

Video: *Friction* by Crash Course Physics

It's really hard to get a bookcase moving and to stay moving because there is a force working against you, stopping the bookcase from sliding:

_____.

There are two kinds of friction:

- _____ friction: the force that slows the bookcase down as it slides
- _____ friction: the force that you have to overcome to get it moving in the first place

Kinetic friction is a _____ force: no matter what, it will act to resist you. It will also often generate _____, or _____, or both.

As the bookcase slides across the floor, the surfaces _____ on each other, slowing it down. The movement produces _____ and _____.

You end up with a force that resists any kind of _____ movement, and it's strength depends partly on what _____ are sliding against each other: _____ materials have _____ surfaces to catch on each other, which is why the bookcase will be easier to slide on the wood floor than if you'd tried it on carpet.

There is another factor at work in friction: how _____ the materials are pressed together puts _____ of their surfaces in contact with each other. That's where the _____ force or F_N comes in. When a force pushes on a bookcase against the floor, the _____ pushes right back. That's Newton's third law. In this case, that's just the _____ of the bookcase on the floor.

So, kinetic friction is equal to the _____ of friction (how rough or smooth the surfaces are) times the _____ force (the weight of the object).

Static friction: when you weren't able to move the bookcase the begin with, that was because of the static friction between the bookcase and the _____. Like kinetic friction, it's also a _____ force. But not only can it's direction change - its _____ can change too.

If you push on the bookcase lightly with just one hand and it doesn't move. Since it doesn't have any _____, the bookcase must be in equilibrium, meaning that the forces on it _____ out. So the force from _____ friction must be exactly equal to the force from your _____, but in the opposite direction because of that equilibrium.

If you really put your back into it, pushing as hard as you can and the bookcase still doesn't move, so static _____ must still be pushing back with the same amount of _____ you are.

However, the static friction between two objects can _____: once your friend starts pushing too, the bookcase starts to slide because the force from your _____ is greater than the _____ amount of static friction.

The maximum force of static friction is equal to the _____ of static friction times the _____ force.