Newton's First Law

Physics

Newton's First Law – The Law of Inertia

INERTIA – a quantity of matter, directly proportional to MASS. Unit for MASS = kilogram.

Object's tendency to resist changes in motion.

In order to change an object's motion a net force must be present.

Newton's First Law

An object in motion is unchanged, UNLESS acted upon by an EXTERNAL (unbalanced) Force.

There are TWO conditions here and one constraint.

Condition #1 – The object CAN move but must be at a CONSTANT VELOCITY
Condition #2 – The object is at REST
Constraint – As long as the forces are BALANCED!!!!! And if all the forces are balanced the SUM of all the forces is ZERO.

The bottom line: There is NO ACCELERATION in this case AND the object must be at EQUILIBRIUM (All the forces cancel out).

$$acc = 0 \rightarrow \sum F = 0$$

Newton's First Law – The Law of "Inertia"

Since the $F_{net} = 0$, a system moving at a constant velocity or at rest MUST be at "EQUILIBRIUM".

TIPS for solving problems

- Draw a FBD
- Resolve anything into COMPONENTS
- Write equations of equilibrium
- Solve for unknowns

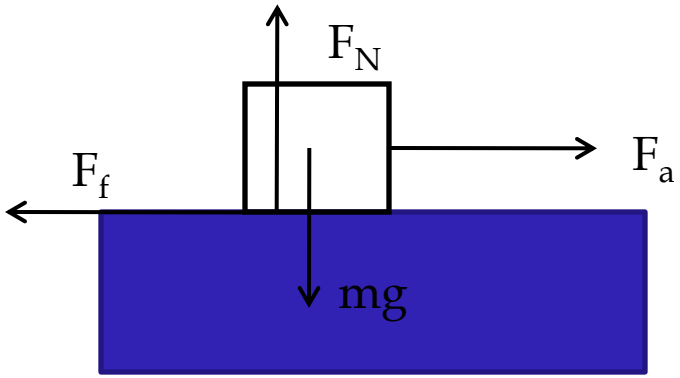
Example

A 10-kg box is being pulled across the table to the right at a constant speed with a force of 50N.

a) Calculate the Force of Friction

$$F_a = F_f = 50N$$

b) Calculate the Force Normal



$$mg = F_n = (10)(9.8) = 98N$$

Example

Suppose the same box is now pulled with an applied force at an angle of 30 degrees above the horizontal.

a) Calculate the Force of Friction

$$F_{ax} = F_a \cos\theta = 50\cos 30 = 43.3N$$

$$F_f = F_{ax} = 43.3N$$

b) Calculate the Force Normal

$$F_N \neq mg!$$

$$F_N + F_{ay} = mg$$

$$F_N = mg - F_{ay} \rightarrow (10)(9.8) - 50\sin 30$$

$$F_N = 73N$$