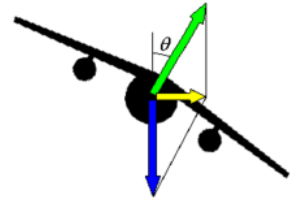
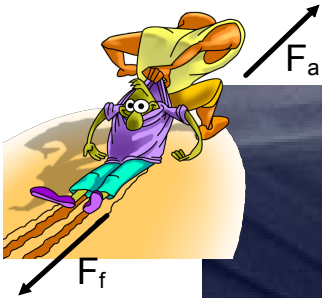
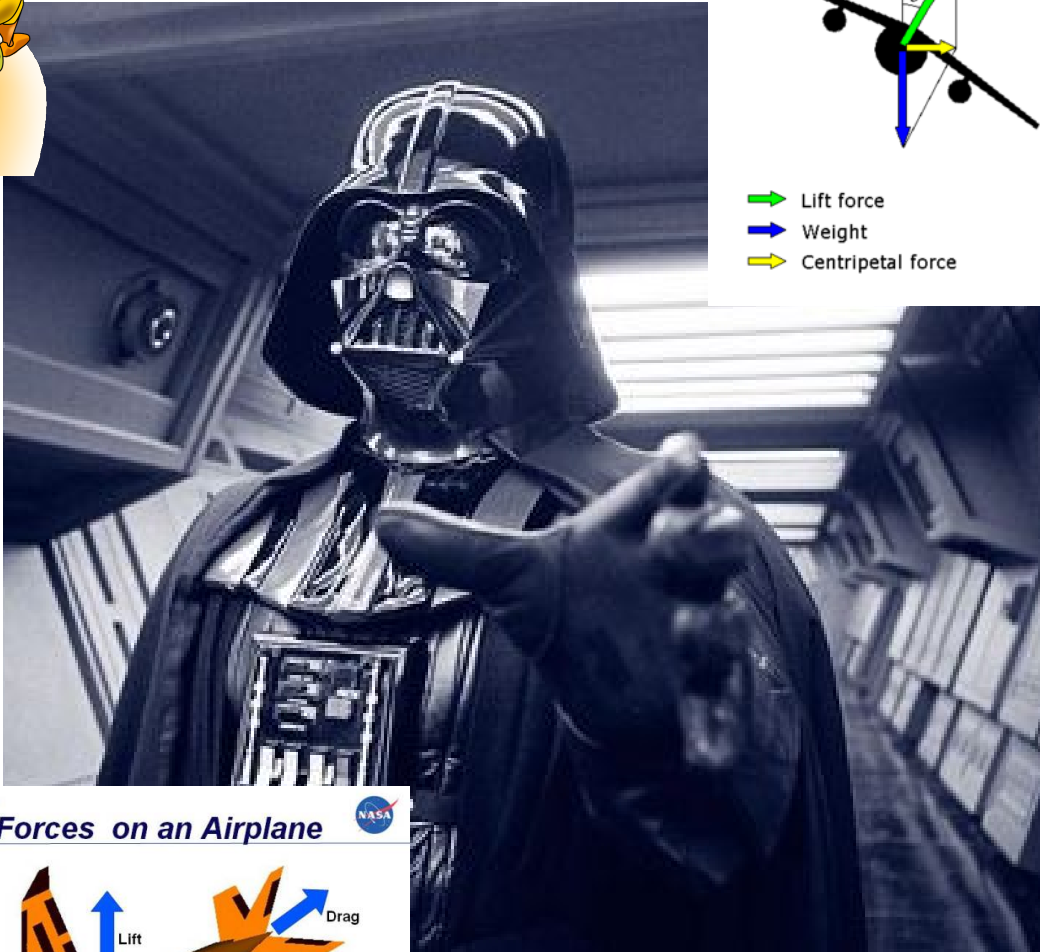


Forces

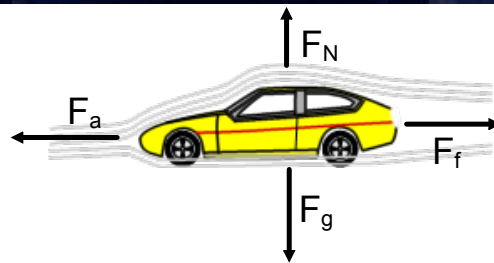
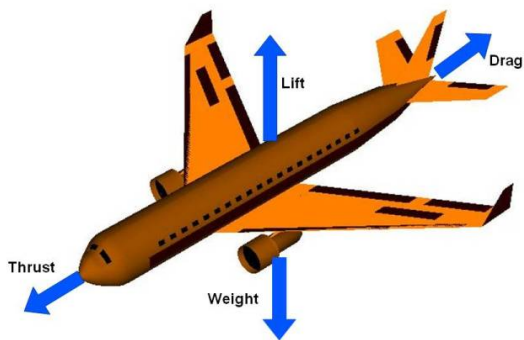


