Forces and Free Body Diagrams

Common Forces

Gravity ("Weight")

- Acts between every two masses in the known universe
- Always attractive
- On Earth, always acts down on an object (towards Earth's centre)

Near the surface of a planetoid for which gravitational field strength is known, weight is calculated with

$$\overrightarrow{F_g} = mg$$

NormalForce

- Exerted on an object by the surface on which it rests
- NOT always equal in magnitude to gravity

Tension

- A pulling force

- Exerted by a rope, string or cable

Compression

- A pushing force
- Exerted on/by rigid bodies (like girders,tie rods, rafters, etc.)
- Can't be exerted on/by ropes, stings, etc.

Static Friction

- Is exerted between surfaces ONLY when they are not moving relative to each other
- Will only be great enough to keep an object from sliding (until it reaches its maximum value)

Example:

The maximum static friction between Iggy's fridge and the floor is 120 N. When he exerts a force of 40 N [E] on the fridge (while the fridge is at rest), the force of static friction is 40 N [W] and the fridge remains at rest.

If he then applies a force of 120 N [E], the force of static friction will be 120 N [W] and the fridge

will still be at rest.

Kinetic Friction

- Is exerted between surfaces ONLY when they **ARE** moving relative to each other
- Is ALWAYS less than the maximum force of static friction

NOTE:

Friction **ALWAYS** opposes the motion of an object relative to the surface it is in contact with.

Free-Body Diagrams

- Used to show ALL the forces acting on an object
- Drawn before adding force vectors together (to find net force), to ensure none are missed
- NEVER include net force ($\overrightarrow{F_{net}}$)

Draw free body diagrams for the following:

- A car skidding to a stop
- A snowboarder going downhill

- Tarzan climbing up a vine with constant speed

When adding force vectors, we must still use accurate trigonometric means (components OR the SIN/COS laws)

Example:

Determine the net force acting on Selma's barge while in the Sydney harbour, with one tug pulling it with a force of 12500 N [E] and another with a force of 9400 N [S 40 $^\circ$ E]
Be sure to draw an FBD.