



CLASS-VIII SUBJECT- SCIENCE

Physics

TERM-1 SYLLABUS

Chapter-12: Friction

Introduction

Friction is a force that opposes motion between any surfaces that are touching. Friction can work for or against us. For example, putting sand on an icy sidewalk increases friction so you are less likely to slip. On the other hand, too much friction between moving parts in a car engine can cause the parts to wear out. Other examples of friction are illustrated in the two **Figures** below



Friction between the graphite in a pencil and a sheet of paper leaves a mark on the paper.



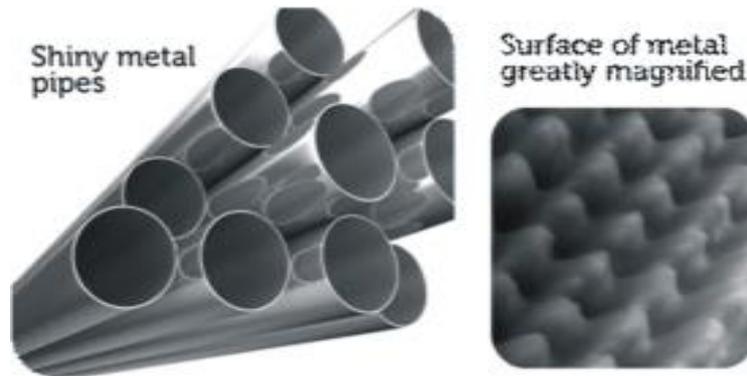
Friction between a bicycle brake pad and the rim of a wheel causes the wheel to stop turning.

Did you ever rub your hands together to warm them up, Why does this make your hands warmer? The answer is friction.

Why Friction Occurs

Friction occurs because no surface is perfectly smooth. Even surfaces that look smooth to the unaided eye make look rough or bumpy when viewed under a microscope. Look at the metal surfaces in the **Figure** below. The aluminum foil is so smooth that it's shiny. However, when highly magnified, the surface of metal appears to be very bumpy. All those mountains and valleys catch and grab

the mountains and valleys of any other surface that contacts the metal. This creates friction.



Factors that Affect Friction

Rougher surfaces have more friction between them than smoother surfaces. That's why we put sand on icy sidewalks and roads. Increasing the area of surfaces that are touching also increases the friction between them. That's why you can't slide as far across ice with shoes as you can on the thin blades of skates. The greater surface area of the soles of the shoes cause more friction and slow you down.

Heavier objects also have more friction. Can you explain why?

Heavier objects press together with greater force, and this causes greater friction between them.

Friction Produces Heat

You know that friction produces heat. That's why rubbing your hands together makes them warmer. But do you know why? Friction causes the molecules on rubbing surfaces to move faster, so they have more energy. This gives them a higher temperature, and they feel warmer. Heat from friction can be useful. It not only warms your hands. It also lets you light a match as shown in the **Figure** below. On the other hand, heat from friction between moving parts inside a car engine can be a big problem. It can cause the car to overheat.

How is friction reduced between the moving parts inside a car engine?

To reduce friction, oil is added to the engine. The oil coats the surfaces of the moving parts and makes them slippery. They slide over each other more easily, so there is less friction.



Friction is always parallel to the surface in contact.

In some cases, friction is desirable while in other cases, friction reduces the effectiveness of machines. Without friction, you would not be able to walk, the wheels on a vehicle would have no grip on a road surfacing and the vehicle would not be able to move forward.

On the other hand, friction is undesirable in most of the cases. Friction causes mechanical parts to seize and wear out.

Fun with Friction:

Activity 1: Take two pieces of paper. Wad one of the pieces of paper into a ball. Leave the other piece of paper like normal.

Hold the pieces of paper above your head. Drop the pieces at the same time. The wadded piece will fall to the ground immediately. The flat piece of paper will flutter down more slowly because it has more surface area to create friction or drag on the air as it drops.



Concept: Air friction.

