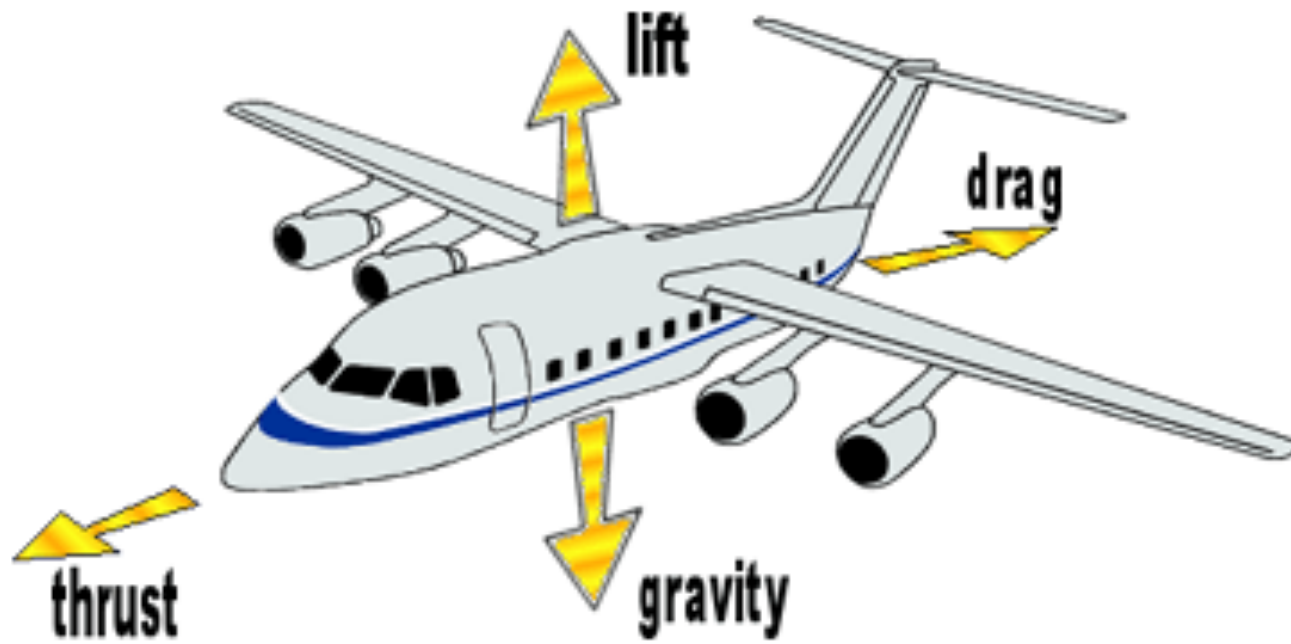


12.1 Forces



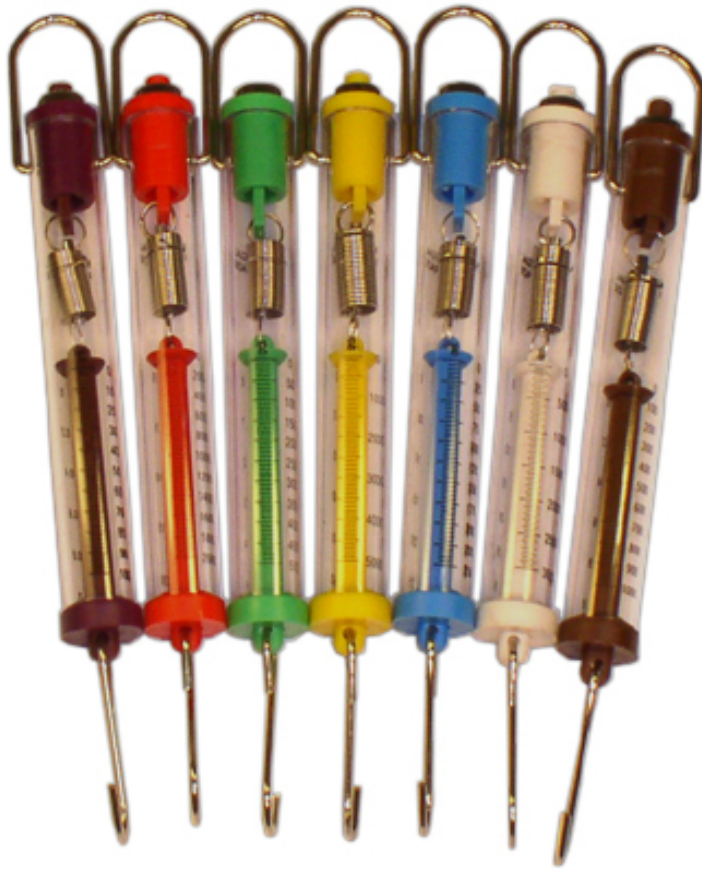
Forces

- A Force is a **push or a pull** on an object
 - Forces can cause a **resting** object to **move**
 - Forces can cause a **moving** object to **accelerate** by changing its **speed** or its **direction**

