MATRIX OLYMPIAD

The Most Innovative Talent Recognition Exam

PHYSICS

Class - VIII

MATRIX

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Few words for the Readers

Dear Reader,

"*Matrix Olympiad is established to encourage school students to go a step further than their regular studies, and get a chance and exposure to competition on a wide scale. It also helps students enhance their learning of basic cognitive skills and deeper knowledge of subjects like Science, Mathematics, English, Mental Ability, Social Studies.“Matrix Olympiad helps students nurture their minds for higher targets of tomorrow and enables them to study School for JEE, NEET, CLAT, NDA, Olympiads , NSEJS, NTSE , STSE etc.*"

The above thought has been our guiding principle while designing and collating the study material for **Matrix Olympiad** . And hence, we hope that this particular material will be helpful towards your preparation for **Matrix Olympiad**.

Our team at **MATRIX** has put in their best efforts for making this particular module interesting and relevant for you. Additional efforts have been made to ensure that the content is easy to understand and error free to the extent possible. However, there might remain some inadvertent errors in answer keys and theoretical portion and we would welcome your valuable feedback regarding the same.

If there are any suggestions for corrections, please write to us at **smd@matrixacademy.co.in** and we would be highly grateful.

Finally, we would like to end this message by a famous quote by Ernest Hemingway - "*There is no friend as loyal as a book*." So, please give your study material the time and attention it deserves, and it will surely help you reach newer heights in your fight with competition examinations.

With love and best wishes !

Team MATRIX

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FORCE AND PRESSURE 1

Concepts

INTRODUCTION

We use force all the time. We use force to open a door, to pick up the school bag, to brush our teeth, to squeeze out toothpaste from a tube, to turn on a tap and so on. Even the earth is exerting a force on us all time.It is pulling all of us and all things on earth towards it.In fact we use force for every single action of ours! You have studied about force in previous classes. Do you remember what a force is ?

1. FORCE

A push or a pull on an object is called force

Unit of Force

(i) The SI unit (in standard international system) of force is called Newton and its symbol is **N** (kg × m/sec^2)

(ii) C.G.S unit of force is dynes (gm cm/s^2)

1 Newton = 10^5 dynes,

1 N = kg-m/s^2

= 1(1000 gm) (100 cm/s^2)

= 10^5 gm-cm/s^2

So that, 1 N = 10^5 dyne

1.1 FORCE DUE TO INTERACTION

When does a force come into play ?

Let us consider a man standing behind a stationary car. [See fig. 1(a)]. Now, if the man begin to push the car, that is, he applies a force on it, the car may begain to move in the direction of the applied force [see fig.1(b)]. The man 'pushes' the car to make it move.

(a) (b)

Figure 1: A car is being pushed by a man

From this example, we can conclude that at least two objects must interact for a force to come into play. Thus, an interaction of one object with another object results in a force between the two object. Some other examples of interaction between two objects are given in fig. 1(c) and fig.1(d)

Fig.1(c) Interaction between man and cow both trying to pull each other

Fig. 1(d) Interaction between two girls both trying to pull each other

1.2 MAGNITUDE & DIRECTION OF FORCE

A force can be described completely by stating its magnitude and the direction in which its acts.

Magnitude : It is a measure of how strong a force is.

Direction of force : When forces are applied on an object in the same dierection, we get the net force by adding the magnitude of forces. When two forces are applied on an object in the opposite direction the net force is the difference in the magnitude of forces and acts in the direction of larger force.

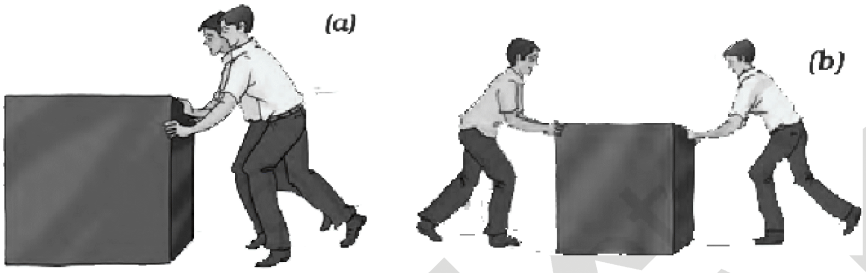


Fig. 2 : Two friends pushing a heavy load (a) in the same direction, (b) in opposite direction

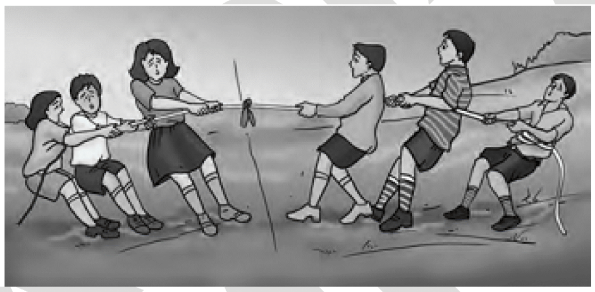


Fig 2(c): The rope may not move if the two teams at it with equal force

BALANCED AND UNBALANCED FORCE

A number of force acting on an object may either be balanced or unbalanced.

(i) Balanced Forces : If a number of forces acting on an object does not produce any change in its state of rest or uniform motion or direction of motion then, they are called as balanced forces.

Example :

(a) A person holding a briefcase in hand

(b) A book resting on table

(c) Squeezing a lemon etc.

(d) Tug of War

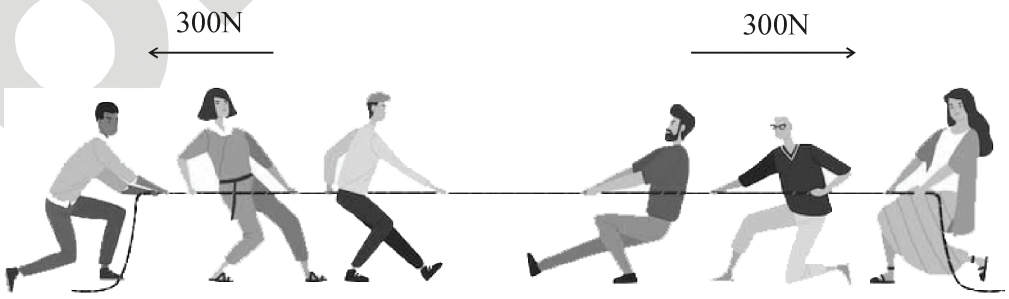


Figure : Tug of War

(ii) Unbalanced Forces :

If a number of forces acting on an object produce a change in its state of rest or uniform motion or direction of motion, then they are called as unbalanced forces.

Example :

(a) A briefcase released from a person's hand

(b) A stone dropped etc.

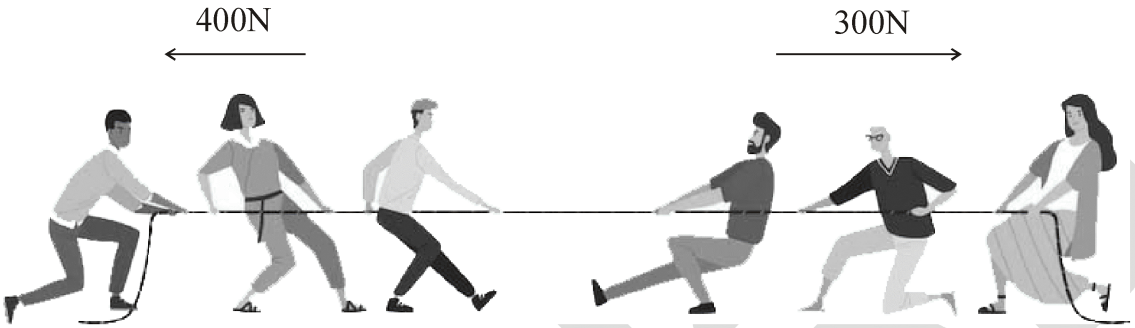


Figure : Tug of War

BUILD THE CONCEPT

Q. 1. How can two forces of 3N and 4N combine to give forces of (a) 7N (b) 1N ?

Ans. By applying both forces in same direction we get 7N force and by applying both forces in opposite direction we get 1N force.

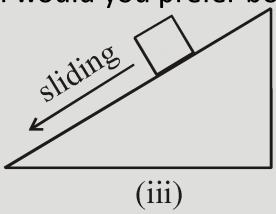
Q. 2. Two men can apply 100 N force each then in the following situation would you prefer both men to apply forces in same direction or opposite direction ?

(i) To lift up the block from ground.

(ii) To seperate magnet stuck to each other.

(iii) In figure to stuck the block from sliding on the inclined surface

(iv) To stick two blocks using fevicol.



(iii)

Ans. (i) same direction (ii) opposite direction (iii) same direction (iv) opposite direction

2. EFFECT OF FORCE

2.1 FORCE CAN CHANGE THE STATE OF MOTION

Force can move a stationary object

Example :

(a) A football player kicking a stationary football.

(b) A man lifting a book kept on the table.

(c) A man hitting a stationary ball with a bat.

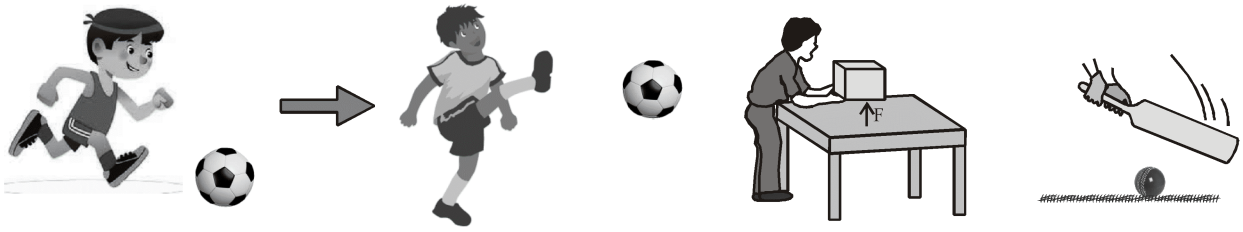


Figure : Force exerting on bodies to move them from rest

However, it is not necessary that force always makes a stationary body move.

For example : If you try to push the wall of your classroom, it will not move. For that matter even if all the boys in your class push the wall, it will not move. The reason is that the force applied by all of your is not sufficient to move the wall.

Force can stop a moving body

Example :

(a) A goalkeeper stopping a football moving towards the goal post.

(b) When we apply breaks to a moving bicycle, its first slow down then stops.

(c) We ourselves have to apply force to stop our bodies while running.

(d) A cricket ball is stoped by a player by applying a force in the direction opposite to that of the ball.

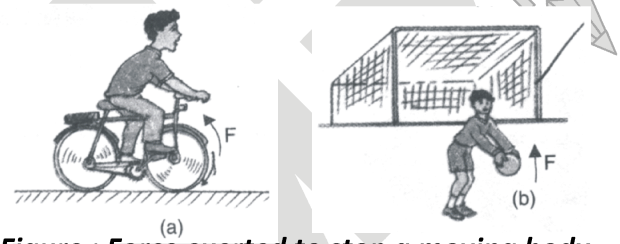


Figure : Force exerted to stop a moving body

Similarly, if we apply brakes to a moving bicycle, it first slows down and then stops. We ourselves have to apply force to stop our bodies while running. A cricket ball is stopped by a player by applying a force in the direction opposite to that of the ball.

From the above examples, it is clear that a force may stop a moving body or may reduce the speed of the moving body.

Force can change the speed of a moving body

Example :

To decrease speed, force is applied in a direction which is opposite to the motion of the body. If we apply force in the direction of motion of the body, it tends to increase the speed of the body.

Example :

(a) if your friend is riding a bicycle and you push the bicycle in the same direction. The speed of bicycle will increase.

(b) On the other hand if you pull the bicycle, i.e., you apply force against the direction of motion, the speed of bicycle decreases.

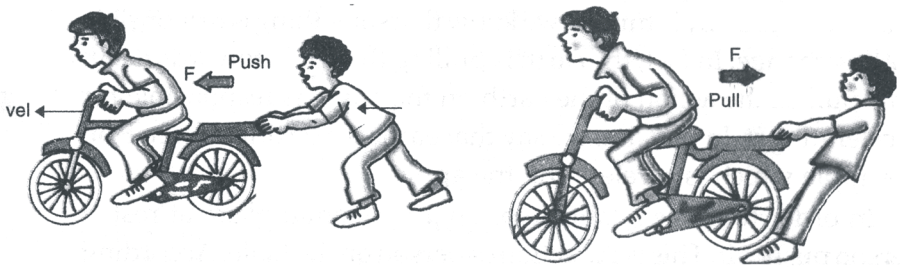


Figure : (a) Force exerted in the direction of velocity *(b) Force exerted in opposite direction of velocity*

Force can change the direction of a moving body

Example :

(a) A carrom striker changes its direction after a collision.

(b) When a batsman hits a ball, he changes the direction of the ball.

(c) When a stone is rotated in a circular path, the direction of motion of the stone changes continuously. The force acting on the stone towards the centre of the circular path is responsible for changing the direction of the stone.

(d) A football player changes the direction of a moving ball by angling his foot.

(e) We can change the directions of our moving bicycle by applying force on its handle in desired direction.

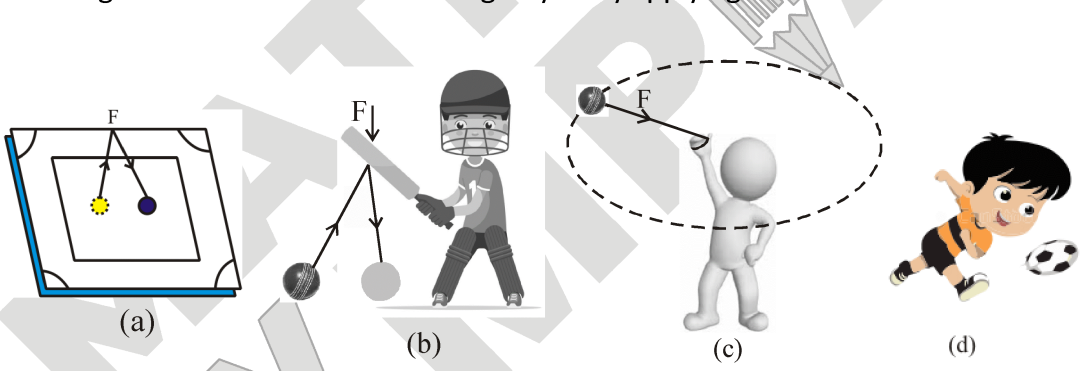


Figure : Force exerted to change the direction of a moving body

Force can rotate an object

Example :

(a) When electric current is passed through a motor of a ceiling fan, forces are produced in the dynamo (or motor) which makes the fan to rotate.

(b) For closing a door you apply a push.

2.2 FORCE CAN CHANGE THE SHAPE AND SIZE OF AN OBJECT

Example :

(a) When we squeeze a toothpaste tube, it gets flattened.

(b) When we stretch a rubber band, its shape and size changes.

(c) On stretching and compressing a spring, its length changes.

(d) When we crumple a paper, it shape changes.

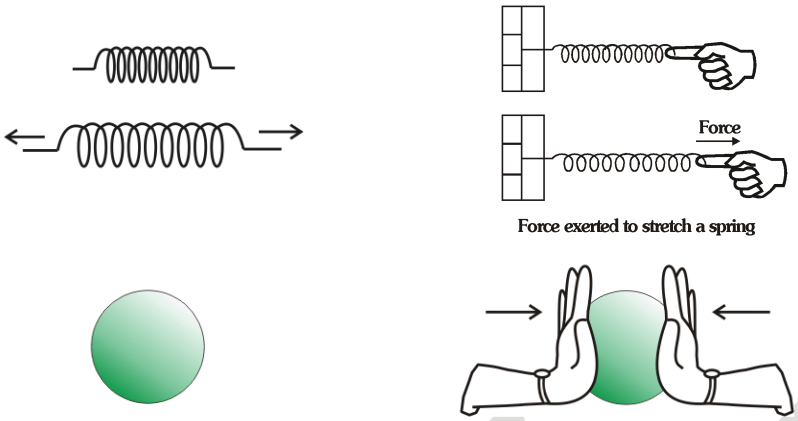
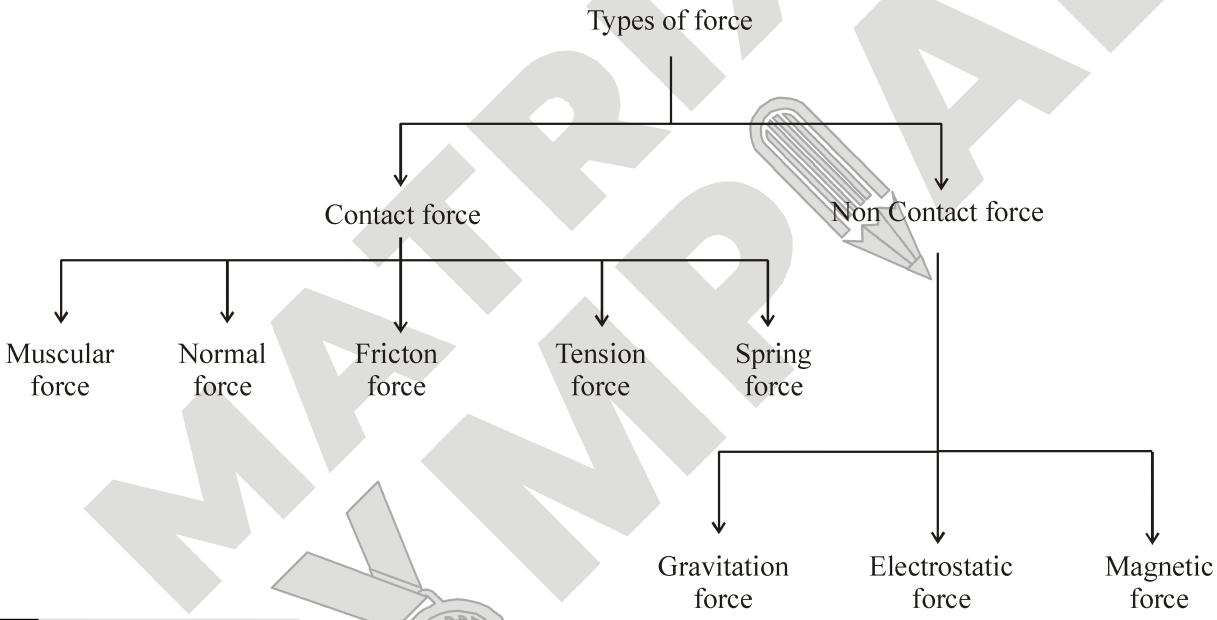


Figure : Force can change the shape

3. TYPE OF FORCE



3.1 CONTACT FORCE

Forces that act only when there is physical contact between two interacting objects are known as contact forces. that means contact force involves only when two bodies are directly contact to each other.