Activity 2:

To begin, fill the bottle with rice. Try sticking the chopstick down into the bottle. When you grab the chopstick and pull up, what happens? The stick should just come right out.

How do you make the rice stick to the chopstick so you can just pick it up? You've got to add more friction. Here's how.

Put the lid on the bottle and tap the bottom of the bottle on a hard surface. Do this a few times to compact the rice and get rid of the air pockets. Now you should have room to add a bit more rice to the bottle.

Once you've added a bit more rice, stick the chopstick back into the bottle. This time, when you pull up on the chopstick, you should be able to pick up the whole bottle.



Fig: Holding up a bottle with just a chopstick

Concept: Friction applied by rice on the chopstick.

Quiz Time

1. Define friction, and explain why it occurs.
2. Identify three factors that affect friction.
3. Why does friction warm your hands when you rub them together?
4. Outside wooden steps may get slippery when they are wet. How could you make them less slippery?

Types of Friction

Friction is the force that opposes motion between any surfaces that are in contact. There are four types of friction: static, sliding, rolling, and fluid friction (Air/Viscous friction). Static, sliding, and rolling friction occur between solid surfaces. Fluid friction occurs in liquids and gases.

Static Friction

Static friction acts on objects when they are resting on a surface. For example, if you are hiking in the woods, there is static friction between your shoes and the trail each time you put down your foot (see **Figure** below). Without this static friction, your feet would slip out from under you, making it difficult to walk. In fact, that's exactly what happens if you try to walk on ice. That's because ice is very slippery and offers very little friction.



Can you think of other examples of static friction?

One example is the friction that helps the girls climb the rock wall in the picture above. Static friction keeps their hands and feet from slipping.

Sliding Friction

Sliding friction is friction that acts on objects when they are sliding over a surface. Sliding friction is weaker than static friction. That's why it's easier to slide a piece of furniture over the floor after you start it moving than it is to get it moving in the first place. Sliding friction can be useful. For example, you use sliding friction when you write with a pencil. The pencil "lead" slides easily over the paper, but there's just enough friction between the pencil and paper to leave a mark.

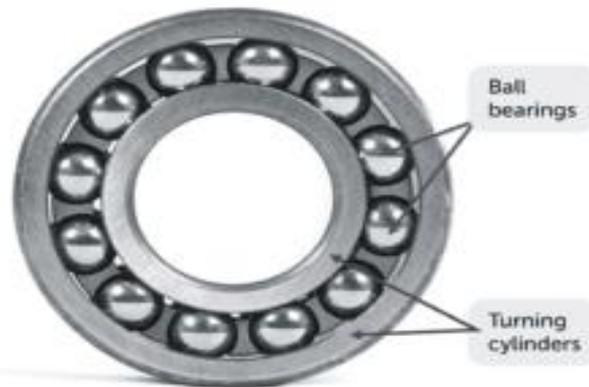
How does sliding friction help you ride a bike?

There is sliding friction between the brake pads and bike rims each time you use your bike's brakes. This friction slows the rolling wheels so you can stop.

Rolling Friction

Rolling friction is friction that acts on objects when they are rolling over a surface. Rolling friction is much weaker than sliding friction or static friction. This explains why most forms of ground transportation use wheels, including bicycles, cars, 4-wheelers, roller skates, scooters, and skateboards. Ball bearings are another use of rolling friction. You can see what they look like in the **Figure** below. They let parts of a wheel or other machine roll rather than slide over on another.

Ball Bearings in a Wheel



The ball bearings in this wheel reduce friction between the inner and outer cylinders when they turn.

It is found that:

Rolling friction < sliding friction < static friction.

Fluid Friction

Fluid friction is friction that acts on objects that are moving through a fluid.

