

Forces Introduction

- Intersections
- smart car crash
- stopping distance
- Crash investigation



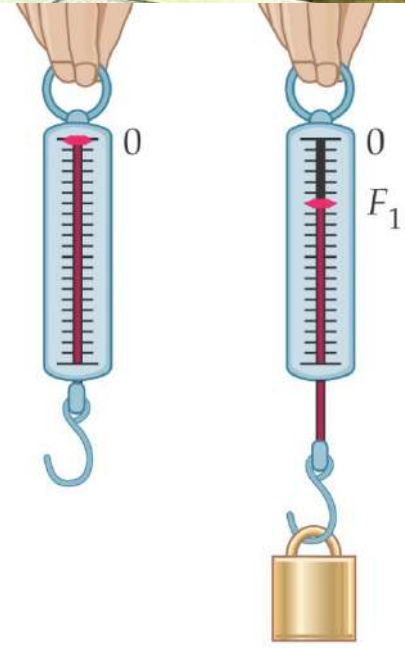
FORCES

Forces are **pushes** or **pulls**

All forces have both size and direction

Any changes in speed and/or direction are caused by forces.

Force is measured in newtons (N)



FORCES

- Just because there are forces are present it does NOT mean that there is motion.
- An **unbalanced** force is needed to start a motion, stop a motion, make something go slower or faster, or to change direction.
- If forces are balanced, there is no change in motion.
- If a force acts on a stationary object and causes motion, the object has gained **kinetic** (movement) **energy**.

Types of Forces

Gravitational

Electrical

Tensional

Frictional

Magnetic

Applied

Spring

Normal

CONTACT FORCES

Some forces only act on contact, others can act from a distance.

Which are which?

Contact	At a Distance

Gravitational

Magnetic

Tensional

Frictional

Electrical

Normal

Spring

Applied

Air resistance

What is Gravitational force?

- Gravity is a force of attraction between two objects.
- Gravity is an “at a distance” force
- Law of Gravitation – any two objects exert an attractive force on each other. The amount of attraction depends upon two things: the mass of the objects and the distance between the objects.

What is magnetic force?

Magnetic force is the attraction or repulsion between electrically charged particles because of their motion.

What is electrical force?

Electrical force is created by attraction of positive and negatively charged particles

What is applied force?

An applied force is a force which is applied to an object by a person or another object.

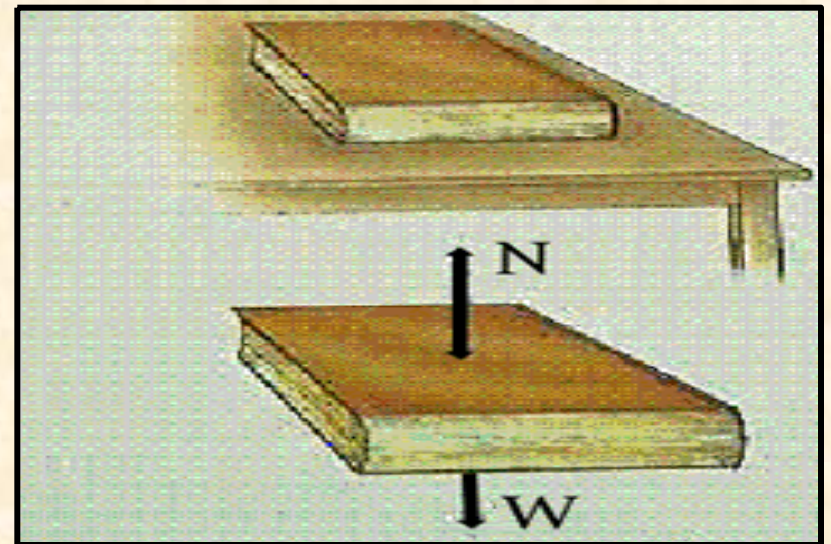
What is spring force?

Spring force is the force exerted by a compressed or stretched spring upon any object which is attached to it.

What is normal force?

Normal force is the support force exerted upon an object which is in contact with another stable object.

Example: If a book is resting on a table, the table is exerting a normal force on the book in order to support the weight of the book.



Air Resistance – another type of friction??

