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Forces and motion





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Forces and motion

A push changes motion



THE IDEA

A push can start a cart, slow it down or turn it. A force is an interaction between objects.

A force can change speed, direction or shape. The effect depends on the other forces acting at the same time.

CHECK YOUR THINKING

Can a moving cart experience zero net force?

A Yes, while moving at constant speed in a straight line.

B No, a forward force must always exceed all others.

A. Yes, while moving at constant speed in a straight line.

A RELATED EXAMPLE

Which way is the net force?

Direction changes the calculation. A box is pushed 8 N right and 5 N left. Opposite forces subtract: the net force is 3 N right. An unbalanced force changes velocity. A rightward net force does not prove the box is already moving right.

Forces and motion

Combine three forces together

Forces on one object

Push A	7 N →
Push B	4 N →
Push C	← 6 N

THE IDEA

Imagine forces of 7 N right, 4 N right and 6 N left. First combine the forces pointing the same way: 7 + 4 = 11 N right.

Now compare 11 N right with 6 N left. State both the size and direction of the net force.

CHECK YOUR THINKING

What is the net force?

A 5 N right.

B 17 N right.

A. The rightward forces total 11 N. Subtract the opposing 6 N to get 5 N right.

A RELATED EXAMPLE

A force across a gap

A magnet can move an iron nail before they touch. Magnetic, electrostatic and gravitational forces can act at a distance. Like magnetic poles repel and unlike poles attract. A rubbed object can attract small neutral scraps by redistributing charge.

Forces and motion

Grip on the ground



THE IDEA

Friction resists sliding between surfaces in contact. Friction can slow a sliding block.

It can also let a tyre grip the road and let a foot push off. Lubrication reduces unwanted friction in machines.

CHECK YOUR THINKING

Why can a very slippery floor make starting a walk difficult?

A Gravity stops acting on the walker.

B The foot cannot grip well enough to push against the floor.

B. The foot cannot grip well enough to push against the floor.

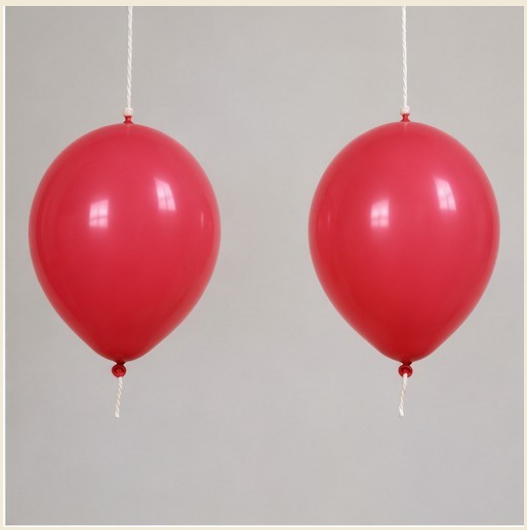
A RELATED EXAMPLE

What a spring measures

A spring balance hangs freely before the weight is attached. Zero the scale, hang the load and wait until it is still. The pull stretches the spring. A scale calibrated in newtons shows force. Holding it at a slant can change what you measure.

Forces and motion

When balloons push apart



THE IDEA

Two similar balloons rubbed with wool move away from each other. Rubbing can transfer electrons between materials.

The balloons usually acquire the same sign of charge. Like charges repel. A charged balloon can still attract an uncharged wall by shifting the distribution of charge in it.

CHECK YOUR THINKING

Which observation is stronger evidence that both balloons carry the same sign of charge?

A. They repel when brought near one another.

B. They each stick to the same neutral wall.

A. They repel when brought near one another.

LOOK AGAIN

What could make their gap grow before they touch?

Balloons carrying like electric charges repel. Their separation can increase before their surfaces touch.

Forces and motion

Same mass, different weight



THE IDEA

A spring balance measures a pull in newtons. Weight is gravitational force.

Near Earth, a 2 kg object weighs about 20 N if g is rounded to 10 N/kg. Its mass stays 2 kg on the Moon while its weight falls.

CHECK YOUR THINKING

Which reading would change on the Moon?

A The spring balance reading in newtons.

B The mass expressed in kilograms.

A. The spring balance reading in newtons.

LOOK AGAIN

Which way does gravity act before and after release?

Gravity points towards the centre of the attracting body. Releasing an object changes its support force, not the direction of gravity.

ONE LAST CHALLENGE

Does floating mean that the cork has no weight?

A cork floats motionless with part of it above the surface.



THE REVEAL

It still has weight.

An upward buoyant force balances the downward weight, so there is no vertical acceleration.

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