

# February 15, Week 5

Today: Chapter 4, Forces

Exam #1 is in mailboxes

Homework Assignment #5 - Due March 1.

**Mastering Physics:** 10 problems from chapters 4 and 5.

**Written Questions:** 5.74

Help sessions with Jonathan:

M: 1000-1100, RH 111

T: 1000-1100, RH 114

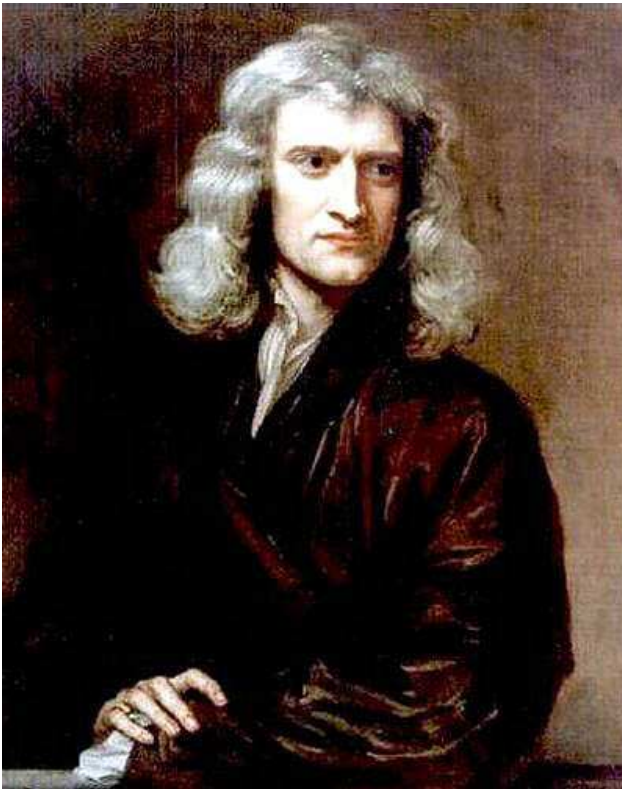
Th: 0900-1000, RH 114

# Dynamics

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Sir Isaac Newton (1642-1727)  
British Physicist, In 1687 he  
published the *Philosophiæ Naturalis  
Principia Mathematica*. The *Principia*  
details how all motion can be  
explained by one of three  
simple statements = Newton's  
Three Laws of Motion.

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When an object's velocity approaches the speed of light - Einstein's theory of relativity.

Motion of atomic-sized objects - Quantum Mechanics (Also started by Einstein).



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Usually there is more than one force acting on an object.

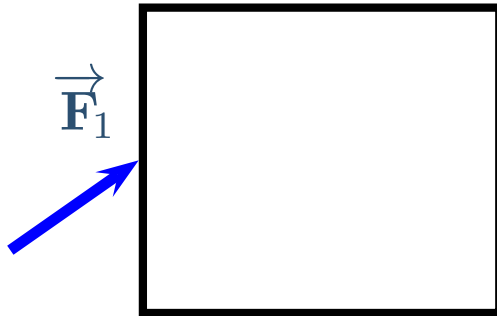
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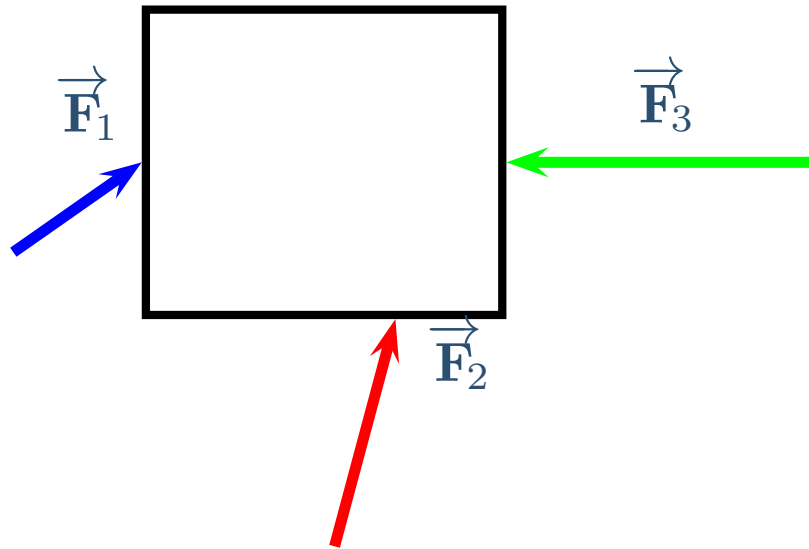
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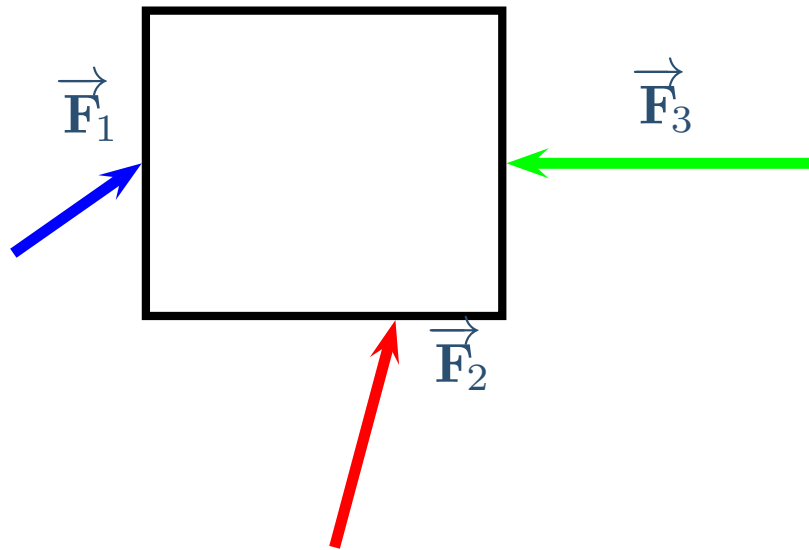
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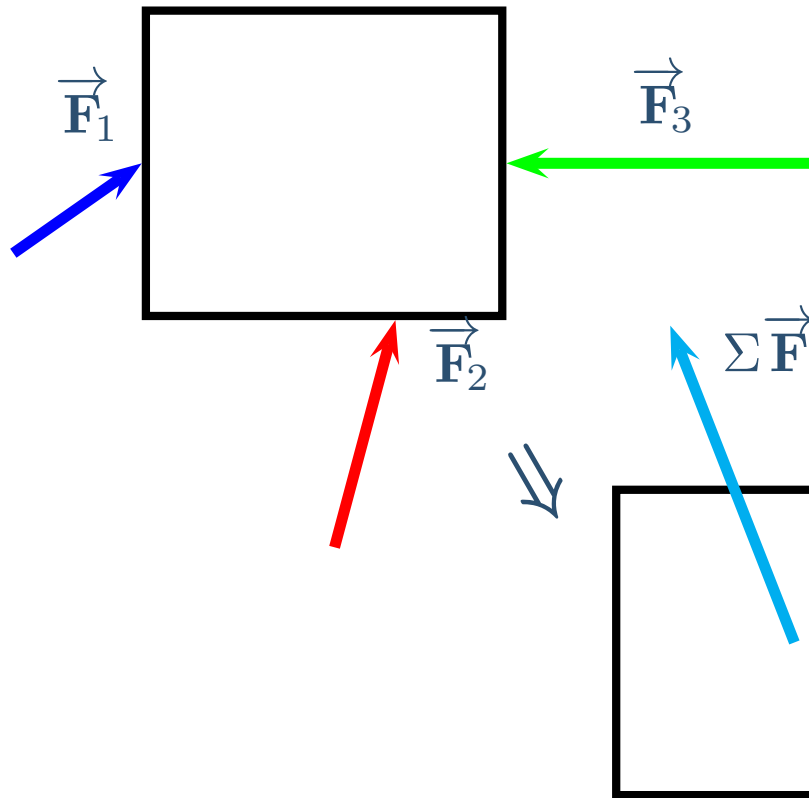
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One single force.  
Applied at the center  
to avoid rotation.