- Air resistance is a force that acts on objects as they travel through the air.
- This force opposes the motion of an object.
- Air resistance force is most noticeable for objects which travel at high speeds or objects with a large surface

Air resistance is the force that air exerts upon a moving object

-- acts in the opposite direction of an object's motion

Factors that affect air resistance:

1) Velocity

-- the faster an object is falling, the more air molecules are hitting it, and the more air resistance

2) Cross-sectional Area

-- the wider an object is, the more air molecules can hit it

Why do parachutes work?????

Parachutes increase the cross-sectional area of a falling object, thus increasing air resistance.

Acceleration stops, and the skydiver falls at a safe terminal velocity

Terminal Velocity

As an object falls, its velocity increases.

As velocity increases, air resistance increases.

Eventually, the air resistance will grow until it equals the force of gravity.

The forces are **balanced** and there is no more acceleration.

When an object stops accelerating, it has reached what is called **terminal velocity**

NOTE: NO ACCELERATION MEANS NO INCREASE/DECREASE IN VELOCITY...THE OBJECT IS STILL IN MOTION!!

What is tensional force?

- A force that is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends.

FRICTION

Friction is a contact force that opposes motion, it causes heat, damage, wear and slowing

Friction can be changed by...

Using oils or grease,

streamlining (aerodynamics),

Making surfaces rougher

smoothing surfaces



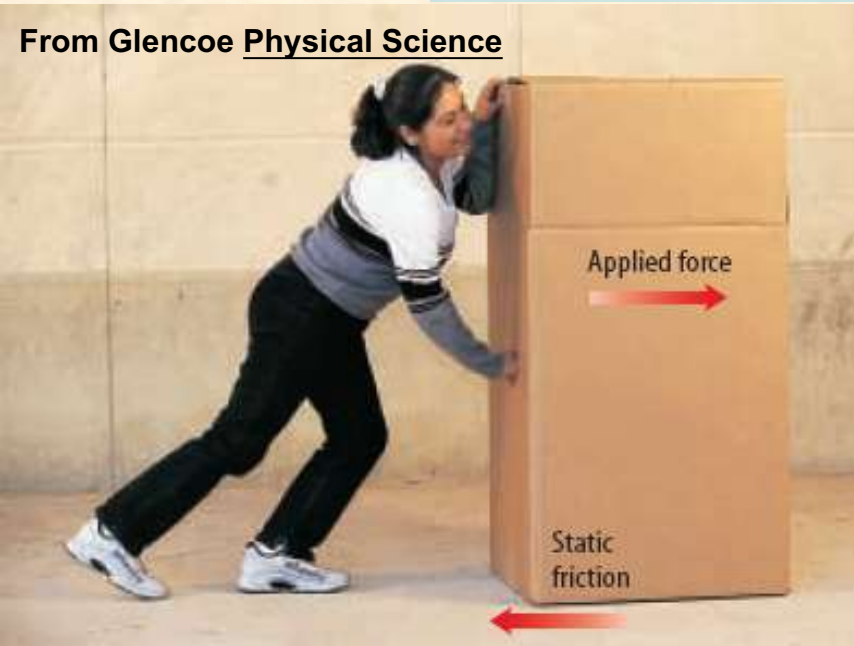
What causes friction?

- **There are two factors which affect friction between two surfaces:**
 - **Kind of surfaces in contact (rough or smooth)**
 - **Amount of force pressing the surfaces together.**

The rougher the surface and the stronger the force between the surfaces, the greater the amount of friction.

What is static friction?

- If you were trying to move a box like pictured below and the box did not move, this would be static friction.
- Static friction is friction between two surfaces which are not moving past each other.



What is sliding friction?

- Sliding friction occurs when a force is great enough to overcome the static friction.



What is rolling friction?

- Rolling friction is the friction which enables wheels to turn and objects to move. If there were no friction, turning wheels would not enable an object to move.

