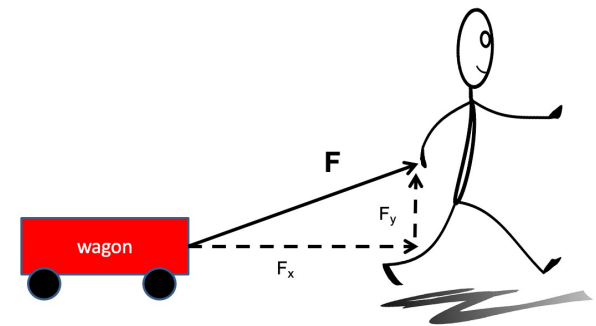


Forces and Free-Body Diagrams

- Forces Review
- Common Forces
- Free-Body Diagrams
- Analyzing Forces
- Force Vectors
- Choosing a coordinate system
- Practice



Preview File

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- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

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Forces around us

What happens when forces are in equilibrium?



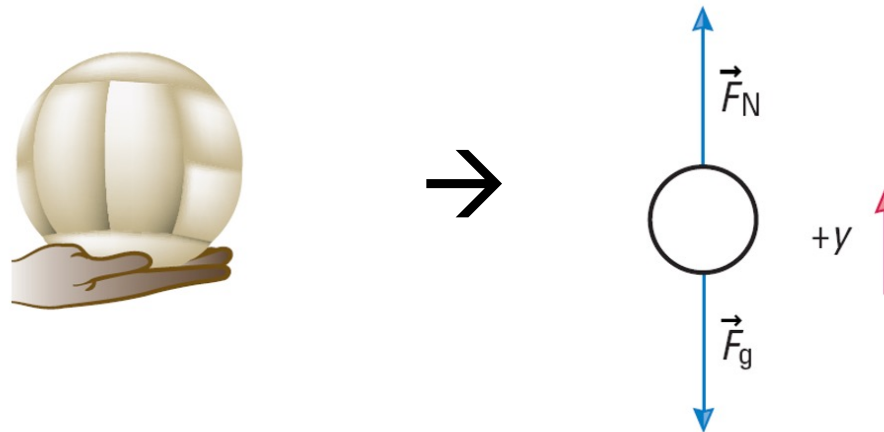
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Common Forces

Force	Symbol	Function
Gravity	F_g	Force of attraction between all objects
Normal	F_N	Force perpendicular to the surfaces of objects in contact
Tension	F_T	Force exerted by materials, such as ropes, fibres, springs, and cables, that can be stretched
Friction	F_f	Force that resists motion or attempted motion between objects in contact
Kinetic Friction	F_K	Force that acts against an object's motion
Static Friction	F_S	Force that tends to prevent a stationary object from starting to move
Air Resistance	F_{air}	Frictional force that opposes an object's motion through air
Applied Force	F_{app}	Any contact force not previous included

Free Body Diagram (FBD)

- A Free Body Diagram (FBD) is a drawing of a single object that shows only the forces (as vectors) acting on that object
- *Always indicate the $+x$ and $+y$ directions*



Check Your Understanding

You toss a ball vertically upward. Draw an FBD of the ball just before it leaves your hand.

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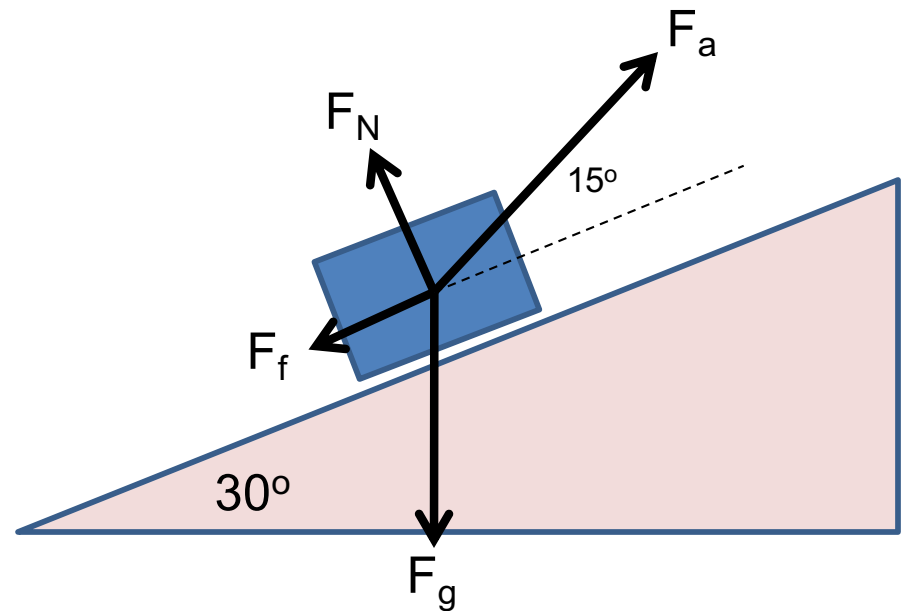
Check Your Understanding

A child pulls a sleigh up a snow-covered hill at a constant velocity with a force parallel to the hillside. Draw a FBD of the sleigh.