Measuring Force

- Force is measured by a **spring scale** (like at the supermarket)
- Force is measured in **Newtons (N)**
 - *Named after **Sir Isaac Newton***
- Force can be represented by an **arrow** on a diagram or graph as a **vector**.

Spring Scales



Force Math

- Force arrows in the **same** direction **add** together
- Force arrows in the **opposite** direction **subtract** from one another
- When the forces on an object are **balanced**, the net force is **zero** and there is **no change** in the object's motion
- When the forces on an object are **unbalanced**, the object **accelerates**.

$F_2 =$
18 Newtons

$F_1 =$
20 Newtons



Net Force =
2 Newtons



$F_1 =$
8 Newtons



$F_2 =$
6 Newtons



Net Force =
14 Newtons



Force Math

What happens in this situation situation?



The truck stays still

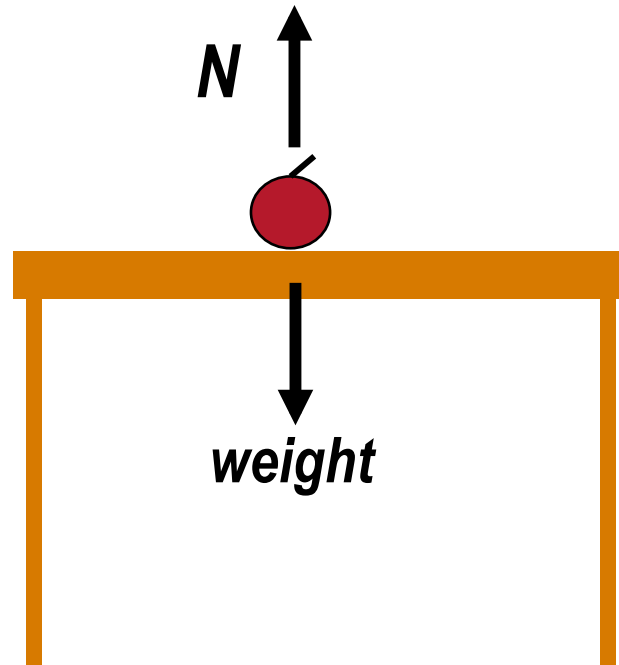


The truck moves to the right at 40 N

Normal force

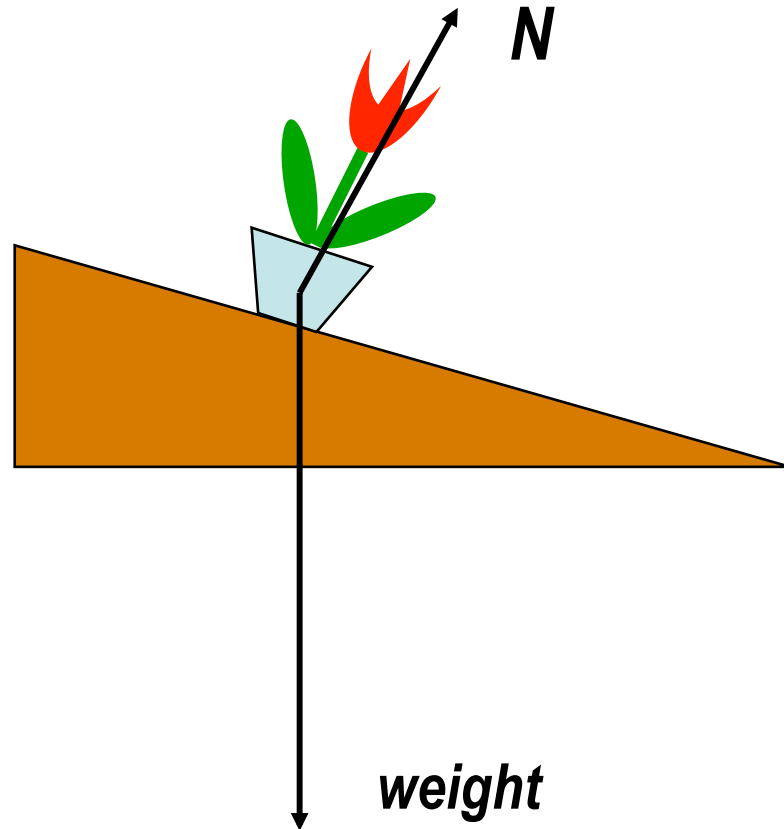
- When an object lies on a table or on the ground, the table or ground must exert an **upward force** on it, otherwise gravity would accelerate it down.
- This force is called the **normal force (F_N)**.
- “Normal” means **perpendicular (right angle)**. A normal force is always perpendicular to the **contact surface**.