MUSCULAR FORCE

This is the force we can exert with our bodies by using our muscles, e.g. pull, push, kick etc. Such forces are also called muscular forces. These are contact forces.

Figure : Muscular force

NORMAL FORCE

The force acting on a body perpendicular to the surface of contact is called a normal force.

Eg. Consider a book on a table. The table pushes the book upwards and book pushes the table downwards, these forces are perpendicular to the surfaces of book and table. Thus the table applies a normal forces on book in the upward direction and book applies a normal force on table in downward direction.

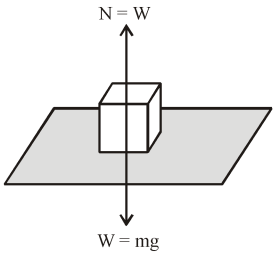


Figure : Normal Force

FRICTION FORCE

The force which acts to reduce relative motion between the surface of contact is called the frictional force.

Suppose block is moving on a horizontal surface with a velocity υ. The darkned line at the bottom of the block is the surface of contact of the block with floor. We notice that this surface of contact is moving towards right with respect to the horizontal surface. To reducing this relative motion, frictional force acts. Frictional force is exerted by the floor on the block in a direction opposite to velocity.

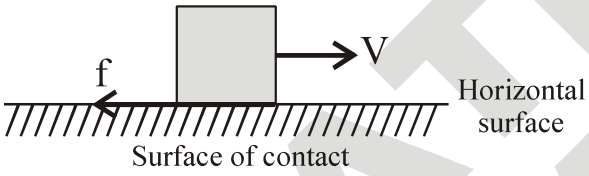
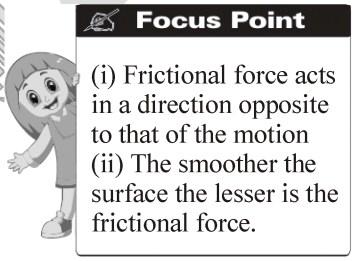


Figure : Friction force



TENSION FORCE

Whenever we try to stretch a string, a force develope in the string which is called tenstion force.

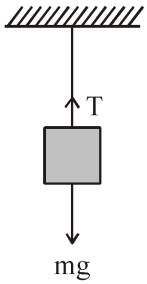


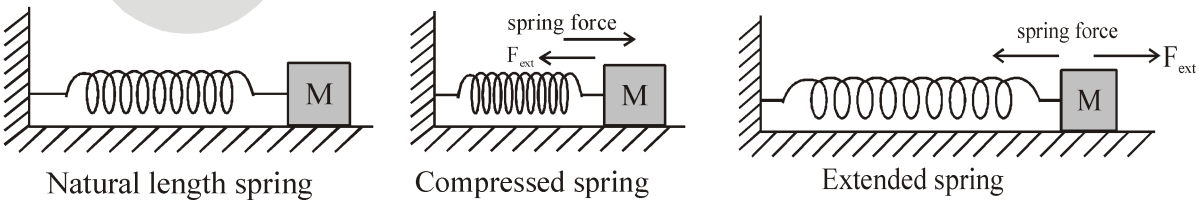
Figure : Tenstion Force

SPRING FORCE

(i) The length of spring at which spring applies no force is called its natural length.

(ii) When ever spring is extended or compressed from its natural length then spring applies a force which is called spring force.

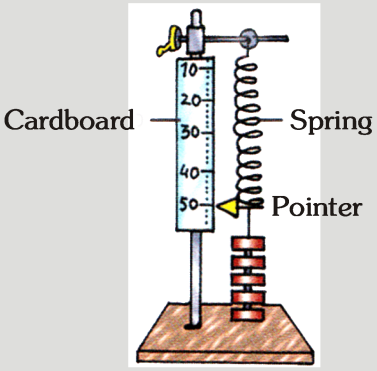
(iii) Spring force act in such a way that it tries to bring the spring back to its natural length or unstreached state.



LAB TIME
Let's Do & Learn

Making of a spring balance :

⏩ Take a spring and hand it from a stand. Attach a pointer near the free end of the spring. Fix a strip of cardboard by the side of the spring and mark '0'. Now suspend a 10g load from the lower end. Mark 10g force against the new position of the pointer. Add another 10g load to the lower end of the spring. The length of the spring increases. Mark 20g against the new position of the pointer on the strip. Go on adding loads in steps of 10g and mark the new position of the pointer on the cardboard as 30, 40, 50. Your spring balance is now ready for use.



Spring Balance

3.2 NON-CONTACT FORCES

The force which a body applies on another body when the two bodies are not in contact with each other is called non-contact force.

GRAVITATIONAL FORCE

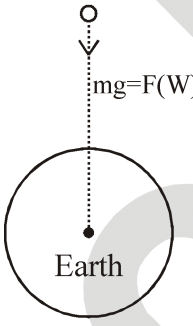
Gravitational Force : The force which a body applies on another body when the two bodies are not in contact with each other is called non-contact force. Gravitational force is the weakest force in nature and still this force is responsible for the revolution of earth around the sun.

Force of gravity due to earth :

The earth attracts all the bodies towards its centre. The force exerted by the earth on the body is known as weight of the body of force of gravity. It acts in vertically downward direction.

If mass of the body is 'm' and acceleration due to gravity is 'g'. Then force of gravity of weight = mg

The value of g is 9.8 m/s^2. The value of 'g' does not depend on the mass of the body.



Earth exerting gravitational force on mass m

Figure 17

Focus Point

The value of g change slightly from place to place but for most of the purpose it is taken as 9.8 m/s^2.

Gravitational unit of force :

The S.I. unit of force is newton symbol (N) another unit of force, called the gravitational unit is kilogram force. 1 Kg-f = 9.80 N. (Kg-f = kilogram force) means force applied by earth on a mass of 1kg.
1gf = 980 dyne means force applied by earth on a mass of 1gm.

DIFFERENCE BETWEEN MASS AND WEIGHT

S. No.	Mass	Weight
1	It is the quantity of matter possessed by a body. It is represented by m.	It is the force with which a body is attracted towards the centre of the earth. It is represented by W = mg.
2	A mass is a constant quantity and is same (for a body) everywhere.	It varies from place to place due to variation in value of g.
3	Mass is never zero.	The weight of an object can be zero. For example. In the interplanetary space, where g = 0, the weight of an object becomes zero.
4	Its unit is kg.	Its unit is Newton.
5	It is a scalar quantity.	It is a vector quantity.

BUILD THE CONCEPT

Q. 1. Mass of a body is 5 kg. What is its weight ? [Take g = 9.8 ms^{-2}]

Ans. Mass(m) = 5 kg
Acceleration due to gravity (g) = 9.8 ms^{-2}
We know that W = mg = 5×9.8 = 49N.

Q. 2 What is the mass of an object whose weight is 98 newton ? [take g = 9.8 ms^{-2}]

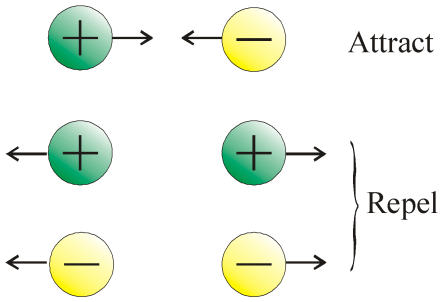
Ans. Weight (W) = 98 N
Acceleration due to gravity (g) = 9.8 ms^{-2}
Mass(m) = ?
We know that

$$W = mg \Rightarrow m = \frac{W}{g}, \; m = \frac{98}{9.8} = 10 \text{ kg}$$

ELECTROSTATIC FORCE

The force exerted by a charged body on another charged or uncharged body is know as electrostatic force. Two similar charged body repel and two opposite charged body attract each other also due to electrostatic force

When a plastic comb is rubbed with silk, it can pick up small bits of paper. This is because the comb acquires an electric charge because of which it can exert a force called electrostatic force. Electrostatic force can also act from a distance and is therefore a non contact force. A body with electrostatic charge can either attract or repel another charged body. Electrostatic force is used to separated solid pollutant particles from smoke given out from factories.



MAGNETIC FORCE

This is the force exerted by magnets on each other and on some metals like iron and nickel. Since magnets attract iron, magnets are used to separate waste iron object from garbage dumps so that they can be recycled. Magnetic force and electrostatic force are inter-related and are together called electro-magnetic force.

4. PRESSURE

The effect that a force has when it acts on a surface depends on two factors :
(i) The amount of force applied.
(ii) The area in contact over which the force is applied
Pressure is defined as the force acting per unit area. Pressure = Force/Area

BUILD THE CONCEPT

Q. 1. If a force of 2N is applied over an area of 2 cm^2, calculate the pressure produced.

Ans. To get the pressure in Pa, we have to make sure that the force is in Newton and the area in m^2. Here, the area is in cm^2. To convert this to m^2, we have to divide the given are a by 10,000

Thus, area = $\frac{2}{10000}$ = 0.002 m^2 ; Now, Pressure = $\frac{\text{Force}}{\text{Area}}$ = $\frac{2N}{0.0002m^2} = 10000Pa$

Q. 2 Calculate the pressure exerted by a brick, which applies a force of 2.5N, when (a) it is placed upright on the soil, (b) when it is placed on its widest base. The dimensions of the brick are 25cm × 10cm × 5cm.

Ans. (a) when the brick is placed up right :

Area in contact with soil = 10cm × 5cm $= \frac{10}{100}m \times \frac{5}{100}m = 0.005m^2$

$\therefore$ Pressure exerted = $\frac{F}{A} = \frac{2.5}{0.005m^2}$ = 500 Pa

(b) When the brick is placed on its widest base :

Area in contact with soil = 25cm × 10cm $= \frac{25}{100}m \times \frac{10}{100}m = 0.025m^2$

$\therefore$ Pressure exerted = $\frac{F}{A} = \frac{2.5N}{0.025m^2} = 100Pa$

4.1 VARIATION OF PRESSURE WITH AREA

The same force, increasing the area over which it acts decreases the pressure applied. The inverse is also true : decreasing the area of application increases the pressure produced for the same force.

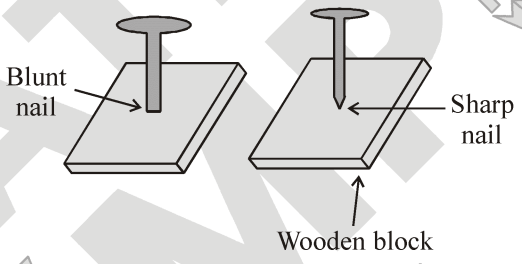
(i) A wide strip school bag is more comfortable to carry :

Children daily carry school bags from home to school and school to home on shoulder. You hang your bag on right shoulder and after some time you happen to hang it on your left one; because your shoulder tired. What makes your shoulder get tired ? Of course, it is the force exerted by the strip of the school bag which you put over your shoulder.

The entire weight (force) of the bag is balanced by the strip. But if you notice, if you choose a bag with broader strip, you feel comfortable and do not get tired easily. So bag A and bag B with equal number of books exert equal weight or force on the shoulder. But bag B with broader strip (larger area) gives you less feel of effort to carry the bag. So here comes the concept of effect of force, which in some way depends upon the area over which it acts. More is the area, lesser is the effect of force.

(ii) It is more difficult to fix a blunt nail than a sharp nail :

We all know that it is more difficult to fix a blunt nail than a sharp nail. Why ? It is because the sharper is on it.



(iii) It is easy to cut fruits and vegetables with a sharp knife :

Daily experience tells us that it is easy to cut fruits and vegetables with a sharp knife than with a blunt one. Why ? The reason is the same that the area of contact of a sharp knife with fruit is less than that of a blunt knife. Therefore, the effect of force applied by a sharp knife is more.

Increasing Pressure :

(i) Sewing needles have pointed tips :

A small force of fingers makes the needle piece into the cloth easily and sewing becomes quicker.

(ii) The studs on football boot have only a small area of contact with the ground. The pressure under the studs is high enough for them to sink into the ground. Which gives extra grip.

Reducing Pressure :

(i) Vehicle breakes have flat surface : This reduces pressure on the vehicle's tyres and avoid their tearing.

(ii) Broad sole shoes : make walking easier on a soft land.

(iii) Wide steel belt over the wheels of an army tank makes its movement easier over marshy land.

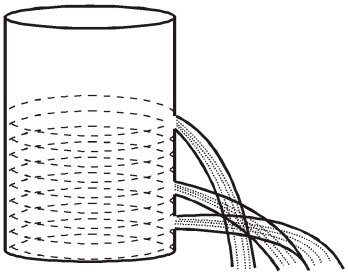
(iv) Tractor tyres are broad : Tractors do not sink in the soft land of the field while operating them.

(v) Camel's foot are broad and soft : They walk swiftly on sand.

(vi) Hanging bags have wide strips : They reduce pressure on the shoulders.

(vii) Skis have a large area to reduce the pressure on the snow so that they do not sink in too far.

4.2 PRESSURE EXERTED BY LIQUIDS



When an object is immersed in a liquid, the liquid exerts a net upward force on the object. This upward force determines whether an object will float or sink in a liquid. If the upward force exceeds the weight of the object, the object will float, if the weight of the object exceeds the upward force, the object will sink.

Pressure in a liquid increases with depth because the further down you go down greater the weight of liquid above.

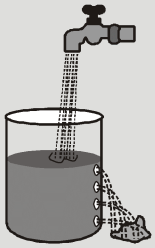
(i) The pressure experienced by deep-sea divers is so great that they have to wear specially designed suits to protect themselves. They use special suits called diving suits and buoyancy compensators to combat the weight of their diving equipment and the water pressure at great depth.

(ii) Dams are made stronger and thicker at the bottom than at the top to withstand the high pressure at greater depths.

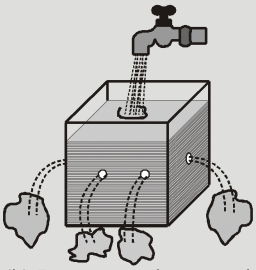
LAB TIME
Let's Do & Learn

To show that liquid pressure varies with depth :

- Take a plastic container and make four holes in it at different heights.



(a) Water pressure increases with depth



(b) Pressure at the same depth is the same in all directions

Fill the container with water, and let water keep flowing into it from a tap (figure a)

- Notice the force with which water comes out of the holes.
- You will find that water comes out with greater force from the holes at greater depth. Water from the botom most hole will be spurted out the farthest from the container. This shows tha the pressure in a liquid increases with increasing depth.

BUILD THE CONCEPT

Q. 1. The dams of water reservoir are made thick near the bottom. Why ?

Ans. Pressure exerted by a liquid column = $h \rho g$ so as 'h' increases P increases. So to withstand high pressure dams are made thick near the bottom.

Q. 2. The blood pressure in human is greater at the feet than at the brain. Why ?

Ans. The height of blood column is quite large at feet than at the brain, hence blood pressure at feet is greater.

4.3 PRESSURE EXERTED BY GASES

All the gases exert pressure on the walls of container because gases are made of tiny particles called molecules which move around quickly in all directions that collide with one another and with the walls of the container that gives rise to pressure due to constant collision of the tiny molecules of the gases with the walls of the container

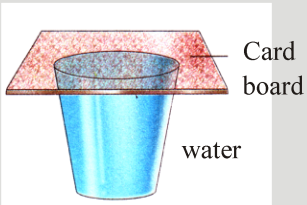
ATMOSPHERIC PRESSURE

A layer of air called the atmosphere surrounds the earth. As you know, air is also matter and has weight. The weight of the atmosphere exerts a pressure on the surface of earth. This pressure is called atmospheric pressure. Its magnitude is around 100 kilo pascals (100 kPa) at sea level. However, as we go upward, the magnitude of atmospheric pressure decreases gradually. The following activity will show the magnitude of atmospheric pressure on the earth's surface.

LAB TIME
Let's Do & Learn

The magnitude of atmospheric :

▶▶ Take a glass tumbler and fill it with water to the brim. Cover it with a thick sheet of paper (or cardboard). Press your palm over the sheet and quickly invert the tumbler. Slowly remove your palm supporting the piece of paper. What do you observe ? Surprised ?



A glass with water covered with a sheet

Figure 22 (a)

You have seen that the paper did not fall (as one expected it to) This is because the atmospheric pressure provides enough force to push the piece of paper unward.

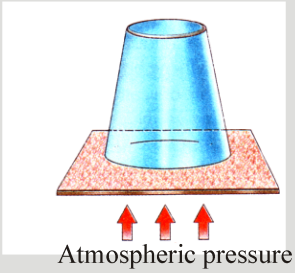


Figure 22 (b)

4.4 APPLICATION OF PRESSURE

(i) Pressure due to liquids in blood vessels helps blood to move throughout the body.
(ii) We use rubber suckers for installing hooks in the kitchen. As the air between wall and sucker is sucked out, it is held firly against the wall.
(iii) We enjoy cold drinks with a straw. This happends when air of straw goes into lungs and forces liquid from straw to come out.
(iv) Vaccum cleaner - Low pressure is created inside the cleaner which sucks dirt into the device.
(v) Squeezing of tooth paste, lemon, spray bottle, perfume bottle, etc. are some activities which are not possible without understanding pressure.

