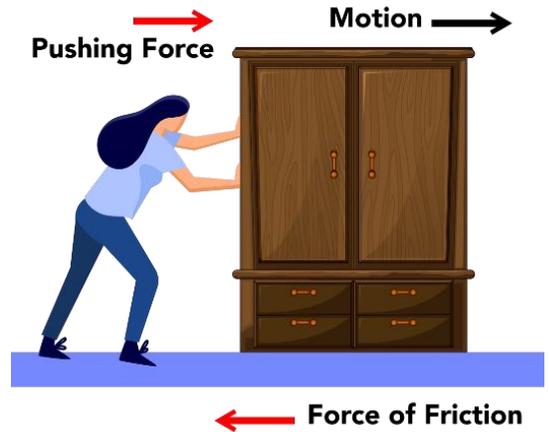


Friction Guided Notes – Student Edition

Defining Friction

Friction is a _____ force which arises whenever a moving object touches a _____. This surface can be a solid, liquid or _____. Friction acts in the _____ direction to motion, slowing the object down and converting some of the object’s kinetic energy to _____ energy. This can cause wear and tear on the surface of the moving object. For example, when a driver breaks heavily, they burn the rubber _____ on their tires causing the tires to wear away.



Types of Friction

There are four main types of friction:

1. Static friction – acts between _____ objects which are resting on a surface. This is the type of friction used when walking, occurring between the tread on your _____ and the _____ to keep you from slipping.



2. Sliding friction – acts between solid objects which are sliding over a _____ surface. Sliding friction is _____ than static friction. Sliding friction is seen when you _____ with a pencil on paper. The pencil slides easily over the paper, but there is still enough friction to leave a mark (i.e., your notes).



3. Rolling friction – acts between solid objects which have a rolling motion. This is the _____ of the three types and explains why most vehicles have wheels.

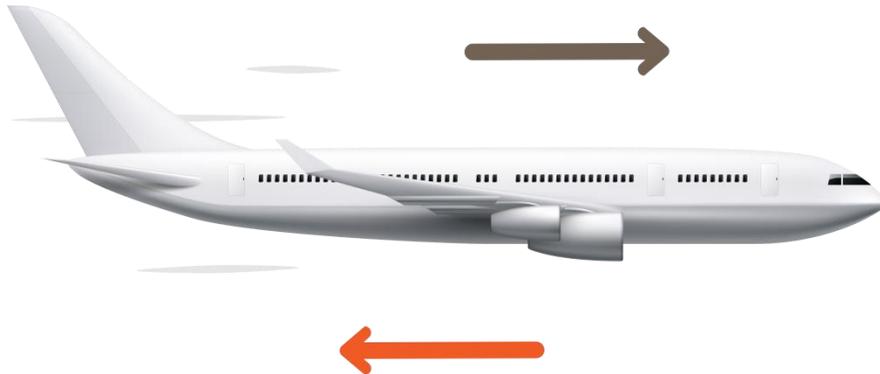


4. Fluid friction – occurs when an object moves through a fluid i.e. a _____ or _____. Fluids can take the shape of their container and therefore their particles collide with and slide past the object. The larger the object, the _____ the fluid friction will resist the object’s _____. Both airplanes



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and boats experience fluid friction which is commonly called _____. During a _____, the air particles hit the airplane and make it more difficult for it to move forward. Boats also experience drag as they move through _____ due to the water particles hitting the boat and opposing their motion. For this reason, airplanes and boats are _____ to ensure minimal fluid friction.



Aerodynamics

Aerodynamics is the study of the movement of _____ as it interacts with a _____ object. As air moves past moving objects it creates _____ which slows the object down, opposing its _____. The purpose of aerodynamic features is to alter the drag force associated with the object's movement. It is commonly seen in professional racing vehicles.

Air moves over the rear wing of the car producing a downwards force. This downwards force helps the car to grip the track when cornering at high speeds

Wind funnels are often used by scientists to help them track the flow of air over an object.



Factors Which Affect Friction

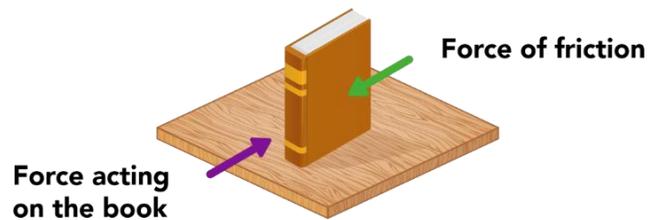
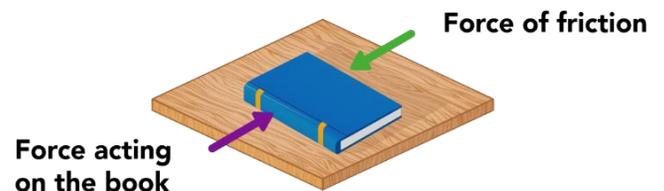
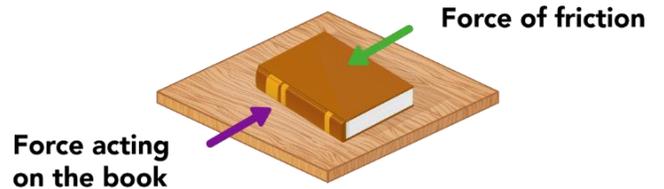
There are several factors which affect the amount of friction that will occur when two objects move past one another:

1. Material - Different _____ of materials have different levels of friction when they move past one another. For example, objects that are made from _____ materials will generally create _____ friction, than those made from _____ materials. However, this is only true to a certain point, in some cases objects which are very smooth can show high amounts of friction due to the _____ attraction between the atoms on the surface of the two objects.

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2. Mass – Newton’s second law tells us that objects which have a greater _____ require more thrust force to move. This is because objects with a greater mass will also have a greater _____ and therefore press down harder on the surface they are moving along.

- There is _____ friction between the book with a greater mass (brown book) and the table compared to the book with lower mass (blue book). Therefore, more _____ is needed to push the larger book.
- Turning the book onto its edge does not change the amount of friction as the mass of the book remains the same.



3. Shape of the Objects – some objects are _____ to move than others. For example, those which are spherical and can be _____ will show much less friction than those which are flat.

4. States of the Objects – typically friction is less in _____ and _____. This is because the particles have an ability to move past an object more freely. In solids both objects are rigid, and their particles are locked in _____.

When Friction is Helpful

Friction can be helpful in some areas, for example providing tire _____ on the road when driving or _____ on a surfboard to avoid sliding off. Ways of increasing friction include:

- Roughened surfaces e.g. textured steps to prevent slipping, _____ road surfaces.
- Tread and _____ on sports shoes, car tires.
- Treatments/chemicals e.g., wax on surfboards, salt/sand on _____



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_____ roads or oil spills.

- Shapes/structures which create drag e.g., flaps on aircraft _____.

When Friction is Unhelpful

Friction can also be unhelpful, especially for cyclists, boats, and planes. If a cyclist stops pedaling, the friction from the road will _____ the bike down and eventually cause it to _____. Therefore, the cyclist must provide sufficient _____ on the pedals to overcome friction and keep the bike moving. As the cyclist applies more force to the pedals, their speed _____, but so does the _____. Eventually, the friction will equal the maximum force applied by the cyclist (called thrust) and the cyclist will be unable to increase their speed any further.

Ways to decrease friction include:

- Use of lubricants e.g. in car _____.
- Adding rollers or _____ to heavy objects such as furniture.
- Creating an air layer e.g. hovercrafts
- Streamlined shapes e.g. spoilers and wings on _____.
- Polished or _____ surfaces e.g., wax on skis

