Warm Up

If I push on a wall and the wall falls over, who feels more force: me or the wall? Newton's 3rd Law says the forces are the same.

Objective: SWBAT solve problems with forces in ~~one~~ two dimensions

Agenda:

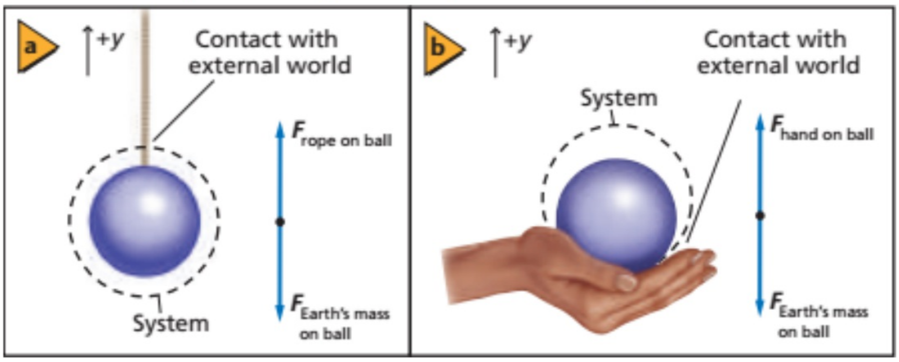
- Warm Up
- HW Huddle
- Notes
- Practice
- Reflection

Notes: Free Body Diagrams

A free-body diagram represents the system as a point particle, and the forces acting on it as arrows.

Any force from outside the system gets represented, even interaction forces.

Size of arrow = magnitude of force



Some Common Forces

Table 4-2			
Some Types of Forces			
Force	**Symbol**	**Definition**	**Direction**
Friction	F_f	The contact force that acts to oppose sliding motion between surfaces	Parallel to the surface and opposite the direction of sliding
Normal	F_N	The contact force exerted by a surface on an object	Perpendicular to and away from the surface
Spring	F_{sp}	A restoring force; that is, the push or pull a spring exerts on an object	Opposite the displacement of the object at the end of the spring
Tension	F_T	The pull exerted by a string, rope, or cable when attached to a body and pulled taut	Away from the object and parallel to the string, rope, or cable at the point of attachment
Thrust	F_{thrust}	A general term for the forces that move objects such as rockets, planes, cars, and people	In the same direction as the acceleration of the object, barring any resistive forces
Weight	F_g	A field force due to gravitational attraction between two objects, generally Earth and an object	Straight down toward the center of Earth

Notes: Gravity Near Earth

Close to the earth's surface, the gravitational force F_g = mg in a downwards direction.

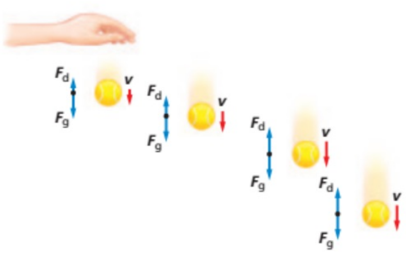
- A system that has only gravity acting on it (ignoring air resistance) is said to be in free fall.

Notes: Drag and Terminal Velocity

When an object moves through a fluid (like air), it feels a drag force that depends on:

- the motion of the object (the force is velocity-dependent)
- the properties of the object (especially surface area)
- the properties of the fluid

After a certain point, a falling object will feel the drag force and gravitational force balance out. The velocity of the object in this state is called terminal velocity.

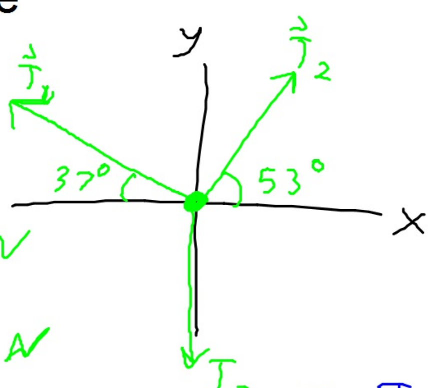


Strategy for Solving Force Problems

1. sketch a picture
2. identify the system and choose a coordinate system
3. draw a free body diagram of the system and forces
4. determine what you need to find and what you know
5. create a plan to answer the question

Example

pg. 102: A Traffic Light At Rest



$\vec{T}_3 = \vec{F}_g$

$F_{net,x} = T_{2,x} - T_{1,x} = 0\,N$

$F_{net,y} = T_{1,y} + T_{2,y} - T_3 = 0\,N$

$T_{2,x} = T_{1,x} \rightarrow T_2 \cos 53 = T_1 \cos 37 \rightarrow T_2 = T_1 \frac{\cos 37}{\cos 53}$

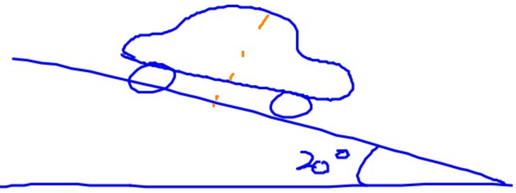
$T_{1,y} + T_{2,y} = T_3 \rightarrow T_1 \sin 37 + T_2 \sin 53 = T_3$

$T_1 \sin 37 + \left(T_1 \frac{\cos 37}{\cos 53}\right) \sin 53 = T_3$

$T_1 (\sin 37 + \cos 37 \tan 53) = 100\,N \rightarrow T_1 = 164\,N$

$T_2 = 217\,N$

Example

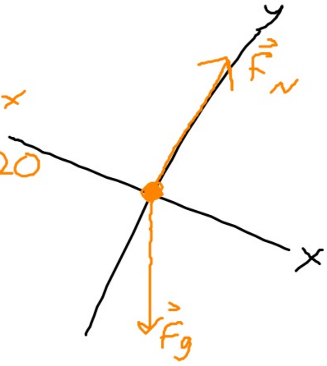


pg. 105: The Runaway Car

a) $a = ?$

b) $\Delta x = 25.0\,m$, $v_0 = 0\,m/s$, $t = ?$

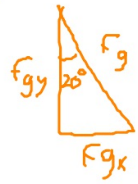
c) $v = ?$



$F_{net,x} = F_{g,x} = mg\sin 20° = ma_x$

$F_{net,y} = 0 = F_N - F_{g,y} = F_N - mg\cos 20$

$a_x = g\sin 20° = (9.8\,m/s^2)\sin 20° \approx 3.35\,m/s^2$



$x = x_0 + v_0 t + \frac{1}{2}at^2$

$t^2 = \frac{2x}{a} \rightarrow t = \sqrt{\frac{2(25m)}{(3.35\,m/s^2)}} \approx 3.86\,s$

$v = at = (3.35\,m/s^2)(3.86\,s) \approx 12.9\,m/s$

Practice

Section 4.5

Reflection

How can we compare magnitudes on a free body diagram?