gwt)**	Weight of beaker with displaced water W_4 **(gwt)**	Weight of water displaced $W'' = W_4 - W_3$ **(gwt)**
1.					

2.					

Observation table 2: [Salty water]

S No	Weight of solid in air, W_1 (gwt)	Weight of solid in salt solution, W_2 (gwt)	Loss inweight of solid $W' = W_1 - W_2$ (gwt)	Weight of beaker with displaced water W_4 (gwt)	Weight of water displaced $W'' = W_4 - W_3$ (gwt)
1.					
2.					

Result :

1. The difference between the apparent loss in weight of the solid when immersed in water/salty water and the weight of the water/ salty water displaced is negligibly small [_____N]
2. In both observation tables, W′ = W″
   That is, loss in weight of the body is equal to the weight of the water displaced.

3. Weight of the water displaced in tap water [for the same solid] is less than the weight of the water displaced in salt water [for the same solid]

Precautions and Sources of error:

1. The graduation marks o the measuring cylinder and on spring balance should be evenly spaced.
2. The impurities present in the water may alter its density.
3. The solid used should be non-porous otherwise it will absorb some water. Absorption of water by the solid may affect the change in its weight and the volume of water displaced by it.
4. The density of the solid should be larger than that of water so that it sinks in water.
5. The measuring cylinder must be kept on a horizontal surface and the line of sight should be at the same level as that of the lower meniscus of water while recording the volume of displaced water.
6. Before reading the liquid meniscus in the measuring cylinder, it must be ensured that there is no air bubble inside the liquid.
7. The thread used in the experiment may also absorb some water.
8. The readings of the spring balance should be taken only after its pointer comes to rest.
9. If the spring balance has some zero error, then it must be noted before taking measurements and the same should be taken into account while using the spring balance.

EXPERIMENT 3

Aim : To determine the velocity of a pulse propagated through a stretched slinky.

Materials required: Long metal slinky, stop watch

Theory: A pulse is a small disturbance in a medium that usually lasts for a short time. A longitudinal pulse is a disturbance that causes the particles of the medium oscillate parallel to the direction of motion of the pulse.

$$\text{Velocity of pulse} = \frac{\text{total distance travelled by pulse}}{\text{Total time taken}}$$

Observation :

S No	Length between A & B, L (cm)	2L ,(cm)	Time taken, t (s)	Average time, T (s)	Velocity of pulse V = 2L / T (cm/s)
1.					
2.					
3.					
4.					
5.					

Result : The speed of the longitudinal pulse in the stretched slinky is _____ cm/s.

Precautions:

1. Do not overstretch the slinky as over stretching may destroy its spring nature.
2. It must be ensured that no part of the stretched slinky touches the surface.
3. The slinky should not have any knot or any kink at any point along its length.
4. At the time of creation of the pulse, the counting must start from zero and the stop watch should be started at the same time.

QUESTIONS BASED ON PRACTICALS [VIVA VOCE]

1. The spring balance used for the experiment has 4 divisions between the markings 1 and 2. Its least count is
   (a) 2 gf
   (b) 0.2 gf
   (c) 1 gf
   (d) 5 gf

2. In a spring balance, there are 25 divisions between 0 and 50 gf. Its least count is
   (a) 10 gf
   (b) 5 gf
   (c) 0.2 gf
   (d) 2 gf

3. Sound waves can travel
   (a) in vacuum only
   (b) in vacuum and material medium
   (c) in material medium only
   (d) neither in vacuum nor in material medium

4. While determining the density of a copper cylinder using a spring balance and measuring cylinder, Sharon followed the given procedure—The wrong step in the procedure is
   (a) Noted the water level in the measuring cylinder without the copper piece
   (b) Immersed the copper piece in water
   (c) Noted the water level in the measuring cylinder with the copper piece inside it
   (d) Removed the copper piece from the water and immediately weighed it using a spring balance

5. Before using the spring balance, its pointer should be
   (a) at zero mark
   (b) at any mark
   (c) below zero mark
   (d) above zero mark

6. The density of which of the following cannot be measured accurately using a spring balance and a measuring cylinder
   (a) a sponge ball
   (b) a block of ice at 0^{o} C
   (c) a balloon filled with water but leaking from a small hole
   (d) all of these

7. Four measuring cylinders with least count 2.5 ml. 1.0ml, 0.5ml and 0.2ml are present. Which one should be preferred to find the density of a solid accurately? The spring balance with least count
   (a) 2.5 ml
   (b) 1.0 ml

(c) 0.5 ml
(d) 0.2 ml

8. A given solid is weighed in air using a spring balance. It is weighed by immersing fully in tap water first and then in salt solution. The reading of the spring balance would be
(a) least in air
(b) least in water
(c) least in salt solution
(d) equal in all the three cases

9. The weight of an object felt in tap water and salt solution are W_T and W_S respectively, then
(a) $W_T = W_S$
(b) $W_T < W_S$
(c) $W_T > W_S$
(d) $W_T = W_S$