SOLVED EXAMPLES

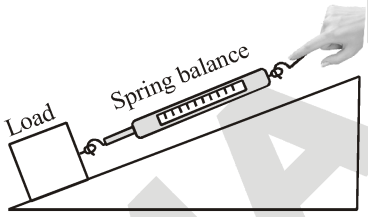
SE. 1

How much would a 70 kg man weight on the moon? What will be his mass on the earth and on the moon? [g on moon = 1.7 m s^{-2}]

Ans. Mass of the man, m = 70 kg
Acceleration due to gravity on moon.g_m=1.7 ms^{-2}
Weight of the man on the moon, W = ?
From relation, W = mg
Putting values, we get, W = 70 × 1.7 = 119 i.e. W=119.N.
The weight of the man on the moon will be 119 N
The mass will remain same (70 kg) on earth and the moon.

SE. 2

A student is pulling a load up an inclined plane. What are the forces the student has to overcome?



Ans. (a) Frictional' force (b) Gravitational force

SE. 3

Why carts with rubber tyres are easier to ply, than those with iron tyres ?

Ans. The friction between rubber and road is less, than between iron and road. Therefore, it is easy to ply a cart with rubber tyres, than with iron tyres.

SE. 4

A person weight 600 N. He is wearing shoes with a total area of 0.02 m^2. What pressure do they exert on the floor ?

Ans. Pressure = $\frac{\text{Force}}{\text{Area}}$

Given, weight = mg = F = 600 N and A = 0.02 m^2

$\therefore$ Pressure = $\frac{600}{0.02}$ = 30000 N

SE. 5

Why are all the things attract towards the earth?

Ans. Because, the huge mass of the earth and its gravity.

SE. 6

What is the effect of force on the shape of an object?

Ans. A force can change or try to change the shape of an object. When a force is applied on an object then change in shape takes place. It may be smaller or greater. At last we can say that the application of force on an object may change its shape.

SE. 7

If several forces act in different direction on a body, in which direction will the body move?

Ans. When several forces act on a body in different directions, the effect on the object is due to the magnitude and direction of the net force acting on it.

SE. 8

Why do the school bags have broad shoulder straps ?

Ans. School bags and shopping bags have broad belts or straps as handles. Narrow handles cause pain in the hand because the weight of the bag acts on a small area, so the pressure will be higher.

SE. 9

What do you mean by state of motion of a body.

Ans. The state of motion of a body is described by its speed and direction of motion. The state of motion of an object at rest is the state of zero speed.

SE. 10

What happens to the pressure when area on which it is applied increases?

Ans. Pressure = Force/Area on which force acts. The pressure is inversely proportional to the area on which force is applied. As the area in which force is increases, the pressure decreases.

SE. 11

How do we feel force in our daily life?

Ans. Various big or small actions make us feel the force. We hit or catch many objects in our daily life. We see that a moving ball stops of its own. The ball changes the direction of its motion when hits with a bat. These are many actions which help us to feel that a force is exerted.

SE. 12

What are the effect of force?

Ans. A force changes or tries to change
(i) Speed of a moving body
(ii) Direction of motion of a body
(iii) Shape of a body.

SE. 13

A force 20 N acts over an area of 4 cm^2. Find the value of pressure? [in N m^{-2}]

Ans. Pressure = $\frac{\text{Force}}{\text{Area}}$

Given F = 20 N
and A = 4 cm^2 = 4 × 10^{-4} m

$\therefore$ Pressure = $\frac{20}{4\times10^{-4}}$ = 50000 Nm^{-2}

SE. 14

Can you separate two hemispheres, if all the air is suck out from them?

Ans. If there is no air inside the two hemispheres, then only outer surface is in contact of atmospheric pressure and atmospheric pressure acts on it. We cannot separate them in that case.

Space for Notes :

NS. 1

Give two examples of each of situation in which you push or pull to change the state of motion of an objects.

Ans. (i) We push a bicycle to move it
(ii) We pull the table to change its position.

NS. 2

Give two examples of situations in which applied force causes a change in the shape of an object.

Ans. (i) When we press the foam, its shape changes,
(ii) When we stretch the rubber band, then its shape changes.

NS. 3

Fill in the blanks.
(a) To draw water from a well we have to _____ at rope.
(b) A charged body _____ an uncharged body towards it.
(c) To move a loaded trolley we have to _____it.
(d) The north pole of a magnet _____ the north pole of another magnet.

Ans. (a) Pull (b) Attracts (c) Push (d) Repels

NS. 4

An archer stretches her bow while taking aim at the target. She then releases the arrow, which begins to move towards the target. Based on this information fill up the gaps in the following statements using the following terms :
muscular, contact, non-contact, gravity, friction, shape, attraction
(a) To stretch the bow, the archer applies a force that causes a change in its _____ .
(b) The force applied by the archer to stretch the bow is an example of _____ force.
(c) The type of force responsible for a change in the state of motion of the arrow is an example of a _____ force.
(d) While the arrow moves towards its target, the forces acting on it are due to _____ and that due to _____ of air.

Ans. (a) shape (b) muscular (c) contact
(d) gravity, friction

NS. 5

In the following situations identity the agent exerting a force and the object on which it acts. State the effects of the force in each case.
(a) Squeezing a piece of lemon between the fingers to extract, its juice.
(b) Taking out paste from a toothpaste tube.
(c) A load suspended from a spring while its other end is on a hook fixed to a wall.
(d) An athlete making a high jump to clear the bar at a certain height.

Ans. (a) The fingers are the agents, lemon is the object. The effect of force is the lemon juice being expelled by squeezing.
(b) The hand is the agent, toothpaste tube is object and the coming out of paste from toothpaste tube is the effect of force.
(c) Suspended load is agent, spring is the object, the effect of force can be seen in the form of elongation of spring on suspension of load.
(d) Athlete is the agent, bar is the object. The force can be seen in the form of jump.

NS. 6

A blacksmith hammers a hot piece of iron while making a tool. How does the force due to hammering affect the piece of iron ?

Ans. The force due to hammering causes change in shape of iron and iron can be moulded in the shape of the required tool

NS. 7

An inflated balloon was pressed against a wall after it has been rubbed with a piece of synthetic cloth. It was found that the balloon sticks to the wall. What force might be responsible for the attraction between the balloon and the wall?

Ans. Electrostatic force.

NS. 8

Name the force acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.

Ans. Muscular and gravitational forces act on plastic bucket. The force acting on the bucket do not bring a change in state of motion because they are acting in opposite direction with equal magnitudes. Therefore the net force on bucket remains zero.

NS. 9

A rocket has been fired upward to launch a satellite in its orbit. Name the two forces acting on the rocket immediately after leaving the launching pad.

Ans. (i) Gravitational force, (ii) Force of friction.

NS. 10

When we press the bulb of a dropper with its nozzle kept in water, air in the dropper is seen to escape, in the form of bubbles. Once we release the pressure on the butb, water gets filled in dropper. The rise of water in the dropper is due to

(a) pressure of water .
(b) gravity of the earth
(c) shape of rubber bulb
(d) atmospheric pressure

Ans. (d) atmospheric pressure.

Space for Notes :

EXERCISE – I

ONLY ONE CORRECT TYPE

1. Pressure is also measured in :
   (A) joule (B) mm of Hg
   (C) mm of Ag (D) meter
2. When an object undergoes acceleration :
   (A) Its speed always increases
   (B) Its velocity always increases
   (C) It always falls towards the earth
   (D) A force always acts on it
3. External forces are :
   (A) Always balanced
   (B) Never balanced
   (C) May or may not be balanced
   (D) None of these
4. The net force acting on a body of mass 1kg moving with a uniform velocity of 5 ms^{-1} is :
   (A) 5N (B) 0.2N
   (C) 0N (D) None of these
5. How many dynes are equal to 1 N :
   (A) 10^6 (B) 10^4
   (C) 10^5 (D) 10^3
6. A force can :
   (A) Change the direction of a moving body
   (B) Change the state of rest or uniform motion of a body
   (C) Change the shape of a body
   (D) All of the above
7. Which among the following will exert maximum pressure when pushed with the same amount of force :
   (A) An eraser of area 2 cm^2
   (B) A sharpened pencil tip
   (C) The blunt end of a pencil
   (D) The rear portion of a closed safety pin
8. How does pressure vary as we come from mountain top to sea level
   (A) Increases (B) Decreases
   (C) Remains same (D) Depends on weather
9. As we go deeper beneath the surface of liquid, the pressure :
   (A) Remains same (B) Increase
   (C) Decreases (D) Depends on weather
10. A contact force cannot act through
    (A) Empty space
    (B) Touching
    (C) Touching with a metal rod
    (D) Touching with a wooden rod
11. A body is moving with certain velocity towards right. A force of 5N is applied on it towards right and a force of 6N is applied on it towards left then:
    (A) Speed of body increases towards right
    (B) Speed of body increases towards left
    (C) Speed of body remains the same
    (D) Speed of body decreases
12. Deep-sea diving vessels have to withstand pressure from the crushing effect of sea water acting
    (A) Upwards (B) Downwards
    (C) Side ways (D) In all directions
13. Which of these is not a contact force :
    (A) Friction (B) Muscular force
    (C) Magnetic force (D) None of these
14. A force has :
    (A) Magnitude only
    (B) Direction only
    (C) Both magnitude and direction
    (D) None of these
15. When a force is applied on a body it may change its :
    (A) Speed only
    (B) Direction only
    (C) Both magnitude and direction
    (D) None of these
16. Gravitational force acts
    (A) Only between the sum and the planets moving around it
    (B) Only between the earth and bodies on it
    (C) Between all bodies in the universe
    (D) Only between the sun and the earth
17. The relation between the S.I. unit of force and the weight of a 1kg mass is :
    (A) 1 kg of = 1N
    (B) 1 kg of = 0.98 N
    (C) 1 kg of = 9.8 N
    (D) 1 N = 9.8 kg

18. If a force of 100 N acts on an area of 10 m^2, the pressure eaual :
(A) 100 N/m^2 (B) 10 N/m^2
(C) 1000 N/m^2 (D) 1000 Nm^2

19. When a force is applied over a larger area, the pressure produced will
(A) Increase
(B) Decrease
(C) Both (A) and (B)
(D) None of these

20. For a fixed area of contact, the pressure exerted
(A) Increases with increase in force
(B) Increases with decrease in force
(C) Is independent of force
(D) None of these

21. Sharper knives cut fruits easily because :
(A) The area of conact is more
(B) The area of contact is less
(C) It shines more
(D) None of these

22. Pressure in solids :
(A) Increases with increase in area of cross section.
(B) Increases with decrease in area of cross section
(C) Independent of area of cross section
(D) None of these

23. Atmospheric pressure,
(A) Increases with height
(B) Decreases with height
(C) Remains constant
(D) None of these

24. Amount of pressure of liquid increases with :
(A) Volume
(B) Base area
(C) Mass
(D) Depth

25. Which one of the following physical quantities increases as we go deeps into the sea.
(A) Temperature
(B) Gravity
(C) Pressure
(D) Upthrust

PARAGRAPH TYPE

PARAGRAPH # 1

The layer of air surrounding the earth is called the atmosphere. It has weight. Te weight of the atmosphere exerts pressure on all of us. This pressure is called atmospheric pressure. Its magnitude is around 100 kilopascal at sea level. However, as we go upward, the magnitude of atmospheric pressure decreases.

26. The pressure exerted by air at sea level is about
(A) 10 Pa
(B) 100 Pa
(C) 10 kPa
(D) 100 kPa

27. The nose of some people start bleeding at higher altitudes because, the pressure in their bodies at higher altitude is
(A) Less than atmospheric pressure
(B) Greater than atmospheric pressure
(C) Equal to atmospheric pressure
(D) Zero

28. Atmospheric pressure at the surface of the moon is
(A) Less than that on earth
(B) Greater than that on earth
(C) Equal to that on earth
(D) Zero

PARAGRAPH # 2

In general, more than one force may be acting on an object. However, the effect on the object is due to the net force acting on it. Imagine that a boy is holding a book weighing 4N at rest on his palm. The weight of the book exerts a downward force on the palm, and in turn palm exerts an equal upward force.

29. A downward force of magnitude 4N is exerted on the book by
(A) The palm of boy
(B) The earth (gravity)
(C) Both (A) and (B)
(D) Neither (A) and (B)

30. An upward force of magnitude _____ is exerted on _____ by the boy's hand.
(A) Zero, the palm
(B) 4N, the book
(C) 4N, the palm
(D) Zero, the book

31. How many forces are acting on the book ?
(A) Two (B) One
(C) Three (D) Four

MATCH THE COLUMN TYPE

32.

Column A	Column B
(P) Magnetic force	(i) Non-contact force
(Q) A physical quantity that determines the pressure in liquids	(ii) Depth
(R) Force	(iii) N m^{-2}
(S) Pressure	(iv) Newton

(A) P → i, Q → ii, R → iv, S → iii
(B) P → iii, Q → ii, R → iv, S → i
(C) P → iii, Q → iv, R → ii, S → i
(D) P → i, Q → iv, R → iii, S → ii

33.

Column A	Column B
(P) Electrostatic force	(i) Spring balance
(Q) Frictional force	(ii) Pascal
(R) Weight	(iii) Contact force
(S) Pressure	(iv) Non-contact force

(A) P → i, Q → ii, R → iv, S → iii
(B) P → iii, Q → ii, R → iv, S → i
(C) P → iv, Q → iii, R → i, S → ii
(D) P → i, Q → iv, R → iii, S → ii

Space for Notes :

EXERCISE – II

VERY SHORT ANSWER TYPE

1. Is weight a force? Write the SI unit of force.
2. What are different types of forces?
3. Define 1 kgf.
4. Name two units of force.
5. Write the SI unit of pressure.
6. Building foundations have a large horizontal area of contact with the ground.
7. Athletes wear specially designed shoes with spikes on the soles.
8. A woman walking across a lawn in high heeled shoes would leave a deeper impression on the ground than an elephant
9. It is easier to sew with a pointed needle than with a blunt needle.
10. It is necessary to keep the bathroom floor clean and free of oily substances.

SHORT ANSWER TYPE

1. Skis have a large area of contract with snow.
2. A needle has a pointy tip.
3. It is easier to use a sharp knife as compared to a blunt one.
4. Dams are made stronger and thicker at the bottom that at the top.
5. Deep sea divers have to wear specially designed suits.

LONG ANSWER TYPE

1. What are electrostatic forces?
2. Distinguish between mass and weight.
3. Explain how it is possible to drink a liquid by using a straw?
4. Why are dams made broader at the bottom than at the top?
5. Explain in suitable detail, the effect of force on a body.

FILL IN THE BLANKS

1. The pressure exerted by a force of 1N acting normally on unit area of $1m^2$ is called .....
2. Sharp knives cut fruit easily as area of contact ..... .
3. Hanging bags have ..... strips which ..... the pressure.
4. A charged body ..... an uncharged body towards it.
5. The north pole of a magnet ..... the north pole of another magnet.

TRUE / FALSE TYPE

1. Atmospheric pressure increases with altitude
2. Pressure increases with depth
3. Pressure of water is equal to pressure of kerosene.
4. The atmospheric pressure on moon is double of Earth.
5. Pressure is inversely proportional to the area.

NUMERICAL PROBLEMS

1. In a game of tug of war, three girls of team A pull the rope with forces of 100N, 120N and 170N. In team B, the three members pull the rope with force of 130N, 150N and 155N. Who will win the tug of war ? What is the resultant force ?
2. A horse pulls a cart with a force of 1500 N. The force of friction between the cart and the ground is 1500 N. The cart does not move. Why ?
3. A force of 500 N acts on a square piece of plywood, each of whose sides is 5m long. Calculate the pressure acting on the piece of plywood
4. A body stands on the ground. The area below his feed is 70 cm^2. The pressure he exerts on the ground is $7N/cm^2$. Calculate the total force acting on the ground.
5. A force exerts a pressure of 45 N/m^2 when it acts on an area of $10m^2$. Calculate the total force.

Answer Key

EXERCISE–I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	D	C	C	C	D	B	A	B	A	D	A	C	C	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
C	C	B	B	A	B	B	B	D	C	D	D	A	B	B
31	32	33												
C	A	C												

EXERCISE II

FILL IN THE BLANKS

1. 1 pascal **2.** Reduces **3.** Broad, reduces **4.** Attract **5.** Repel

TRUE / FALSE

1. F **2.** T **3.** F **4.** F **5.** T

NUMERICAL PROBLEMS

1. Team B will win, 45N

2. Same force applied in opposite direction so resultant force zero

3. 20N

4. 490N/cm^2

5. 450 N/m^2

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : FORCE AND PRESSURE)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

Space for Notes :

FRICTION 2

Concepts

INTRODUCTION

Friction is a contact force that opposes the relative motion of two bodies. It is natural to assume that friction is caused by roughness of the surface in contact. Friction is found every where in the world. You can feel the effects of friction when you ride a bicycle, while walking, and even when you sit on a sofa, without it we could not walk, drive cars, climb ropes etc.

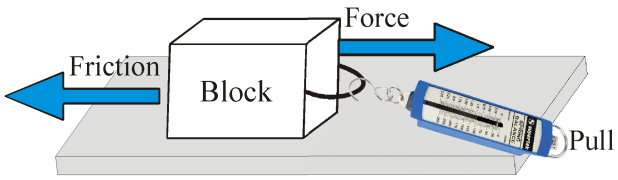


Figure : Friction

1. FRICTION

The force which opposes the relative motion between two surfaces in contact is called friction. The force of friction always opposes the applied net force that may be push or pull.

The magnitude of the frictional force depends on the types of surfaces in contact. The frictional force is usually larger on the rough surfaces and smaller on the smooth surfaces.

1.1 CAUSE OF FRICTION

The friction between any two sufaces is mainly caused by the following factors :

(a) Due to the interlocking of surfaces :

No solid surface is perfectly smooth. This means all solid surfaces are rough. The degree of roughness varies from surface to surface. Some are more rough, while some others are less. Even a surface which looks smooth to the naked eyes is actually rough. In the case of highly rough surfaces, the surface roughness can be seen, felt easily.