- Lift force
- Weight
- Centripetal force



National Aeronautics and Space Administration

Four Forces on an Airplane



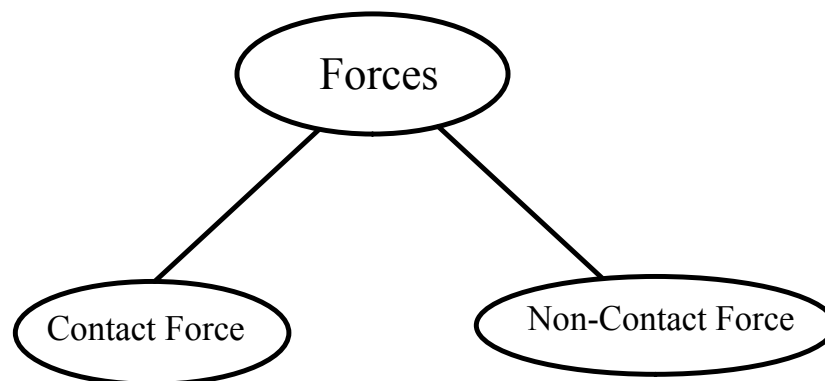
www.nasa.gov

Common Forces

A **force** is defined as a push or a pull.

They are vector quantities.

The sum of all the forces acting on an object is referred to as the resultant force. **Net force**, F_{net} , is another term used for the vector sum of forces.



a force exerted by an object in direct contact with another object

Examples

friction
tension
normal force
applied force

a force that acts over a distance

Examples

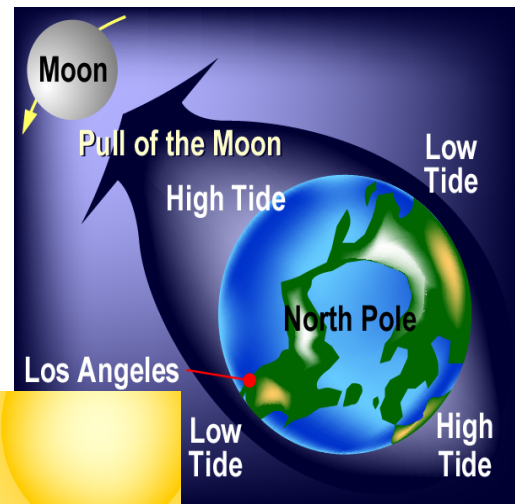
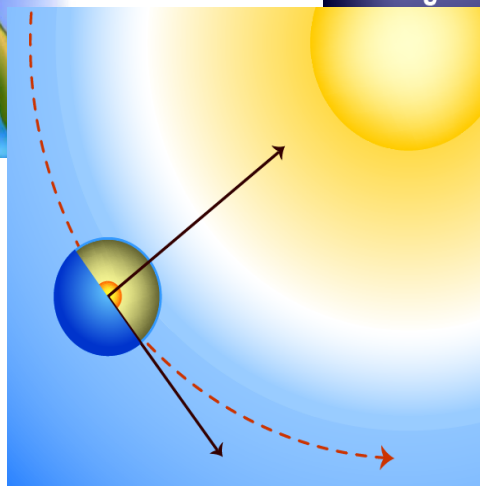
force of gravity
magnetic force
electric force

Many of the above forces can act on an object simultaneously, however, the process of problem solving for net force is independent of the type of force.

The Force of Gravity



F_g : gravitational force (force of *gravity*) - an attractive force that acts over a distance between masses



- What object is responsible for the tides on Earth, the Sun or Moon?
- What object pair has the stronger gravitational pull: Earth-Sun or Earth-Moon?

Did you know? That the interactions of the Earth-Moon tidal system is resulting in the Moon moving farther away and the Earth's spin is slowing down. Not to worry, it won't stop spinning or slow down all that much, but at some point in the distance future the Moon will only be visible from one side of the Earth.