Normal force



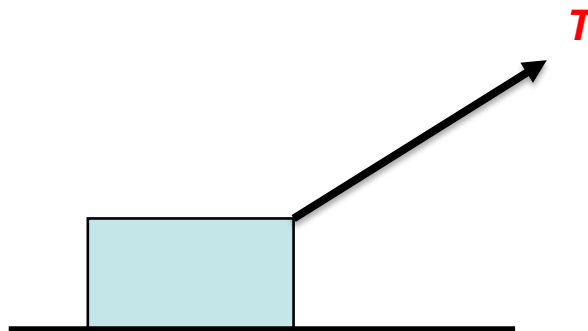
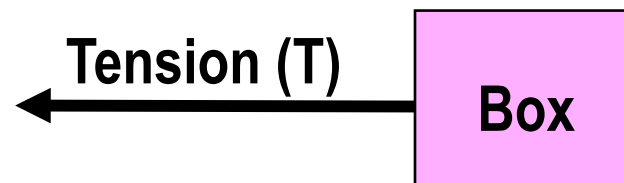
Normal force

If a flower pot is setting on an incline, *the normal force* is not vertical; it's at a right angle to the incline.



Tension Force

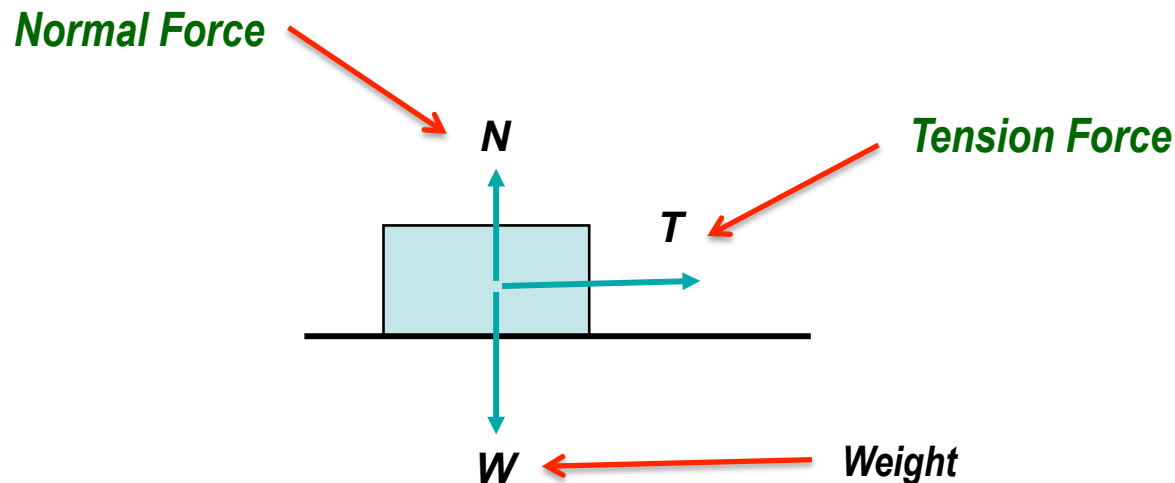
- A pulled rope has a **force** exerted on it.
- This force is called **tension** and points **along the rope**.



Tension and Normal Force

Tension and normal forces are different.

- A pull on an object: **Tension**
- A push from a surface: **Normal Force**
- Either one **or both** may be present.



Friction



Friction

Friction

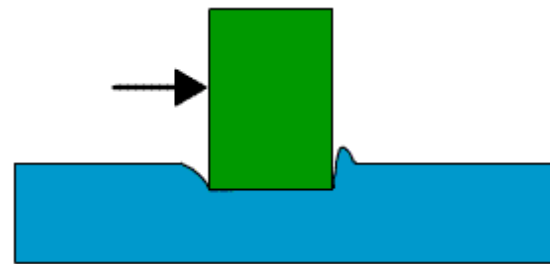
The **force** that opposes **motion** of objects that are in **contact** with each other.