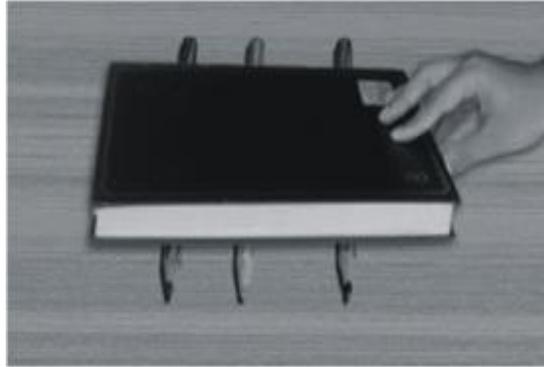
A **fluid** is a substance that can flow and take the shape of its container. Fluids include liquids and gases. If you've ever tried to push your open hand through the water in a tub or pool, then you've experienced fluid friction. You can feel the resistance of the water against your hand. Look at the skydiver in the **Figure** below. He's falling toward Earth with a parachute. Resistance of the air against the parachute slows his descent. The faster or larger a moving object is, the greater is the fluid friction resisting its motion. That's why there is greater air resistance against the parachute than the skydiver's body.



Fun with Friction:

Activity 1:

Take a few pencils which are cylindrical in shape. Place them parallel to each other on a table. Place a thick book over it. Now push the book. You observe the pencils rolling as the book moves. Do you feel it easier to move the book in this way than to slide it? Do you think that resistance to the motion of the book has been reduced? Have you seen heavy machinery being moved by placing logs under it?



Motion of the book on rollers

Concept: Rolling friction

Quiz Time

1. List four types of friction.
2. You can move heavy boxes by sliding them over the ground. Or you can put them on a dolly, like the one in the **Figure** below, and then roll them over the ground. Explain which way makes it easier to move the boxes.



3. What is a fluid? Give an original example of fluid friction.

Advantages of Friction

- Friction between pen and paper enables us to write on the paper.
- Friction between our feet and the ground allows our movements like standing, walking and running.
- Friction between the surface of the road and tyres of our vehicles allow the vehicles to move without slipping.

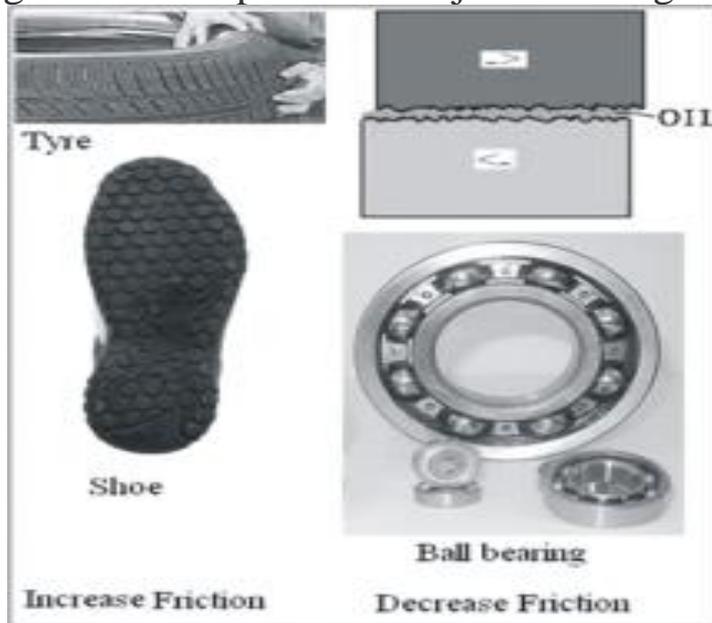
Disadvantages of Friction

- Friction causes moving objects to stop or slow down
- Friction produces heat causing wastage of energy in machines.

- Friction causes wear and tear of moving parts of machinery, soles of shoes, etc.

Methods of Increasing and Reducing Friction

In real life, there are circumstances where we have to increase the friction and minimize the friction. Friction can be increased by increasing the roughness of the surfaces in contact. For example, treading of shoes and tires is done to increase friction. When friction is undesirable we have to reduce the friction. Friction can be minimized by using lubricants like oil and grease and by using ball bearing between machine parts. A substance that is introduced between two surfaces in contact, to reduce friction, is called a lubricant. Fluid friction can be minimized by giving suitable shapes to the objects moving in the fluids.



