

How do forces affect the motion of an object?

How do Newton's Laws of Motion allow us to make predictions and draw conclusions dealing with the motion of an object?

Explain what the equilibrium rule means for objects in static and dynamic equilibrium.

Equilibrium

Moving and Nonmoving
Objects

NO 2 HB

Balanced Forces

A ball sits at rest on a table.

What forces are acting on the ball?

Draw a free body diagram for the ball.

Because the ball is at rest, we know

$F_n = \text{Normal Force}$

$$\Sigma F = 0$$

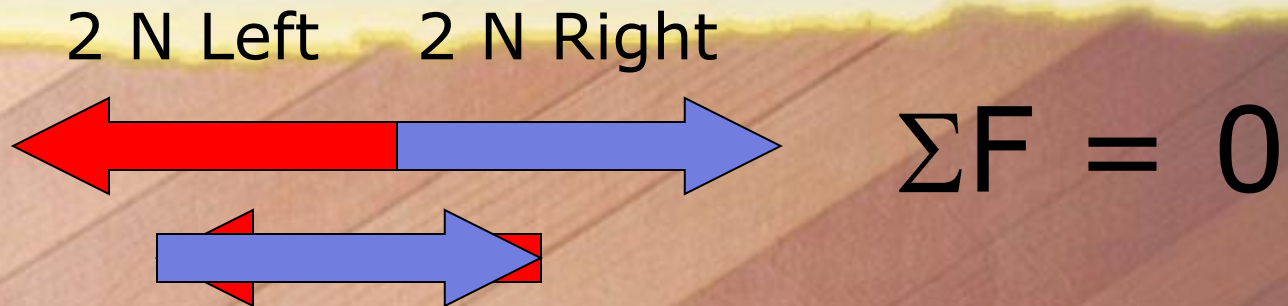


$F_g = \text{Gravitational Force}$

The Equilibrium Rule ($\Sigma F = 0$) :

- The **net force** is the combination of all the forces acting on an object
- If all of the forces on an object **cancel out**, the net force is equal to zero.
- If the net force on the object is equal to zero, the object is in **equilibrium**

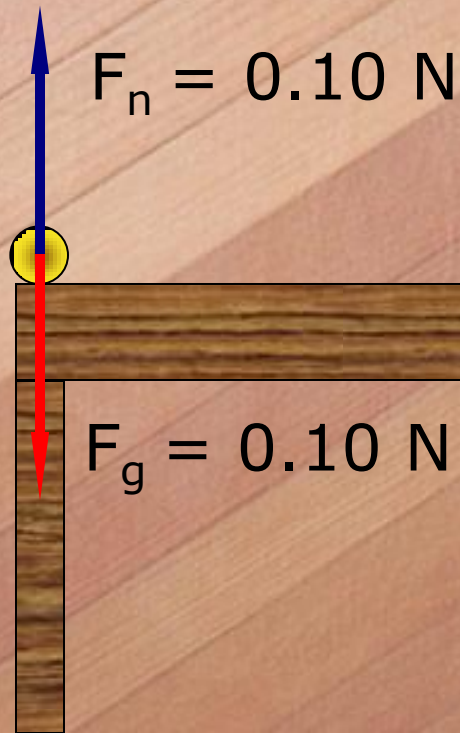
Net Force



- These objects are in mechanical equilibrium
- No change in the objects' motions will occur