- Friction depends on two things:
 - **Type of Surface or material**
 - **The force pushing the surfaces together**

Examples:

- *Pulling a sled on snow vs. grass*

Friction



Friction

Four Types of Friction:

1. **Static**
2. **Sliding**
3. **Rolling**
4. **Fluid**

Static Friction

Static Friction

Friction of objects that are **not moving**

- Acts in the **opposite direction of motion**
- Static friction between your **shoe and the floor** keep it from **sliding** when you take a step

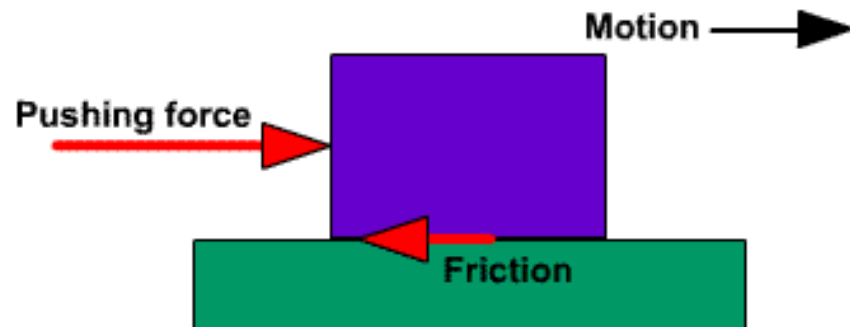


Sliding Friction

Sliding Friction

A force that **opposes motion** as it **slides** over a surface

- Sliding friction is less than **static friction**, therefore object keeps moving



Sliding Friction Examples

Helpful uses of Sliding Friction

1. **Striking a match**
2. **Tires on road**
3. **Nail or screw in wood**
4. **Opening a jar lid with your hand**
5. **Brake pad on a disc brake**
6. **Gripping a bat or racquet**
7. **Bow on violin strings (plays music)**

Sliding Friction Examples

Harmful uses of Sliding Friction

1. Moving furniture on carpet
2. Pistons on cylinder walls
3. Sliding on gym floor (floor burn)
4. Hand on shovel handle (blisters)
5. Valves or slides sticking on trumpet/trombone
6. Drawers hard to open
7. Ring stuck on finger

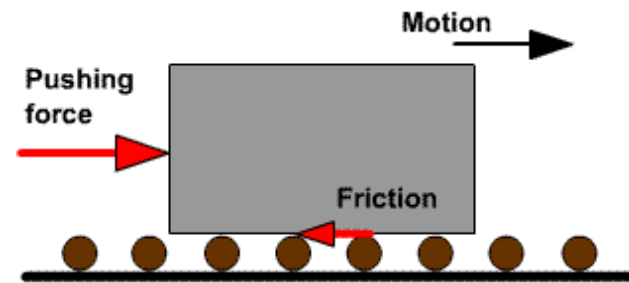
Rolling Friction

Rolling Friction

The friction **force** that acts on **rolling** objects

- **100 to 1,000** times less than **sliding** friction

So why do we use wheels to move heavy objects?



Rolling Friction



Fluid Friction

Fluid Friction

Opposes the **movement** of an object through a **liquid or a gas**

- **Air Resistance** is a type of fluid resistance



Fluid Friction



Fluid Friction

Helpful uses of fluid friction

1. **Slowing down the space shuttle & parachute for landing**
2. **Burns more calories during water aerobics**
3. **Burns up meteors**

Fluid Friction

Harmful uses of fluid friction

1. **Slowing down skis & boats in water**
2. **Oil flowing in a pipeline**
3. **Slowing down cars and planes**

12.1 Assessment

Question #1

How is the motion of an object affected when a force acts on it?

A force can set an object at rest into motion, or it can accelerate a moving object by changing its speed or direction.

12.1 Assessment

Question #2

List four types of friction

1. **Static Friction**
2. **Sliding Friction**
3. **Rolling Friction**
4. **Fluid Friction**

12.1 Assessment

Question #3

You push a box and are unable to move it. What force opposes your push?

Static Friction

12.1 Assessment

Question #4

If the net force on an object is zero:

- a. Then object is stopped
- b. Then the object continues as it was
- c. The object accelerate
- d. The object explodes

The object continues as it was