12 Friction as a Force

We'll cover the following key points:

- Friction and its ways to reduce
- Advantages and Disadvantages of friction

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Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of friction as a force and how it affects motion.
- Explain the different ways to reduce friction, including lubrication and smooth surfaces.
- Identify the advantages and disadvantages of friction in various everyday situations.
- Recognize the role of friction in the functioning of machines and human activities.

Guidelines for Teachers

The teacher can begin the chapter by explaining the concept of friction as a force that resists motion when two surfaces come into contact. Use examples like pushing a box or riding a bicycle to demonstrate how friction acts in daily life. Discuss the methods used to reduce friction, such as the application of lubricants or the use of ball bearings. Encourage students to identify both the advantages (e.g., providing grip and preventing slipping) and disadvantages (e.g., causing wear and tear on materials) of friction. Simple demonstrations, like sliding objects on different surfaces or observing the effect of oil on a surface, can help make the concept more tangible and relatable.

Warm Up

Experiential Learning

1. The taxi driver has to be more careful when driving in winter because the road is more slippery than when he drives in summer. That means the friction on the road during winter is _____ the friction during summer.

   A. more than B. less than C. the same as

2. The carpenter finds maple wood easier to saw than oak. This means that

   A. There is less friction on the maple wood than on the oak.

   B. There is more friction on the maple wood than on the oak.

   C. The carpenter was lazy.

3. The mover pushed his cart on the tile floor and it went fast and easy .When he pushed his cart on the carpet, it was harder because there is more friction on the carpet. Therefore, he must _____ .

   A. leave the cart outside and take a nap.

   B. use less force to push the cart when he's on the carpet.

   C. use more force to push the cart when he's on the carpet.

Fun Fact

Rubbing your hands together on a cold day creates heat because of friction! Friction is the force that resists motion between two surfaces. It slows things down but also generates heat. This useful force helps us walk, drive cars, and hold onto objects. Without friction, everything would just slip and slide away!

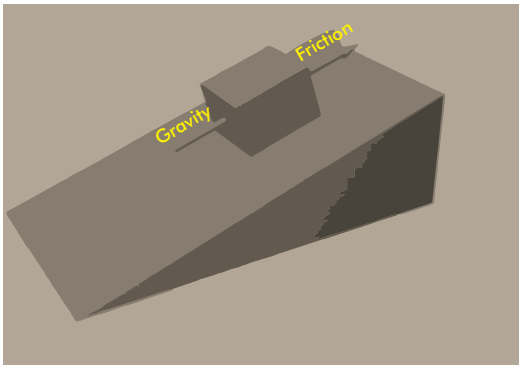
Activity

Creative Learning

Take a toy car and give it a slight push to move it on the smooth surface of the floor. Watch how far it travels. Now, push the car with same force on a rough grass surface. You will notice that the car travels a shorter distance on the rough surface than on the smooth surface of the floor. What makes the car move for a shorter distance on the grass surface? The toy car stops because of friction.

Friction and its ways to reduce

The force that acts between the object and the surface, which either slows down or stops the moving object, is called frictional force or friction.

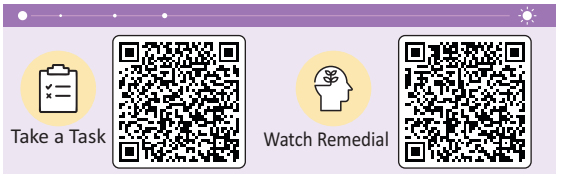


A force that acts at the point of contact between the objects is called a contact force. We can find friction whenever objects come in contact with each other. This force acts in the direction opposite to the direction of the moving object.

Friction plays a very important role in our day to day activities. We are able to walk due to friction. Vehicles stop on applying brakes. This is again due to friction between the brakes and the wheels. In absence of friction, anything that starts moving cannot be stopped.

Friction is more on a rough surface and less on a smooth surface.

Advantages and Disadvantages of friction



Some advantages of friction are listed below:

- Friction provides the grip necessary for motion. We are able to walk because of the friction between our feet and the ground. Otherwise we would slip or fall.
- Friction helps us to hold things. We can write on paper because of the friction between the pencil tip and the paper.
- Our shoes and sandals have ridges on the underside to increase friction with the ground so that we do not slip while walking.
- Friction helps us to light a matchstick. The rough surface of the matchstick provides friction to light the matchstick.
- We are unable to hold wet soap because the smooth surface provides very less friction.
- Friction ensures that vehicles can move on the surface of the road in a controlled manner, avoiding accidents.

There are various ways to reduce friction:

- **By using lubricants:** Friction increases as the roughness of the surface increases. Lubricants such as oil and grease can be applied on the moving parts of engines such as in cars, fans etc. to reduce friction.
- **By polishing surfaces:** Polishing makes the surfaces even and hence reduces friction. For example a slide in the park is polished to make its surface smooth and reduce friction.
- **By using ball bearings:** Rotating machines can be mounted on ball bearings which can reduce friction.
- **By using fine powder:** Talcum powder is sprinkled on carrom board before playing to reduce friction.
- **Making the objects streamlined:** Many animals, such as birds and dolphins, and many machines, such as airplanes and submarines, have streamlined bodies to reduce friction as they move through air or water.

Did you know ?

Friction also comes into play when objects are in the air. When an aircraft is in the air, the air particles create friction and try to resist the movement of the plane.

Disadvantages of friction

- Friction makes it difficult to move heavy furniture and other heavy objects across the floor.
- Friction causes parts of machines that are rubbing against each other to get heated up. The parts of machines get worn out and damaged due to friction.
- Friction also causes wear and tear of the surfaces of objects that constantly move against each other: such as the soles of our footwear, a pencil lead, an eraser, the tyres of vehicles etc.