Analyzing Forces

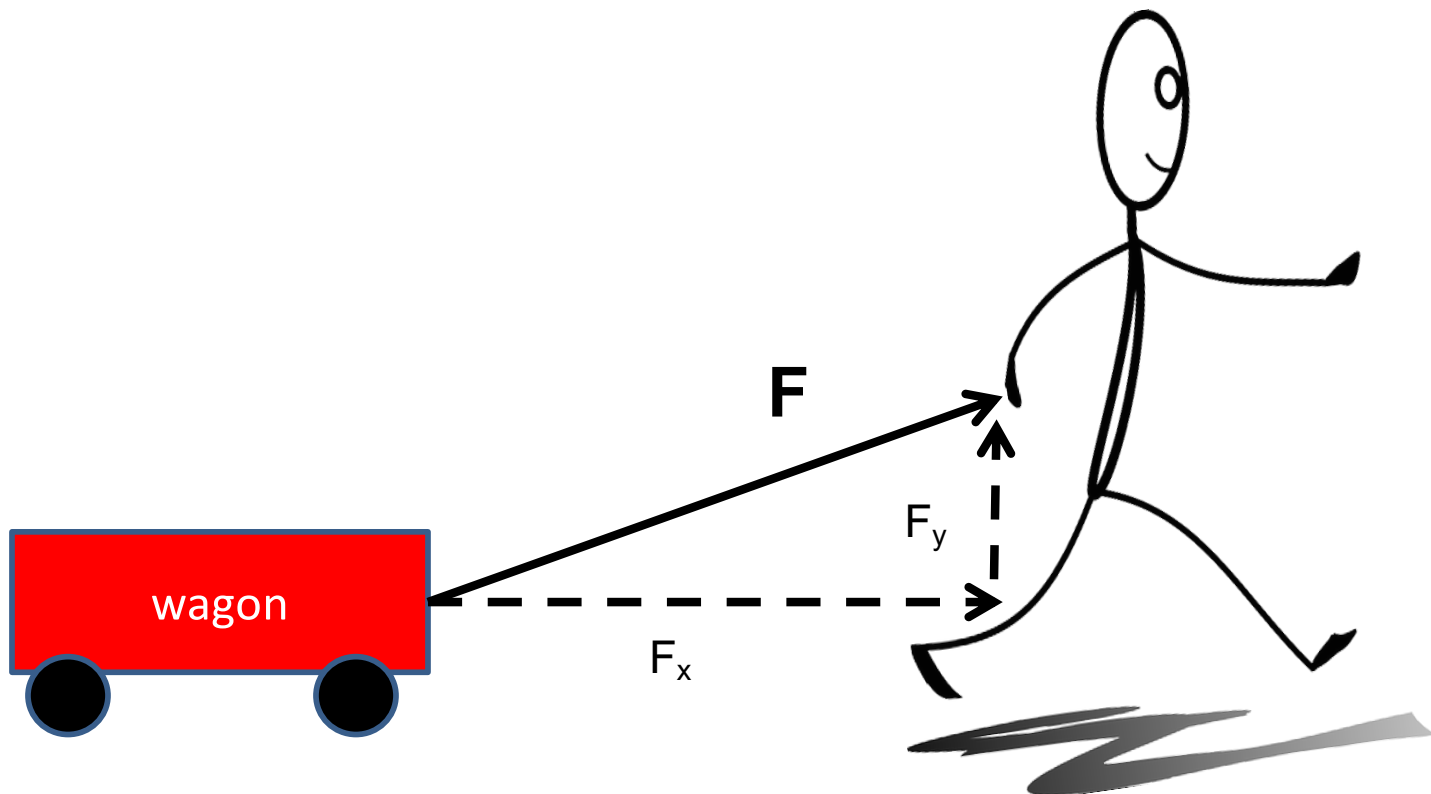
When analyzing a problem involving forces acting on an object, you must find the sum of all the forces acting on that object (called the net force).

$$\vec{F}_{net} = \sum \vec{F}$$



Force Vectors

In order to deal with force vectors that point in odd directions, we will resolve the vectors into components of the coordinate system.



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Check Your Understanding

In hitting a volleyball, a player applies an average force of 9.9 N [33° above the horizontal] for 5.0 ms. The force of gravity on the ball is 2.6 N [down]. Determine the net force on the ball as it is being struck.

Answer: 8.8 N [19° above the horizontal]

Check Your Understanding

A boat is secured to a lakeside pier with two horizontal ropes. A wind is blowing out to sea. The tensions in the ropes are $F_1 = 48 \text{ N [E } 16^\circ \text{ N]}$ and $F_2 = 48 \text{ N [E } 16^\circ \text{ S]}$.

- a) Use a vector scale diagram to determine the sum of the tension forces in the two ropes.
- b) Assuming that the net horizontal force on the boat is zero, determine the force of the wind on the boat.

Answer: a) 92 N [E] b) If the tension force is 92 N [E] and the boat is stationary, the force of the wind must be 92 N [W]

Practice

Determine the net force on the following objects.

1. At a particular instant, a soaring bird travelling east is subject to an upward lift of 3.74 N, a downward gravitational force of 3.27 N, and a horizontal air resistance force of 0.354 N west.
2. A crate is being dragged across a horizontal icy sidewalk by two people pulling horizontally on cords (below). The net horizontal force on the crate is 56 N [16° S of E]. The tension in cord 1 is 27 N [E]. If friction is negligible, determine the tension in cord 2.

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Practice #2

Determine the net force.

A crate is being dragged across a horizontal icy sidewalk by two people pulling horizontally on cords (below). The net horizontal force on the crate is 56 N [16° S of E]. The tension in cord 1 is 27 N [E]. If friction is negligible, determine the tension in cord 2.

$$\mathbf{T_2 = 31\text{ N [E } 30^\circ \text{ S]}}$$