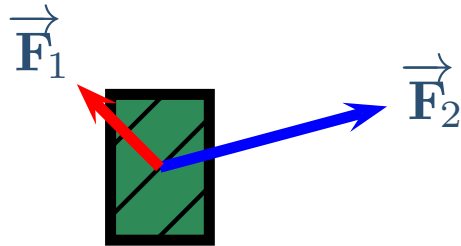
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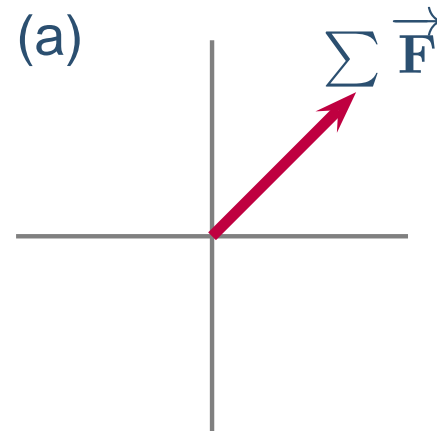
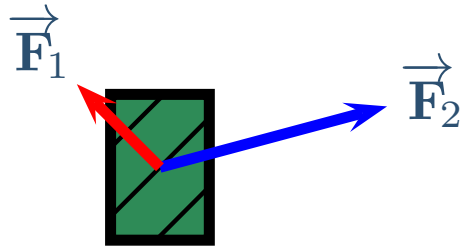
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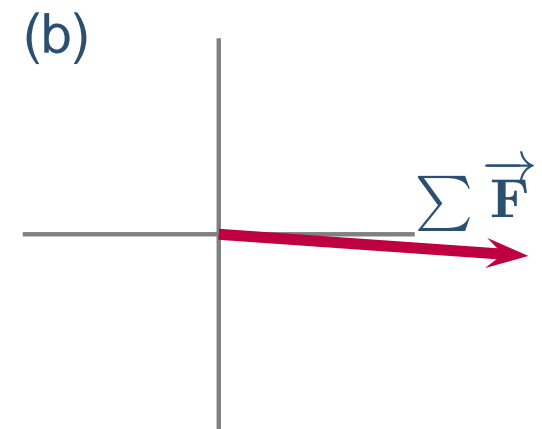
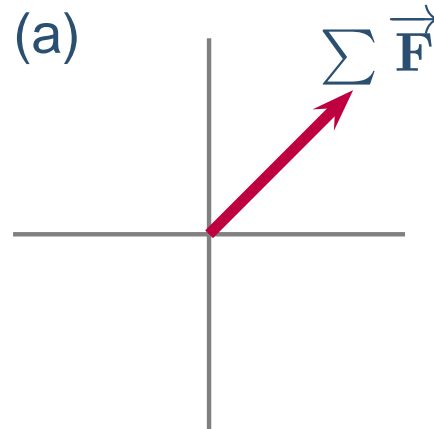
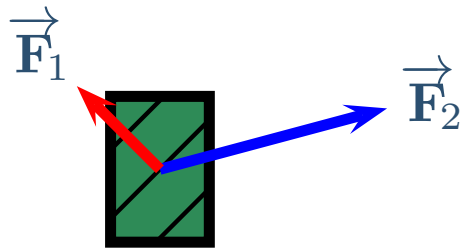
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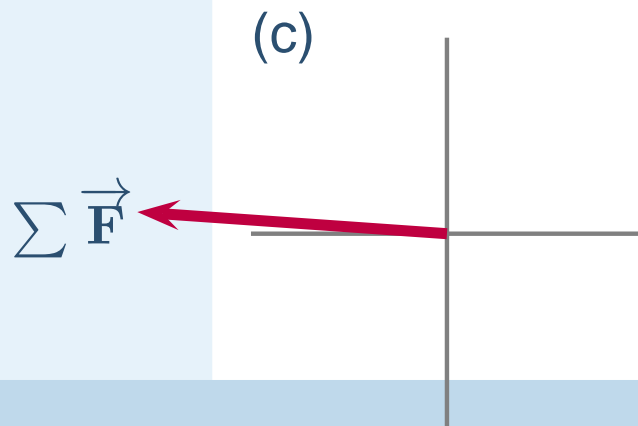
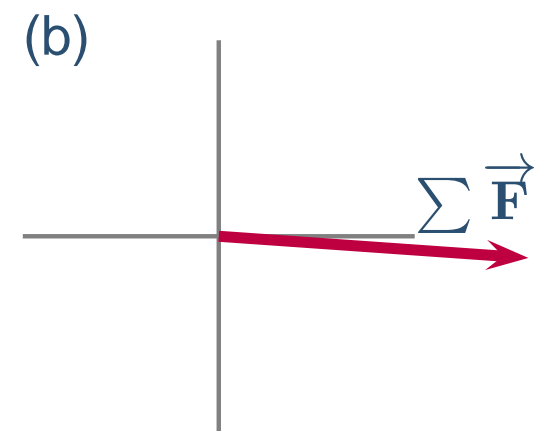
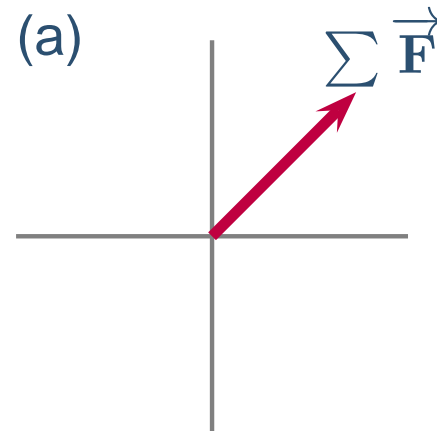
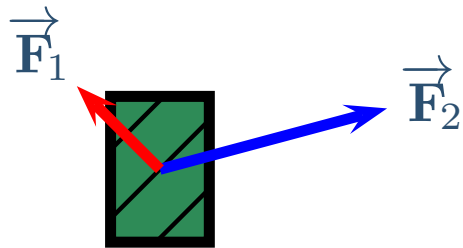
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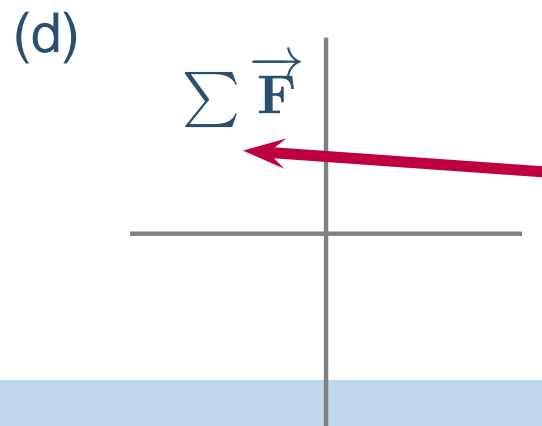
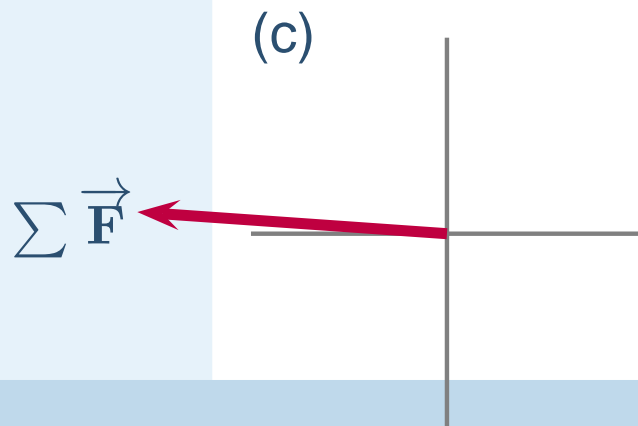
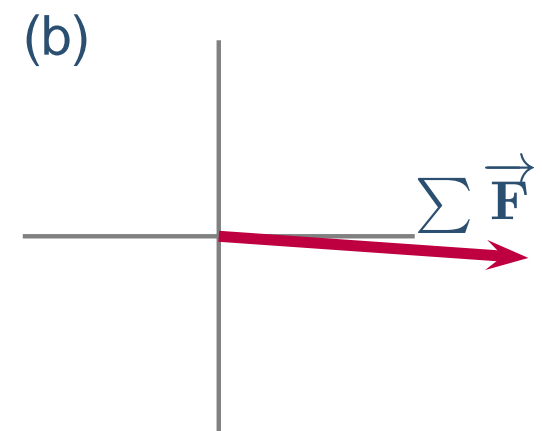
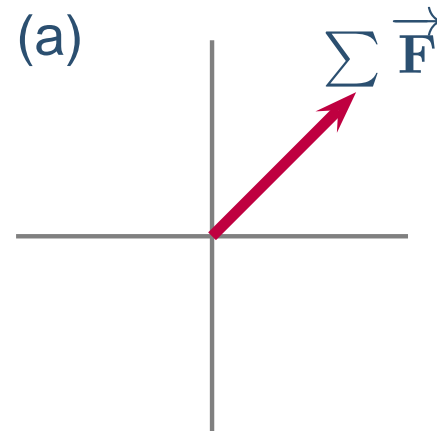
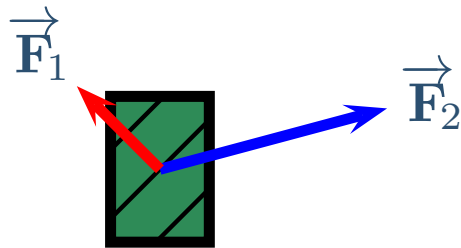
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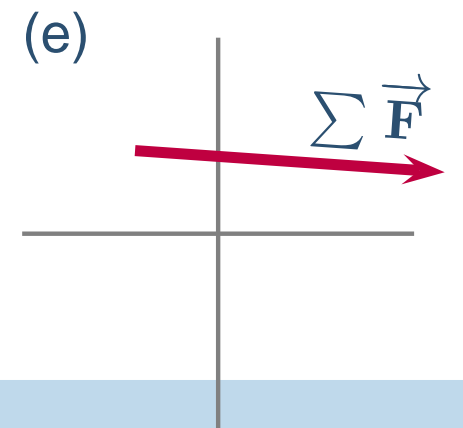
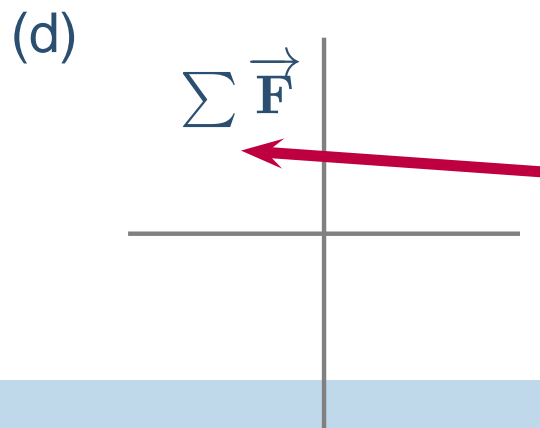
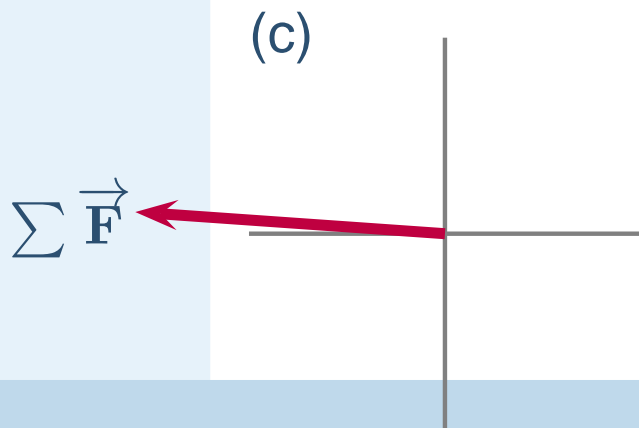
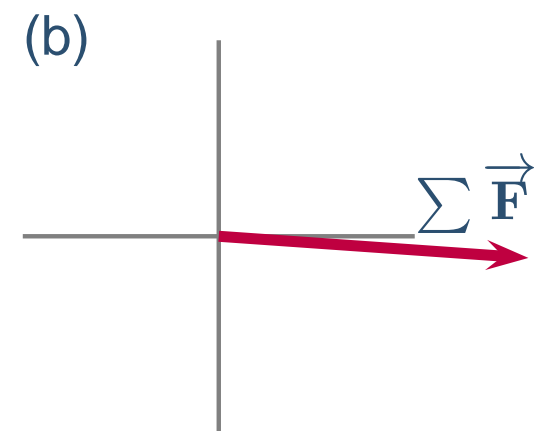
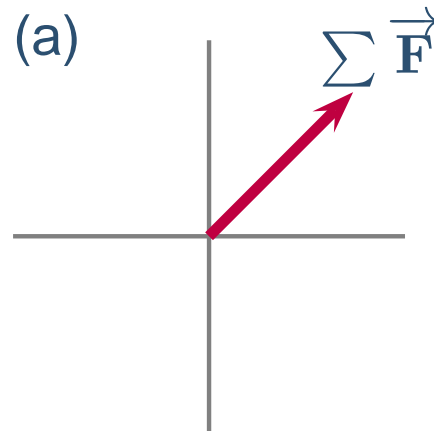
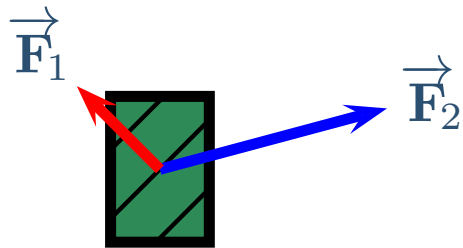