Boy pushing table

Tyre

Soles of shoes

Activity

Creative Learning

We can pick up rice grains using a pair of chopsticks. But can you pick up a bottle of thousands of rice grains using only one chopstick? Let's try this simple friction experiment and see what we can learn from this.

What you need?

- Uncooked rice grains
- Chopstick, pencil, pen or stick
- Plastic bottle
- Funnel (optional)

Steps:

1. Fill the plastic bottle to the top with rice grains. Optional: You can use a funnel for easier filling.
2. Make sure you fill the bottle all the way to the top. Press on the rice to compress it tightly.
3. Insert the blunt end of the chopstick or pencil into the rice and press it all the way to the bottom.
4. Lift slowly to test if the bottle comes up with the chopstick. If not, repeat this step several times. It will become increasingly difficult to push (or stab) the chopstick down.
5. Eventually, you won't be able to pull the chopstick out and you can lift the bottle and the rice together with it.

Observation:

When the grains are packed so tightly together, the friction between the rice and the pencil is strong enough to hold the pencil in place, allowing you to pick up the whole bottle with the pencil.

In this case, the friction is bigger than the gravitational force that is pulling the rice and the bottle towards the Earth.

Check 'N' Mate

Critical Thinking

A. Write 'T' for true and 'F' for false statements.

1. Contact force acts in the direction opposite to the direction of the moving objects. ☐
2. Vehicles stop due to friction between the brakes and the wheel. ☐
3. Smooth surface provides very high friction. ☐
4. Friction helps us to hold things. ☐

B. Fill in the blanks.

1. _____ (Polishing/Roughness) makes the surfaces even and hence reduces friction.
2. The parts of machines get worn out and damaged due to _____ (friction/smoothness).
3. Friction causes wear and tear of the _____ (surfaces/inner parts) of the objects that constantly move against each other.

Activity

Creative Learning

Materials:

- Slide (or ramp)
- Items to be tested (toy car, shoe, paper, book, ball, block etc.)
- Water (optional)

You can test how much friction an item will produce by heading to a playground. You could also do this experiment on a ramp.

1. Gather some items to be tested. You want a wide range of materials like a toy car, ball, book, shoe with rubber sole, a wooden block.
2. Put each item at the top of the slide or ramp and let it fall down on its own. Don't give it a push. Measure how far it went.
3. You could try wetting the slide and then retesting the items to see if they went farther than before. You could tape sandpaper to the slide or ramp and see how that affects the distance the items go. Spraying or rubbing oil onto the slide is another good way to test friction.

In a Nutshell

- Friction is the force that opposes the motion between the two surfaces of objects in contact.
- The force of friction always acts in the direction opposite to that of the applied force.
- Friction is useful in our day to day life. Without friction life would be difficult. It prevents us from slipping, road accidents etc.
- Friction can be reduced by using substances such as oil, grease, talcum powder etc.
- Friction causes difficulty in sliding heavy objects, wear and tear of machinery parts. It also gives rise to unwanted heat.

Key Words

Improving Vocabulary

Polishing	:	Make the surface of (something) smooth and shiny by rubbing it.
Ball bearing	:	Are small metal balls placed between the moving parts of a machine to make the parts move smoothly.
Streamlined	:	Designed in a way that presents very little resistance to a flow of air or water.

Gap Analyzer™

EXERCISE

That turn curiosity into confidence—let's begin!

A. Objective Type Questions.

1. Alisha runs her toy car on a 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.
2. Why are new tyres on a car better than older, worn tyres?
   a. New tyres are less affected by gravity than older tyres.
   b. New tyres allow the car to travel faster than older tyres.
   c. New tyres provide more friction on the road than older tyres
3. The force that works against motion and tries to slow objects down is called:
   a. A push or pull
   b. Friction
   c. Mass
4. Which of the following surfaces has the least amount of friction?
   a. A gravel driveway
   b. A dirt road
   c. A road covered with ice

B. Fill in the blanks :

1. Friction depends on the _____ of surfaces.
2. Friction produces _____.
3. Sprinkling of powder on the carrom board _____ friction.

C. Short Answer Questions.

1. Define:
   a. Contact force
   b. Force of friction
2. Give two examples of friction related to our daily life.
3. How application of lubricants helps in reducing friction?

Custom Learning Path

Scan to Create Your Own Learning Path

D. Long Answer Questions.

1. Write the different ways in which friction is useful in our day to day life.
2. What are the disadvantages of friction? Explain.
3. Mention the ways in which friction can be reduced.

Time to Recall

Remembering and Analysing

Recall and complete the concept map given below.

Ways to reduce friction

Time to Apply

Applying and Creating

1. Why do we sprinkle fine powder on carrom board?
2. Why do you think athletes and runners use shoes with spikes?
3. Why are aeroplanes streamlined? Where do we find streamlined shapes in nature?

Time to Discuss

Pondering and Communicating

Why are handles of motorcycles covered with a rubber sheet having spikes on it.

Time to Observe

Observing, Critical Thinking, Analysing

The picture here shows a skier moving down a slope. Answer the questions that follow:

a. In this picture, draw an arrow to show the direction of friction as the skier moves down the slope.

b. If the skier were to move down a grassy slope, how would the amount of friction change?

c. What does this tell you about the relationship between friction and the type of surface?

Time to Create

Creating and Collaborating

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? Write about your observation.

Have you seen heavy machinery being moved by placing logs under it?