Friction ... Pros and Cons

PROS

- Enables us to stand and move without falling
- Makes a pencil work
- Need friction for tires to move a car

CONS

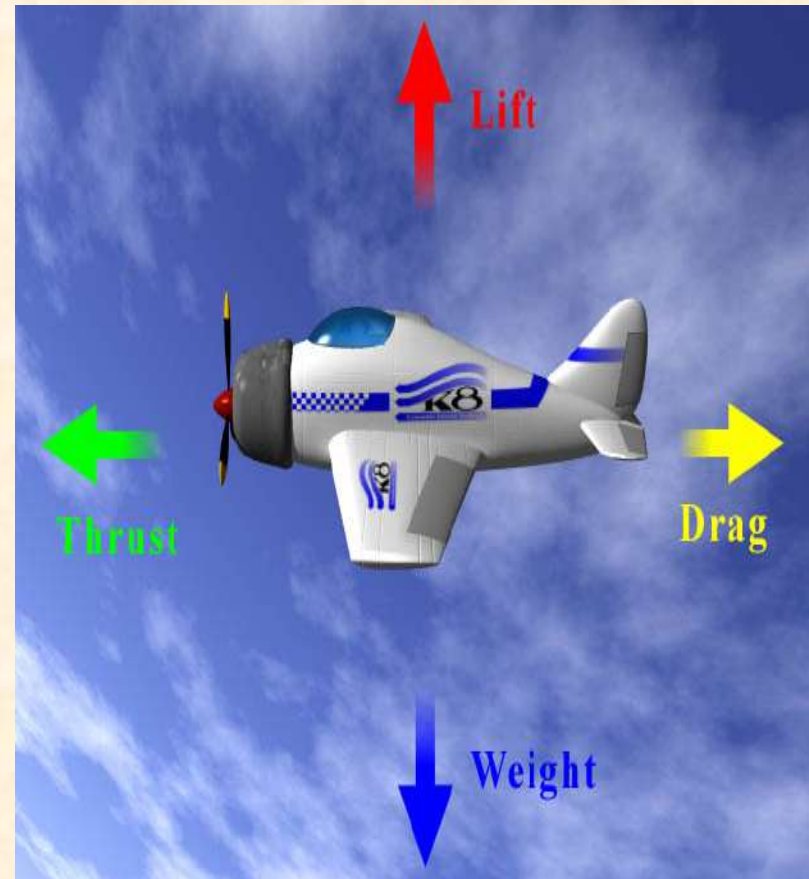
- Causes engine parts to wear out
- Causes holes in your socks
- Causes wind and water erosion

FORCE PAIRS

Forces act in **pairs** (e.g. thrust and friction, gravity and support).

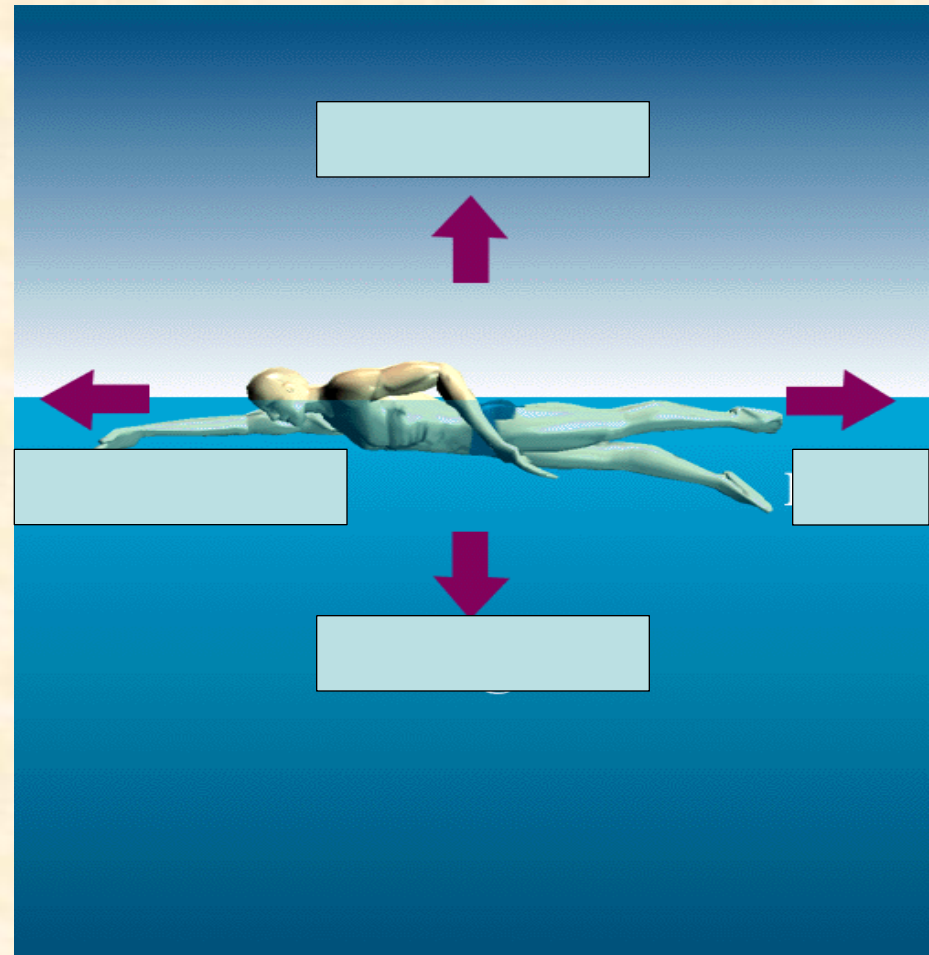
Force diagrams show the forces acting on an object and whether they are **balanced** or **unbalanced**.