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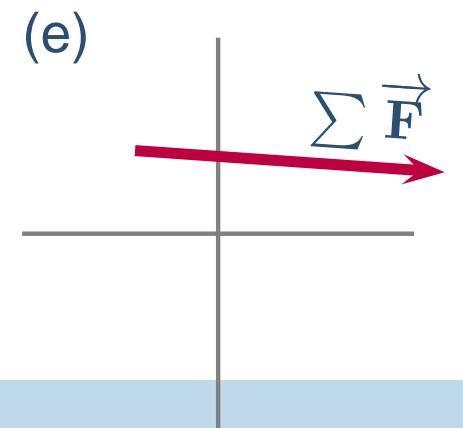
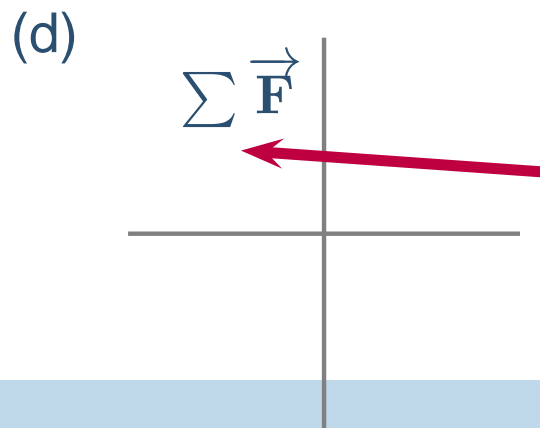
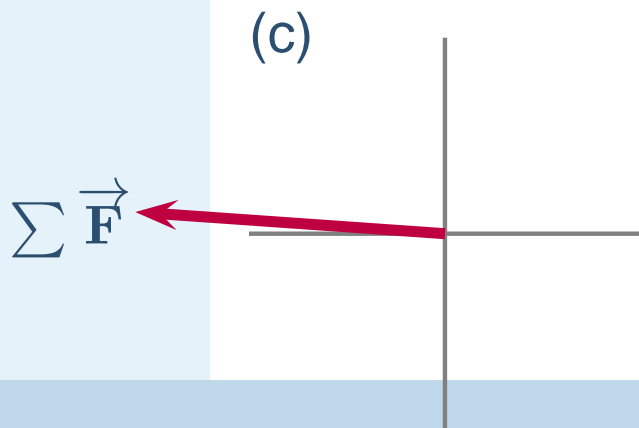
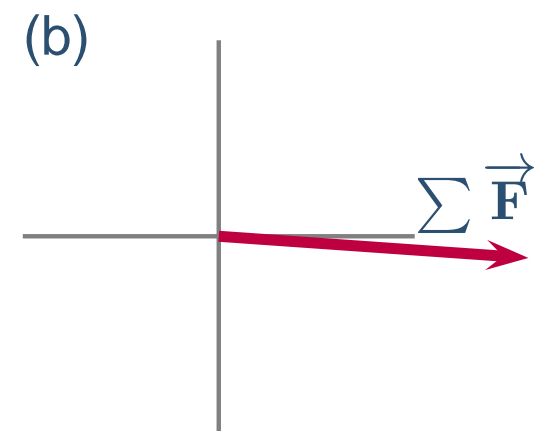
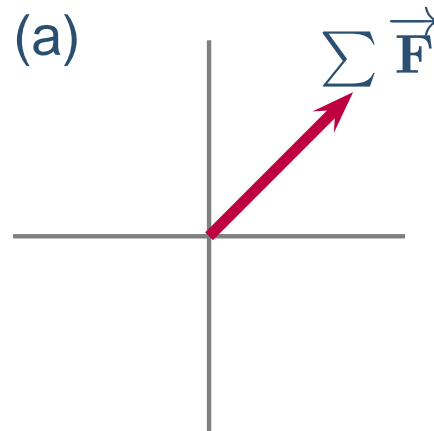
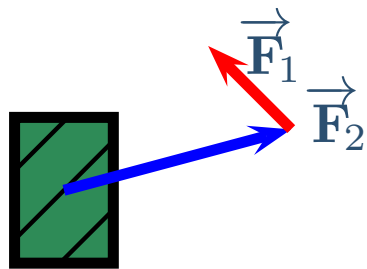
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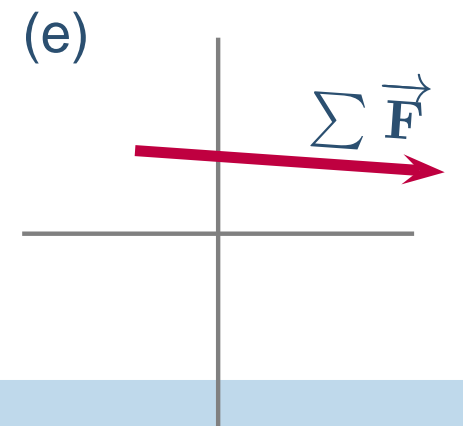
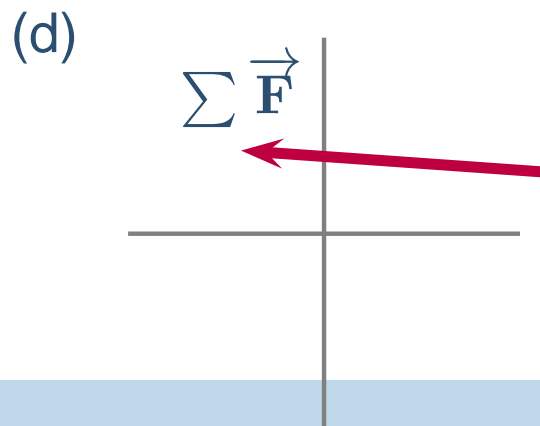
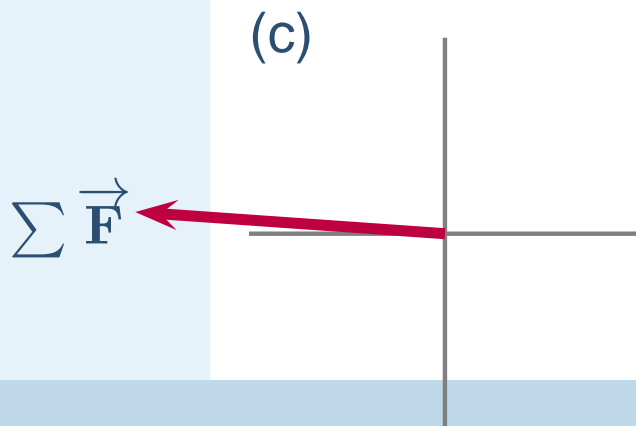
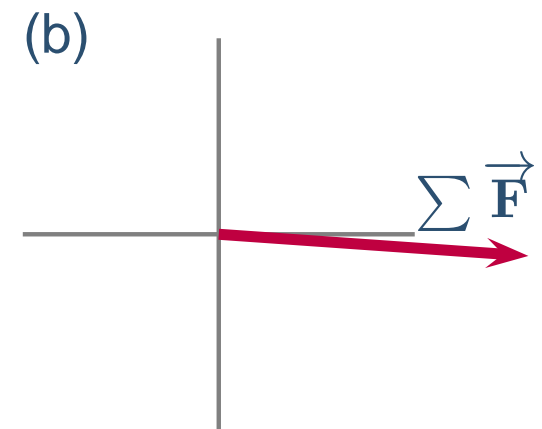
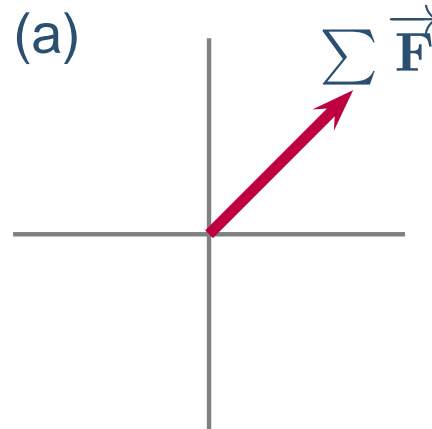
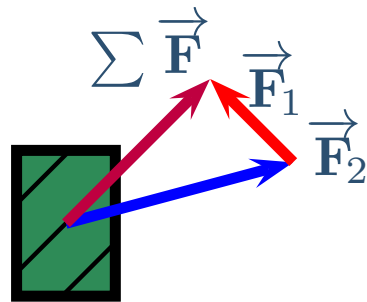
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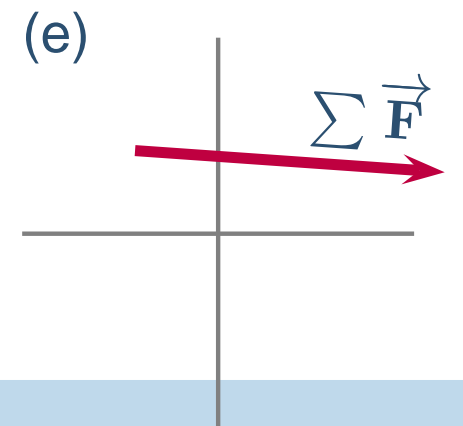
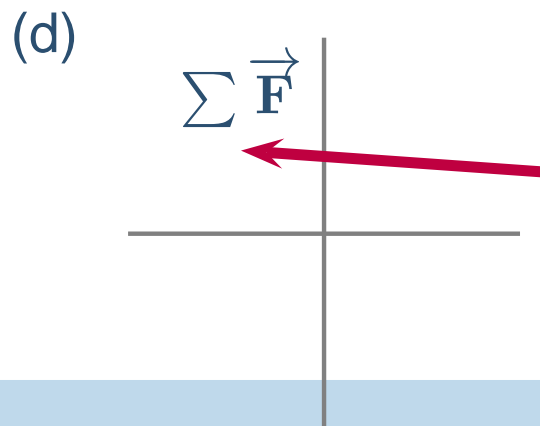
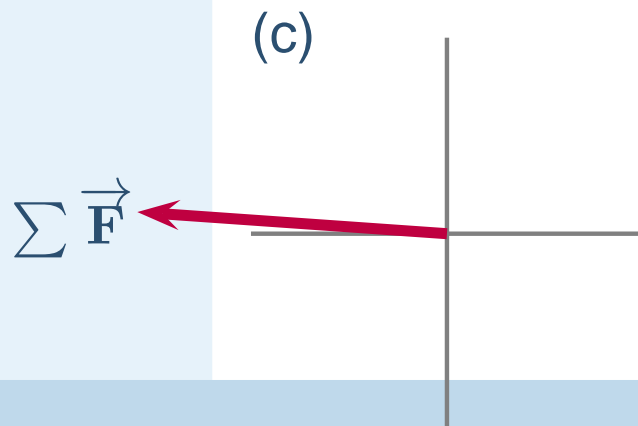
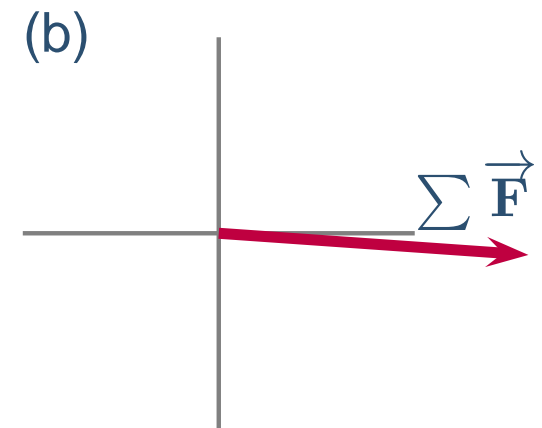
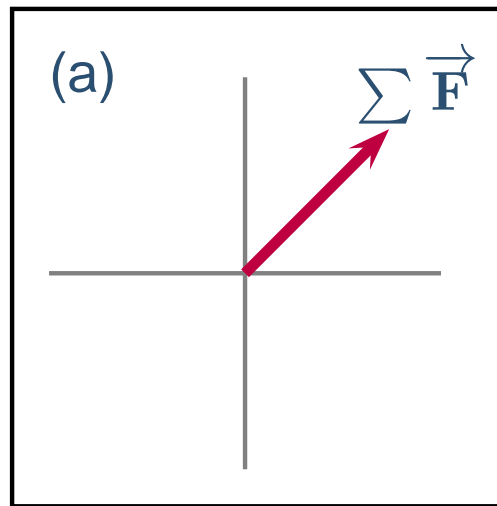
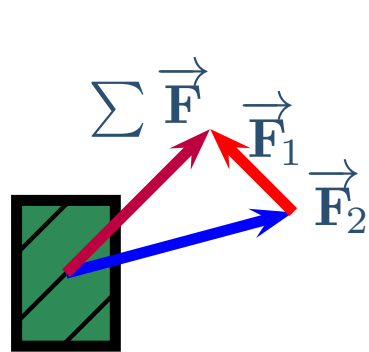
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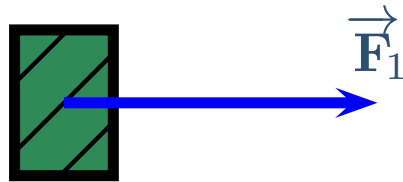
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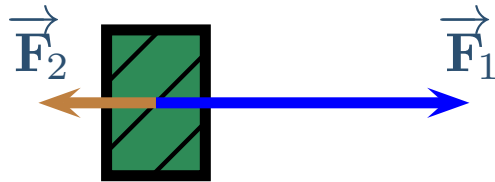