Gravitational Force

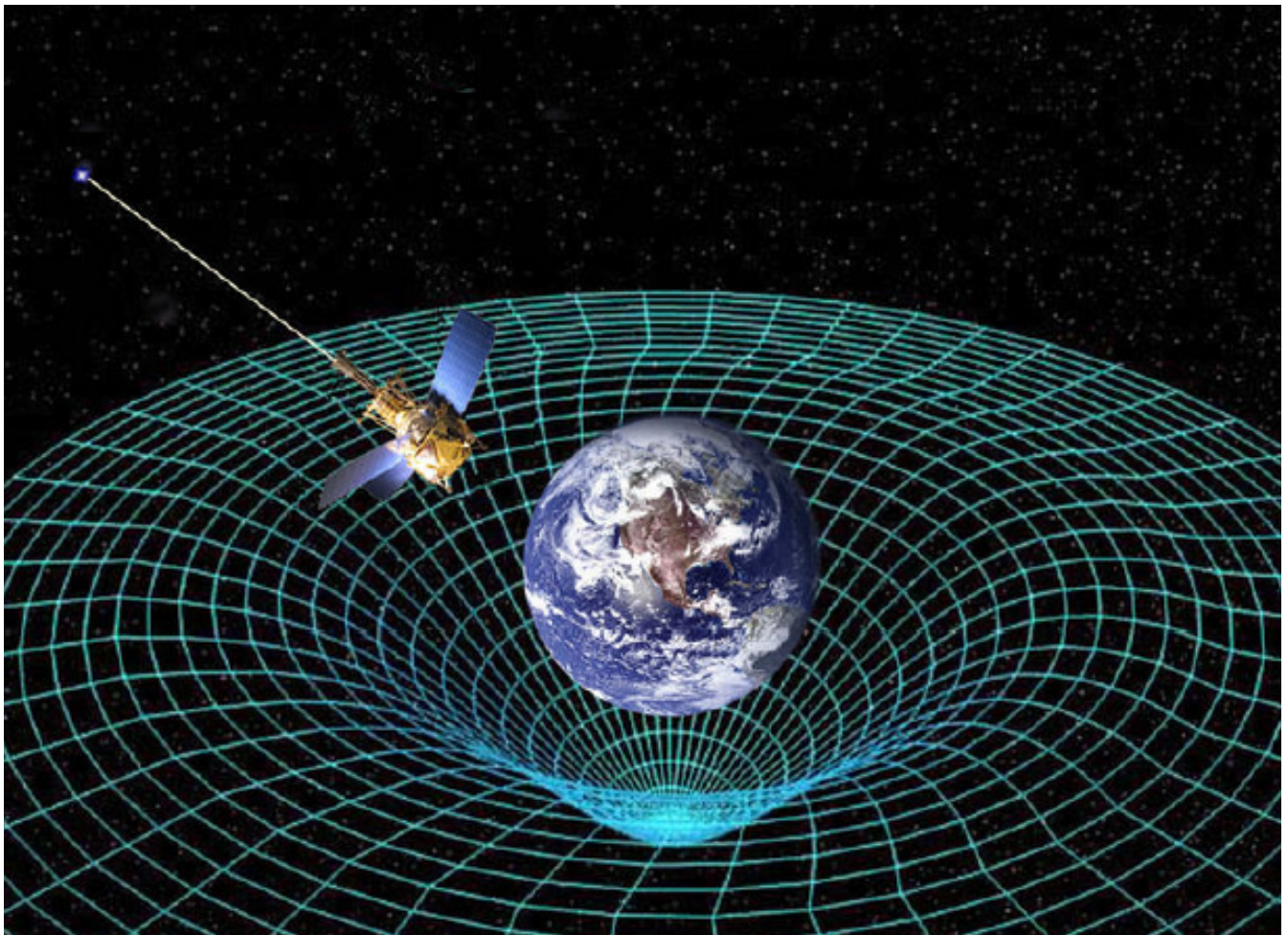
Terms to know:

- Mass : *measure of amount of matter. (Kg)*
- Weight : *measure of the force of gravity.*
- Acceleration due to gravity (Newton)

$$F_g = mg$$

Discussion Question

The force of gravity is dependent on the distance between an object and the Earth; looking at the formula for the force of gravity, how or where is distance taken into account?



Force of Gravity Practice Problems

1. Calculate the force of gravity on a 45 kg mass located at the peak of Mt. Everest.

$$F_g = ?$$

$$m = 45 \text{ kg}$$

$$g_{\text{Everest}} = 9.7647 \text{ m/s}^2$$

$$F_g = mg$$

$$= (45)(9.7647)$$

$$F_g = 439 \text{ N}$$

2. At the equator a person has a weight of 1075 N, calculate his mass.

$$m = ?$$

$$F_g = 1075 \text{ N}$$

$$g = 9.7805 \text{ m/s}^2$$

$$F_g = mg$$

$$1075 = m(9.7805)$$

$$\frac{1075}{9.7805} = 110 \text{ kg}$$

3. How many times stronger is the force of gravity at the bottom of the Mariana Trench than on the ISS? (assume the same object at each location)

