

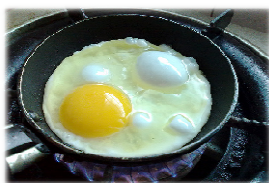
SPH3U UNIVERSITY PHYSICS

FORCES

Friction (P.168)

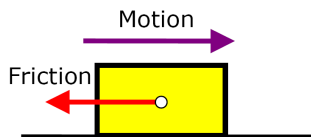
The Effects of Friction

Friction is part of everyday life. Removing a fried egg from a frying pan is easier if the pan has a non-stick surface. You find running easier on a dry sidewalk than on ice. Skiers use wax to reduce the friction between their skis and the snow. Cars need friction to speed up, slow down, and go around corners.



Static & Kinetic Friction

Friction resists motion and acts in a direction opposite to the direction of motion. It occurs because of the electrical forces between the surfaces where the two objects are in contact.



Static & Kinetic Friction

One type of friction, called **static friction (F_s)**, is the force that tends to prevent a stationary object from starting to move. ("Static" comes from the Greek word **statikos**, which means "causing to stand.") The maximum static friction is called the **starting friction**. It is the amount of force that must be overcome to start a stationary object moving.

STATIC FRICTION (F_s)

- force that prevents a stationary object from starting to move

NOTE!
In certain circumstances static friction is useful; in others, it is not.

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Static & Kinetic Friction

Once the force applied to an object overcomes the starting friction, the object begins moving. Then, moving or kinetic friction replaces static friction. **Kinetic friction (F_k)** is the force that acts against an object's motion in a direction opposite to the direction of motion. Different types of kinetic friction have different names including: sliding friction, rolling friction, fluid friction, ...

KINETIC FRICTION (F_k)

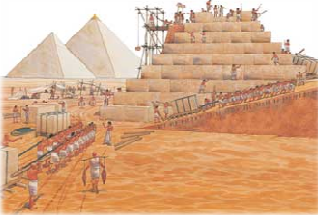
- force that acts against an object that is in motion
- includes sliding friction, rolling friction, fluid friction, ...

NOTE!
For horizontal motion, if the applied force has the same magnitude as the kinetic friction, the moving object will maintain uniform velocity.

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Controlling Friction

About 4500 years ago, the Egyptians built enormous pyramids using huge stone blocks that were difficult to move by sliding. The Egyptians placed logs beneath the blocks to push them and move them. By doing this, people were taking advantage of the fact that rolling friction is much less than sliding friction.



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Controlling Friction

Modern technology uses the same principles as the Egyptians, though in a more sophisticated way. For instance, all machines have moving parts that experience friction during operation. Friction can wear out the machines, reduce efficiency, and cause unwanted heat. Excess friction in machines can be overcome by making surfaces smooth, using materials with little friction, lubricating with grease or oil, and using bearings.



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Controlling Friction


FRICION

- ❖ can wear out machines, reduce efficiency, cause unwanted heat, ...
- ❖ can be controlled by:
 - making surfaces smooth
 - using materials with little friction
 - lubricating with grease or oil
 - using ball bearings

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Controlling Friction – DYK?


Ways of reducing undesirable friction in other situations are also common. The wax applied to skis reduces sliding friction. A layer of air between a hovercraft and the water reduces fluid friction. A human joint is lubricated by synovial fluid between the layers of cartilage lining the joint. The amount of lubrication provided by synovial fluid increases when a person moves. In fact, our lubrication systems work so well that it is difficult for technologists to design artificial joints that function to the same standard.



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Controlling Friction – DYK?


Although friction is often undesirable, it can be useful. For example, South America has many earthquake zones and buildings have a tendency to crumble during an earthquake. To help overcome this problem the Inca stonemasons developed great skill in fitting building stones together very tightly so that a great deal of sliding friction would help hold their buildings together, even during an earthquake.



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Controlling Friction – DYK?

The material called Teflon has many uses when low friction is desired, such as in non-stick frying pans. Two research scientists created this chemical by chance in 1938, but its usefulness was not realized until 20 years later. Since Teflon does not stick to any materials, the process used to make it stick onto a frying pan is unique: the Teflon is blasted into tiny holes in the surface of the pan where the material sticks well enough for use.



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Friction

PRACTICE

1. For each situation, determine if friction is helpful, makes the action more difficult, or both. Explain your reasoning.

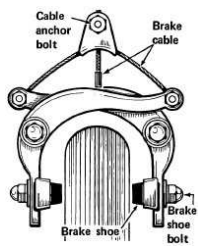
(a) turning a door knob	helpful
(b) streamlining in the transportation industry	more difficult
(c) pushing a heavy box across a rough surface	more difficult
(d) tying a knot	both
(e) a car going around a curve	helpful

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 Friction

PRACTICE

2. A typical bicycle braking system involves a lever that you pull on the handle bars and a brake pad near the rim of the wheel. Describe how the braking system works.



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