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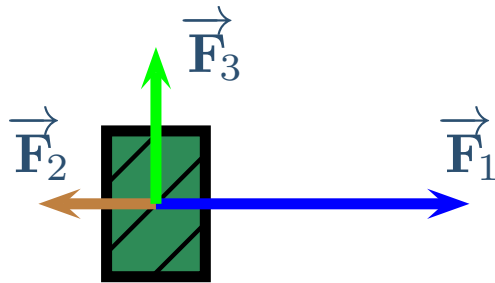
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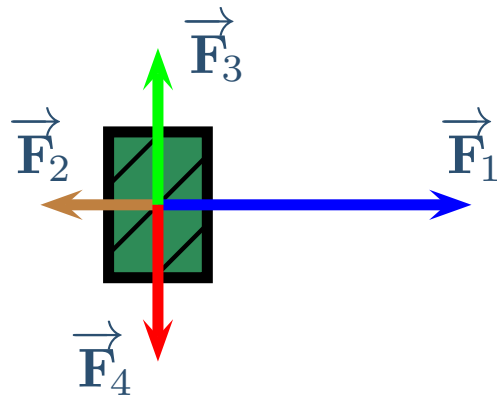
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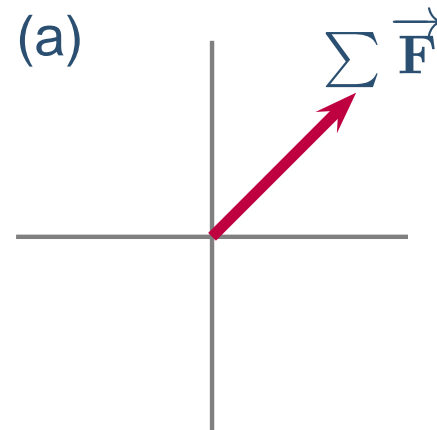
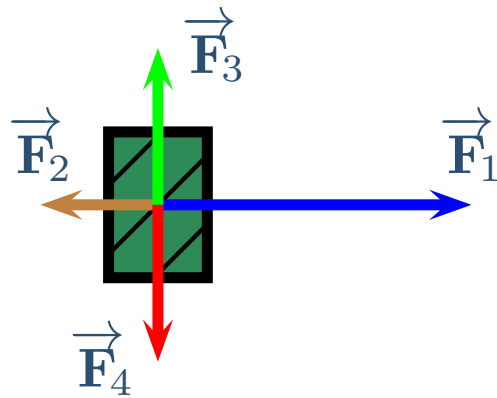
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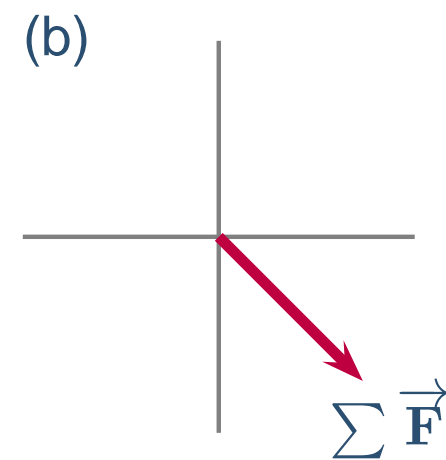
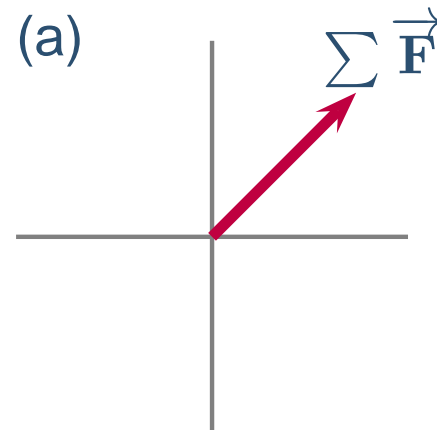
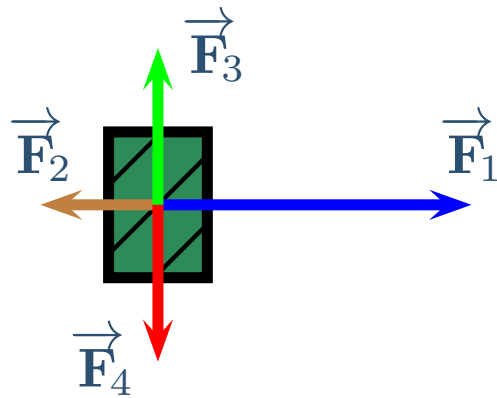
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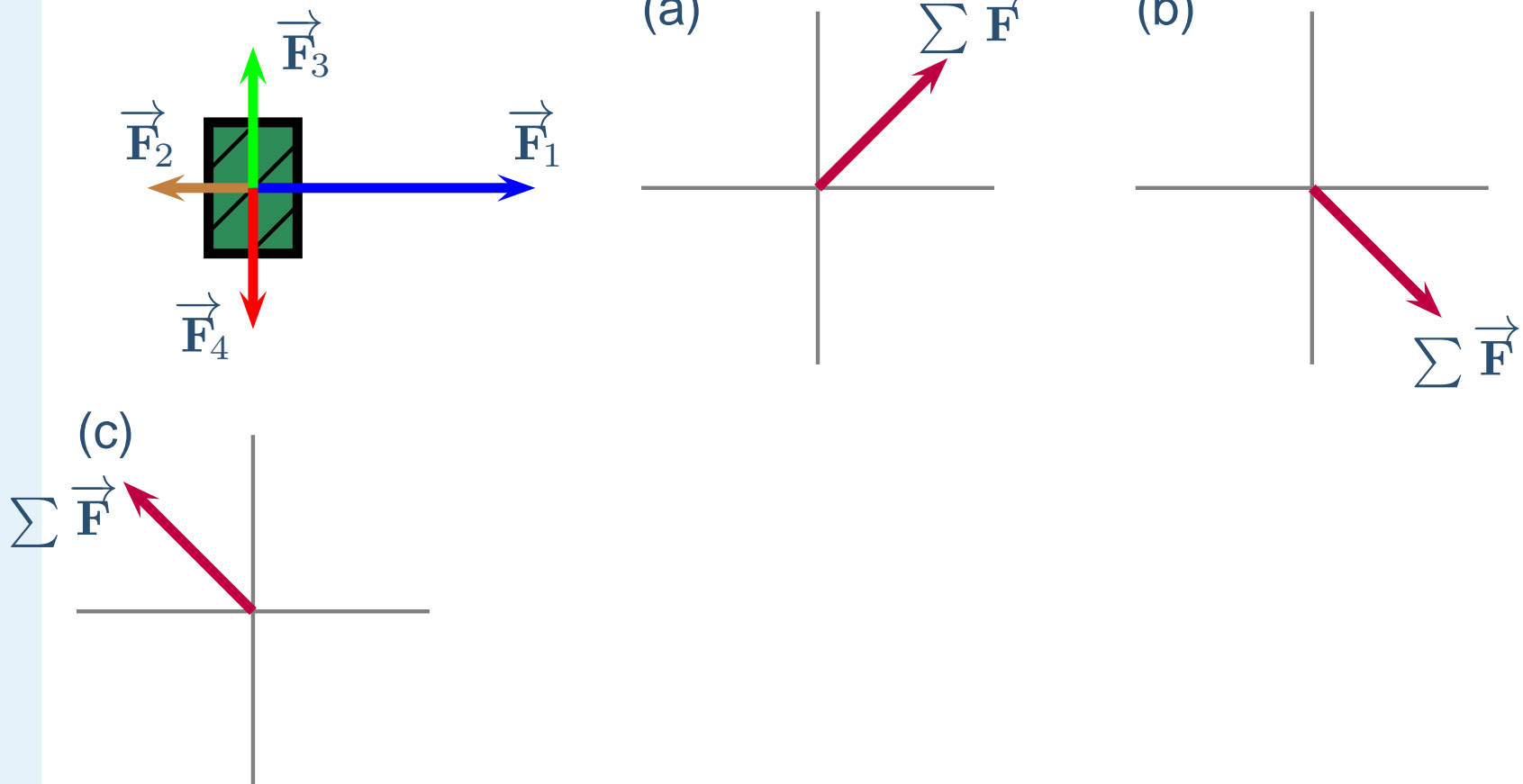
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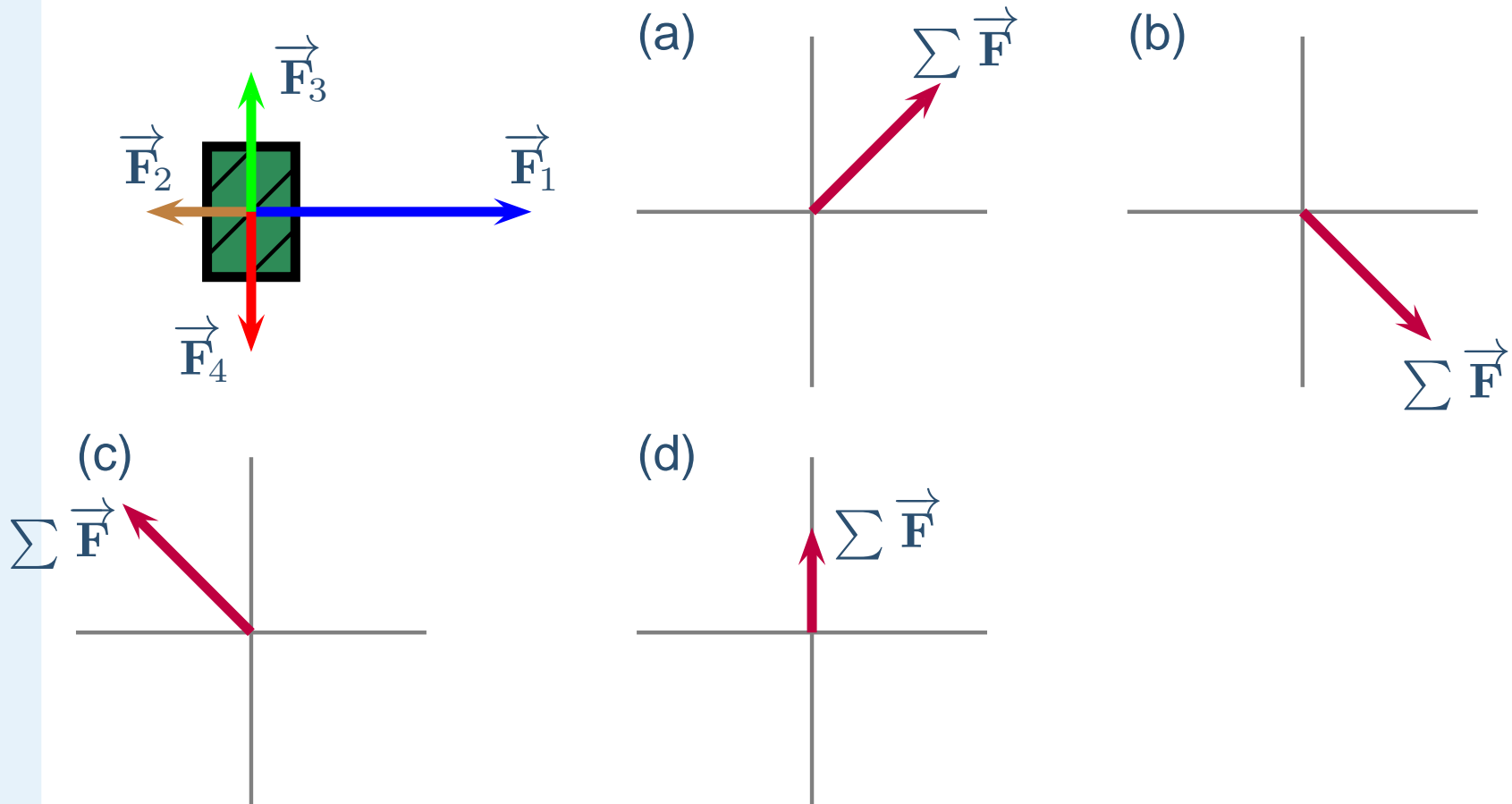
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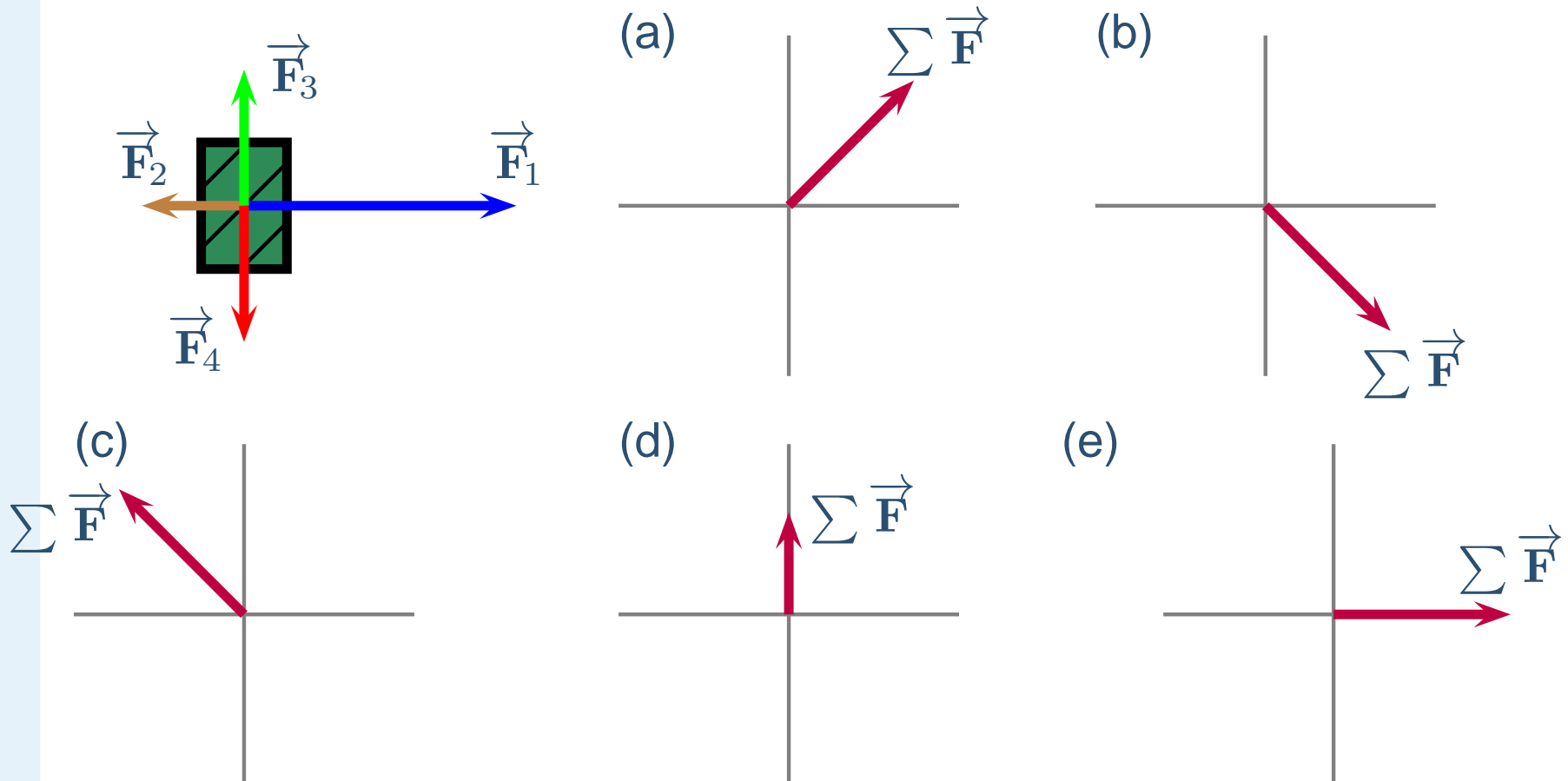
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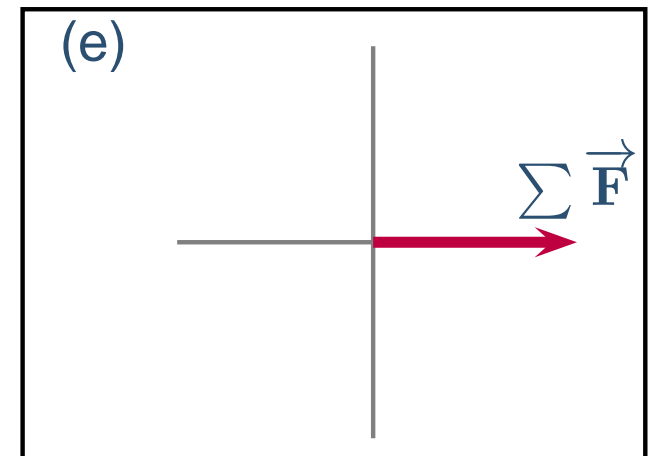
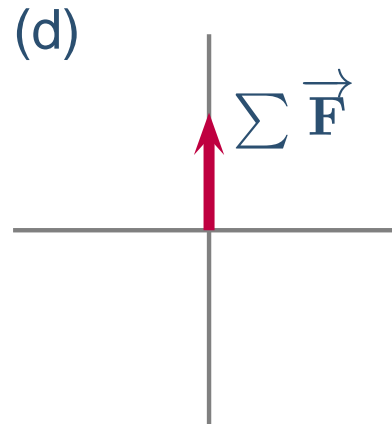
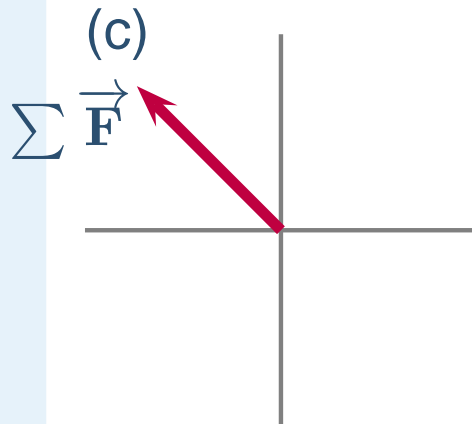
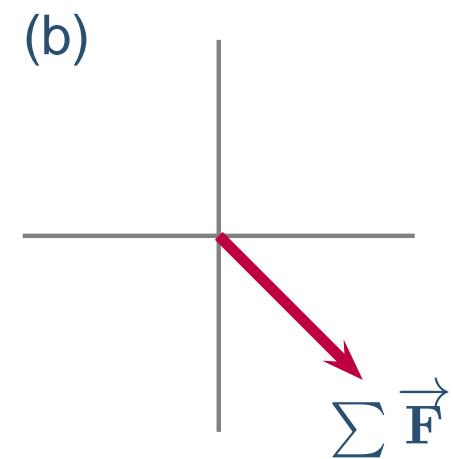
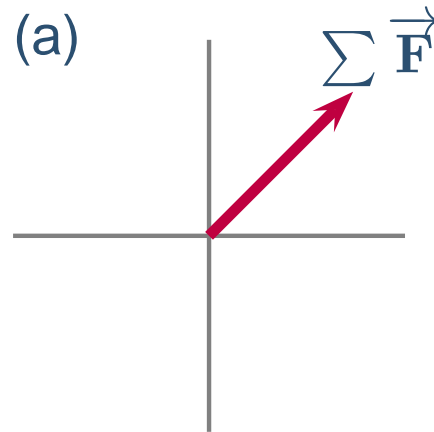
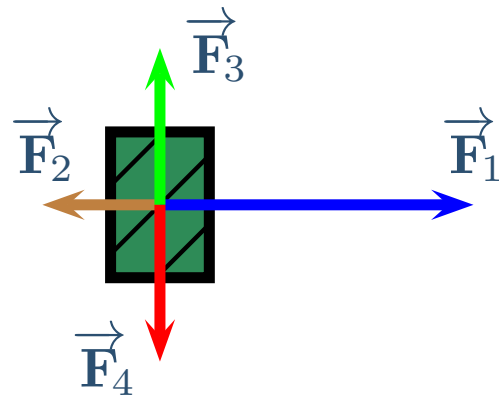
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Forces you will be expected to Identify:

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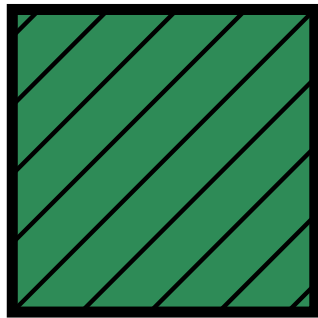
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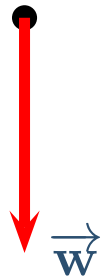
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- Still using the particle model, so replace object with dot

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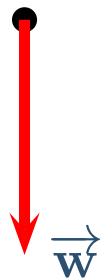
Still using the particle model, so  
replace object with dot

# Weight

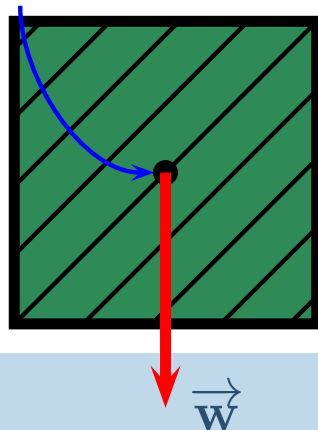
Forces you will be expected to Identify:

Weight,  $\vec{w}$  - Downward force exerted by gravity.

Still using the particle model, so  
replace object with dot



Center of Gravity



When we stop using the particle model  
and assuming all forces applied at the  
center, we'll locate the weight at a point  
called the center of gravity

# Normal Force

Forces you will be expected to Identify:

# Normal Force

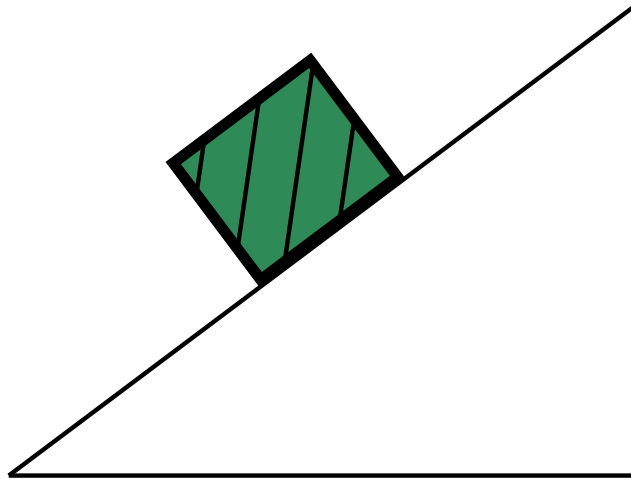
Forces you will be expected to Identify:

Normal Force -  $\vec{n}$ , the perpendicular force exerted by one solid object onto another solid object.

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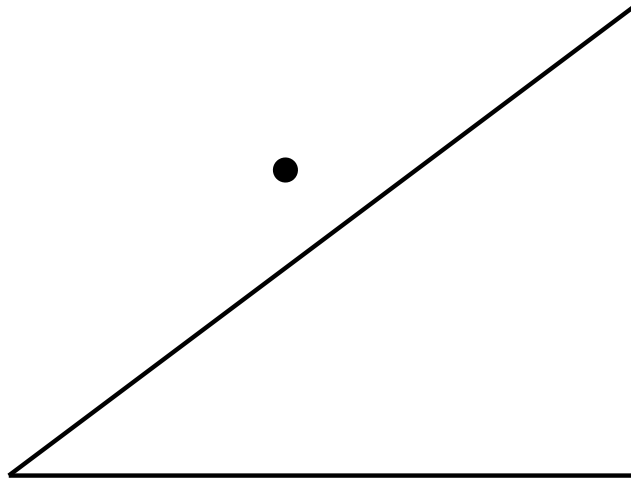
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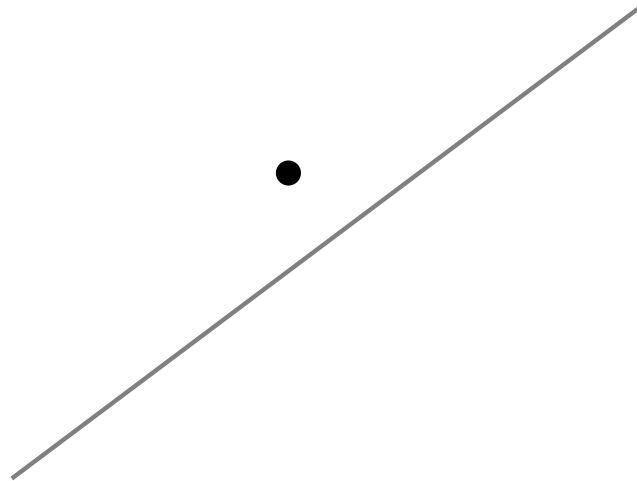
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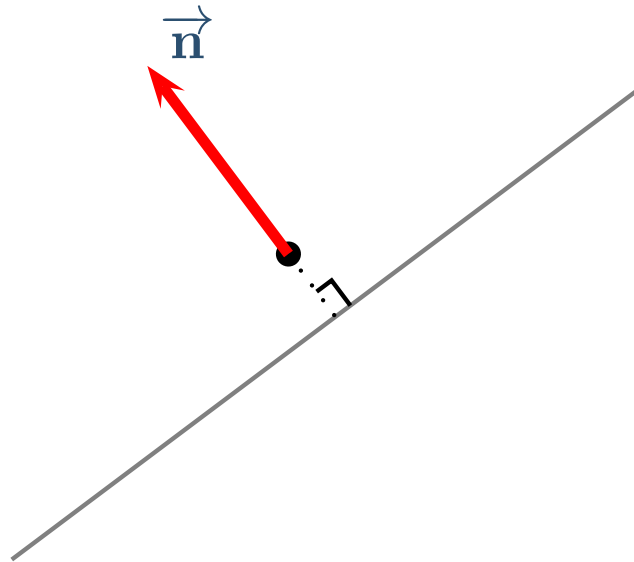




# Normal Force

Forces you will be expected to Identify:

Normal Force -  $\vec{n}$ , the perpendicular force exerted by one solid object onto another solid object.



Whether object is being pushed or pulled we always draw the forces going away from the dot

# Friction

Forces you will be expected to Identify:

# Friction

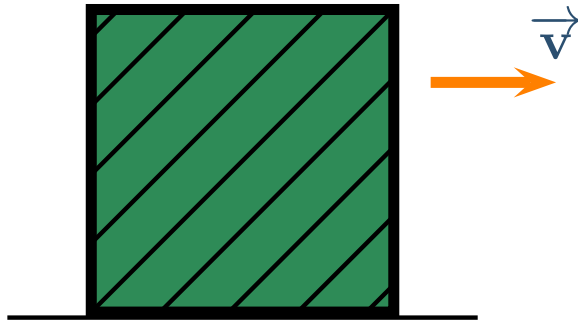
Forces you will be expected to Identify:

Friction -  $\vec{f}$ , force which slows a moving object, always opposed to the motion

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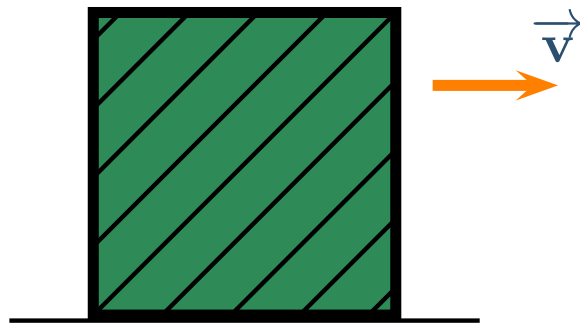
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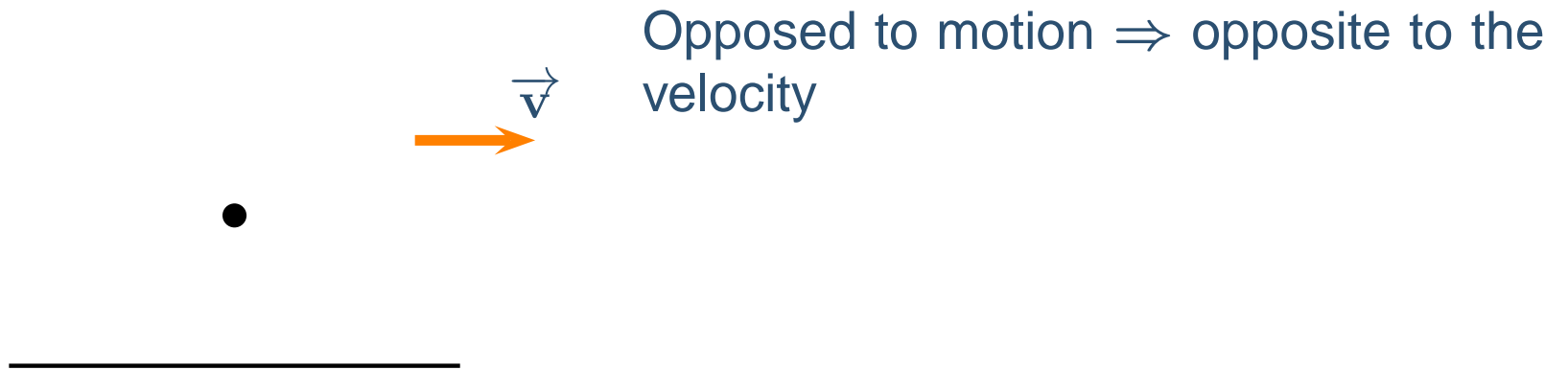


Opposed to motion  $\Rightarrow$  opposite to the velocity

# Friction

Forces you will be expected to Identify:

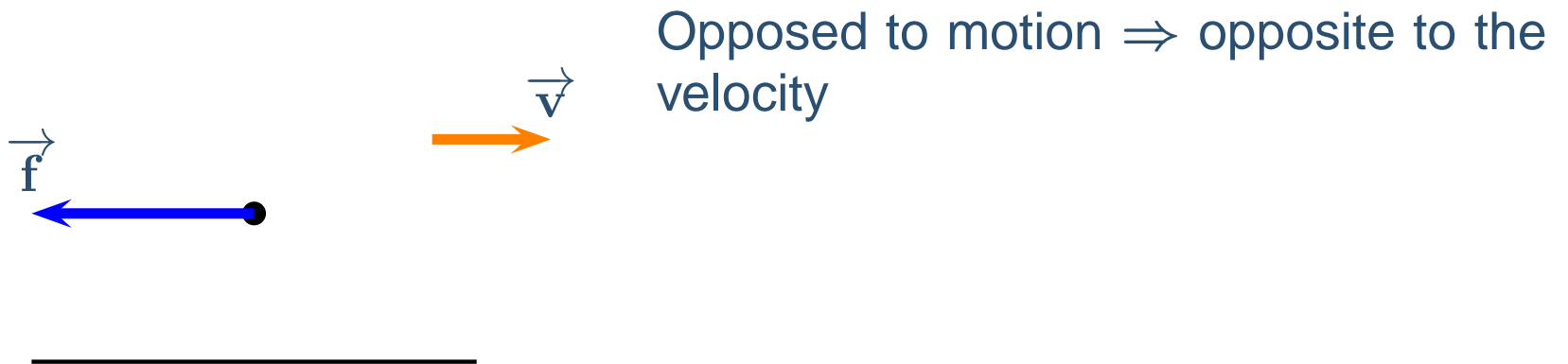
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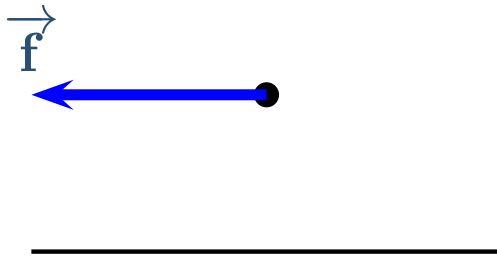
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# Friction

Forces you will be expected to Identify:

Friction -  $\vec{f}$ , force which slows a moving object, always opposed to the motion



Opposed to motion  $\Rightarrow$  opposite to the velocity

Later, we'll be more precise and distinguish sliding friction = kinetic friction from friction on a stationary object = static friction

