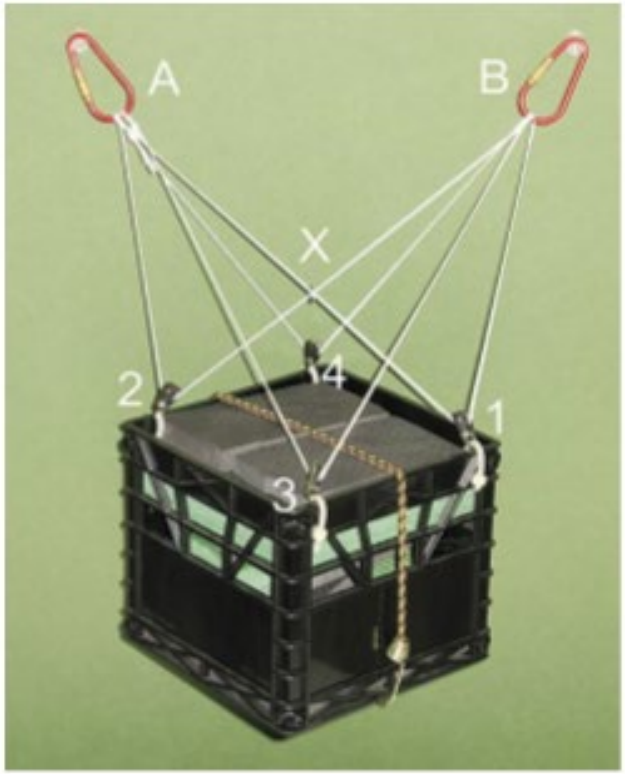
P20 Unit 2 - Forces

Static Equilibrium



Static Equilibrium

Static = not moving

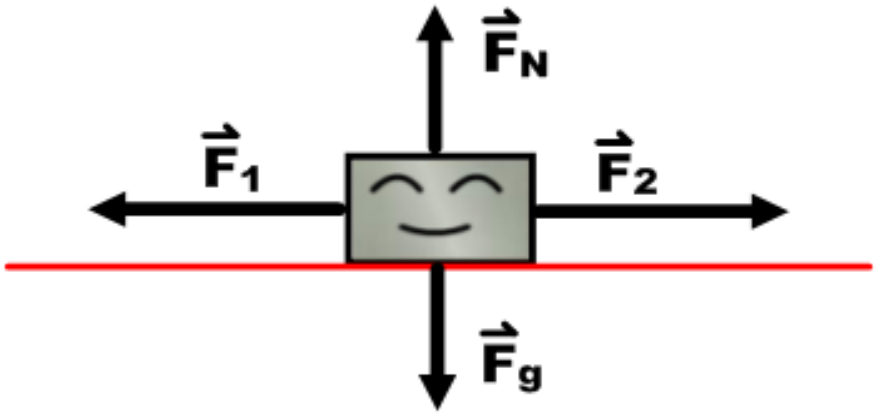
Equilibrium = balance

When the total force (the sum of all forces acting on an object) in both the x and y directions is zero, we can say that the object is at equilibrium. The forces are balanced.

By Newton's _____ Law, an object with no total force acting on it will not accelerate. Thus, objects in equilibrium do not accelerate.

Often , these objects are at rest, hence the term static.

ex) Static Equilibrium



- Force 1 = Force 2 (in magnitude)
- Normal force = Gravitational force (in magnitude)
- The box is at rest.

$\vec{F}_{totx}$ =

$\vec{F}_{toty}$ =

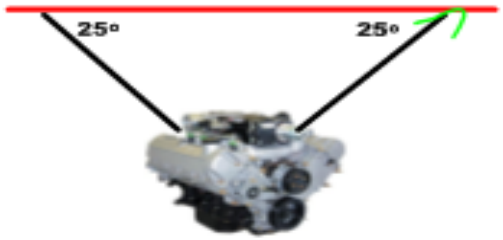
ex) Ashley and Megan are "steering" a 4H steer into a pen with ropes. Ashley pulls with 5.0 N due North while Megan pulls with 5.0 N due West. With what force must the steer pull at to maintain static equilibrium?

Step 1: Draw the vectors.

Step 2: Write out total force statements.

Step 3: Solve for the missing force.

ex) a) Two cables suspend a 450 N engine. The ropes are both at 25° from the horizontal, acting in opposite directions. What is the force of tension in each rope?



Step 1: Draw the vectors.

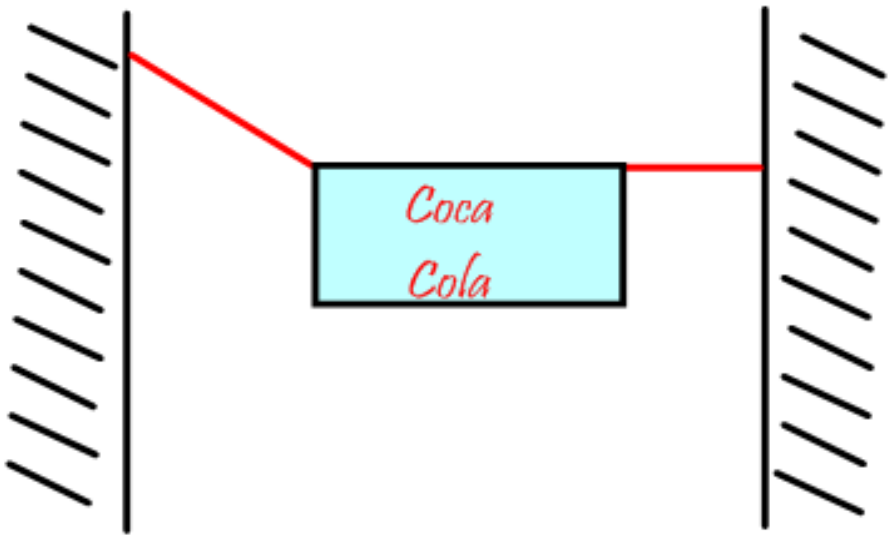
Step 2: Write out total force statements.

Step 3: Solve for the missing force.

b) What will happen to the tension in the cables if the angle of the cables increase? Decrease?

ex) A 50 kg sign is suspended by two ropes tied to buildings. Rope A makes an angle of 30° to the horizontal while rope B is perfectly horizontal. What is the tension in each rope?

Step 1: Draw the vectors.



Step 2: Write out total force statements.

Step 3: Solve for the missing force.

ex) A 3.0 kg photo (width = 80 cm) is hung by a 120 cm wire attached to the corners of the frame. The frame is then hung on a nail so it is level. What is the tension in each wire?

*Warning: Diagram not drawn to scale.

A guy is suspended by two ropes between two buildings. The first rope makes an angle of 20° to the horizontal, the second rope makes an angle of 35° to the horizontal. What is the tension needed in each rope to suspend his beefy 847 N weight?