Newton's Laws **Name:** _____

Inertia and Mass

Read from **Lesson 1** of the **Newton's Laws** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/newtlaws/u2l1a.html
http://www.physicsclassroom.com/Class/newtlaws/u2l1b.html

1. **Inertia** is _____

   _____

2. The amount of inertia possessed by an object is dependent solely upon its _____.

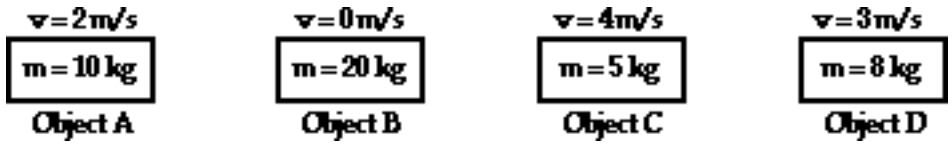
3. Two bricks are resting on edge of the lab table. Shirley Sheshort stands on her toes and spots the two bricks. She acquires an intense desire to know which of the two bricks are most massive. Since Shirley is vertically challenged, she is unable to reach high enough and lift the bricks; she can however reach high enough to give the bricks a push. Discuss how the process of pushing the bricks will allow Shirley to determine which of the two bricks is most massive. What difference will Shirley observe and how can this observation lead to the necessary conclusion?

4. Would Shirley Sheshort be able to conduct this same study if she was on a spaceship in a location in space far from the influence of significant gravitational forces? _____ Explain your answer.

5. If a moose were chasing you through the woods, its enormous mass would be very threatening. But if you zigzagged, then its great mass would be to your advantage. Explain why.

6. Inertia can best be described as _____.
   a. the force which keeps moving objects moving an stationary objects at rest.
   b. the willingness of an object to eventually lose its motion
   c. the force which causes all objects to stop
   d. the tendency of any object to resist change and keep doing whatever its doing

7. Mass and velocity values for a variety of objects are listed below. Rank the objects from smallest to greatest inertia. _____ < _____ < _____ < _____



Newton's Second Law of Motion

Read from **Lesson 3** of the **Newton's Laws** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/newtlaws/u2l3a.html
http://www.physicsclassroom.com/Class/newtlaws/u2l3b.html

1. The acceleration of an object is _____ related to the net force exerted upon it and _____ related to the mass of the object. In equation form: $a = F_{net} / m$.
   a. directly, inversely b. inversely, directly c. directly, directly d. inversely, inversely

2. Use Newton's second law to predict the effect of an alteration in mass or net force upon the acceleration of an object.
   a. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon increased by a factor of 2. The new acceleration will be _____ m/s^2.

   b. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon increased by a factor of 4. The new acceleration will be _____ m/s^2.

   c. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon decreased by a factor of 2. The new acceleration will be _____ m/s^2.

   d. An object is accelerating at a rate of 8 m/s^2 when it suddenly has its mass increased by a factor of 2. The new acceleration will be _____ m/s^2.

   e. An object is accelerating at a rate of 8 m/s^2 when it suddenly has its mass decreased by a factor of 4. The new acceleration will be _____ m/s^2.

   f. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon increased by a factor of 2 and its mass decreased by a factor of 4. The new acceleration will be _____ m/s^2.

   g. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon increased by a factor of 4 and its mass increased by a factor of 2. The new acceleration will be _____ m/s^2.

   h. An object is accelerating at a rate of 8 m/s^2 when it suddenly has the net force exerted upon increased by a factor of 3 and its mass decreased by a factor of 4. The new acceleration will be _____ m/s^2.

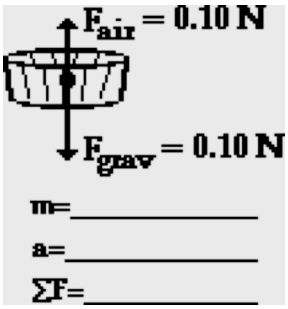
Newton's Second Law

Read from **Lesson 3** of the **Newton's Laws** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/newtlaws/u2l3c.html
http://www.physicsclassroom.com/Class/newtlaws/u2l3d.html

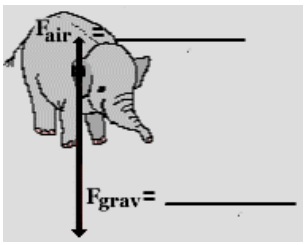
Free-body diagrams are shown for a variety of physical situations. Use Newton's second law of motion ($\sum F = m \bullet a$) to fill in all blanks. Use the approximation that g = ~10 m/s/s.

a.



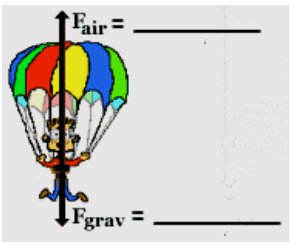
m=_____
a=_____
ΣF=_____

b.



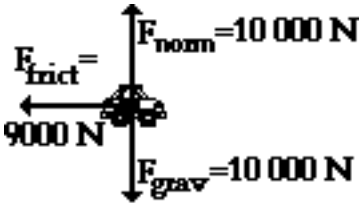
m=10000 kg
a = 8.0 m/s/s, down
ΣF = _____

c.