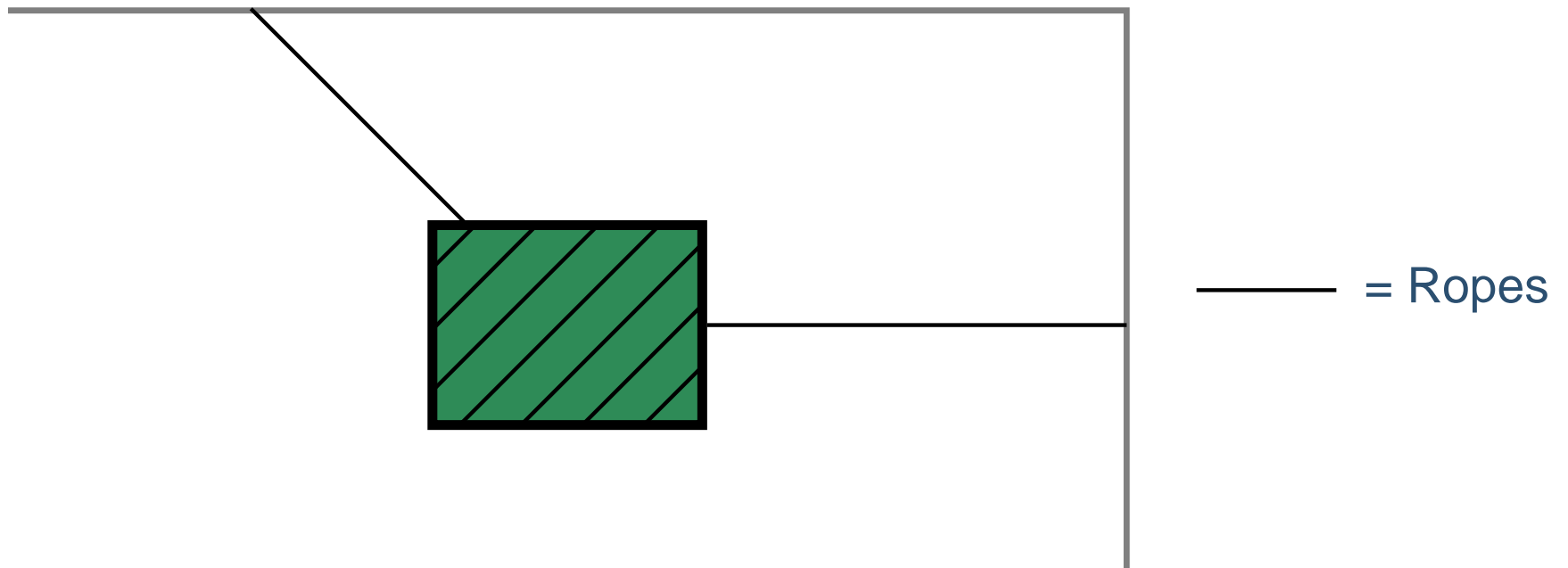


# Tension

Tension -  $\vec{T}$ , pulling force exerted by a thin rope, chain, or spring. Always in the same direction as the rope itself.

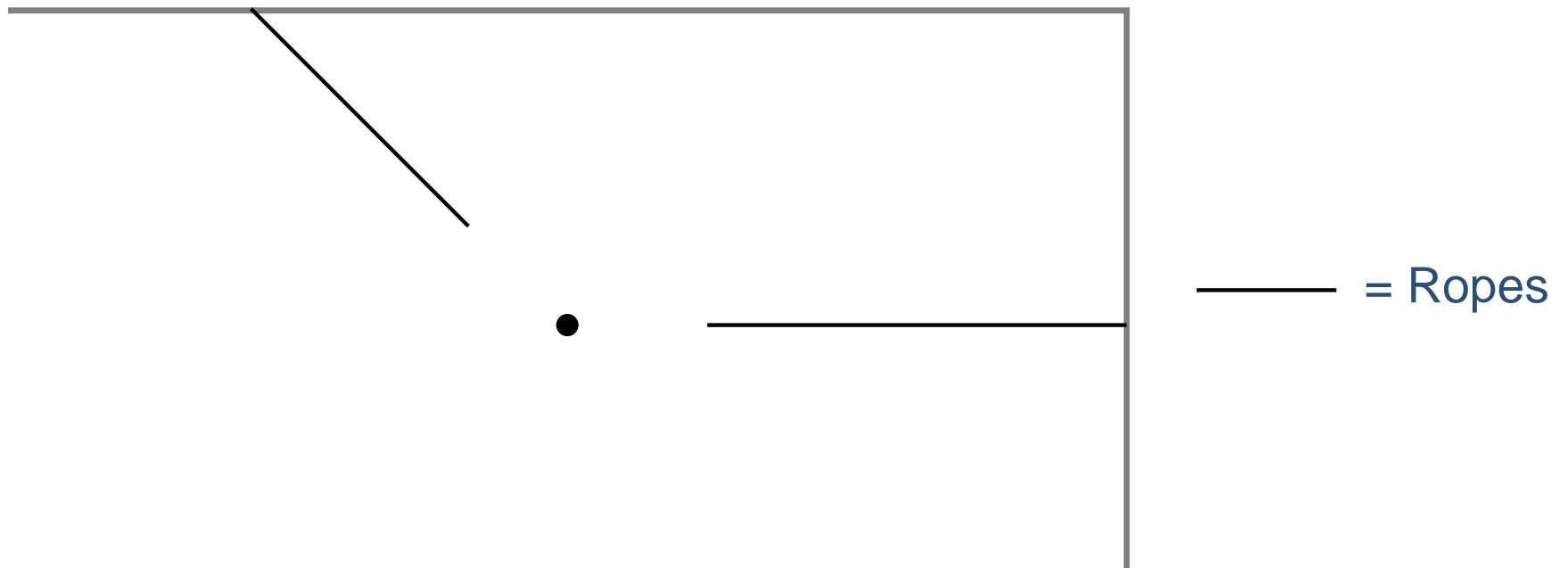
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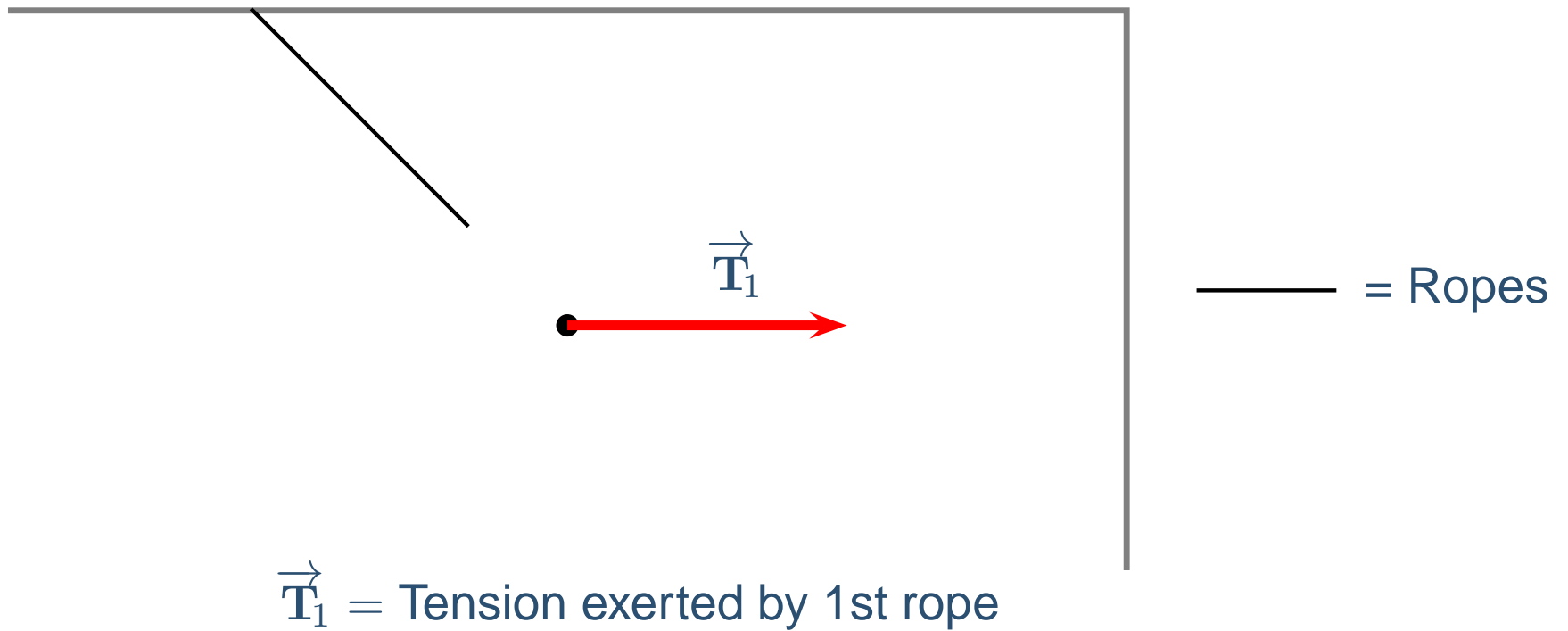
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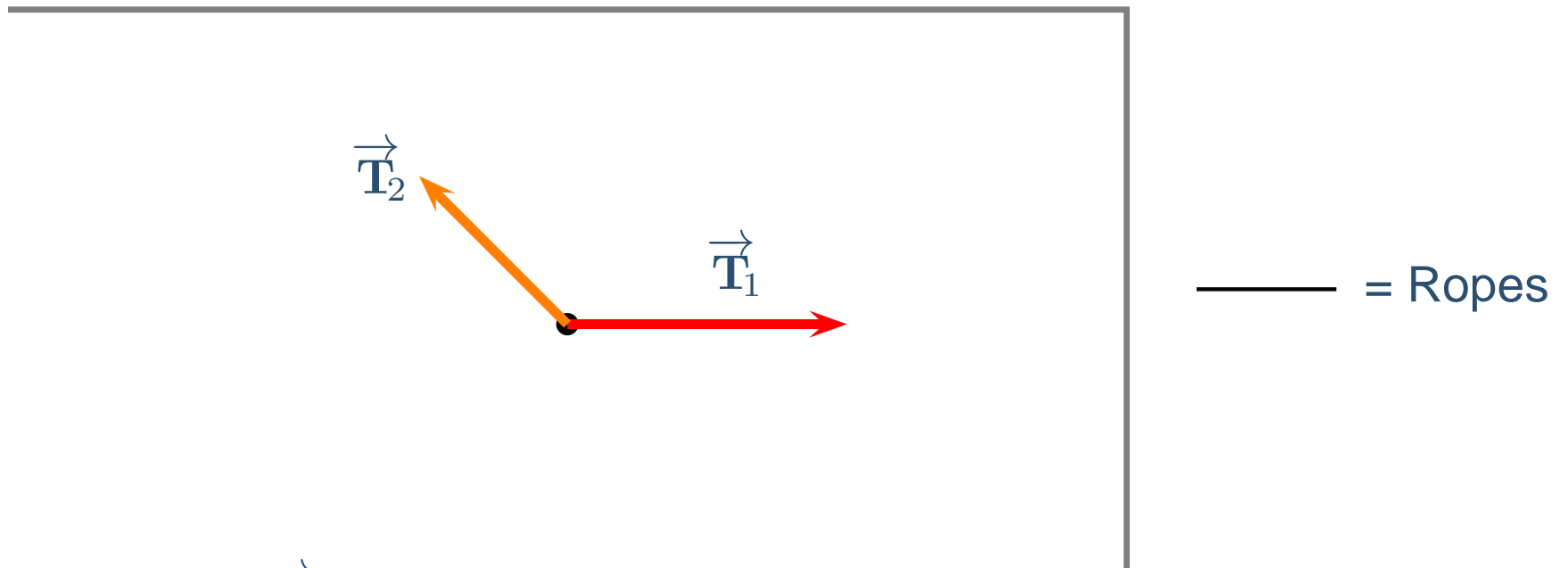
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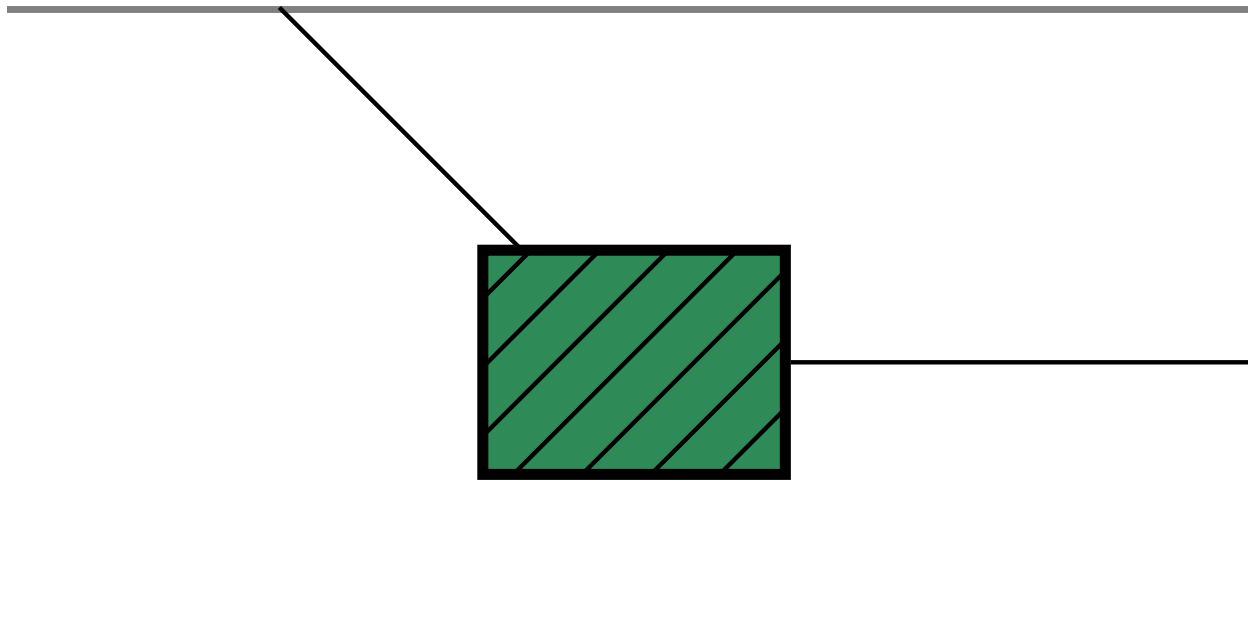
$\vec{T}_1$  = Tension exerted by 1st rope  
 $\vec{T}_2$  = Tension exerted by 2nd rope

# Identifying Forces

To identify what forces are acting on an object, draw a circle around the object and remember that only things that touch the object at the boundary can exert contact forces.