Arrow size represents **force size** if no measurements are available.



Force pairs

- What are the missing terms?
- Buoyancy
- Drag
- Thrust
- Weight



Forces

BALANCED

- Net force = 0
- No **change** in motion
- No change in direction

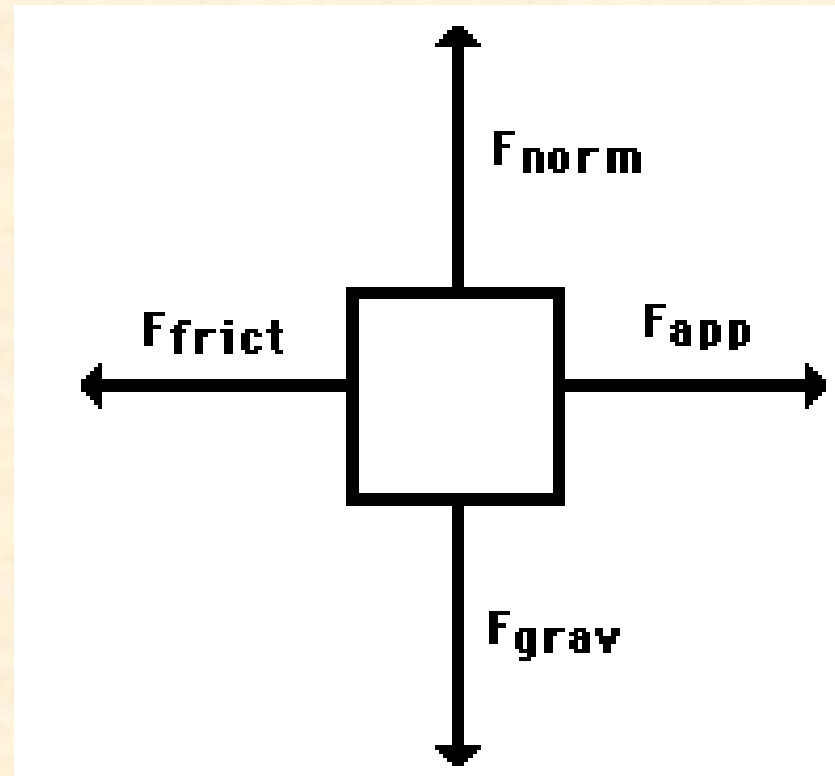
UNBALANCED

- Net force not equal to zero
- Causes motion to stop, start and/or change direction

Net Force Calculations....

Net force = combination of all the forces acting on an object. There may be one force or more than 4 forces involved.

Free Body diagrams are a way to show the forces acting on an object.



Practice Problems

Problem 1

A book is at rest on a table top.

Problem 2

An egg is falling from a nest in a tree.

Reaction Times

- http://www.bbc.co.uk/science/humanbody/sleep/sheep/reaction_version5.swf