$$F_{g_{\text{ISS}}} = 9.0795$$

$$F_{g_{\text{Trench}}} = 9.8331$$

$$\frac{F_{g_T}}{F_{g_I}} = \frac{9.8331}{9.0795} = 1.09$$

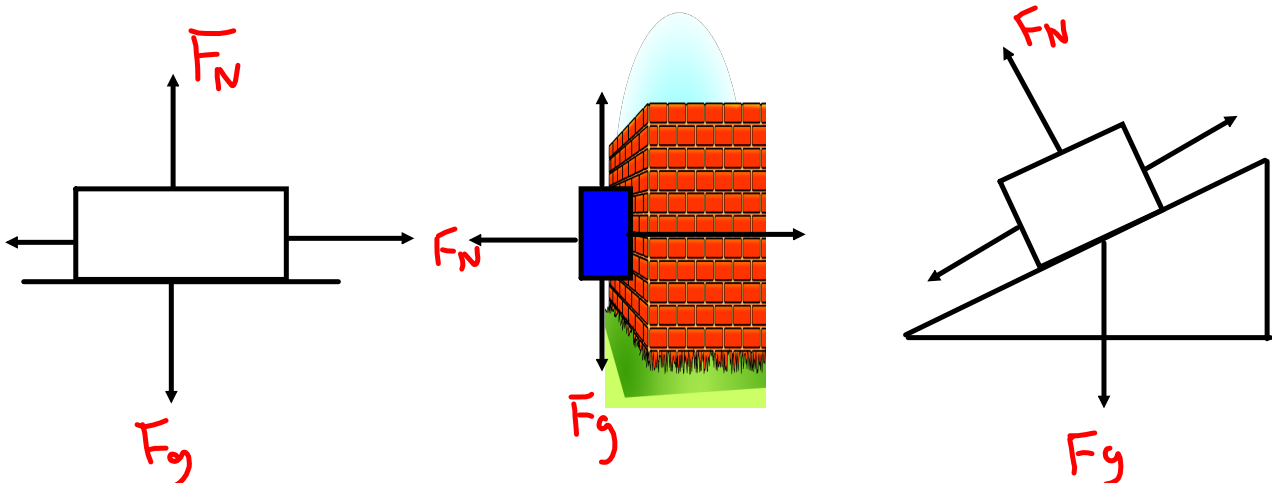
*Unless given a specific location, take the $g = 9.81 \text{ m/s}^2$ for an object located anywhere on the Earth.

Common Forces

F_a : an *applied* force
- a push or pull you exert on an object

F_N : the *normal* force
- a force that acts perpendicular to the surface on which an object rests

NOTE: "normal" means perpendicular

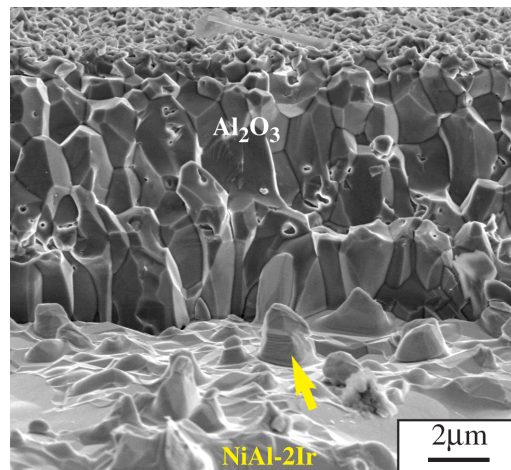
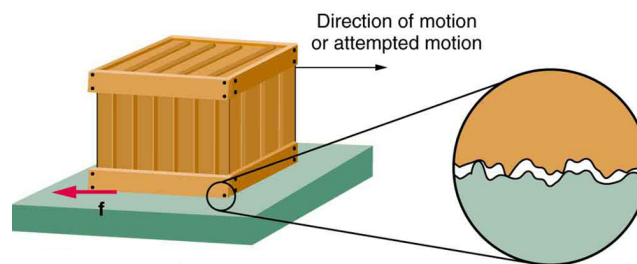
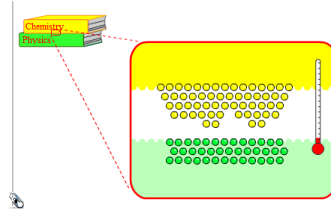


F_T : *tension*
- the force that acts along a rope, wire, string, etc.

F_e : *elastic*
- the force that an elastic pulls with (dependant on distance stretched or compressed).

The Force of Friction

1. What is friction?
2. What causes it?



It is very important to have a detailed understanding of friction as all motion is affected by some type of friction (surface, fluid, air, etc).



Attachments

forces-and-motion-basics_all.jar

forces-1d_all.jar

friction_en.jar