Friction Is A Necessary Evil

There are instances in daily life where friction is a necessity. For example, without friction, we cannot hold objects in our hands; we cannot walk and cannot light a match stick. Sometimes friction is not desirable, for example friction between machinery parts, which causes wear and tear. As friction is advantageous to us it is considered as a friend but due to its disadvantages it is a foe. Depending on the circumstance, friction can be a help or a hindrance. Thus it is a necessary evil.

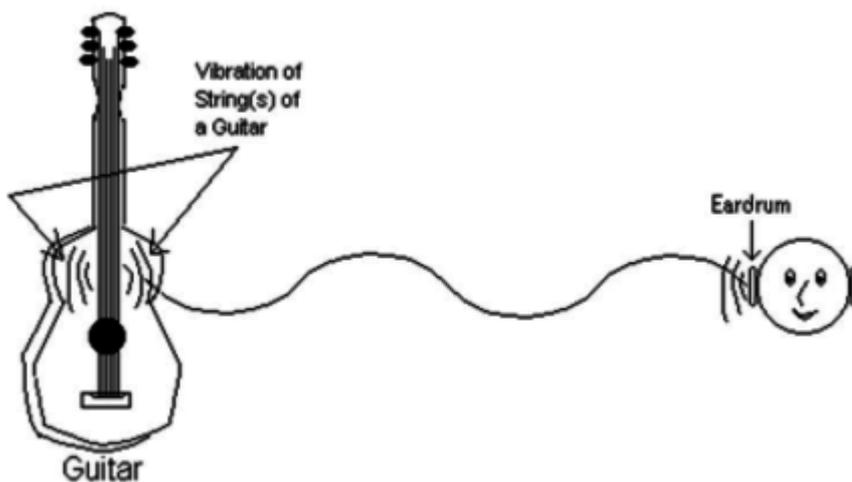
Chapter-13:Sound

Sound plays an important role in our life. It is through sound we know that a period in school is over or if someone is approaching you by just listening to the footsteps. Vibrating objects produce sound. Vibration is the to and fro or back and forth movement of an object. Sound needs a medium to travel. Hence, it cannot travel in a vacuum.

Introduction to Sound

Introduction to waves

- The sound is produced by vibrating objects.
- They travel from one place to another in the form of waves. Hence, the name sound waves.

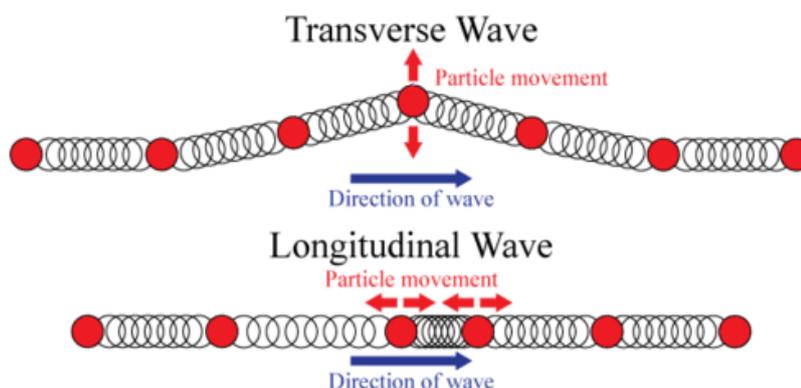


Wave and particle motion of waves

- Mechanical waves are waves that travel through a material medium.
- It is of two types: depending on the direction of motion of the particle of the medium and the wave propagation:

*transverse

*longitudinal



Transverse waves

- Particle motion is to **perpendicular** the direction of wave motion.
- This type of wave is a mechanical wave called a transverse wave. E.g: Light, or even Mexican wave in a stadium.

