Newton's Laws

I. An object in a state of motion will maintain that state of motion unless acted on by an outside force.

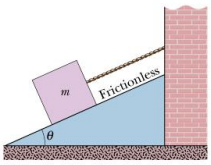
$$\text{If } \vec{F}_{net} = 0 \text{ then } \Delta\vec{v} = 0$$

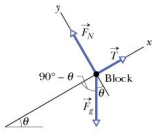
II. The acceleration of an object is proportional to the net force on the object.

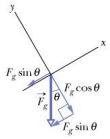
$$\vec{F}_{net} = m\vec{a}$$

III. For every force, there is an equal and opposite force.

$$\vec{F}_{AB} = -\vec{F}_{BA}$$





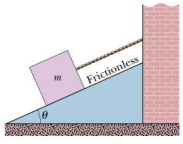


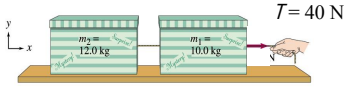
Recipe for the Application of Newton's Laws of Motion

1. Choose the system or component parts to be studied.
2. Make a simple sketch of the system (or its component parts).
   - Gather knowns
   - Take note of what the problem is asking for.
3. Choose a convenient coordinate system.
4. Draw a free-body diagram and identify all the forces that act on the system (or its parts).
5. Apply Newton's laws of motion to the system (or each part).
   - Set up a system of algebraic equations
   - Solve the system of equations.
   - Plug in any given values.

Some Basics

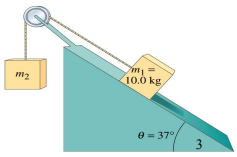
Types of (effective) forces
1. Gravity
2. Normal
3. Tension
4. Centripetal
5. Friction (Chapter 6)





Types of objects
1. Blocks
2. Ropes
3. Pulleys
4. Inclined planes

} simple machines



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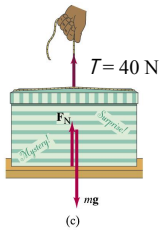
Example

A 10 kg box is sitting on the table. You pull up with a string attached to the box and apply 40 N.

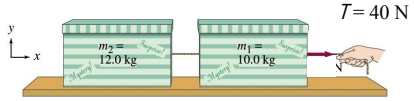
What is the normal force applied by the table on the box?



Example

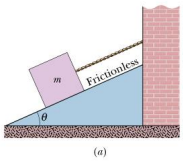
Two boxes are connected by a cord and pulled by a second cord attached to the first box with a force of 40.0 N. The two boxes have masses of 12.0 kg and 10.0 kg as shown.

Find the acceleration of each box and the tension in the cord.



Example

Block on a smooth inclined plane.

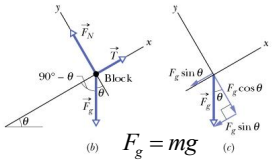


(a)

Choose a sensible coordinate system!

(a) Cord holds block in place.

$$\sum F_y = F_N - mg\cos\theta = 0$$
$$\sum F_x = T - mg\sin\theta = 0$$



$$F_g = mg$$

(a) Cord is cut.

$$\sum F_y = F_N - mg\cos\theta = 0$$
$$\sum F_x = -mg\sin\theta = ma_x \qquad \therefore a_x = -g\sin\theta$$