

Chp 3.1 – 3.2

Newton's Laws of Motion

Force

- A force is a push or a pull or any action that has the ability to change motion.
- An object DOES NOT have to move when a force is exerted on it.
- A force is needed to change motion.
- Unit is Newton (N)
- $4.48 \text{ N} = 1 \text{ lbs}$

Mass vs Weight

- Mass is the amount of “stuff” or matter of an object. It is a basic property of the object.
- **MASS IS CONSTANT**
- Weight is the force of gravity on an object.
Weight is a type of force
- **WEIGHT CHANGES depending on location**
- Mass is measured in kilograms (kg)
- Weight is measured in Newtons (N)

Weight Force (N)

Acceleration of gravity
9.8 m/sec²

$$F_w = mg$$

Mass (kg)

A diagram showing the equation $F_w = mg$. An arrow points from the text 'Weight Force (N)' to the variable F_w . Another arrow points from the text 'Acceleration of gravity 9.8 m/sec²' to the variable g . A third arrow points from the text 'Mass (kg)' to the variable m .

- Gravity (g) is a force that pulls every mass toward every other mass
- Gravity is different depending upon your location
 - Earth $g=9.8 \text{ m/sec}^2$
 - Mars $g=3.8 \text{ m/sec}^2$

Inertia

- Inertia is defined as the property of an object to resist changing its state of motion.
- An object with a lot of inertia takes a lot of force to stop
- Mass is a measure of the inertia of an object
- The more mass an object has the greater the inertia and the greater the force needed to change the object's motion.

Newton's 1st Law of Motion

- Called the Law of Inertia
- States any object at rest will remain at rest unless acted on by an unbalanced force
- Any object in motion will stay in motion unless acted by an unbalanced force

- Example:
 - A car is pushed on a ramp. The cart moves because an unbalanced force acted upon it. The cart will eventually stop because the force of friction acts against it
 - If the cart was pushed in space it would continue forever because there isn't any friction to stop it

Newton's 2nd Law

- Newton's 2nd Law says that
 - Force causes acceleration
 - Mass resists acceleration
 - The acceleration you get is equal to the ratio of force over mass
- The second law says that the more mass an object has more force is needed to speed it up or slow it down.

Newton's Second Law of Motion

Push with force F ...



and the car will accelerate.

Add mass to the car and push with the same force F ...



and you get less acceleration.

Acceleration (m/sec^2) — $\mathbf{a} = \frac{\mathbf{F}}{\mathbf{m}}$ — Force (newtons, N)
— Mass (kg)

Newton's 3rd Law

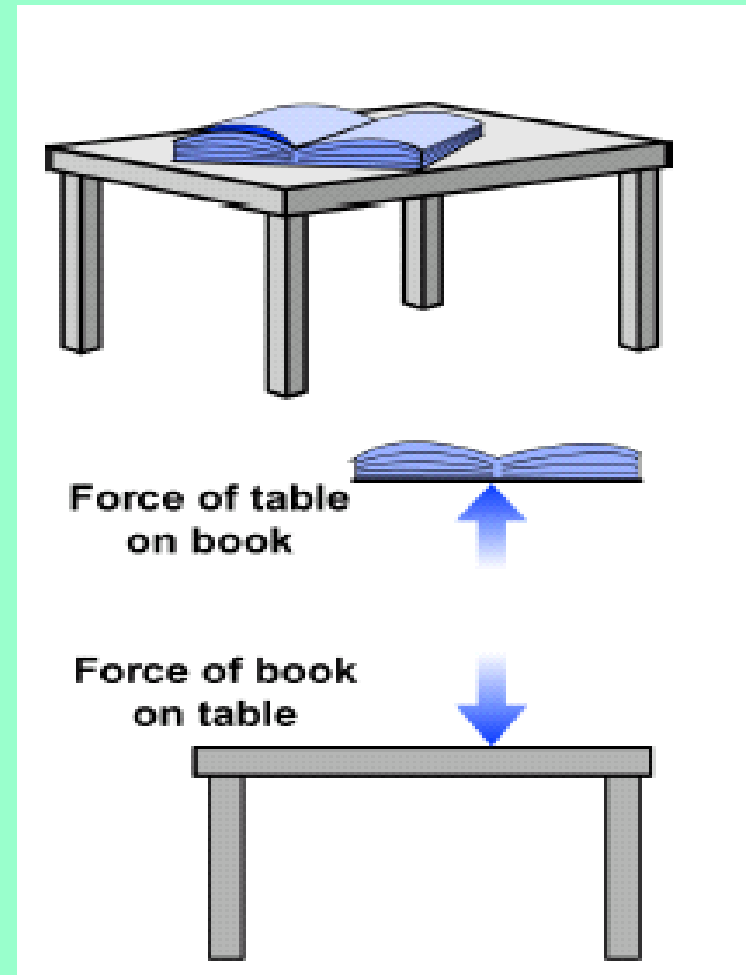
- Newton's 3rd Law states that whenever one object exerts a force on another, the second object exerts an equal and opposite force on the first.
- The 3rd law operates with pairs of objects
- The two forces don't always cancel out because the forces act on different objects

Newton's Third Law of Motion



For every **action force**, there is a **reaction force** equal in strength and opposite in direction.

- Even when things are not moving there are forces acting.
- Gravity pulls the book down with a force.
- The table pushes back up with an equal and opposite force.
- The book stays still because the forces are balanced



Homework 6

- A company uses a ramp to slide boxes of parts to a shipping area. Each box has a mass of 5 kilograms. When sliding down the ramp, the boxes accelerate at a speed of 0.25 m/sec^2 . What is the force acting on each box?

Homework 13

- a) Which object fell fastest?
- b) Which object fell slowest?
- c) Which object has the greatest weight?
- d) Is air resistance stronger on A or B?
- e) Why are the times different?

Object	Mass (g)	Time of Fall (sec)
A	5.0	2.0
B	5.0	1.0
C	30.0	0.5
D	35.0	1.5