Longitudinal waves

- When the particles of the medium travel **parallel** to the direction of the wave motion by means of successive compression or rarefaction.
- It is also a mechanical wave.
- Example: a slinky

Sound Properties

Introduction to sound waves

- Sound needs a medium to propagate. The matter or material through which sounds propagates is called a medium.
- Sound cannot travel in a vacuum. The moon does not have an atmosphere, hence, you can hear on the moon.

Sounds by Humans

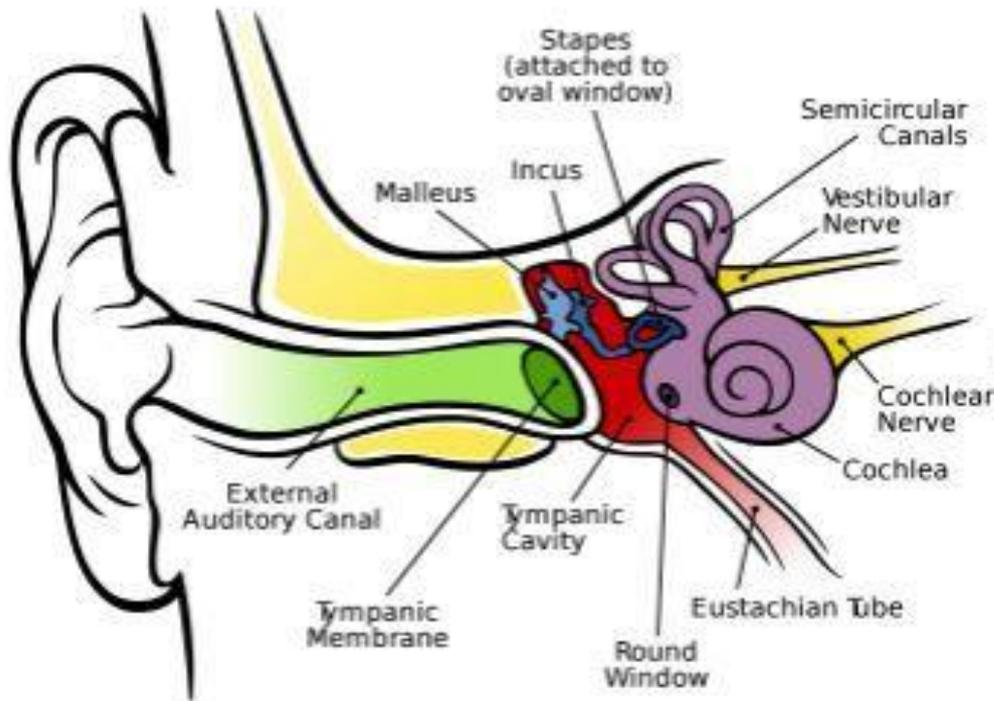
How do humans produce sound?

- The sound produced in the voice box called larynx located at the upper end of the windpipe.
- 2 vocal cords get stretched across in the voice box. Has a slit, through which air is forced out by the lungs.
- Muscles attached to vocal cords make it tight or loose.

Hearing

Human ear

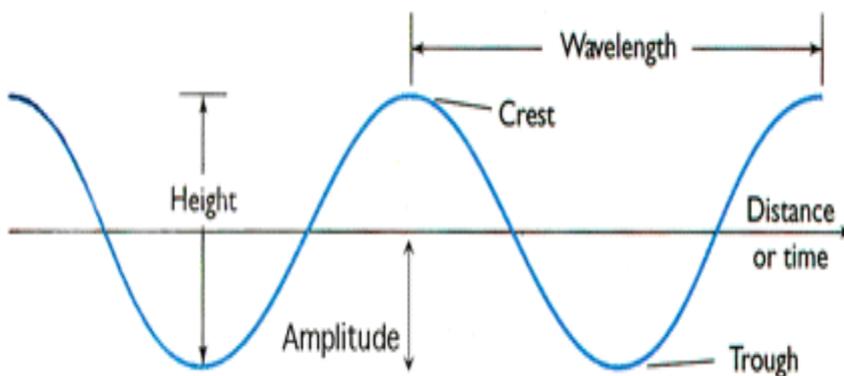
- Outer ear = pinna: collects sound from the surroundings.
- Sound passes through a tube called an auditory canal.
- Eardrum (tympanic membrane) → vibrates when the sound incident.
- Vibrations are sent to the inner ear, from there it goes to the brain as signals via the auditory nerve.



