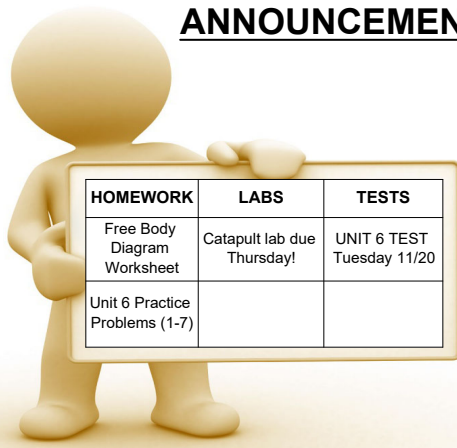
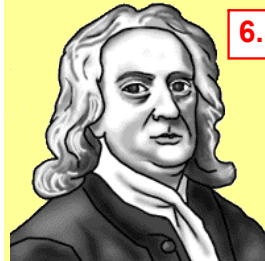


ANNOUNCEMENTS



6.4 Newton's 3rd Law

LEARNING TARGETS



6.3 I can define, explain, and apply Newton's third law to solve problems.



Newton's Laws of Motion

1. Newton's First Law of Motion
 - Every object will continue in a **state of rest** or **with constant speed in a straight line** unless acted upon by an external force.
2. Newton's Second Law of Motion
 - When a net force act on an object, the **object accelerates** in the direction of the net force. The acceleration is directly proportional to the net force and inversely proportional to the mass. Thus, $a \sim F/m$ or, $a \propto F/m$



Mass vs. Weight

Mass

Weight

- a measure of how much matter an object is made of
- does not change, regardless of where something or someone is

- the force of gravity on an object
- equal to the mass of the body times the local acceleration of gravity



Mass = 59 kg

Weight = 579 N

Why do you think the person's weight is less on the moon?



Mass = 59 kg

Weight = 96 N

<http://www.exploratorium.edu/ronh/weight/index.html>



Force?

A force is an interaction between two objects.



Newton's 3rd Law

Forces come in "pairs"

An **interaction pair** is two forces that are in opposite directions and have equal magnitude.



Newton's 3rd Law

For every force that acts on an object, there is a reaction force acting on a different object that is equal in magnitude and opposite in direction.

ACTION = -REACTION

Simple Formula

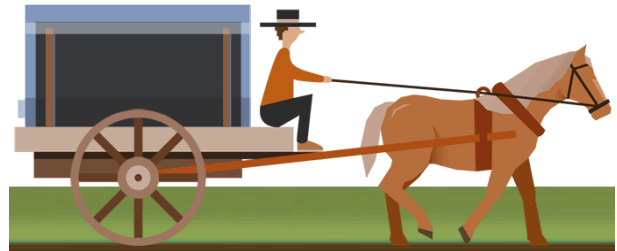
ACTION A acts on B

REACTION B acts on A

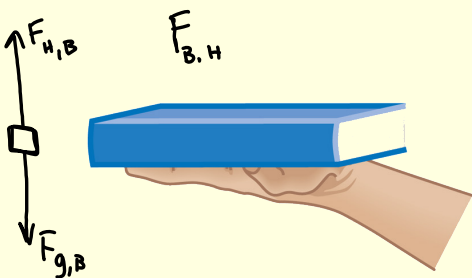
Motion



The Horse and The Carriage

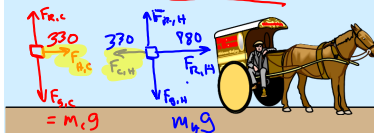


Free-Body Diagram



Horse and Carriage

A 500 kg horse pulls a 300 kg carriage with an acceleration of 1.10 m/s^2 . What is the net force exerted by the horse on the carriage?



$$F_{net,c} = F_{H,c}$$

$$m_c a_c = F_{H,c}$$

$$(300 \text{ kg})(1.10 \text{ m/s}^2) = F_{H,c}$$

$$330 \text{ N} = F_{H,c}$$

Horse and Carriage

What force does the carriage exert on the horse?

$$F_{c,H} = -330 \text{ N}$$



Horse and Carriage

What is the net force acting on the horse?

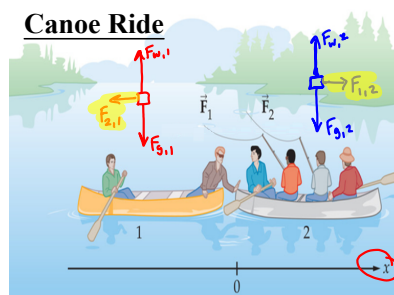
$$F_{net,H} = m_H a_H = (500 \text{ kg})(1.10 \text{ m/s}^2)$$

$$F_{net,H} = 550 \text{ N}$$



Canoe Ride

Two groups of canoeists meet in the middle of a lake. After a brief visit, a person in canoe 1 pushes on canoe 2 with a force of 46 N to separate the canoes. If the mass of canoe 1 and its occupants is $m_1=150 \text{ kg}$, and the mass of canoe 2 and its occupants is $m_2=250 \text{ kg}$, find the acceleration the push gives to each canoe.



$$F_{net,1} = F_{2,1}$$

$$F_{net,2} = F_{1,2}$$

$$m_1 a_1 = F_{2,1}$$

$$m_2 a_2 = F_{1,2}$$

$$(150 \text{ kg}) a_1 = -46 \text{ N}$$

$$(250 \text{ kg}) a_2 = 46 \text{ N}$$

$$a_1 = -0.30 \text{ m/s}^2$$

$$a_2 = 0.18 \text{ m/s}^2$$

HOMEWORK

Practice Problems (8-11)