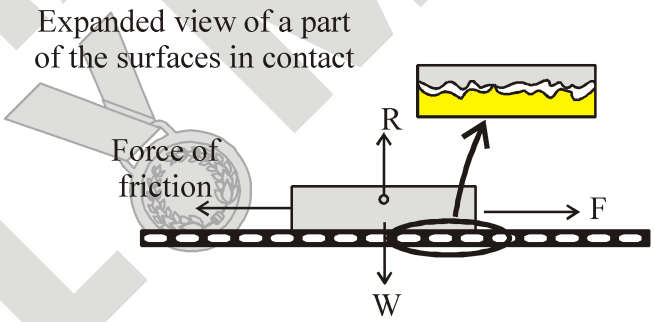


Figure : Interlocking of surface

Roughness of the surfaces in contact can be seen as the presence of hills and valleys in expanded view of a part of the surface is shown in figure.

In the case of surfaces which appear to be smooth, the surface roughness can be seen only with the help of a microscope. A magnified view of the surface roughness is shown alongside.

When a body (say, a wooden block) is pulled over another, these 'hills' and Valleys' interlock with each other and oppose the relative motion between the two bodies. This gives rise to a frictional force. Thus, friction is due to the roughness of the two surfaces in contact.

(b) Due to force of adhesion between the two surfaces :

Two rough surfaces when placed together meet only at certain points. The atoms or molecules present at such points of contact attract each other due to electrostatic attractions. These attractions are called forces of adhesion.

When one body is made to move over the other, the force of adhesion opposes the motion. This force which opposes the motion also gives rise to frictional force. So, the force of adhesion between the two surfaces gives rise to friction.

1.2 DIRECTION AND MAGNITUDE OF FRICTIONAL FORCE

When a block is pulled by force F towards the right, the force of friction acts towards the left and when the block is pulled by force F towards the left, the force of friction acts towards the right.

So we can say that force of friction always acts in the direction opposite to that of motion or intended motion.

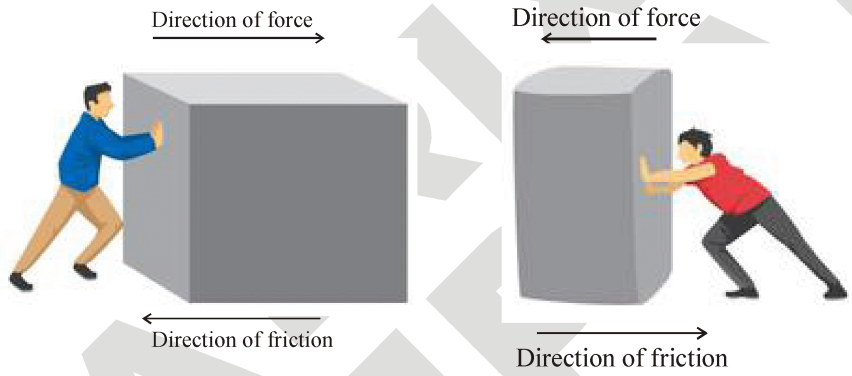


Figure : Direction of friction

1.3 FACTORS ON WHICH FRICTION FORCE DEPENDS

The force of friction depends upon the following factors.

(i) On a horizontal surfaces, the force of friction is directly proportional to the weight of the body which moves.

(ii) The force of friction depends on the nature of surface in contact. For example, the force of friction between a pair of polished surfaces is very small as compared to the force of friction between two rough surfaces.

(iii) The force of friction does not depend upon the area of the surfaces in contact till weight remains the same.

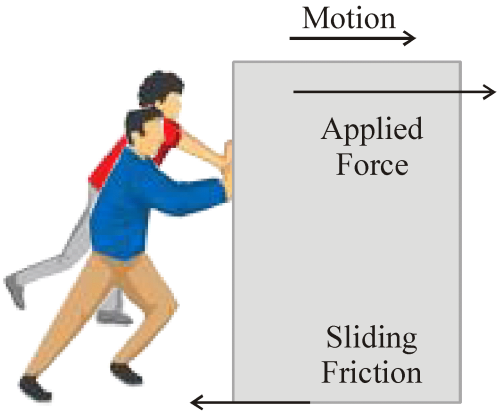


Figure : Sliding Friction

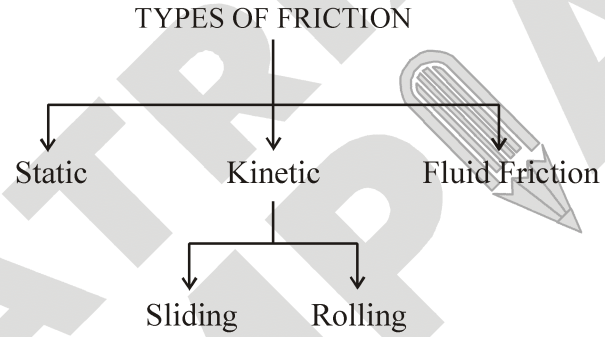
BUILD THE CONCEPT

A boy falls down when he steps on a banana peel. Why ?

Explanation :

When a boy walks on a road, the friction between soles of his shoes and the road surface is quite large. Thus, he has an adequate grip on the road surface and he can walk easily. When he steps on a banana peel, a smooth layer of banana peel between his shoes and the road reduces the friction significantly. This causes the boy to slide easily see figure.

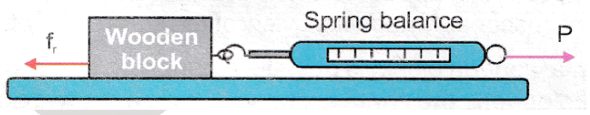
2. TYPES OF FRICTION



2.1 STATIC FRICTION

Friction is a self-adjusting force.Thus, when the applied force is gradually increased, the force of friction also increases at the same rate and the body remains stationary. This force of friction is called force of static friction (f_s) or simple static friction. If the applied force is increased further, a stage reaches when the body begins to just move. At this stage the force of static friction is maximum ($f_{s\ max}$). The maximum force of friction when the block just starts moving is called the limiting value of the static friction, or limiting friction.

For example : Place a rectangular block with a hook on one side on a table. Attach a spring balance to the hook to measure the least horizontal force needed to make the block move.



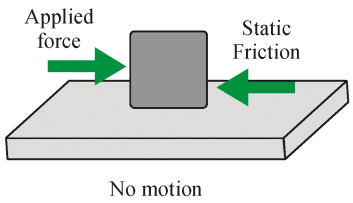
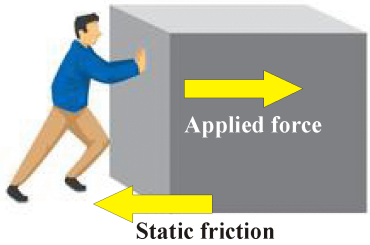


Figure : Static Friction

Apply a small force on the block by pulling the spring balance. The block remains at rest because a force of friction, f_r, equal but opposite to the applied pull comes into action between the surfaces. Increase the force a little, the block does not move. This means that the force of friction has increased to balance the pulling force on the block. If the pulling force P is increased further, at a certain stage for the block static friction will be maximum.

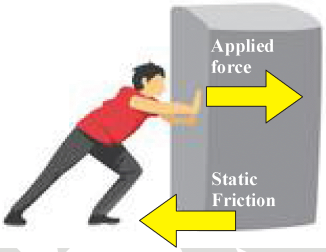
Focus Point

Static Friction is greater than sliding friction. This is because it takes more force to break the interlocking between two surfaces than it does to keep them sliding once they are already moving.



Static friction balances, the force applied to the box

Figure 7 (a)



Static friction increases to balance the greater force applied to the box

Figure 7 (b)

2.2 KINETIC FRICTION

It is the friction experienced by a body, when it is in motion. The Kinetic friction is also called Dynamic friction, and is less than the static friction. It includes sliding friction & rolling friction.

(A) Sliding Friction : The force of friction between the two surfaces in contact when one surface slides over the other is called sliding friction.

For example : Continue pulling the block with the spring balance, so that it slides at a steady speed. The reading on the spring balance is also steady. Kinetic or sliding friction between the two surface is acting.

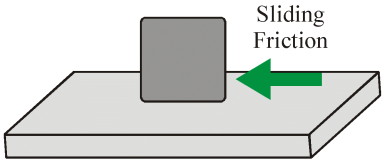


Figure : Sliding Friction

The force required to keep a body in motion is less than the force required to start the motion. Therefore sliding (kinetic) friction is less than the limiting.

Focus Point

The direction of sliding friction is opposite to the applied force. Also, the direction of sliding friction is always opposite to the motion of the sliding object.

(B) Rolling Friction : The force of friction between the two surfaces in contact when one of them is rolling on the other is called rolling friction.

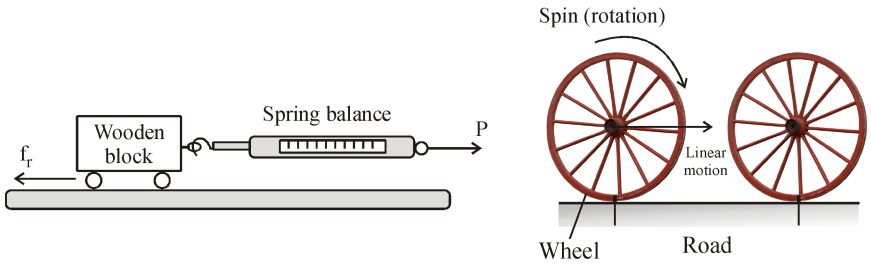


Figure : Rolling friction

Provided with wheels on either side, the reading on the spring balance when the block moves with a steady speed is much less than the sliding friction measured above. Rolling friction is less than sliding friction.

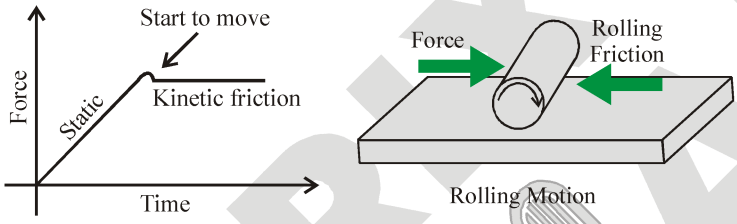


Figure : Rolling Friction

2.3 FLUID FRICTION

Fluids are the substances which can flow by an application of force or pressure on them. Gases and liquids are fluids.

The force of friction exerted by the fluids on the objects moving through them is called fluid friction.

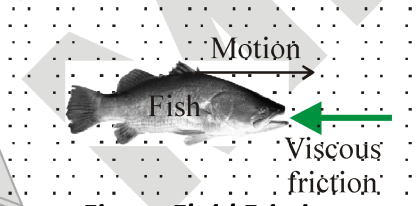


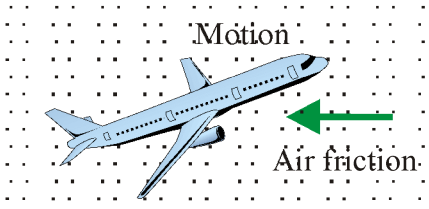
Figure Fluid Friction

⇒ The frictional froce exerted by fluids is also called drag. Fluid friction affects a boat moving through water and an aeroplane flying through air.

⇒ Air is a mixture of gases and it is also a fluid. Though air is very light, yet it exerts frictional force on objects moving through it. This friction is called air resistance.

⇒ Air resistance is a form of friction that acts to slow down any object moving in the air.

Similarly, water and other liquids exert force of friction when objects move through them. This friction is called viscous friction.



Motion through air

Figure : Air Friction

Factors that affect fluid friction :

The fluid friction (air resistance or viscous friction) on an object moving in a fluid depends on:

(i) Speed of the object in the fluid : The faster an object moves in a fluid the greater is the fluid friction acting on it.

(ii) Shape of the object moving in the fluid : For example, a piece of paper falls. Here, the force of friction on the flat piece of paper is more than the piece of paper crumpled into a ball.

(iii) Nature of the fluid : This means a given object experiences different amounts of friction is different fluids. For example, an object moving with a certain speed experiences a greater friction in water than that experienced in air.

3. ADVANTAGES AND DISADVANTAGES OF FRICTION

3.1 ADVANTAGES OF FRICTION

Friction plays an important role in our daily life :

(a) Without friction we would slip and fall every time we attempt to walk or run. There is very little friction on a wet polished floor. That is why it is easy to slip on such a floor.

Figure : Little friction on a wet polished floor

(b) Friction causes nails and screws to hold on to walls.

(c) It would not be possible to light a matchstick without friction between its head and the side of the match box.

(d) Cars and buses are able to run or roads because of friction between the tyres and the road.

(e) Without friction writing on paper would be impossible as the tip of the pen will slip on paper.

(f) It is because of friction between the brake 'shoes' and wheels that bicycles and automobiles stop when brakes are applied.

3.2 DISADVANTAGES OF FRICTION

Friction is a demerit too in some circumstances :

(a) The heat produced in the moving parts of machinery due to friction results in wear and tear of the parts.

(b) Forest fires are caused due to friction between branches of trees rubbing against each other.

(c) Tyres of vehicles and soles of footwear wear out because of friction.

(d) Energy is wasted in overcoming the force of friction.

4. WAYS TO REDUCE AND INCREASE FRICTION

The friction between two surfaces can be reduced by the following methods,

4.1 WAY TO REDUCE FRICTION

(i) By Polishing the Surfaces :

Rough surfaces can be made smooth by polishing. Polishing removes 'hills' and 'valleys' from the surfaces. Therefore, polishing of the surfaces reduces the friction.

(ii) Lubrication (By Applying Oil or Grease on the Surfaces) :

Oil/grease forms a thin layer between the two surfaces. Thus, a lubricant separates the two surfaces. This reduces the changes of interlocking of the two surfaces and thus reduces the friction.

Soap solution also acts as a lubricant. That is why we tend to slip on the floor if it is covered with soap solution.

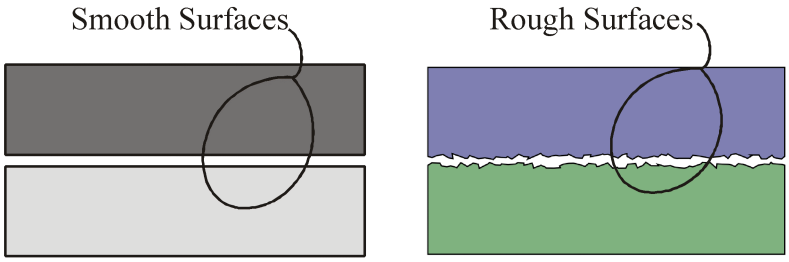


Figure : Reduce friction by Lubrication

(iii) By Sprinkling a Soft, Slippery Fine Powder on the Surfaces :

A small quantity of talcum powder on a wooden surface or floor etc. reduces friction. This is why a small quantity of talcum powder is applied on carrom board. Graphite powder is used in machines to reduce friction.

(iv) By Using Ball-Bearings or Roller-Bearings :

When a body rolls over a surface, the force of friction is much less. That is why, friction can be reduced by using ball bearings or roller bearings in machines.

Figure : Ball-Bearing

Figure : Roller-Bearing

(v) By streamlining the body of an object:

Properly shaped bodies (called streamlined) experience less friction from air or water. Bodies of cars, aeroplanes, rockets, ships, etc. are streamlined. Birds and fishes also have streamlined bodies.

Figure : Streameline Objects

4.2 WAY TO INCREASE FRICTION

The friction between two surfaces can be increased by the following methods.

(i) By making the surface rough :

Friction can be increased by increasing the roughness of the surfaces in contact. For example, the surface of the head of a matchstick and the sides of the matchbox are deliberately made rough to increase the friction to produce more heat because of which the matchstick lights up easily.

(ii) By making grooves :

We can increase the friction in case of tyres of bicycles, cars, buses, etc. by making grooves in them. Due to greater friction, the tyres get a better grip on the road which prevents skidding of the vehicles.

5. FRICTION DUE TO LIQUID AND GASES

It has been found that when a solid moves in a liquid or a gas the surface of the solid experiences friction. However, it is found that liquids exert less force of friction as compared to the solids. Similarly, the gases exert least force of friction as compared to the solids or liquids. As the most common liquid is water and most common gas is air, therefore, we will discuss friction due to water and friction due to air. The frictional force exerted by fluids is also called drag.

The force of (fluid) friction on an object, in a fluid, depends on -

(i) Nature of fluid.

(ii) Shape of the moving object (the area of contact).

(iii) Speed of the moving object with respect to the fluid.

5.1 FRICTION DUE TO WATER

Before we discuss the friction due to water, let us know about the "streamlined shape". The special shape of a body or an object around which a fluid (air or water) can flow easily offering minimum amount of friction is called streamlined shape.

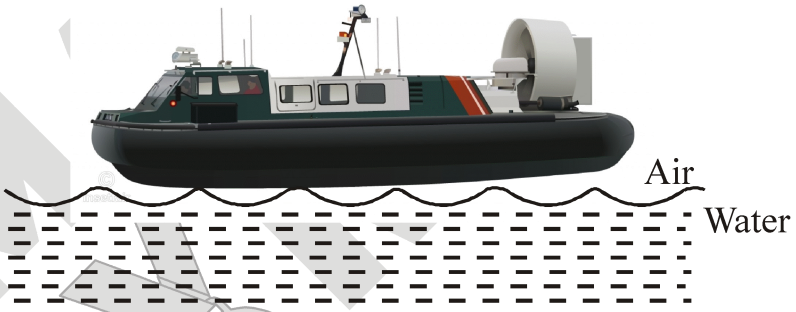


Figure : Hovercraft moving just above water.

Air cushion present between hovercraft and water reduces friction.

This gives a smoother and faster drive as compared to a boat

Examples:

(A) The body of ships and boats is streamlined so that they experience minimum amount of friction while moving through water.

(B) In nature the body of fishes is streamlined, such that they experience least amount of friction in water.

(C) When a swimmer swims in water he tries to streamline his body as far as possible so that he experiences least friction due to water.

5.2 FRICTION DUE TO AIR

Friction due to air is so small that we hardly feel it. However following activity will show the friction of air.

LAB TIME
Let's Do & Learn

Take a full sheet of paper and allow it to fall down from the level of your head. Record the time in which the sheet of paper reaches the ground level. Now crumple the sheet in the form of a ball and allow it to fall down from the level of your head. You will notice the crumpled ball quickly reaches the ground

level. Why?

It is because when the sheet is flat, it has a large surface area which experiences a large force of friction due to air and hence slows down. However, when the sheet is crumpled in the form of ball, it has very small surface area. The small surface area experiences less force of friction due to air and hence

reaches the ground level quickly.