Amplitude, Time Period and Frequency

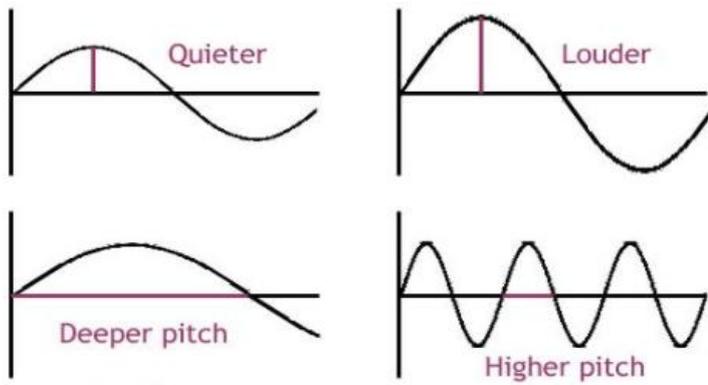
Amplitude, frequency and time period of vibrations

- The magnitude of disturbance in the medium on either side of the mean value is called as **Amplitude**(A). Larger the amplitude, louder the sound.
- The number of oscillations per second is called **frequency**. Expressed in Hertz (**Hz**).
- Time taken for one complete oscillation to travel across a point. $T = 1/f$. (Seconds)



Loudness and Pitch

- Volume or loudness of a sound depends on the amplitude. The force with which an object is made to vibrate gives the loudness.
- The number of oscillations per unit time. Directly proportional to frequency.



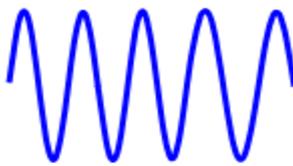
Audible and inaudible sounds

- Audible range = 20Hz to 20kHz known as the Sonic range.
- Below 20 Hz (inaudible) → infrasonic range
- Above 20 kHz (inaudible) → Ultrasonic range

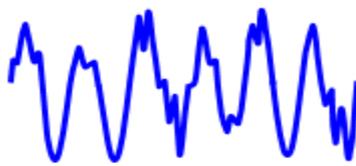
Noise Pollution

Noise and music

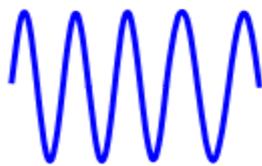
- Sounds with the same pitch and loudness can be distinguished based on the quality. Music is pleasant to the ears while noise is not.
- Unpleasant sounds are called as noise.



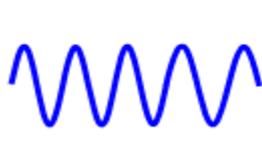
A "pure note"



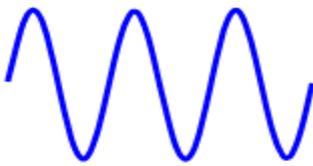
Noise



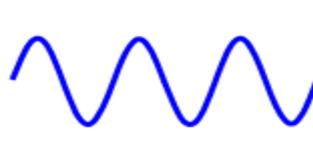
A loud, high pitched note



A soft, high pitched note



A loud, low pitched note



A soft, low pitched note

Noise pollution and measures to control it

- Presence of excessive unwanted noise in our surroundings is called as noise pollution.
- Can cause hearing impairment, sleeplessness and also hypertension.

– Must be minimised by reducing noisy operations and honking in residential areas. Planting trees along roads also cut down the noise.