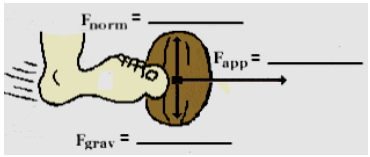
m=800 kg
a = 6.0 m/s/s, up
ΣF = _____

d.



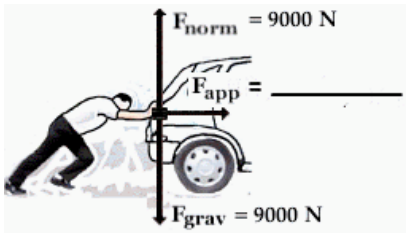
m=_____
a=_____
ΣF=_____

e.



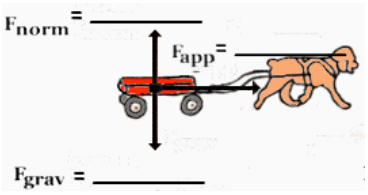
m=0.500 kg
a = _____
ΣF = 124 N, right

f.



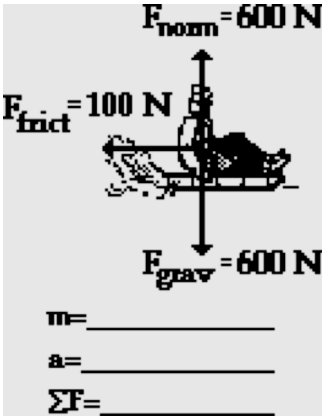
m= _____
a = 1.50 m/s/s, right
ΣF = _____

g.



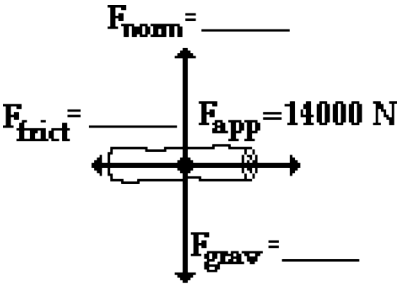
m=15.0 kg
a = 0.50 m/s/s, right
ΣF = _____

h.



m=_____
a=_____
ΣF=_____

i.



m=2000 kg
a= 2.0 m/s/s, right
ΣF=_____

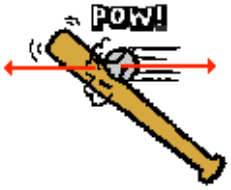
Newton's Third Law

Read from **Lesson 4** of the **Newton's Laws** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/newtlaws/u2l4a.html
http://www.physicsclassroom.com/Class/newtlaws/u2l4b.html

A force is a push or pull resulting from an interaction between two objects. Whenever there is a force, there are two objects involved - with both objects pushing (or pulling) on each other in opposite directions. While the direction of the pushes (or pulls) is opposite, the strength or magnitude is equal. This is sometimes stated as Newton's Third Law of motion: *for every action, there is an equal and opposite reaction*. A force is a push or a pull and it always results from an interaction between two objects. These forces always come in pairs.

1. For each stated *action force*, identify the *reaction force*.

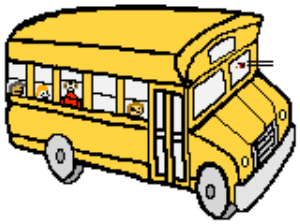


Bat hits ball.

_____

Man pushes car.

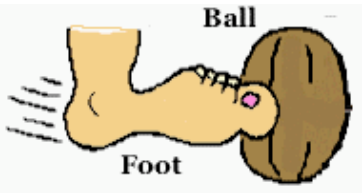
_____



Bus hits bug.

_____

2. Identify by words the action-reaction force pairs in each of the following diagrams.

Newton's Laws

3. **TRUE** or **FALSE**:

   As you sit in your seat in the physics classroom, the Earth pulls down upon your body with a gravitational force; the reaction force is the chair pushing upwards on your body with an equal magnitude.

   If False, correct the answer.

4. Shirley Bored sits in her seat in the English classroom. The Earth pulls down on Shirley's body with a gravitational force of 600 N. Describe the reaction force of the force of gravity acting upon Shirley.

5. Use Newton's third law (law of action-reaction) and Newton's second law (law of acceleration: $a = F_{net}/m$) to complete the following statements by filling in the blanks.

   a. A bullet is loaded in a rifle and the trigger is pulled. The force experienced by the bullet is _____ (less than, equal to, greater than) the force experienced by the rifle. The resulting acceleration of the bullet is _____ (less than, equal to, greater than) the resulting acceleration of the rifle.

   b. A bug crashes into a high-speed bus. The force experienced by the bug is _____ (less than, equal to, greater than) the force experienced by the bus. The resulting acceleration of the bug is _____ (less than, equal to, greater than) the resulting acceleration of the bus.

   c. A massive linebacker collides with a smaller halfback at midfield. The force experienced by the linebacker is _____ (less than, equal to, greater than) the force experienced by the halfback. The resulting acceleration of the linebacker is _____ (less than, equal to, greater than) the resulting acceleration of the halfback.

   d. The 10-ball collides with the 14-ball on the billiards table (assume equal mass balls). The force experienced by the 10-ball is _____ (less than, equal to, greater than) the force experienced by the 14-ball. The resulting acceleration of the 10-ball is _____ (less than, equal to, greater than) the resulting acceleration of the 14-ball.