Figure 16 : This parachutist need not worry he will land safely on the ground as friction offered by air slows down his speed

Examples:

(A) Nature has shaped the body of birds in such a way that air offers least resistance and hence they can fly with good speed.

(B) The body of aeroplanes is streamlined so that the air offers least possible friction.

(C) The body of automobiles (cars, buses, motorcycles, etc.) is streamlined so that air offers least possible friction.

(D) The meteors (shooting stars) enter the atmosphere of the earth at a very high speed. At such speeds the friction due to air is extremely high. Due to this high friction the temperature of meteors rises to such a high

degree that they catch fire.

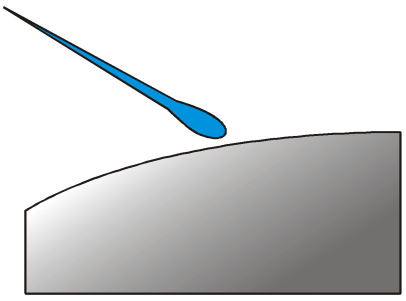
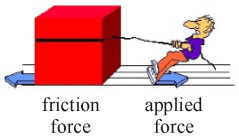


Figure : Falling Star

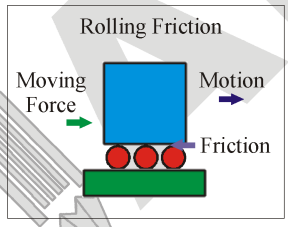
6. CONCEPT OF MAP

Friction

- Cause of friction
  - Due to the interlocking of surfaces
  - Due to force of adhesion between the two surfaces



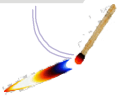
- Factors on which Frictional Force Depends
  - Weight of the body which moves
  - Nature of surface in contact
- Types of friction
  - Static Friction
  - Kinetic Friction
    - Sliding Friction
    - Rolling Friction



- Causes of Rolling Friction
  - Due to continuously forward moving inclined plane between roller and surfaces

- Effects of friction
  - Advantages of Friction
  - Disadvantages of Friction
- Ways to decrease Friction
  - By Polishing the Surfaces
  - By Applying Oil or Grease on the Surfaces
  - By Sprinkling a Soft, Slippery Fine Powder on the Surfaces
  - By Using Ball-Bearings or Roller-Bearings
  - By streamlining the body of an object

- Ways to Increase Friction
  - By making the surface rough
  - By making grooves



- Friction Due to Liquids and Gases
  - Friction due to water
  - Friction due to Air

Figure : Concept of Map

SOLVED EXAMPLES

SE. 1

Give two positive effects of friction.

Ans. Positive effects of friction are as follows:

(a) Friction is needed for walking or holding a pair of chopsticks.

(b) Friction is used in braking pads to slow down cars.

SE. 2

A force of 50 N is needed to keep a trolley of mass 60 kg moving at a uniform velocity of 2 ms^{-1}. What is the frictional force on the trolley?

Ans. The frictional fo rce on the trolley is 50 N. Because the force applied here is used to over come the frictional force at the surfaces in contact.

SE. 3

Give two ways to increase friction?

Ans. (a) Sand and gravel is strewn on slippery ground during the rainy season to increase friction,

(b) Gymnasts apply a coarse substance on their hands to improve their grip.

SE. 4

Why do we shape aeroplanes like that of a bird?

Ans. The moving objects are given special shapes to minimise friction. Aeroplane and birds both fly in the air and have to face friction exerted by air. They are so shaped that they do not have to lose energy while over coming the frictional force exerted by air to fly. Therefore aeroplanes are also shaped streamlined, so that they can overcome the frictional force of air.

SE. 5

Mention three examples which show that friction produces heat.

Ans. Some examples are following which show that friction produces heat:

(a) Warming of our palms when we rub them.

(b) Jar of mixer becomes hot when it is run.

(c) Warming of the parts of a machine when it is operated.

SE. 6

Why we could not write with chalk if there were no friction?

Ans. We could not write with chalk, pen, pencil if there were no friction. If we are writing with chalk on frictionless surface then no chalk particles stick to the surface. So we can not write with chalk if there were no friction. On the other hand when we are writing with chalk on the blackboard, its rough surface rubs off some chalk particles which stick to the blackboard.

SE. 7

What is fluid friction? Write the factors on which fluid friction depends.

Ans. The gases and liquids are called fluids. The friction exerted by fluids on objects is called fluid friction. The fluid friction is also called drag. The fluid friction of an object depends on its speed with respect to fluid, shape of the object and the frictional force due to fluids also depends on the nature of the fluid.

SE. 8

A large size brake on bicycle is as effective as small one. Comment.

Ans. Action of brakes is based upon friction. But the friction is independent of the area of surfaces in contact as long as the normal reaction remain the same. Hence, large size brakes and normal size brakes will be equally effective if the material of brakes remains unchanged.

SE. 9

Proper inflation of tyres of vehicles saves fuel. Why?

Ans. When the tyre is properly inflated, the area of contact between the tyre and the ground is reduced. This reduces rolling friction. Consequently, the automobile covers greater distance from the same quantity of fuel consumed.

SE. 10

How does friction affected by the nature of surface?

Ans. Nature of surface is the major factor which affect friction. When we attempt to move any surface, we have to apply a force to overcome the interlocking of the surfaces. On rough surfaces, there are a larger number of irregularities. So the force of friction is greater if a rough surface is involved.

Space for Notes :

NS. 1

Fill in the blanks.

(a) Friction opposes the..... between the surfaces in contact with each other.

(b) Friction depends on the ..... of surfaces.

(c) Friction produces ..... .

(d) Sprinkling of powder on the carom board ..... friction.

(e) Sliding friction is ..... than the static friction.

Ans. (a) relative motion (b) nature

(c) heat (d) reduces

(e) less.

NS. 2

Four children were asked to arrange forces due to rolling, static and sliding frictions in a decreasing order. Their arrangements are given below. Choose the correct arrangement.

(a) rolling, static, sliding

(b) rolling, sliding, static

(c) static, sliding, rolling

(d) sliding, static, rolling

Ans. (c) static, sliding, rolling

NS. 3

Alida runs her toy car on dry marble floor, wet marble floor, newspaper and towel spread on the floor. The force of friction acting on the car on different surfaces in increasing order will be

(a) wet marble floor, dry marble floor, newspaper, towel.

(b) newspaper, towel, dry marble floor, wet marble floor.

(c) towel, newspaper, dry marble floor, wet marble floor.

(d) wet marble floor, dry marble floor, towel, newspaper.

Ans. (a) wet marble floor, dry marble floor, newspaper, towel.

NS. 4

Suppose your writing desk is tilted a little, a book kept on it starts sliding down. Show the direction of frictional force acting on its.

Ans. The book moves downwards. The frictional force is acting opposite to the movement of book. So it acts upwards.

NS. 5

You spill a bucket of soapy water on a marble floor accidently. Would it make it easier or more difficult for you to walk on the floor? Why?

Ans. The layer of soap makes floor smooth due to which the friction is reduced and the foot cannot make a proper grip on the floor. Therefore it is difficult to walk on a soapy floor and we start to slip on the floor.

NS. 6

Explain why sportsmen use shoes with spikes.

Ans. Sportsmen use shoes with spikes to increase the friction between shoes and surface. The shoes with spikes do not slip while they run or play.

NS. 7

Iqbal has to push a lighter box and Seema has to push a similar heavier box on the same floor. Who will have to apply a larger force and why?

Ans. The heavy object will be pressed hard against the opposite surface and produces more friction. So, Seema will have to apply a larger force due to more friction.

NS. 8

Explain why sliding friction is less than static friction.

Ans. The two sliding objects find less time to get interlocked against each other (objects and irregularities of surface). So they get less friction. Therefore sliding friction is always less than static friction.

NS. 9

Give examples to show that friction is both a friend and a foe.

Ans. Examples to show that friction is a friend and a foe:

Friction is friend:

(i) Friction allows us to grip and catch different objects.

(ii) It helps us to walk comfortably on the surface.
(iii) It helps to minimise the speed or to stop the moving objects.
(iv) It helps us to write on paper or blackboard.
(v) The things do not move from their places if no force is applied, due to friction.
Friction is foe:
(i) Friction causes wear and tear in objects.
(ii) It causes damage to the parts of machines.
(iii) The machines or tools need regular maintenance due to which a lot of money is wasted.
(iv) It reduces the speed of moving objects so more force is required.
(v) It does not allow the free movement of objects.

NS. 10

Explain why objects moving in fluids must have special shapes.

Ans. The objects moving in fluids must have a special shape. This type of shape is called streamlined shape. The streamlined shape helps to overcome the friction between objects and fluids. The objects have pointed front part with little broader middle portion which gets tapered at the back.

Space for Notes :

EXERCISE – I

ONLY ONE CORRECT TYPE

1. A force that opposes the motion of one surface over another is called :
   (A) Lubrication (B) Ball bearing
   (C) Friction (D) Polishing
2. Which of the following is the greatest :
   (A) Limiting friction (B) Sliding friction
   (C) Rolling friction (D) Can not say
3. What type of frictional force comes into play when wheat is grinded in floor mill :
   (A) Rolling friction (B) Sliding friction
   (C) Static friction (D) None of these
4. What type of frictional force comes into play in case of car moving on a straight road :
   (A) Rolling friction (B) Sliding friction
   (C) Static friction (D) Both (A) & (B) are correct
5. Name the force responsible to fall down a boy when he steps on a banana peel.
   (A) Force of friction
   (B) Gravitational force
   (C) Both A & B
   (D) None of these
6. An object is at rest on a floor, a force is applied to move that object which friction force will comes into an action at this moment ?
   (A) Sliding friction (B) Static friction
   (C) Rolling friction (D) Fluid friction
7. Which of the following statement is not true ?
   (A) Friction makes the things slow down
   (B) Friction produce heat
   (C) Friction can stop the moving object
   (D) Friction is not useful
8. Friction is most often experienced when :
   (A) When two object are in contact
   (B) When two object are not in contact
   (C) Both A and B
   (D) None of these
9. Examples of dry lubricants are :
   (A) Finely grinded graphite
   (B) Talcum powder
   (C) Boric acid
   (D) All are correct
10. Ball bearing are used to
    (A) Decrease friction
    (B) Decrease surface area
    (C) Increase friction
    (D) Increase surface area
11. Lubricants are used to :
    (A) Reduce friction
    (B) Increases friction
    (C) Make a surface oily
    (D) Make a surface shiny
12. Friction can be increased by :
    (A) Making the surface rough
    (B) Increasing the mass of object
    (C) Both (A) and (B)
    (D) None of these
13. When a bicycle travels on a rough surface, its speed
    (A) Increases (B) Decreases
    (C) Remains the same (D) None of these
14. If we polish the two surfaces which are in contact with each other, the frictional force acting on them will be :
    (A) Increases (B) Decreases
    (C) Remains same (D) Nothing can be said
15. If we apply oil on door hings, the friction will :
    (A) Decreases (B) Increases
    (C) Neither a nor b (D) None of these
16. The friction offered by wheels while applying brakes is called
    (A) limiting friction (B) rolling friction
    (C) sliding friction (D) All of these
17. We slip in rainy day because water
    (A) acts as a lubricant
    (B) increase the roughness of the surface
    (C) both (A) and (B)
    (D) none of these
18. A matchstick lights due to :
    (A) Pressure (B) Friction
    (C) Smoothness (D) None of these
19. Fluids are :
    (A) gases (B) liquids
    (C) gases and liquids (D) none of these

20. Smooth surfaces has
(A) Less friction force
(B) More frictional force
(C) Sometimes less and sometime more force
(D) All of these

21. The force of friction between two bodies is :
(A) Parallel to the contact surface
(B) Perpendicular to the contact surface
(C) Inclined at 30° to the contact surface
(D) Inclined at 60° to the contact surface

22. The easiest way to move a heavy wooden crate is to
(A) tie a rope on one end and pull
(B) get friends to help push it
(C) place it in trolley
(D) none of these

23. Ball rolling on the floor stops due to :
(A) gravitational force
(B) magnetic force
(C) muscular force
(D) frictional force

24. Name the material which when applied between two surfaces in contact, reduces friction between them
(A) Lubricant (B) Sand
(C) Coarse powder (D) Gum

25. It is difficult to walk on a marble floor if soapy water is spilled on it, because
(A) It reduces area of contact
(B) It reduces the friction between the floor and the shoes
(C) It increases the friction between the floor and the shoes
(D) Interlocking between the marble floor and the shoes increases

PARAGRAPH

PARAGRAPH # 1

Friction is the opposition to the relative motion, when the two surfaces in contact move or tend to move over each other. Friction causes the wastage of energy. This is because anything that moves posses friction which is reduced by using suitable lubricants, polishing the surfaces to make them smooth, using wheels and ball bearings and streamlining the objects.

26. Which of the following activities is easiest to perform ?
(A) Dragging a box on marble floor
(B) Dragging the box on wet marble floor
(C) Rolling a drum of the same weight and material as the box on marble floor
(D) All of the above need same efforts

27. Fine powder is sprinkled on the carrom-board
(A) To increase friction
(B) To decrease friction
(C) For decoration
(D) For fragrance

28. Which of the following is used to reduce friction between the moving parts of machines ?
(A) Wheels (B) Rollers
(C) Ball bearings (D) Polishing

PARAGRAPH # 2

If a force of 5N is applied on a block of mass 10 kg and the block remains at rest, then the magnitude and the directin of friction is

29. What is the magnitude of friction force is
(A) 10N (B) 5N
(C) 15N (D) None of these

30. What is the direction of friction force
(A) Normal to the direction of motion
(B) A long the direction of the applied force
(C) Opposite to the direction of the applied force
(D) None of these

31. What is the acceleration of a block.
(A) Zero (B) $10m/s^2$
(C) $5m/s^2$ (D) $15m/s^2$

MATCH THE COLUMN TYPE

32.

Column I	Column II
(P) Friction	(i) Streamlined shape
(Q) Reduces friction	(ii) Self adjusting force
(R) Grooves	(iii) Special shape of body in order to experience less friction
(S) Streamlining	(iv) Rolling friction
(T) Ball bearing	(v) Increases friction

(A) P → ii, Q → i, R → v, S → iii, T → iv
(B) P → i, Q → ii, R → v, S → iii, T → iv
(C) P → ii, Q → iii, R → v, S → i, T → iv
(D) P → iv, Q → i, R → v, S → ii, T → iv

33.

Column I	Column II
(P) Sparks are produced when a pair of scissors is sharpened against a grinding wheel.	(i) To make them rough and increase friction
(Q) A piece of chalk wear out as it is used on a blackboad.	(ii) Friction produces heat
(R) Trolleys have wheels	(iii) Friction causes wear and tear.
(S) The leather soles of new shoes are rubbed on a rough surface	(iv) Rolling reduces friction

(A) P $\rightarrow$ ii, Q $\rightarrow$ i, R $\rightarrow$ iv, S $\rightarrow$ iii
(B) P $\rightarrow$ i, Q $\rightarrow$ ii, R $\rightarrow$ iv, S $\rightarrow$ iii
(C) P $\rightarrow$ ii, Q $\rightarrow$ iii, R $\rightarrow$ iv, S $\rightarrow$ i
(D) P $\rightarrow$ iii, Q $\rightarrow$ i, R $\rightarrow$ iv, S $\rightarrow$ ii

Space for Notes :

EXERCISE – II

VERY SHORT ANSWER TYPE

1. Define friction
2. Is frictional force a contact force ?
3. What happens to the force of friction if the surface of contact is polished ?
4. What is the direction of friction force ?
5. Does friction depend on smoothness of the surface?
6. Friction is considered as necessary Evil. Why ?
7. How many types of friction are there ?
8. Is friction force is a contact force ?
9. Why is it difficult to move on a wet marble floor ?
10. Why does a match stick catch fire when it rubbed on rough surface ?

SHORT ANSWER TYPE

1. What is the cause of friction ?
2. Push the book on a table. You observer that after sometime it stops. Explain why.
3. Why do painters use sand paper in white washing the walls and in polishing doors ?
4. What are the main factors on which friction depends?
5. How does the friction affected by the nature of surface ?

LONG ANSWER TYPE

1. What is fluid friction ? Write the factors on which fluid friction depends ?
2. Write some methods used to reduce friction ?
3. What are the ways to reduce Friction ?
4. Explain the types of friction ?
5. Explain the advantages and the disadvantages of friction ?

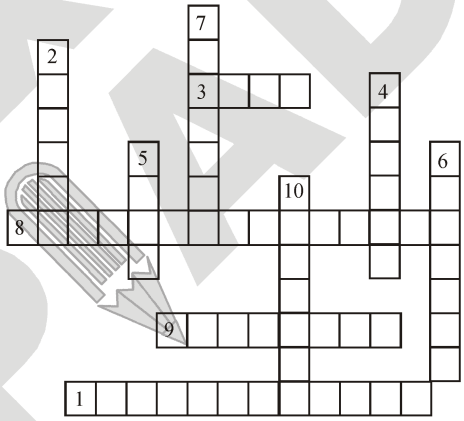
FILL IN THE BLANKS

1. A frictional force is an example of a ..... force
2. When two bodies are made extra smooth the force of friction .....
3. Friction arises due to the interlocking of hills and ..... present in a body.
4. ..... is a self adjusting force.
5. Friction depends upon ..... of surfaces.

TRUE / FALSE TYPE

1. Friction always support the motion.
2. Can we reduce frition to zero by polishing surface.
3. Streamlined shape reduces fluid frition.
4. The maximum force of friction which appears when one body just slides over another is called sliding friction.
5. Limiting friction is greater than sliding friction.

CROSS WORD PUZZLE



Across :

1. The force of friction arises due to ..... of the depression and elevations.
3. Magnitude of rolling friction is much ..... than the sliding friction.
8. Which friction is present when a body slides on the surface ?
9. The maximum static friction is also called .....

Down :

2. ..... reaction is the force exerted by the surface against the body along the direction perpendicular to the surface.
4. Which friction is present if there is no relative motion between the surfaces in contact ?
5. Friction is necessary .....
6. The sliding friction is also called ..... friction
7. ..... friction is present when a body rolls on the surface.
10. ..... friction experienced by a body, when it is in motion.