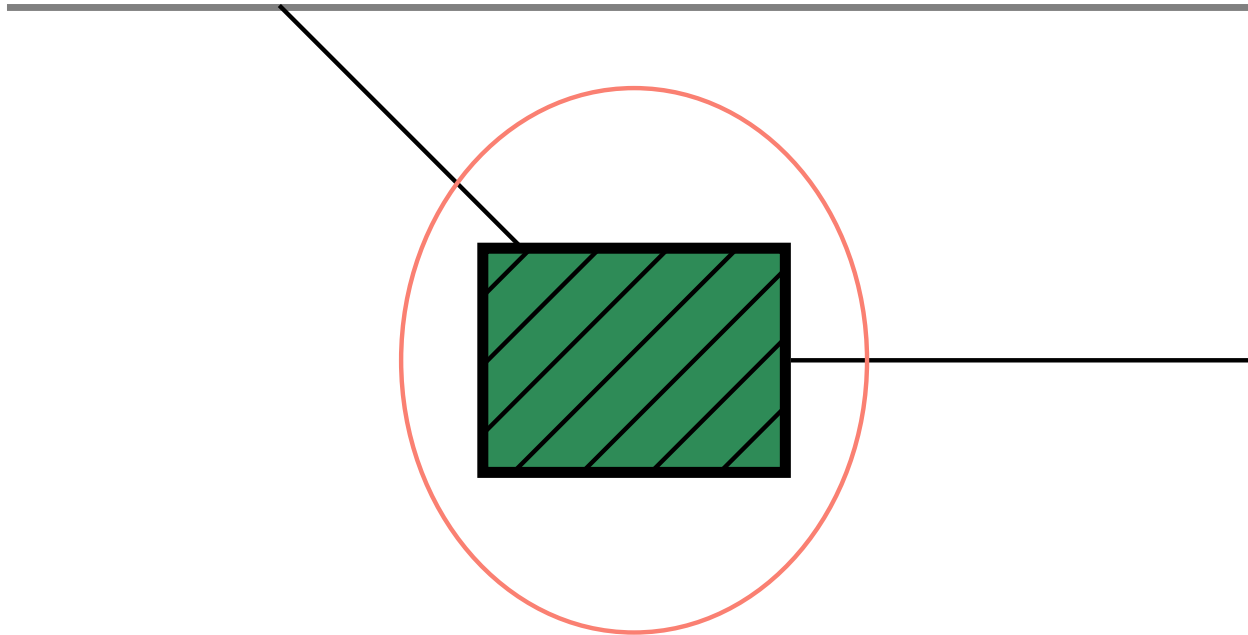
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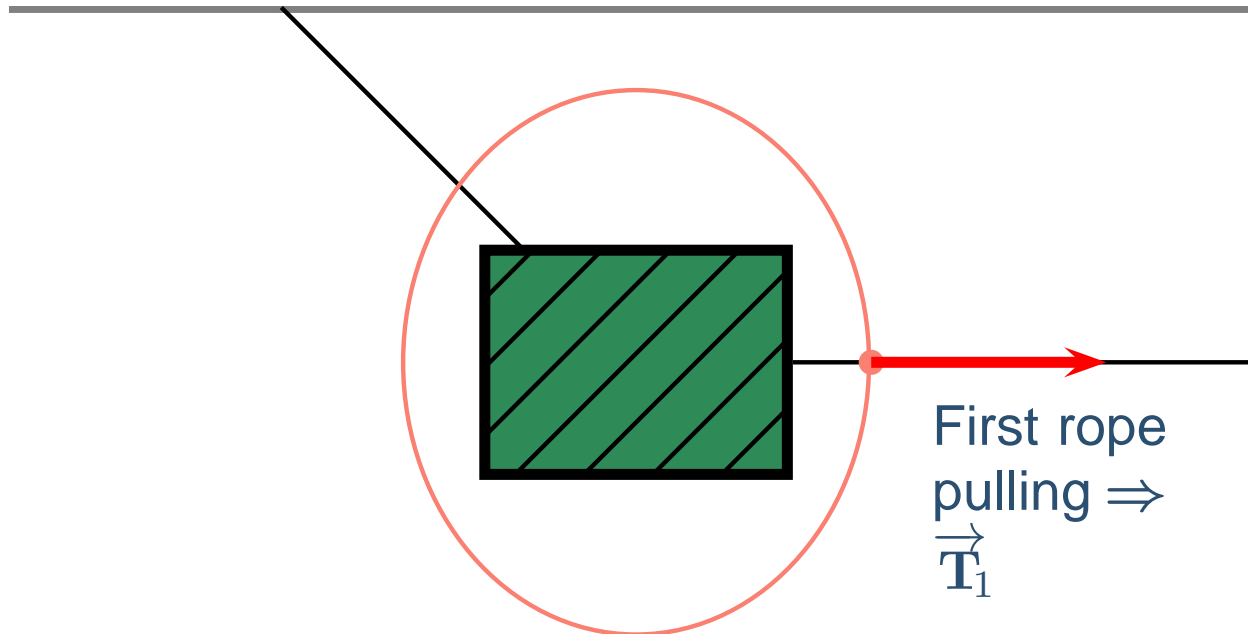
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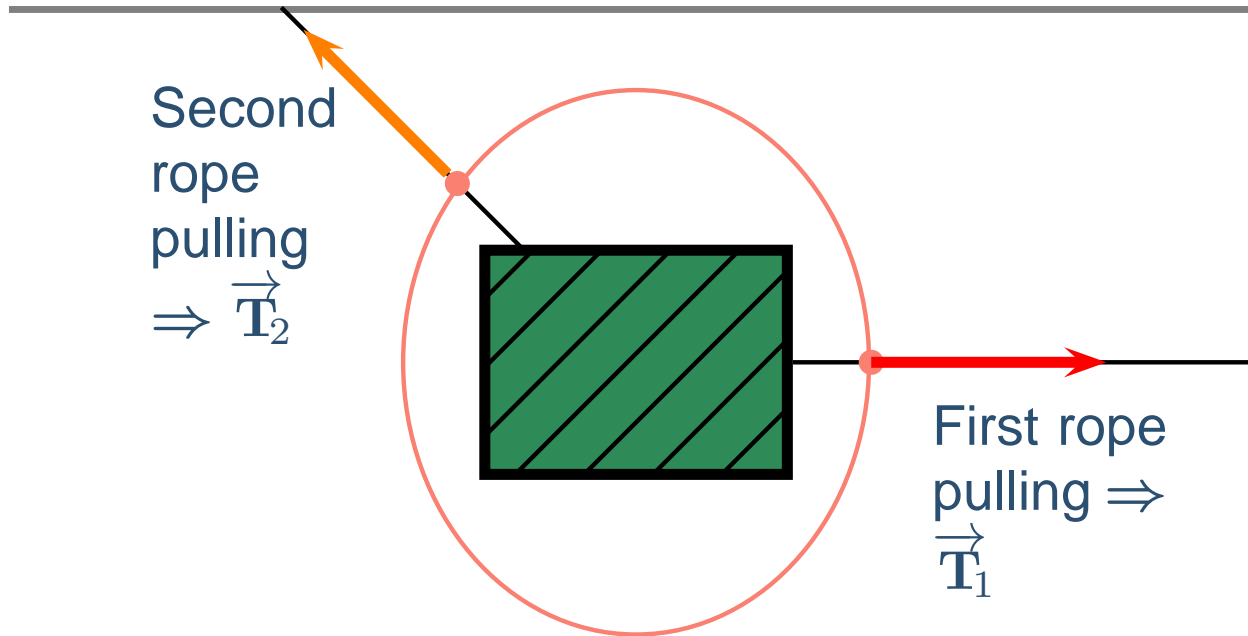
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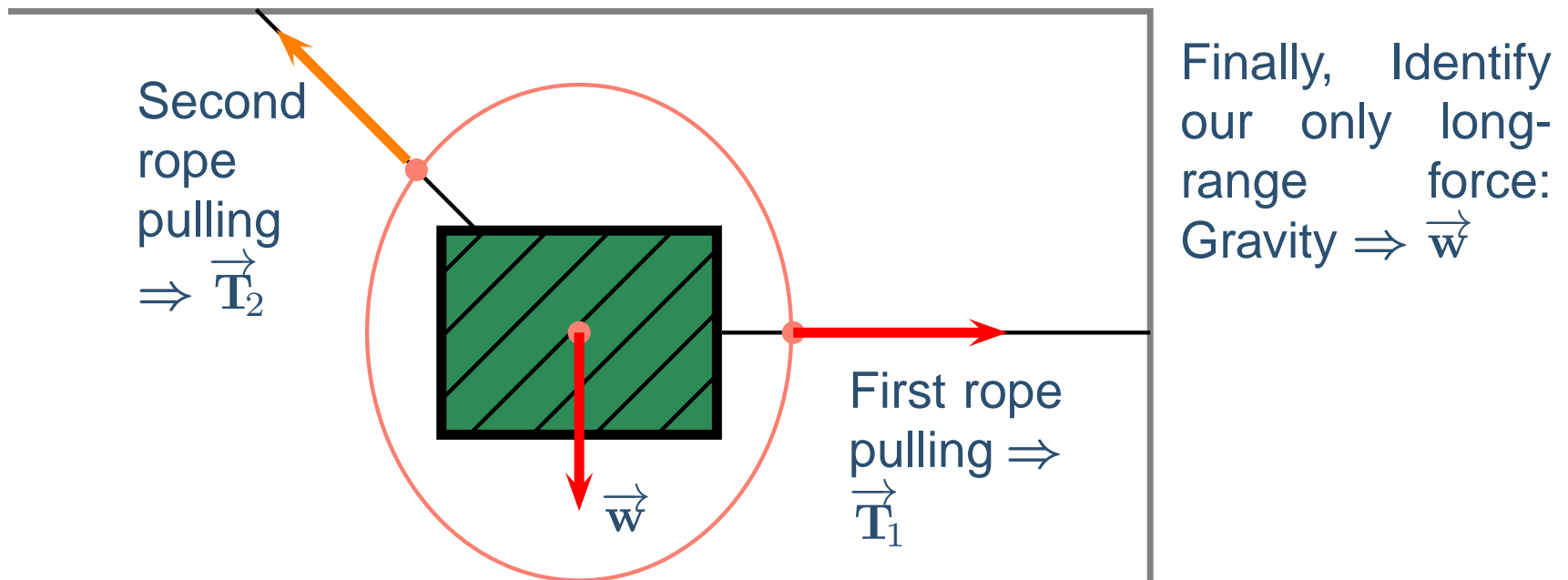
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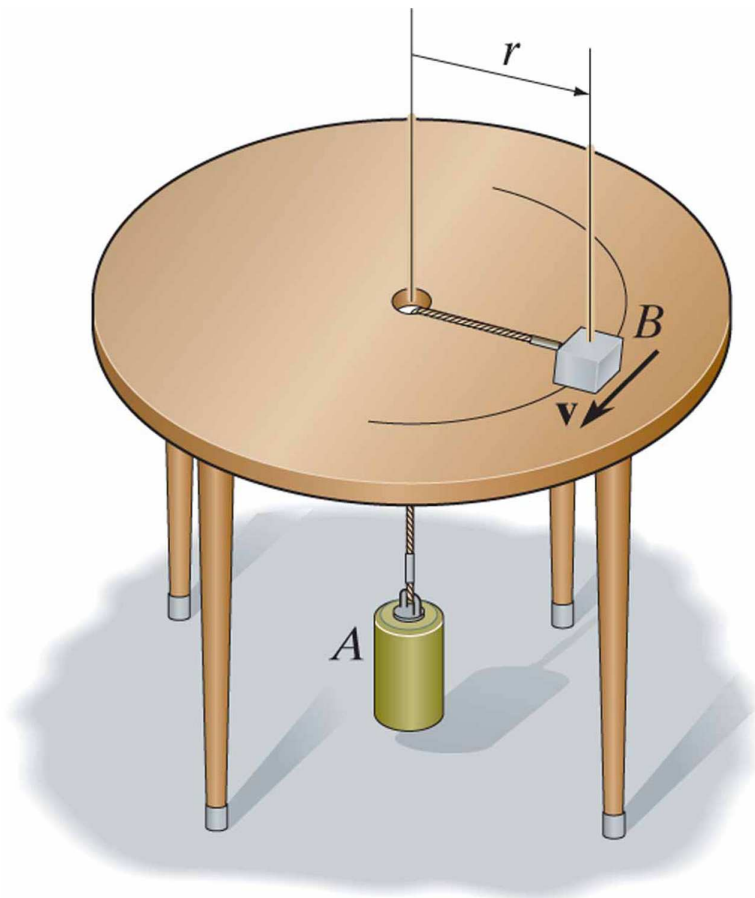
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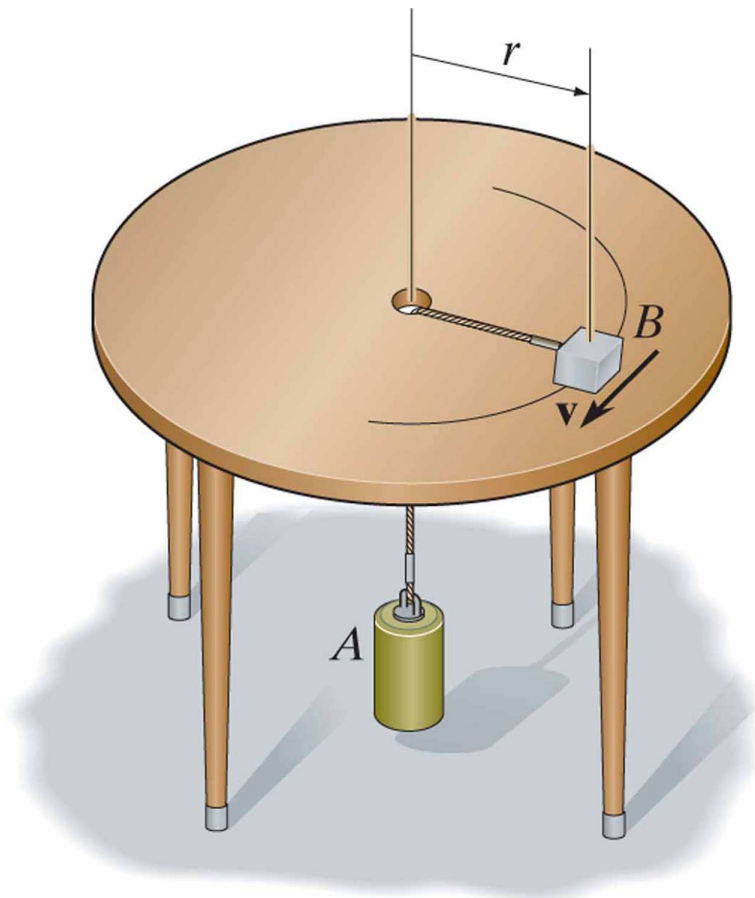
# Force Identification Exercise