Equilibrium

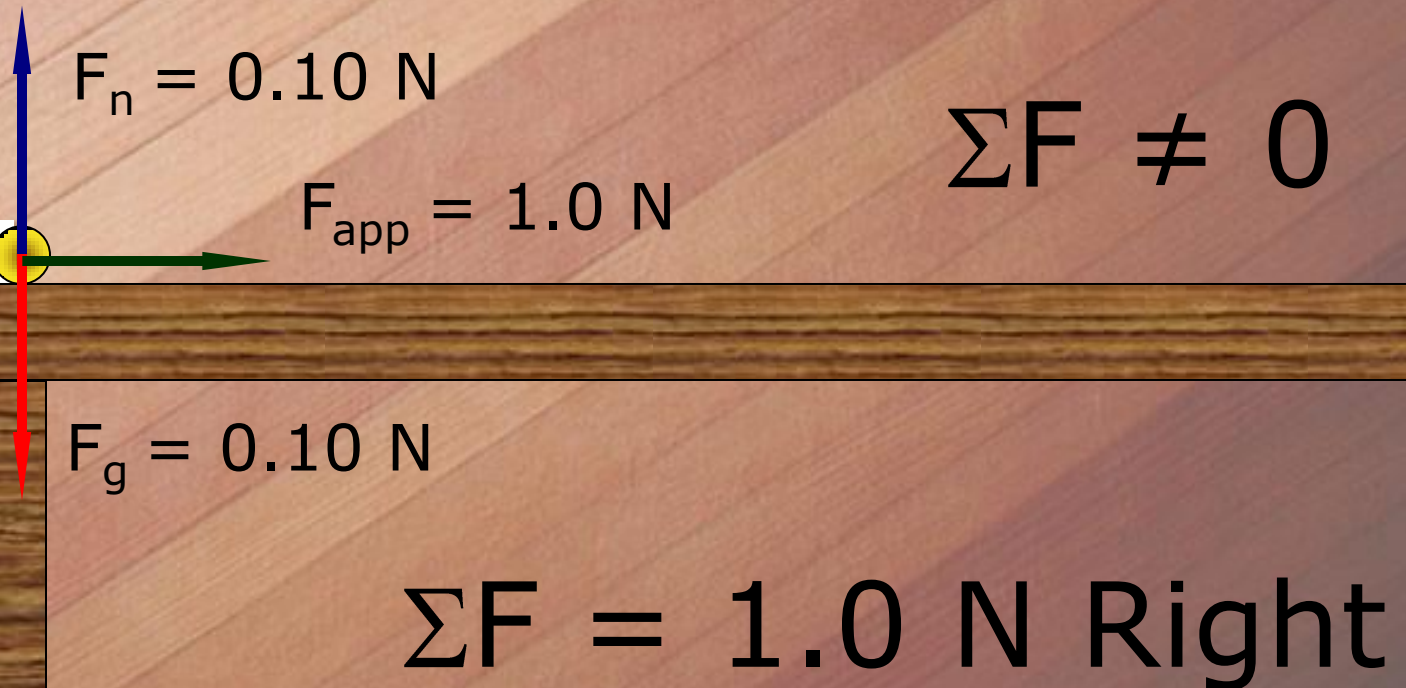
If an object is at rest, it is in static equilibrium



$$\Sigma F = 0$$

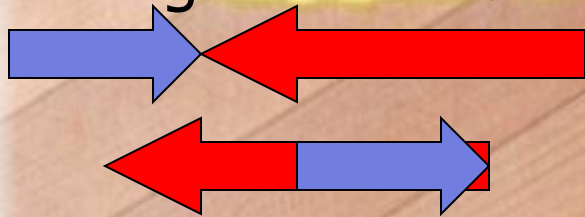
Unbalanced Forces

To change the object's motion, an **unbalanced** force must be applied.



Net Force

1 N Right 2 N Left



$$\Sigma F = 1 \text{ N Left}$$

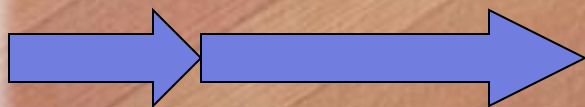
1 N Left 2 N Right



$$\Sigma F = 1 \text{ N Right}$$

1 N Right

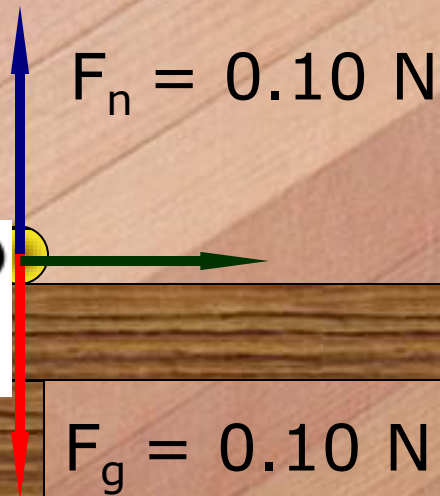
2 N Right



$$\Sigma F = 3 \text{ N Right}$$

Equilibrium

Once in motion, the ball will continue at a **constant velocity**


$$F_n = 0.10 \text{ N}$$

$$\Sigma F = 0$$

$$F_g = 0.10 \text{ N}$$

Equilibrium

- If an object is moving at a constant velocity, it is in dynamic equilibrium
- The object will continue moving at a constant velocity until an unbalanced force acts on it.

