
Discussion 3: Force

Objective

- State and apply the relationship between force and motion.

Summary

Newton's laws of motion

1. $(\sum \vec{F} = \vec{0}) \Leftrightarrow (\vec{a} = \vec{0})$
2. $\vec{a} = \sum \vec{F} / m$
3. $\vec{F}_{1 \rightarrow 2} = -\vec{F}_{2 \rightarrow 1}$

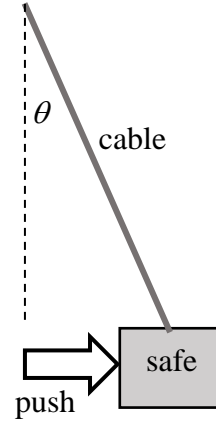
Problems

There is not room on this worksheet for your work. Use scratch paper.

1. A 2880-kg elevator suspended by a steel cable accelerates upward at a rate of 1.0 m/s^2 . Find the tension \vec{F}_T in the cable using the following procedure.
 - a. Draw a diagram of the situation. Indicate your coordinate axes and origin.
 - b. List the forces acting on the elevator. Make a free-body diagram for the elevator.
 - c. Find the weight \vec{F}_g of the elevator (magnitude and direction).
 - d. Complete the table below. Use Newton's second law and the rules for addition of vectors to find the formulas.

vector	x	y
\vec{F}_g	$mg_x = 0$	$mg_y =$
\vec{F}_T		
$\sum \vec{F}$	$ma_x = 0$	$ma_y =$
\vec{a}	0	1.0 m/s^2

2. A 225-kg safe carried by a crane hangs from a cable. A worker installing the safe pushes the safe horizontally, so that the safe is motionless with the cable at an angle of $\theta = 20^\circ$ from vertical. What is the magnitude of the worker's push F_P ? What is the tension F_T in the cable?



- Draw a diagram of the situation. Include coordinate axes in the diagram. Here, I'll ask that you make x horizontal and y vertical.
- Draw a labeled free body diagram for the safe.
- Decompose the cable tension vector \vec{F}_T into its x and y components by identifying and applying the appropriate trigonometric functions of the angle θ .

$$F_{Tx} = F_T \sin \theta$$

$$F_{Ty} = F_T \cos \theta$$

- Complete the table below to find the magnitudes of F_P and F_T . Signs matter! Make sure they are consistent with your coordinate axes.

vector	x	y
\vec{F}_g	$mg_x = 0$	$mg_y =$
\vec{F}_P	$F_P =$	0
\vec{F}_T	$F_{Tx} =$	$F_{Ty} =$
$\Sigma \vec{F}$	0	0

3. Two tugboats push a large (5.0×10^6 kg) tanker ship to dock. The first tugboat pushes with a force of 50,000 N due north (0°), and the second pushes with a force of 100,000 N 50° east of north (50°). Find the magnitude and direction of the ship's resulting acceleration.

Feel free to use tools and techniques from the previous problems.