Answer Key

EXERCISE–I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	A	B	A	A	B	D	A	D	A	A	C	B	B	A
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
C	A	B	C	A	A	C	D	A	B	C	B	D	B	C
31	32	33												
A	A	C												

EXERCISE II

FILL IN THE BLANKS

1. Contact **2.** Decreases **3.** Valleys **4.** Friction

5. Nature

TRUE / FALSE

1. F 2. F 3. T 4. F 5. T

CROSSWORD PUZZLE

Across :

1. Interlocking **3.** Less **8.** slidingfriction **9.** limiting

Down :

2. normal **4.** static **5.** evil **6.** dynamic **7.** rolling **10.** kinetic

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : FRICTION)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
NCERT Exercises			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

Space for Notes :

SOUND 3

Concepts

INTRODUCTION

In our daily life, we hear sound everywhere. We hear sounds from many different sources like humans, birds, bells, machines, vehicles, televisions, radios etc. Sound produces a sensation of hearing in our ears. Sound is produced due to vibrations and it helps us to communicate with one another.

In this chapter we will discuss the properties of sound waves, their propagation and their production by vibrating systems

1. WAVE

A wave motion is a means of transferring energy from one point to another without any actual transportation of matter between these points.

In a wave motion, disturbance travels through some medium, but the medium does not travel along with the disturbance.

1.1 MECHANICAL WAVE

Those waves which need a material medium (like solid, liquid or gas) for their propagation, are called mechanical waves or elastic waves.

A mechanical wave cannot travel through vacuum.

Examples of mechanical waves :

⇒ Sound waves in air.

⇒ Water waves.

⇒ Waves produced in a stretched string.

⇒ Waves produced in a spring.

1.2 ELECTROMAGNETIC WAVE

Those waves which do not need a material medium for their propagation and can travel even through a vacuum, are called electromagnetic waves, because they do not require a material medium (like solid, liquid or gas) for their propagation, they can travel even through vacuum.

Examples of electromagnetic waves are : Radio waves, infra-red waves, Visible (light) waves.

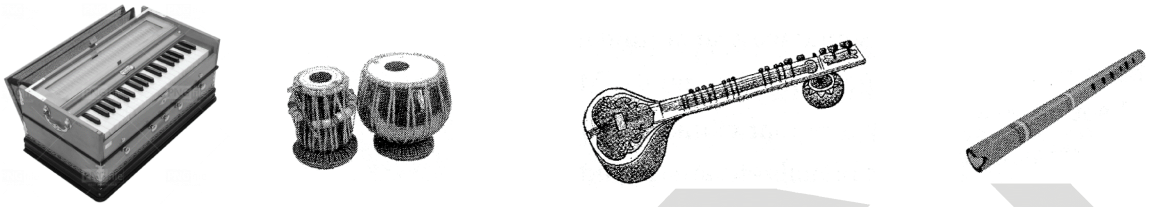
1.3 DIFFERENCE BETWEEN MECHANICAL WAVE AND NON MECHANICAL WAVE

Sr.No.	Mechanical waves (Elastic waves)	Nonmechanical waves
1	They require material medium (solid, liquid or gas) for their propagation.	They do not require a material medium for their propagation.
2	They are caused due to the vibrations of the particles of the medium.	They are caused due to the varying electric & magnetic fields.
3	Their speed varies from medium to medium.	Their speed is always constant (in vacuum) and its value is 3×10^8 m/s.
4	Generally, they have low frequency and large wavelength.	Generally, they have high frequency and short wavelength.
5	They can be transverse or longitudinal	They are only transverse.
6	Sound waves, Matter waves.	Light waves, Radio waves.

2. SOUND WAVE

Sound are a form of energy produced by rapidly vibrating objects. We hear sounds because this energy stimulates the auditory nerve in the human ear.

Sound plays an important role in our life. It helps us to communicate with one another. We hear a variety of sounds in our surroundings. In the music room of your school you hear the sounds made by musical instruments like flute, tabla, harmonium, etc. (see figure)



Harmonium Tabla Veena Flute

Figure : Musical Instrument

Some vibrations are visible some are not. If you pluck a guitar string (see figure) or strike a low frequency tuning fork (see figure), you can see the actual vibrations of the object. Similarly, if you watch the low-frequency woofer of a loudspeaker system, you can see it vibrating.

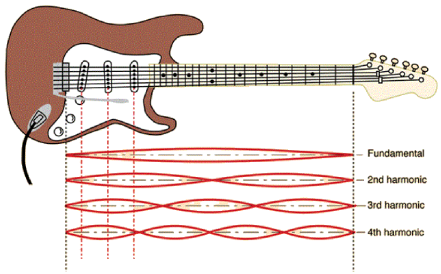


Figure : Vibratory Guitar String

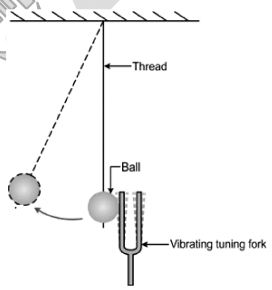


Figure : Vibratory Tuning Fork

2.1 SOUND IS PRODUCED BY A VIBRATING

Sound travels through a medium. It may be gas, liquid or solid. It cannot travel through vacuum. So, we find that sound needs a medium to travel. The speed of sound is different in different medium. The speed of sound depends on temperature, nature of the material and on the physical state of the material.

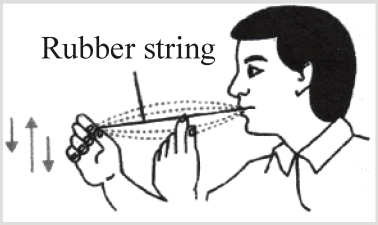
The speed of sound in different medium at normal temperature is given below :

Table : Speed of sound in different medium

Substance (20°C)	Speed of sound (m/s)
1. Air	343
2. Water	1482
3. Sea water at 3.5% salinity	1522
4. Aluminium	6420
5. Granite	6000

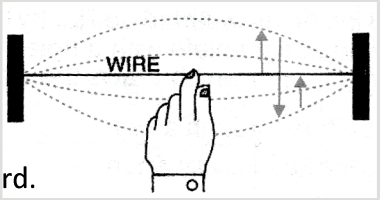
LAB TIME
Let's Do & Learn

Stretch a string holding one end your mouth under the teeth and the other end in one hand as shown in figure
Pluck it by the other hand near the middle.
You will notice that the string starts vibrating and simultaneously a sound is heard. After some time when the string is not vibrating, no sound is heard.



LAB TIME
Let's Do & Learn

Take a thin wire and stretch it between the two nails about a metre apart. Pluck the wire near the middle as shown in the figure. Sound is heard. To see that the wire is vibrating, place a small bit of paper as rider near the middle of the wire while it is sounding.
You will see that the rider files off. This shows that the sound is heard when the wire vibrates. After some time when the wire stops vibrating (i.e. the paper rider placed on the wire does not fly off), no sound is heard.



2.2 SOUND PRODUCED BY HUMAN

In humans, the sound is produced by the voice box of the larynx. Put your fingers on the throat and find a hard bump that seems to move when you swallow. This part of the body is known as the voice box. It is at the upper end of the windpipe. Two vocal cords, are stretched across the voice box or larynx in such a way that it leaves a narrow slit between them for the passage of air.
When the lungs force air through the slit, the vocal cords vibrate, producing sound. Muscles attached to the vocal cords can make the cords tight or loose. When the vocal cords are tight and thin, the type of quality of voice is different from that when they are loose and thick.

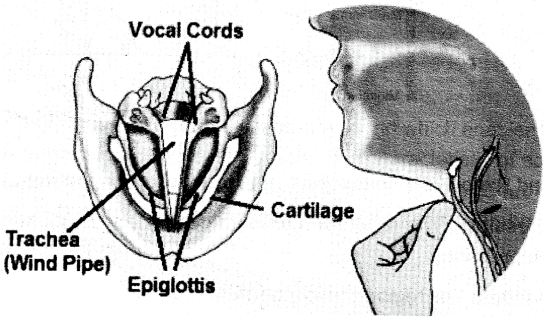


Figure : Voice box in Human

Focus Point

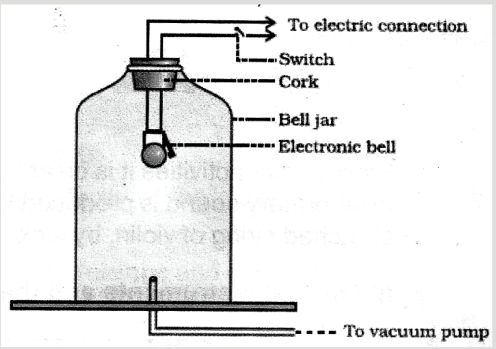
Healthy vocal cords are smooth and moist. Laryngitis is an inflammation and swelling of the vocal cords. As a result, the vocal cord vibrates with low frequency that is, your voice will sound hoarse or heavy.

2.3 PROPOGATION OF SOUND WAVE

The vibrating string of a musical instrument of the vibrating prongs of the tuning fork, set the molecules of the air surrounding them into vibration. These vibrating air molecules, in turn, pass on their vibrations to the neighbouring air molecules and in this manner, sound travels to the listener in the form of waves. A wave is a disturbance which travels through a medium due to the vibratory motion of the particles of the medium. Sound cannot travel in vacuum. It always need a medium to travel.

LAB TIME
Let's Do & Learn

An electric bell is enclosed inside an inverted bell jar by hanging from the rubber cork. The jar is closed at the bottom by an airtight plate with a hole in the centre. A pipe through the hole leads out to a vacuum pump (pump which draws the air out of a vessel).
The bell is connected to a battery through a key. The bell is started by closing the key. Initially when jar has normal air inside it, sound waves produced by the ringing bell heard outside the jar. The vacuum pump is started and the air from inside the jar is gradually drawn out. With decrease air inside the jar, sound heard becomes weaker and weaker. After sometime no sound is heard, but the bell hammer is seen in vibration.



2.4 CHARACTERISTICS OF SOUND

Two sounds can be distinguished from one another by the following different characteristics :

(i) Pitch :

⇒ Pitch is the sensation (brain interpretation) of the frequency of an emitted sound.

⇒ Faster the vibration of the source, higher is the frequency and higher is the pitch. Similarly low pitch sound corresponds to low frequency.

⇒ A high pitch sound is called a shrill sound (Eg. : Humming of a bee, sound of guitar etc).

⇒ A low pitch sound is called a hoarse sound (Eg. : Roar of a lion, car horn etc).

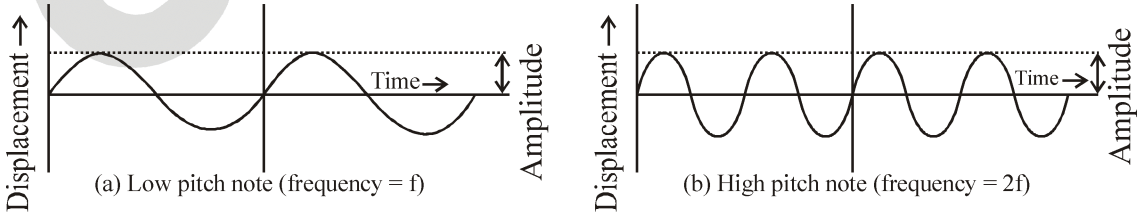


Figure : Pitch note

(ii) Loudness or softness :

Loudness or softness of a sound wave is the sensation that depends upon its amplitude. When we strike a table top with more force, it vibrates and produces load sound waves which have more amplitude. When struck with smaller force, vibrating table top produces soft sound waves which have less amplitude. A loud sound wave carries more energy and can be heard at large distance. Reduction in amplitude at large distance, makes the sound soft.

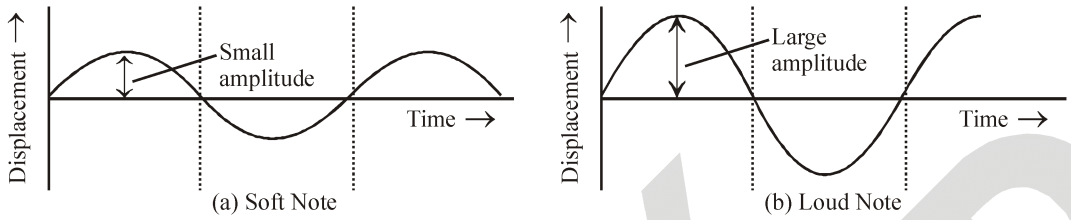


Figure : Note

(iii) Quality (Timber) :

Quality or timbre is a characteristic of a sound which enables us to distinguish between the sounds of same loudness and pitch. This characteristic of sound helps us to recognize our friend from his voice without seeing him. The quality of two sounds of same loudness and pitch produced by two different sources are distinguishable because of different wave forms produced by them.

Eg. : The violin and flute (Bansuri)

(iv) Intensity :

$\Rightarrow$ Intensity of a sound is defined as the sound energy transferred per unit time per unit area placed perpendicular to the direction of the propagation of sound.

$\Rightarrow$ That is, intensity of sound = $\frac{\text{Sound energy}}{\text{Time} \times \text{Area}}$

$\Rightarrow$ Intensity of a sound is an objective physical quantity. It does not depend on the response of our ears.

$\Rightarrow$ The SI unit of intensity of sound is joule s^{-1} m^{-2}or watt m^{-2} ($\therefore$ 1 Js^{-1} = 1W)

(v) Difference between loudness and intensity of sound :

Sr.No.	Loudness	Intensity of sound
1	Loudness is a subjective quantity. It depends upon the sensitivity of the human ear. A sound may be loud for a person but the same may be feeble for another who is hard of hearing.	Intensity of a sound is an objective physical quantity. It does not depend on the senstivity of a human ear.
2	Loudness cannot be measured as a physical quantity because it is just sensation which can be felt only.	Intensity of a sound can be measured as a physical quantity.

2.5 MEASURE OF INTENSITY OF SOUND

It is measured in decibels (dB). It signifies the sound pressure level. Human ear can pick up sound from 10 dB to 180 dB. The loudness of sound is considered normal if it is between 50 dB to 60 dB. A nornal human being can tolerate loudness of 80 dB above which is painful and causes various health problems.
The table below gives the level of sound in dB produced by different objects.

Sr.No.	Object producing sound	Sound level (dB)
1	Jet at takeoff	140
2	Pop concert	130
3	Police car siren	120
4	Heavy hammering machine	110
5	Diesel lorry	90
6	Motorcycle or car	80
7	Vacuum cleaner	60
8	Normal conversation	50
9	Soft whisper	30
10	Recording studio	20
11	Leaves rustling	10
12	Dropping pin (minimum audible sound)	0

2.6 SPEED OF SOUND IN DIFFERENT MEDIUM

Sound travels with different speed in different media like solid, liquid and gas. This is because, sound travels in a medium due to the transfer of energy from one particle to another particle of the medium.

(i) Solid : Since the particles of solid are close to each other, so the transfer of enegy fron one particle to another takes place in lower time (i.e. faster). Hence speed of sound in solids is high.

(ii) Liquid : Speed of sounds in liquids is lower than in solids since the particles are away from each other as compared to solids.

(iii) Gas : Speed of sound in gases is lower than the speed in liquids and solids as the particles are far away as compare to solids and liquids.

$v_{gas} < v_{liquid} < v_{solid}$ Speed of sound increases from left to right.

Medium	Speed of sound
Gases	
Air at 0°C	332 m/s
Air at 20°C	344 m/s
Carbon dioxide at 0°C	260 m/s
Hydrogen at 0°C	1284 m/s
Liquids	
Water (diatilled) at 25°C	1498 m/s
Sea water at 25°C	1531 m/s
Alcohol	1210 m/s
Terpentine	1325 m/s
Solids	
Copper at 20°C	3560 m/s
Steel at at 20°C	5100 m/s
Glass at at 20°C	5500 m/s
Granite at at 20°C	6000 m/s

2.7 EFFECT OF TEMPERATURE ON THE SPEED OF SOUND

Sound travels faster as the temperature of the medium increases and vice-versa. This happens because as temperature increases, the particles of the medium collide more frequently and hence the disturbance spreads faster.

Speed of sound in air increases by 0.61 m/s with every 1°C increase in temperature. If V_0 is the velocity of sound at 0°C then at temperature its speed is given by $V_t = V_0 + 0.61t$.

Eg. If speed of sound in air at 0°C is 330 m/s, then its speed at 25°C will be 345 m/s.

Speed of sound does not depends on the pressure of the medium if temperature of the medium remains constant.

2.8 RANGE OF HEARING

The human ear is able to hear sound in a frequency range of about 20 Hz to 20 KHz. We can not hear sounds of frequencies less than 20 Hz or more than 20 KHz, these limits vary from person to person and with age. Children can hear sounds of somewhat higher frequencies, say upto 30 kHz. With age, our ability to hear sounds of somewhat higher frequencies, say upto 30 kHz. With age, our ability to hear high frequency sound diminishes. For the elders, the upper limit often falls to 10-12 kHz. We take 20 Hz - 20kHz as the audible range for an average person.

⇒ Even in the audible range the human ear is not equally sensitive for all frequncy. It is most sensitive to frequencies around 2000-3000 Hz.

⇒ Sound of frequncies less than 20 Hz is known as infrasonic sound or infrasound. Sound of frequency greater than 20 KHz is known as ultrasonic or ultrasound.

⇒ Different animals have different range of audible frequencies. A dog can hear sounds of frequencies upto about 50 kHz and a bat upto about 100 KHz. Dolphins can hear sounds of even higher frequencies. Animals such as elephants and whales can hear sounds of frequencies less than 20 Hz. Some fishes can hear sounds of frequencies as low as 1-25 Hz.

(a) Audible wave : The human ear is sensitive to sound waves of frequency between 20 Hz to 20 KHz. This range is known as audible range and these waves are known as audible waves.

Eg. Waves produced by vibrating sitar, guitar, organ pipes, flutes shehnai etc.

(b) Ultrasonic wave : As longitudinal wave whose frequency is above the upper limit of audible range i.e. 20 kHz, is called ultrasonic wave. It is generated by very small sources.