Equilibrium

A crate of apples exerts a force of 50 N on the floor.

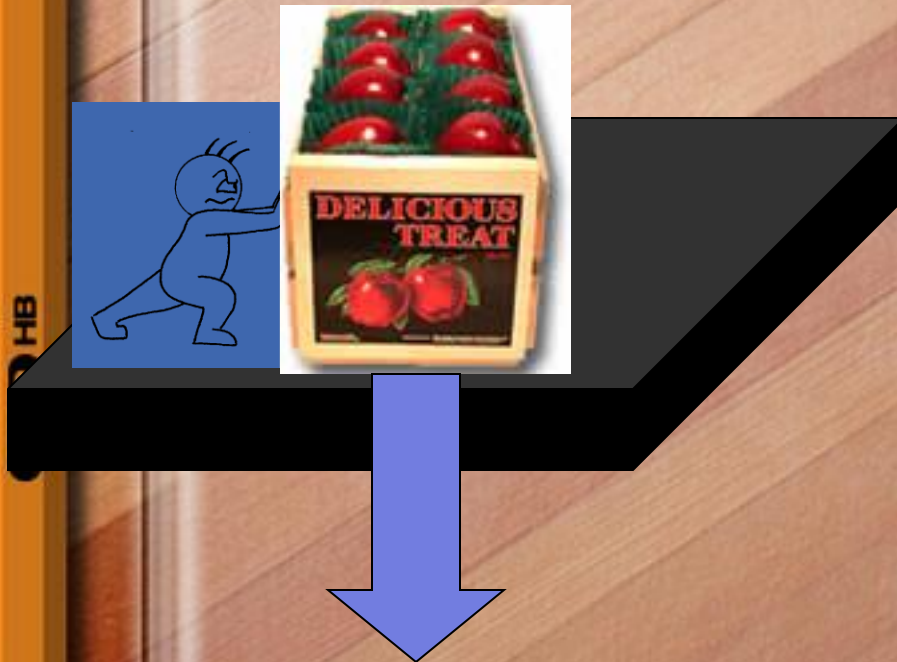


1. What is the support force provided by the floor?
2. What type of equilibrium is the crate in?

Equilibrium

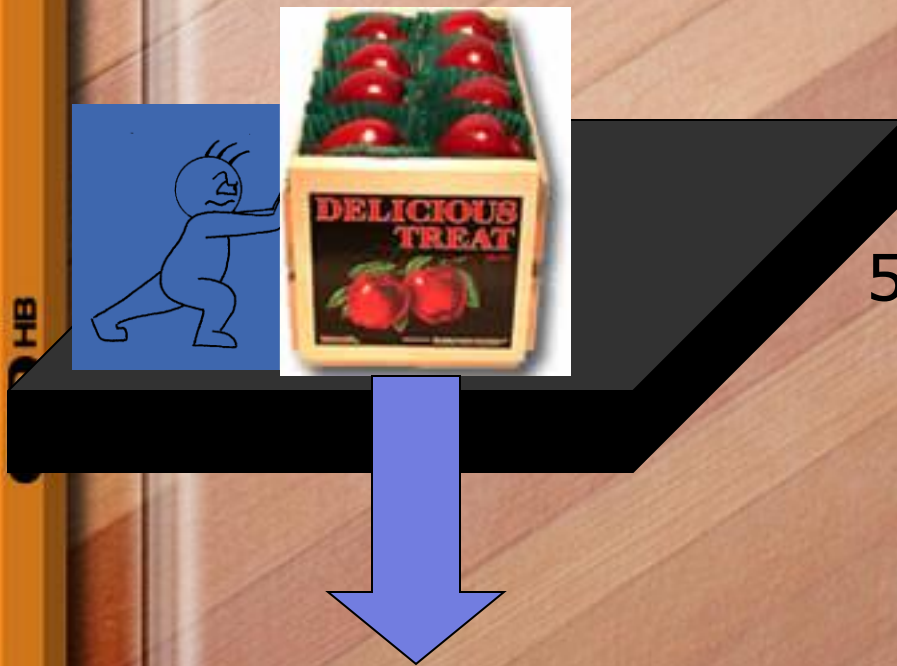
The crate is pushed and begins to move.

3. What type of force was provided to get the crate to move?



Equilibrium

The crate continues moving at a constant velocity.



4. If the applied force is equal to 35 N, what is the force of the friction?
5. What type of equilibrium is the crate in?