11. In an experiment on determining the velocity of a pulse, as it propagates through a stretched wire, a student uses four different lengths of the same wire, in increasing order. The velocity og propagation of the pulse, observed by him, would
(a) show random variations depending on the strengths of the jerk given to the wire
(b) increase with increase in length
(c) be the same for all lengths of the wire
(d) decrease with increase in length

12. A student is given an iron cube of side 1 cm, a measuring cylinder of range 100ml and least count 1 ml and a spring balance of range 100 gwt and least count 1 gwt. He can use these to measure
(a) both the mass and the volume of the given iron cube
(b) neither the mass nor the volume of the given iron cube
(c) only the mass of the iron cube but not its volume
(d) only the volume of the iron cube but not its mass

13. The number of pulses created in a slinky depends on
(a) the length of the slinky
(b) the number of turns of slinky
(c) nature of material of slinky
(d) none of the above

14. A body of mass 300g is floating in water. The results recorded for the apparent weight by four students are as follows. Which one is correct?
(a) zero
(b) 300 g wt
(c) less than 300 g wt
(d) more than 300 g wt

15. The same iron block is immersed in two liquids A and B one after another. The extent to which the body sinks in liquid B is less than in liquid A. Which of the following conclusions can be drawn from the observation?
(a) No definite conclusion can be made
(b) density of the iron block is less than any one liquid

(c) density of liquid A is more than that of B
(d) density of liquid B is more than that of A

16. A student took solid objects of different shapes, sizes and materials and noted down the apparent loss in weight on partially or fully immersing the objects in different liquids. Based on the observations, he concluded the following statements. Which one of them is not correct?
(a) Upthrust depends on the density of the liquid
(b) Upthrust depends on the volume of the object immersed
(c) Upthrust increases as the object is taken deeper in a liquid
(d) Upthrust depends on the shape of the container containing liquid

17. Adding salt to water will
(a) initially increase and the decrease its density
(b) increase its density
(c) decrease its density
(d) not change its density

18. Two slinky A and B of the same length are made up of two different materials. The times taken by 20 pulses to travel in both of them are 50 s and 70 s respectively.
(a) the pulse travels faster in A than B
(b) the pulse travels faster in B and A
(c) speed of the pulse cannot be decided
(d) there is no relation between speed of pulse and material of slinky

19. In a slinky, one can produce
(a) transverse waves
(b) longitudinal waves
(c) both transverse and longitudinal waves
(d) neither transverse nor longitudinal waves

20. The SI unit for speed of pulse is
(a) second
(b) kilogram
(c) metre
(d) metre per second

21. A student sets up a slinky on a smooth table top with one end fixed and other end free. How can one produce transverse wave in the slinky by moving its free end?
(a) backward and forward along the length of the slinky
(b) up and down
(c) left and right
(d) at an angle of 45^0 with the table top

22. Before making use of spring balance, the pointer should be
(a) below zero mark
(b) above zero mark
(c) at zero mark
(d) at any mark

23. The density of which of the following cannot be measured accurately using a spring balance and a measuring cylinder?
(a) a bag filled with a liquid having a leakage

(b) a block of ice at 0^0C
(c) a small porous solid
(d) all of these

ANSWER KEY

Assignment 8.1 1. 7m, 5m along AC 3. 44m, 0, 33m, 9.8m along AB 4. 35m, 25m along AC 5. 132m, 0, 42m, 42m along diameter 6. 120m, 0 7. 23.55m, 15cm along diameter, 47.1cm, 0	**Assignment 8.2** 1. 30m/s, 16.67m/s, 54km/h 2. 0.1km/min, 1.67m/s, 6km/h 3. 10m/s 4. 3m/s 5. 14m/s 6. 4m/s 7. 80km/h 8. 36km/h 9. 36km/h
Assignment 8.5 **4.** 3000km/h^2 **5.** 0.6m/s **6.** 60m/s **7.** 20m/s **8.** -5m/s^2 **9.** -4000m/s^2 **10.** 30km **11.** 0.05m/s2 **12.** 37.5m **13.** Overspeeding **14.** 2400m **15.** 75m	**Assignment 9.2** 1. 4m/s2 2. 22N 3. -16N 4. B 5. 15kgm/s 6. A 7. 4s
Assignment 9.3 1. -1m/s 2. -30m/s 3. 2.25m/s 4. 0.025m, -2.5N	**Assignment 10.5** 1. 6m/s 2. 4.9m, 19.6m 3. 19.6m/s 4. 0 5. 4s, 80m
Assignment 10.6 1. 10N, 1.25N, 1.25N	**Assignment 10.7** 1. 4 x 105 Pa 2. 3 x 10-3 N

4. 5m/s 5. 50m/s, 375m 6. 2.18m/s2	3. 109Pa 4. 30000Pa 5. 1000Pa 6. 3333.33Pa, 2000Pa
Assignment 10.12 1. 30 2. - 3. 10N 4. - 5. 19.32 6. 0.84 7. 141120gcm/s2 8. 49000gcm/s2	**Assignment 11.1** 1. 160J 2. 0 3. 300J 4. 0, 0 5. 578764.8J