Block  $B$  is circling around a rough table while connected to a rope that passes through a hole in the center of the table down to cylinder  $A$ . Which of the following forces do we *NOT* identify as acting on the block  $B$ ?



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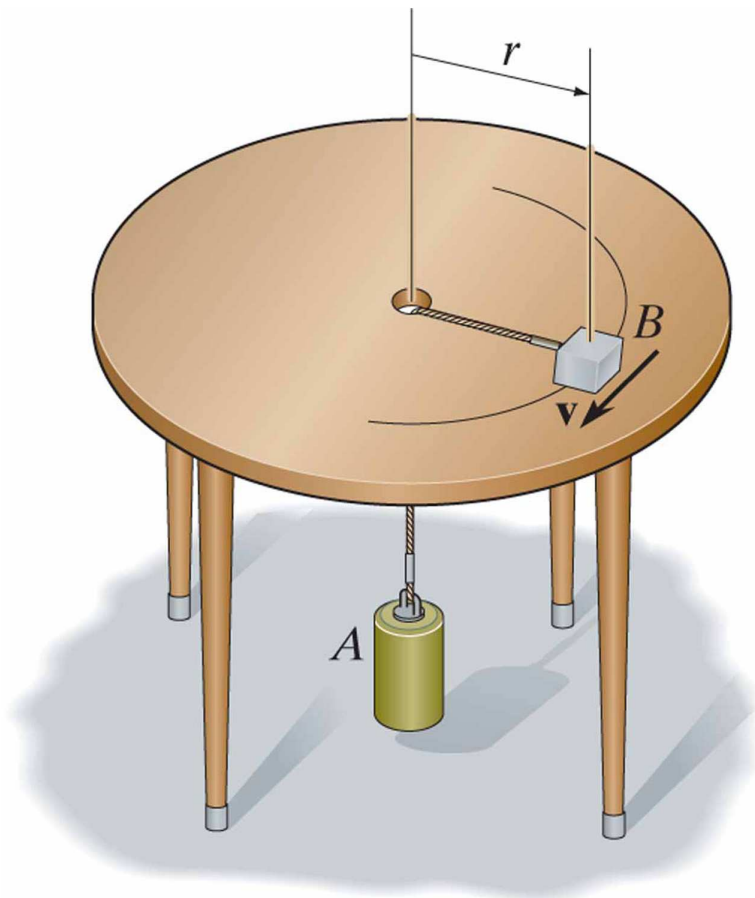
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(a) The weight of block  $B$

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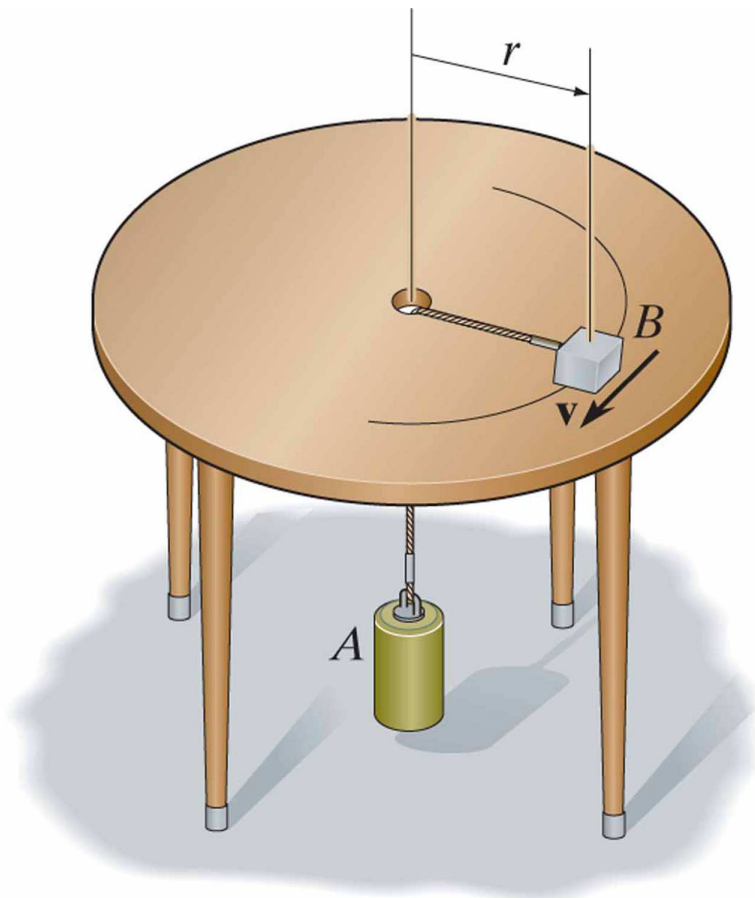


(a) The weight of block  $B$

(b) The weight of block  $A$

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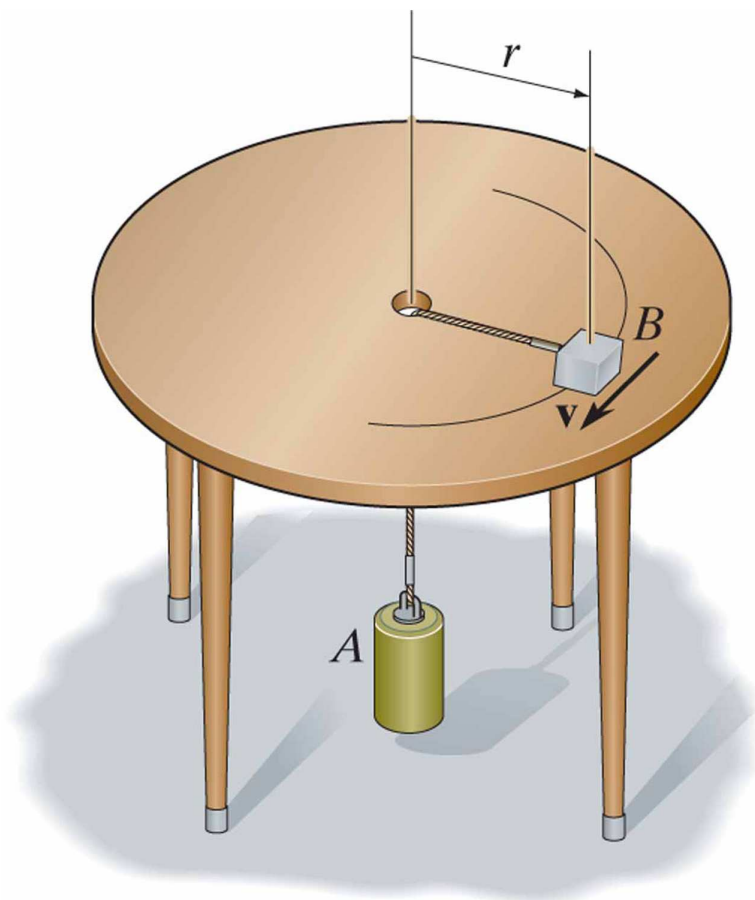
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- (a) The weight of block  $B$
- (b) The weight of block  $A$
- (c) Tension

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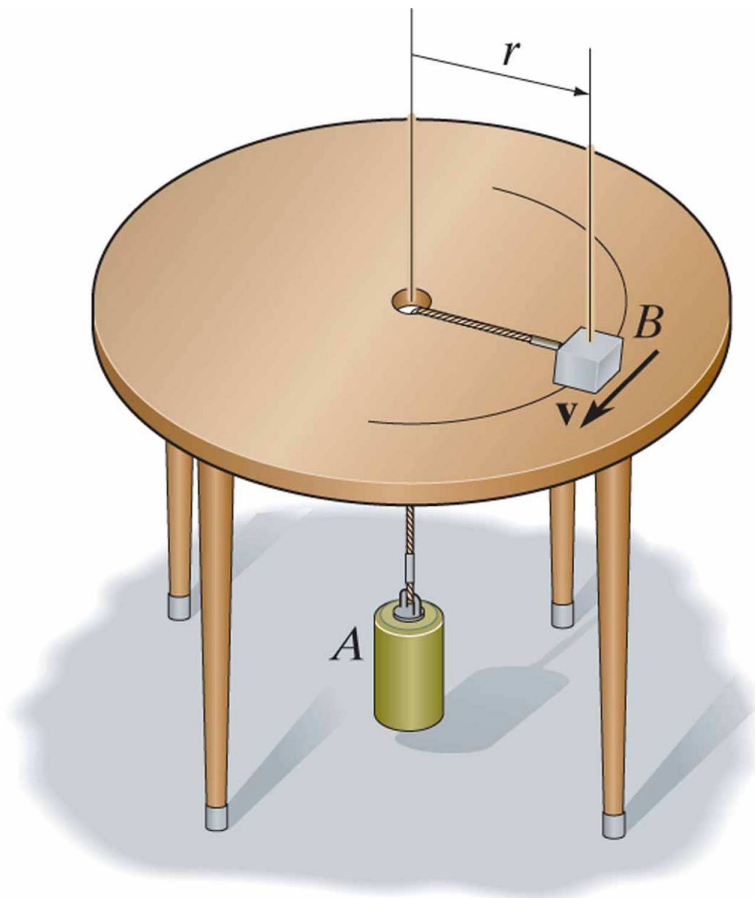


- (a) The weight of block  $B$
- (b) The weight of block  $A$
- (c) Tension
- (d) Friction



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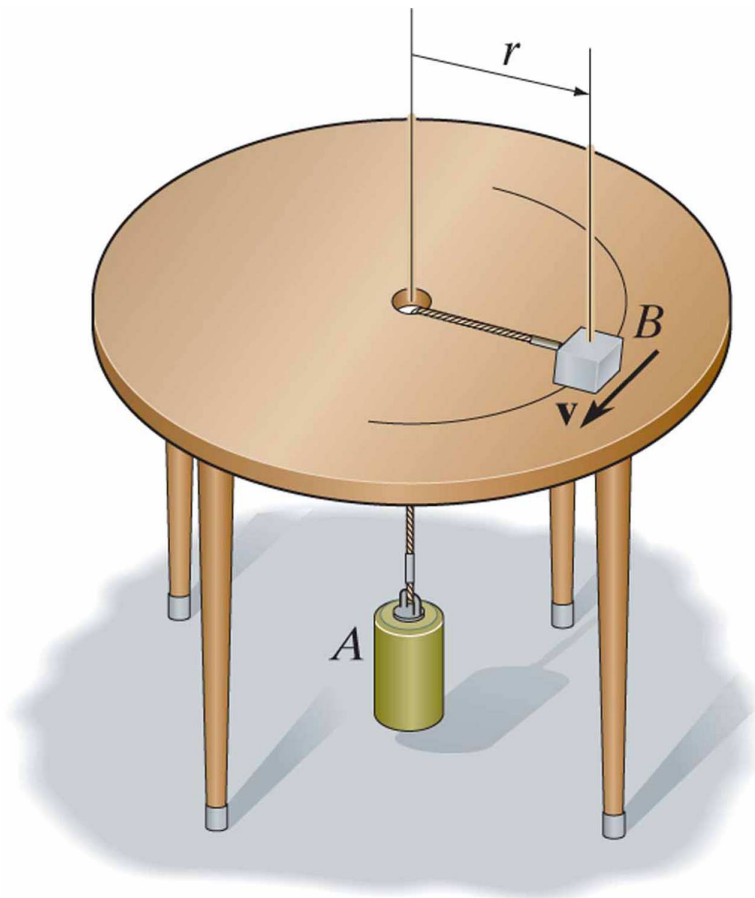
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- (b) The weight of block  $A$
- (c) Tension
- (d) Friction
- (e) The Normal force

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(a) The weight of block  $B$

(b) The weight of block  $A$

(c) Tension

(d) Friction

(e) The Normal force