(c) Infrasonic : A longitudinal elastic wave whose frequency is below the audible range i.e. 20 Hz, is called an infrasonic wave. It is generally generated by a large source.

Eg. : Earthquake.

Focus Point

Elephants use infrasonic sound waves to communicate with one another. Their large ears enable them to detect these low-frequency sound waves, which have relatively long wavelengths. Elephants can effectively communicate in this way, even when they are separated by many kilometers.

2.9 MUSIC AND NOISE

All sounds, which produce the sensation of hearing, can be roughly divided into two categories : (i) music and (ii) noise.

The distinction between a music and a noise is not very sharp, it is rather subjective

(i) Music : It is a pleasant, continuous and uniform sound produced by the regular and periodic vibrations. For example, the sounds produced by a violin, piano, flute, tuning fork, etc., are the musical sounds. Its sound level is usually between 10 dB and 30 dB.

(ii) Noise : The sounds other than the musical sounds are called the noise. It is a sound produced by an irregular succession of disturbances and it is a discontinuous sound.It is discordant and unpleasant to the ear. For example, the sound produced when a stone is thrown on a tin sheet is a noise. Usually all the sounds to level above 120 dB are termed as noise.

(iii) Harmful Effects of Noise :

(a) A long exposure to noise pollution may result in the loss of hearing which may lead to deafness.

(b) Noise pollution reduces concentration and results in the loss of work efficiency.

(c) Noise causes anger, tension and it can also interferes with the sleep pattern of individuals.

(d) Noise can cause loss of night vision as well as colour blindness.

(iv) Prevention and Control of Noise :

(A) Machines should be designed in such a way, so that they produce minimum sound.

(B) All automobiles, generators etc. should be provided with improved silencers.

(C) At homes T.V. radio etc. should be played at lowest volume.

3. WAVE TERMINOLOGY

(i) Amplitude : The maximum displacement of a vibrating particle from its mean position is known as amplitude. It is denoted by 'a' or A.

(ii) Wavelength : Wavelength is defined in following different ways :

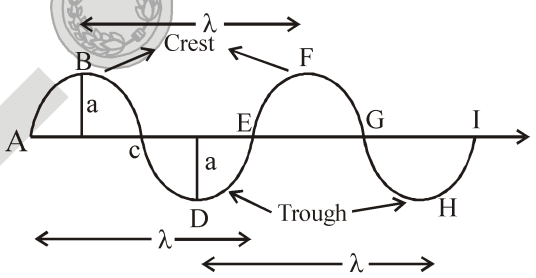
(a) It is the distance travelled by a wave during one complete vibration of the vibrating paricle.

(b) It is the distance between two nearest particles in the same phase.

(c) It is the distance between two consecutive crests or troughs of a transverse wave.

(d) It is the distance between two consecutive rarefactions or compressions of a longitudinal wave.

(e) It is the length of one complete wave. Wavelength is denoted by 'λ' (lambda). Its unit is metre (m)



(iii) Time-period : Time taken by a vibrating particle to make one complete vibration is called its time-period.

Also, time taken by a wave to move a distance equal to its wavelength λ is called the time-period of the wave.

It is denoted by T. Its unit is second (s).

(iv) Frequency : The number of vibrations completed by a particle in one second is called its frequency. Frequency is also defined as the number of waves (or crests) passing a given point in one second.
It is denoted by 'n' or N . Its unit is Hertz (Hz)

Relation between Time period and Frequency :

Let frequency = n

$\therefore$ Time taken to complete n vibrations = 1 second

or Time taken to complete 1 vibration = $\frac{1}{n}$ second

But the time taken to complete one vibration is called time-period T, hence

$$T = \frac{1}{n}$$

or $n \times T = 1$

$\therefore$ Frequency × Time period = 1

(v) Wave-velocity :

The distance travelled by a wave in one second is called its wave velocity. It is denoted by letter v. Its SI unit is m/s.

Velocity of wave has constant value for a given medium. It depends on the elasticity and density of the medium.

Wave-velocity is defined as the distance travelled by the wave per unit time taken.

(a) Relation between Wave Velocity, Frequency and Wavelength :

$\therefore$ Wave-velocity = $\frac{\text{Distance travelled by one wave}}{\text{Time taken by one wave}} = \frac{\text{Wavelength}}{\text{Time period}}$ or $v = \frac{\lambda}{T}$

But $n = \frac{1}{T}$

$\therefore$ $v = n\lambda$

or Wave-velocity = Frequency × Wavelength

4. ECHO

Echo is based on the reflection of sound. An echo is defined as repetition of sound due to reflection. There are a number of tourist places where echo points are marked. If you speak something from there loudly you will hear back your sound after sometime. This is called an echo. At some places, you might listen a number of echoes one after the other. This is called as multiple echo. It is not that you will hear an echo at any place. There are certain conditions required for an echo to be heard. BEfore discussing these conditions we will firstly talk about the term persistence of sound. The impact of any sound heard by us does not vanish immediately. It is due to this that a person can't hear two sounds if the time delay between them is less than the minimum required. It is found by scientists that if the time delay between the sounds is less than 1/10 sec, they are heard as single sound. Thus to hear two sounds as different sounds the time delay must be at least 1/10 sec. This forms the basis of an important condition needed to hear an echo.

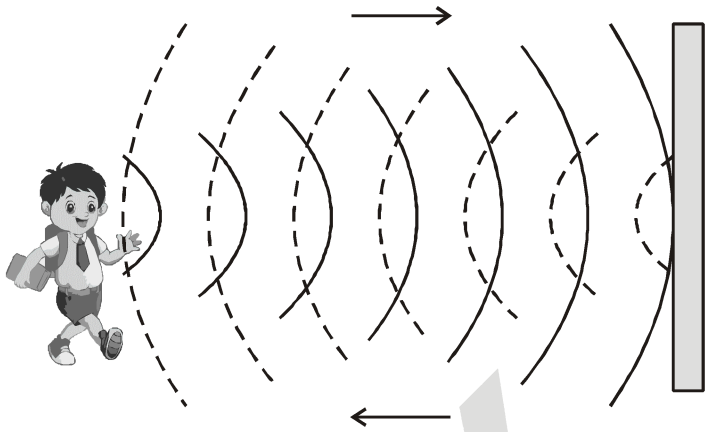


Figure : Echo

(i) Relation between speed of sound, Time of hearing echo and distance of reflecting body :

If t is the at which an echo is heard, d is the distance between the source of sound and the reflecting body and v is the speed of sound. The total distance travelled by the sound is 2d.

Speed of sound, $v = \frac{2d}{t}$

or $d = \frac{vt}{2}$

(ii) Calculation of minimum distance of Hearing Echo :

If d is minimum distance required for hearing an echo when persistence of hearing is $\frac{1}{10}$ second. The velocity of sound (at room temperature) is 340 m/s.

So, $d = \frac{vt}{2} = \frac{340}{2} \times \frac{1}{10} = \frac{340}{20}$

d = 17 metre

17 metre is the minimum distance of hearing echo.

(iii) Conditions for Formation of an Echo :

(A) The minimum distance between the source of sound and the reflecting body should be 17 metres.

(B) The wavelength of the sound should be less than the height of the reflecting body.

(C) The intensity of sound should be sufficient so that it can be heard after reflection.

5. THE HUMAN EAR

The ear are the sense organs which help us in hearing sound.

(a) Construction of Human Ear :

The ear consists of three compartments : Outer ear, middle ear and inner ear.

The part of ear which we see outside the head is called outer ear. The outer ear consists of broad part called pinna and about 2 or 3 centimeters long passage called ear canal. At the end of ear canal, there is a thin, elastic and circular membrane called ear-drum. The ear-drum is also called tympanum. The outer ear contains air. The middle ear contains three small and delicate bones called hammer, anvil and stirrup.

These ear-bones are linked to one another. One end of the bone called hammer is touching the ear-drum and its other end is connected to the second bone called anvil. The other end of anvil is connected to the third bone called stirrup and the free end of stirrup is held against the membrane over the oval window of inner ear. The middle ear also contains air. The lower part of middle ear has a narrow tube called 'eustachian tube' going to the throat. Eustachian tube connects the middle ear to throat and ensures that the air pressure inside the middle ear is the same as that on the outside.

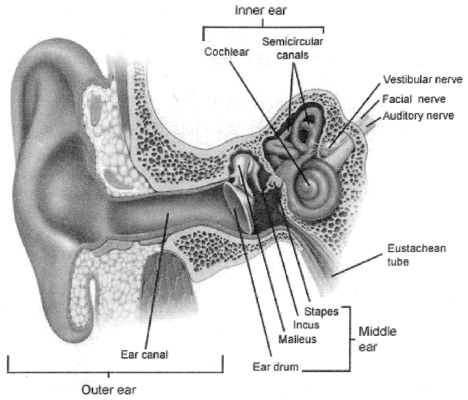


Figure : Human Ear

The inner ear has a coiled tube called cochlea. One side of cochlea is connected to the middle ear through the elastic membrane over the oval window. The cochlea is filled with a liquid. The liquid present in cochlea contains nerve cells which are sensitive to sound. The other side of cochlea is connected to auditory nerve which goes into the brain.

(b) Working of Human Ear :

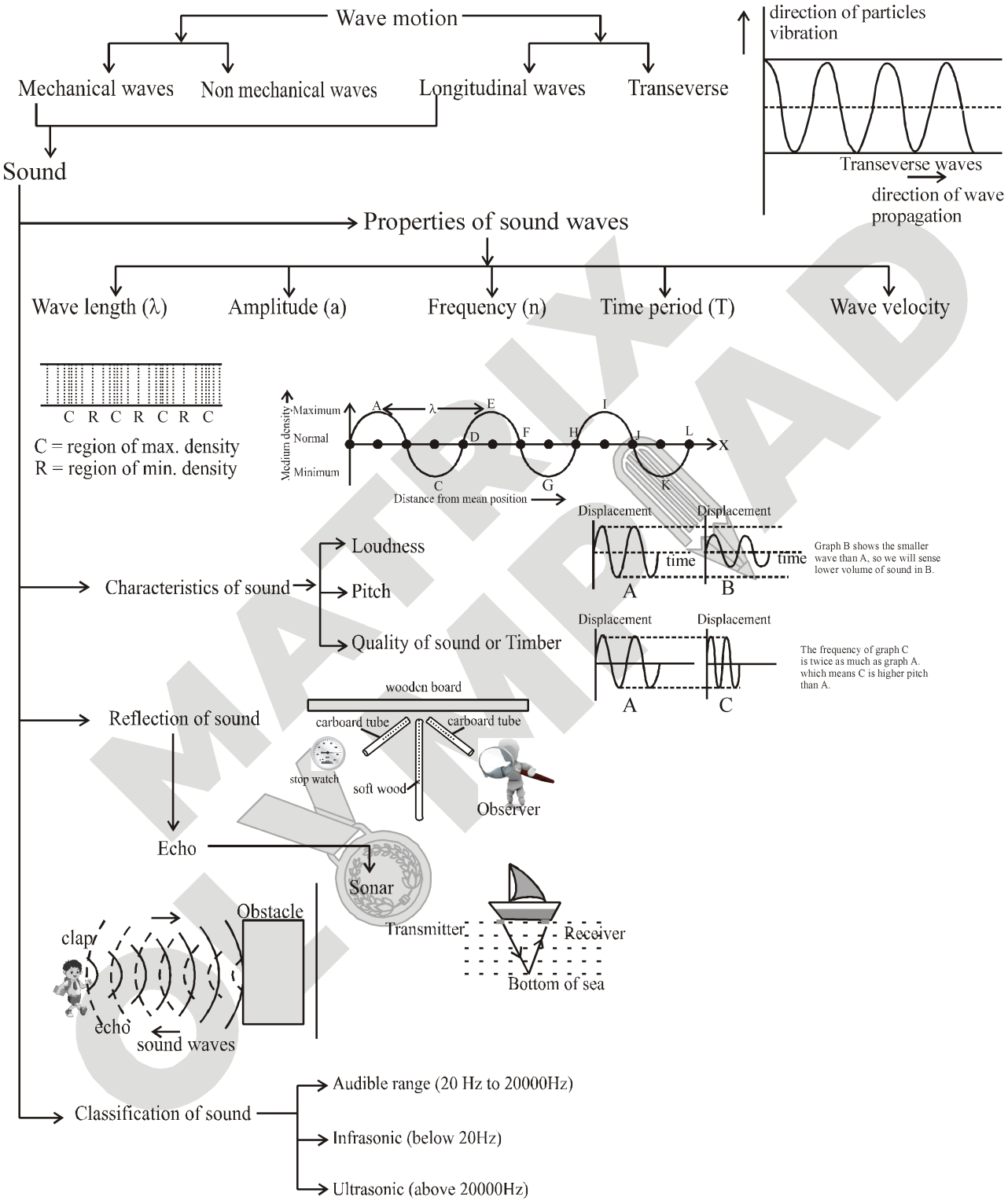
The sound waves (coming from a sound producing body) are collected by the pinna of outer ear. These sound waves pass through the ear canal and fall on the ear-drum. Sound waves consist of compressions (high pressure regions) and rarefactions (low pressure regions). When the compression of sound wave strikes the ear-drum, the pressure on the outside of ear-drum increases and pushes the ear-drum inwards and when the rarefaction of sound wave falls on the ear-drum, the pressure on the outside of ear-drum decreases and it moves outward. Thus, when the sound waves fall on the ear-drum, the ear-drum starts vibrating back and forth rapidly.

The vibrating ear-drum causes a small bone hammer to vibrate. From hammer, vibrations are passed on to the second bone anvil and finally to the third bone stirrup. The vibrating body strikes on the membrane of the oval window and passes its vibrations to the liquid in the cochlea. Due to this, the liquid in the cochlea begins to vibrate. The vibrating liquid of cochlea set up electrical pulses in the nerve cells present in it. These electrical pulses are carried by auditory nerve to the brain. The brain interprets these electrical pulses as sound and we get the sensation of hearing.

(c) Hearing impairment :

Total hearing impairment,which is rare, is usually from birth itself.Partial disability is generally the result of a disease, injury or age.Children with impaired hearing need special care. By learning sign language, such children can communicate effectively because speech develops as the direct result of hearing, a child with a hearing loss may have defective speech also. Technological devices for the hearing-impaired have made.

6. CONCEPT MAP



SOLVED EXAMPLES

SE. 1

Fill in the blanks with appropriate words: If a violin string is plucked strongly, its amplitude of vibration ____ (increases/decreases) and the note heard is ____ (louder/softer). If it is plucked lightly, its amplitude of vibration _____ (increases/decreases) and the note heard is ____ (louder/softer).

Ans. Increases, louder, decreases, softer

SE. 2

Give an example of object to be the best absorber of sound?

Ans. Porous material like wool is an effective sound absorber.

SE. 3

What do you mean by loudness and pitch of sound?

Ans. Loudness of the sound produced by a vibrating object is the measure of the amplitude of vibration. Loudness is proportional to the square of the amplitude. The shrillness of sound is called its pitch. It depends on the frequency of vibration. The higher the frequency the more shrill is the sound.

SE. 4

Give some methods to control noise pollution?

Ans. Some methods of controlling noise pollution are as follows :

(i) Reducing noise emission by developing low-noise products, for example, better silencers for automobiles.

(ii) Control over recreational noise, such as use of loudspeakers.

(iii) Measures at home such as double glazed glass in windows to keep out noise.

SE. 5

Find the time period of a wave whose frequency is 400 Hz?

Ans. Here, frequency of the wave, f = 400 Hz

Time period of the wave, $T = \frac{1}{f} = \frac{1}{400} = 0.0025$ s

SE. 6

Differentiate between musical sound and noise?

Ans.

Musical Sound	Noise
(i) It has a pleasant effect on the ear.	(i) It has an unpleasant effect on the ear.
(ii) It consists of a series of sound impulses which follow one another regularly.	(ii) The sound impulses do not follow one another regularly.
(iii) The frequency of musical sound is high.	(iii) The frequency of noise is low.

SE. 7

Suppose you and your friend are on the Moon. Will you be able to hear any sound produced by your friend?

Ans. Sound waves need a material medium for their propagation. Since there is no atmosphere on the Moon, one person cannot hear the sound produced by another person.

SE. 8

The frequency of a source of sound is 200 Hz. How many times does it vibrate in a minute?

Ans. Since the frequency of the source of sound is 200 Hz, Number of vibrations of the source in 1 second = 200 Number of vibrations of the source in 1 minute (i.e., 60 second) = 200 × 60 = 12000 Hz

SE. 9

How is ultrasound used for cleaning?

Ans. The object to be cleaned is placed in a cleaning solution. When ultrasonic waves are passed through the solution, due to their high frequency, particles of dust, dirt and grease get detached even from the. unreachable portion of the object and drop out in the solution.

SE. 10

How can you make a building sound proof?

Ans. A building can be made sound proof by insulating it from its surroundings. The doors used in such buildings should be heavy and sound proof. All the surfaces including the floor, are also covered with several centimetres of highly absorbent materials such as rock wood or asbestos fibre. Further, absorbent deflectors can be placed at suitable places in the building.

SE. 11

The sound of distant horses can be heard by applying the ear to the ground whereas it is inaudible if the ear is held a little distance above the ground. Explain?

Ans. We know that the speed of sound is greater is solid than in air. Therefore, by applying ear to the ground, we can hear this sound. But when the ear is a little distance above the ground, the sound travels through air and is hardly audible.

SE. 12

The sonic boom of an aircraft has a time period of 0.00005 s. Calculate the frequency of the sound produced.

Ans. Here, T = 0.00005 s,

$$f = \frac{1}{T} = \frac{1}{0.00005} = 20000 \text{ Hz}$$

SE. 13

What are the three factors on which the speed of sound depend upon?

Ans. The speed of sound depend upon the properties like elasticity and density of medium through which it propagates and the temperature of the medium.

SE. 14

Define persistence of hearing.

Ans. The sensation of sound persists in our ears for 0.1 second or one-tenth of a second, after the original sound dies off. This time is called persistence of hearing.

SE. 15

We have a stringed musical instrument. The string is plucked in the middle first with a force of greater magnitude and then with a force of smaller magnitude. In which case would the instrument produce a louder sound?

Ans. Loudness of sound is proportional to the square of the amplitude of the vibration producing the sound. The amplitude is larger when it is plucked with force of greater magnitude and hence the sound produced will be louder in that case.

NS. 1

Choose the correct answer. Sound can travel through
(a) gases only (b) solids only
(c) liquids only (d) solids, liquids and gases.

Ans. Solids, liquids and gases

NS. 2

Voice of which o£ the following is likely to have minimum frequency?
(a) Baby girl (b) Baby boy
(c) A man (d) A woman

Ans. (a) : Baby girl

NS. 3

In the following statements, tick 'T' against those which are true, and 'F' against those which are false.
(a) Sound cannot travel in vacuum.
(b) The number of oscillations per second of a vibrating object is called its time period.
(c) If the amplitude of vibration is large, sound is feeble.
(d) For human ears, the audible range is 20 Hz to 20,000 Hz.
(e) Lower the frequency of vibration, higher is the pitch.
(f) Unwanted or unpleasant sound is termed as music.
(g) Noise pollution may cause partial hearing impairment.

Ans. (a) True (b) False (c) False
(d) True
(e) False (f) False (g) True

NS. 4

Fill in the blanks with suitable words.
(a) Time taken by an object to complete one oscillation is called ____.
(b) Loudness is determined by the ____ of vibration.
(c) The unit of frequency is ____.
(d) Unwanted sound is called _____.
(e) Shrillness of a sound is determined by the___ of vibration.

Ans. (a) time period (b) amplitude
(c) hertz (d) noise
(e) frequency

NS. 5

A pendulum oscillates 40 times in 4 seconds. Find its time period and frequency.

Ans. Number of oscillations = 40
Time taken to complete 40 oscillations = 4 s

Time taken to complete one oscillation = $\frac{4}{40}$ = 0.1 s

So time period = 0.1 s

Frequency = $\frac{1}{\text{Time period}} = \frac{1}{0.1}$ = 10 Hz

NS. 6

The sound from the mosquito is produced when it vibrates its wings at an average rate of 500 vibrations per second. What is the time period of the vibration ?

Ans. Total vibrations = 500
Time taken to complete 500 vibrations = 1 s

Time taken to complete 1 vibration= $\frac{1}{500}$ =0.002 s

Time period of vibration = 0.002 s
So time period = 0.002 s

NS. 7

Identify the part which vibrates to produce sound in the following instruments.
(a) Dholak (b) Sitar (c) Flute

Ans. (a) Stretched membrane
(b) Stretched Strings
(c) Air column

NS. 8

What is the difference between noise and music ? Can music become noise sometimes ?

Ans. The sound which is unpleasant for our ears is called noise. Music is the sound which is pleasant for our ears and has soothing effect. Music becomes noise sometimes when it crosses the bearable range of sound for our ears.

NS. 9

List sources of noise pollution in your surroundings.

Ans. There are various sources which cause sound pollution in our surroundings, for example, loud sound of T.V., radio, loud sound of machines in factories, loud music in parties and honking of horns etc.

NS. 10

Explain in what way noise pollution is harmful to humans.

Ans. There are. many harmful effects of noise pollution. They are as follows,

(i) Noise pollution can cause temporary or permanent deafening.

(ii) Noise pollution can cause many health related problems like headache, high blood pressure etc.

(iii) It can cause mental illness due to lack of sleep.

NS. 11

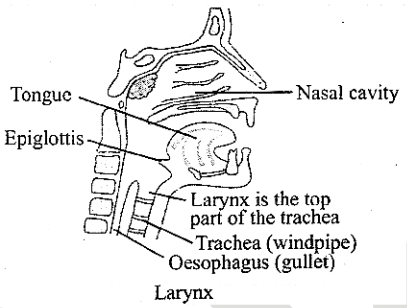
Your parents are going to buy a house. They have been offered one on the roadside and another three lanes away from the roadside. Which house would you suggest your parents should buy ? Explain your answer.

Ans. I would suggest my parents to buy house three lanes away from the roadside because area away from the roadside have less traffic and thus less noise pollution. This would safe guard our health and peace of mind.

NS. 12

Sketch larynx and explain its function in your own words.

Ans. Larynx is the top part of the trachea. It is also called the voice box. The larynx contains the vocal cords. These are V shaped ridges of muscle tissue on the inside lining of the larynx. They vibrate when air passes between them too produce speech. When you breathe in, air passes into the larynx and down the trachea towards the lungs. When you swallow, the larynx moves upwards slightly and a flap of cartilage tissue at the back of the tongue called epiglottis closes over the entrance to the larynx. This ensures that food or drink go down the oesophagus (gullet) and not down the trachea.



NS. 13

Lightning and thunder take place in the sky at the same time and at the same distance from us. Lightning is seen earlier and thunder is heard latter. Can you explain why ?

Ans. Lightning and thundering take place in the sky at same time and at the same distance from us but lightning is seen earlier than thunder is heard because the speed of light is much greater than that of sound so it reaches us before the sound does.

EXERCISE – I

ONLY ONE CORRECT TYPE

1. A tuning fork, a violin string and a loud speaker cone are producing sound. This is because they are all in state of :
   (A) Rest
   (B) Vibration
   (C) Rotation
   (D) Displacement
2. In which of the following we cannot see vibrations ?
   (A) Vibrations in string of guiter
   (B) Vibrations of flute
   (C) Low frequency tuning fork
   (D) Vibration in a low frequency woofer of loudspeaker
3. Which of the following statements is correct :
   (A) The time taken for one oscillation is the frequency
   (B) The distance covered by a vibrating body while making one complete oscillation is four times the amplitude.
   (C) The greater the amplitude of a vibrating body, the higher will be pitch of the sound it gives out.
   (D) In a string instrument, thin strings are used for low pitch notes.
4. What is a wave ?
   (A) Disturbance that travels and carrries energy through the medium.
   (B) There is not net displacement of particles of medium.
   (C) A disturbance of medium in which particles of medium oscillate from their mean position.
   (D) All of the above
5. In transverse wave, an object
   (A) Vibrates perpendicular to its axis at the normal rest position.
   (B) Vibrates parallel to its axis at the normal rest position.
   (C) Sometimes vibrates perpendicular and sometimes parallel to its axis at the normal rest position.
   (D) None of these
6. Sound is a :
   (A) Transverse wave
   (B) Longitudinal wave
   (C) Wave in which particles of medium oscillate perpendicular to its axis at normal rest position
   (D) None of these
7. Sound waves cannot travel through :
   (A) Solids (B) Liquids
   (C) Gases (D) Vacuum
8. The speed of a sound wave is determined by :
   (A) Its amplitude
   (B) Its intensity
   (C) Its pitch
   (D) The transmitting medium
9. Arrange the materials in the decreasing order of the speed with which sound will travel through them :
   metal rod, air, water
   (A) Metal rod, air, water
   (B) Air, water, metal rod
   (C) Metal rod, water, air
   (D) Water, air, metal rod
10. You see lightning before you hear the thunder because
    (A) Lightning is much brighter than thunder.
    (B) Thunder is heavier than lightning
    (C) Light can travel through air but sound cannot
    (D) Sound travels slower than light
11. An object attached to one end of a spring makes 20 vibrations in 10 s.Its frequency is :
    (A) 2 Hz (B) 10 Hz
    (C) 0.05 Hz (D) 0.2 Hz
12. The part of the ear that transmits sound vibrations to the brain is the :
    (A) Cochlea (B) Stirrup
    (C) Eardrum (D) Auditory nerve
13. The magnified pressure variation is transmitted to inner ear by :
    (A) Hammer (B) Cochlea
    (C) Stirrup (D) Auditory canal
14. Ultrasound is sound above the human hearing range. It can be heard by :
    (A) Bats (B) Elephants
    (C) Lions (D) Sheep

15. Which of the following properties of a sound wave determine its 'pitch' ?
(A) Amplitude
(B) Distance from source to detector
(C) Frequency
(D) Speed

16. To raise the pitch of a certain piano string, the piano tuner :
(A) Loosen the string
(B) Tightens the string
(C) Increases the area of cross-section of the string
(D) Lengthens the string

17. What do you think a tabla player does to increase the pitch of the sound produced ?
(A) He strikes the tabla skin harder.
(B) The pitch cannot be changed in a tabla.
(C) He tightens the skin by stretching the string around it.
(D) He gets a bigger tabla.

18. Rahul is playing the drums. Which of the following characteristics of sound would result in an increase in loudness ?
(A) Amplitude (B) Speed
(C) Pitch (D) Quality

19. Sound levels are measured in :
(A) Decimeters (B) Decibels
(C) Decilitres (D) Decigrams

20. The voice box is also called as
(A) stomach (B) heart
(C) larynx (D) mouth

21. Sound is a kind of
(A) work (B) energy
(C) force (D) pressure

22. The hearing range of human ear is
(A) 20 hz to 20,000 Hz (B) less than 20 Hz
(C) more than 20,000 Hz (D) 20 Hz to 25,000 Hz

23. The frequency of subsonic sound is
(A) more than 20 Hz
(B) 100 Hz
(C) less than 20 Hz
(D) more than 20,000 Hz

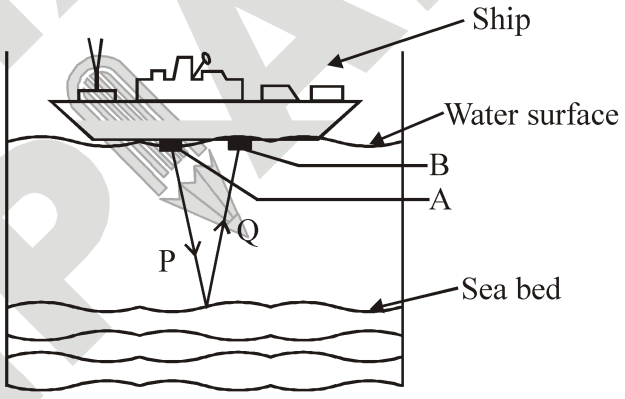
24. 1 hertz is equal to
(A) 1 vibration per minute
(B) 10 vibrations per minute
(C) 60 vibrations per minute
(D) 600 vibrations per minute

25. The sound in the audible range is called
(A) ultrasonic osund
(B) sonic sound
(C) subsonic sound
(D) light sound

PARAGRAPH TYPE QUESTION

PARAGRAPH#1

A ship with SONAR device is shown in the figure given below.



SONAR device is use to calculate depth of sea level.

26. Sonar technique utilises
(A) Radio wave (B) Audible sound
(C) Infrasound (D) Ultrasound

27. In given figure, P represents
(A) Incident ray (B) Refected ray
(C) Transmitter (D) Detector

28. What is the formula depth of sea ?

(A) $D = \frac{v \times t}{2}$

(B) $D = v \times t$

(C) $D = 2v \times t$

(D) None of these

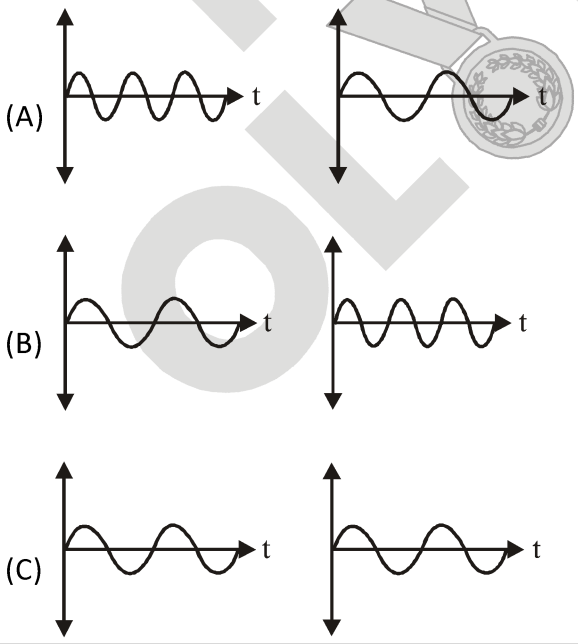
PARAGRAPH#2

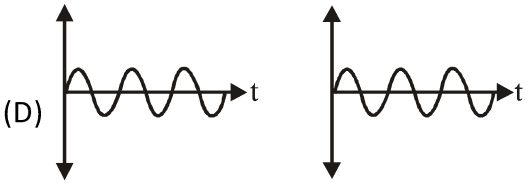
In fig. (A), a boy is beating the drum using a stick and thus, drum produces a sound. In fig. (B), another girl produces sound using a whistle.

Figure : (A)

Figure : (B)

29. Choose the option which shows the correct waveforms of fig. (A) and fig. (B) respectively.





30. In above question, frequencies in case of fig. (A) and fig. (B) are respectively,
(A) high frequency ; high frequency
(B) low frequency ; low frequency
(C) low frequency ; high frequency
(D) high frequency ; low frequency

31. The pitch of the sound produced by a whistle is _____ than that of sound produced by the drum.
(A) Higher (B) Lower
(C) Equal (D) None of these

MATCH THE COLUMN TYPE

32.

Column I	**Column II**
(P) Maximum displacement from mean position	(i) Time period
(Q) Time in which a particle completes one vibration	(ii) Amplitude
(R) Number of vibrations produced in 1 second	(iii) Vibration
(S) A complete to and from motion	(iv) Frequency

(A) P → ii, Q → i, R → iv, S → iii
(B) P → i, Q → iv, R → iii, S → ii
(C) P → iv, Q → iii, R → ii, S → i
(D) P → iii, Q → ii, R → iv, S → i

33.

Column I	**Column II**
(P) An unpleasant sound	(i)Infrasonic sound
(Q) Production of human	(ii) Sitar voice
(R) A stringed instrument	(iii) Noise
(S) Sound with frequency less than 20 Hz	(iv) Vocal cords

(A) P → ii, Q → i, R → iv, S → iii
(B) P → i, Q → iv, R → iii, S → ii
(C) P → ii, Q → iv, R → iii, S → i
(D) P → iii, Q → iv, R → ii, S → i

EXERCISE – II

VERY SHORT ANSWER TYPE

1. Dolphins communicate under water using sound. What is the name of this sound ?
2. When sound enters in human ear, it travels down a canal at the end of which a thin membrane is stretched tightly, What is the name of this membrane
3. A medical instrument is used for investigating and tracking many medical problems, works at frequencies higher than 20,000 Hz. What type of sound wave is used by this instrument ?
4. What do you give a name for sound that originates from a source where the frequencies are constantly changing in a random manner ?
5. In what form of waves, sound travels in air ?
6. Can sound waves travel in vacuum ?
7. What is the minimum distance required to produce a distinct ECHO ?
8. Are all sounds audible to us ? What is the audible range of frequencies for human beings ?
9. Define the following related to sound waves :
   (i) Pitch (ii) Loudness and softness
   (iii) Intensity (iv) Quality
10. Draw the well labelled diagram of human ear showing the different parts ?

SHORT ANSWER TYPE

1. Why does the speed of sound differ in different media ? Arrange the speed of sound in solids, liquids and gases in the increasing order.
2. Why do we see lightning before we hear the thunder from it ?
3. What happens when the inner ear is exposed to very loud noises ? (Some musicians wear earplugs when playing in concerts).
4. How are the pitch and frequency of a sound related ? Give one example each for a low pitch voice and a high pitch voice.
5. What do you understand by loudness of audible sound ? Which property of sound is linked with loudness ? Show waveforms to show a loud sound and a soft sound.

LONG ANSWER TYPE

1. Explain in detail how the human ear receives and intercepts sound. Make figure.
2. What is noise pollution ? What are its sources ? How can it be minimised ?
3. Sound needs a material medium for its propagation. Explain with the help of a experiment.
4. Define reflection of sound. Describe an experiment to demonstrate the reflection of sound.
5. Describe the working of human hear ?

FILL IN THE BLANKS

1. To and from motion in regular time intervals is called ..... motion.
2. A violin is a ..... musical instrument.
3. The maximum displacement in a cycle from its rest position is called .....
4. The number of cycles an oscillator completes in each second is called its .....
5. A ..... wave has oscillations in the same direction as its motion.

TRUE / FALSE TYPE

1. The number of oscillations per second of a vibrating object is called its time period.
2. If the amplitude of vibration is large, sound is feeble.
3. The lower the frequency of vibration, the higher is the pitch.
4. Unwanted or unpleasant sound is termed as music.
5 Noise pollution may cause partial hearing impairment.

NUMERICAL PROBLEMS

1. A bicycle wheels spins 25 times in 5 seconds. Calculate the period and frequency of the wheel.
2. Calculate the period and frequency for the second hand, minute hand, and hour hand of a clock.
3. The time period of a sound wave from a piano is 1.18×10^{-3}s. Find its frequency.
4. A tuning fork's tongs vibrate 250 times in 2.0 s. Find (a) the frequency of vibration
   (b) the period of vibration.
5. Calculate the period and frequency, in hertz, for the following cyclical events :
   (a) 120 oscillations in 2.0 s
   (b) 45 revolutions of a turntable in one minute

Space for Notes :

Answer Key

EXERCISE–I														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	B	B	D	A	B	D	D	C	D	A	D	C	A	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
B	C	A	B	C	B	A	C	C	B	D	A	A	B	C
31	32	33												
B	A	D												

EXERCISE II

FILL IN THE BLANKS

1.Vibratory or oscillatory 2. Stringed 3. Amplitude 4. Frequency 5. Longitudinal

TRUE / FALSE

1. F 2. F 3. F 4. F 5. T

NUMERIC PROBLEMS

1. f = Hz, T = 0.20 sec.

2. For second hand, period = 1 min = 60 sec, Frequency = 0.0166 Hz.

For minute hand, period = 1 hr = 3600 sec, Frequency = 2.77×10^{-4} Hz.

For hour hand , period = 12 hrs = 43200 sec, Frequency = 2.3×10^{-5} Hz.

3. Frequency = 847.45 Hz.

4. (a) Frequency = 125 Hz, (b) T = 8×10^{-3} sec.

5. (a) f = 60 Hz, T = 0.0167 sec (b) f = 0.75 Hz, T = 1.34 sec.

Space for Notes :