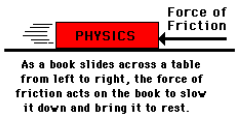
CH 4: NEWTON 1ST LAW - INERTIA AND MASS



Newton's first law of motion states that "An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force." Objects tend to "keep on doing what they're doing." In fact, it is the natural tendency of objects to resist changes in their state of motion. This tendency to resist changes in their state of motion is described as **inertia**.

1. **What is meant by the phrase *state of motion*?**

Newton's first law of motion declares that a force is not needed to keep an object in motion. Slide a book across a table and watch it slide to a rest position. The book in motion on the table top does not come to a rest position because of the *absence* of a force; rather it is the *presence* of a force - that force being the force of friction - that brings the book to a rest position. In the absence of a force of friction, the book would continue in motion with the same speed and direction - forever! (Or at least to the end of the table top.) A force is not required to keep a moving book in motion. In actuality, it is a force that brings the book to rest.

2. **Draw a force diagram for the book sliding across the table and slowing down.**

All objects resist changes in their state of motion. All objects have this tendency - they have inertia. But do some objects have more of a tendency to resist changes than others? Absolutely yes! The tendency of an object to resist changes in its state of motion varies with mass. Mass is that quantity that is solely dependent upon the inertia of an object. The more inertia that an object has, the more mass that it has. A more massive object has a greater tendency to resist changes in its state of motion.

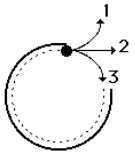
3. Compare the inertia of a bowling ball to a golf ball.

4. Imagine a place in the *cosmos* far from all gravitational and frictional influences. Suppose that you visit that place (just suppose) and throw a rock. The rock will
   a. gradually stop.
   b. continue in motion in the same direction at constant speed.

5. A 4.0-kg object is moving across a friction-free surface with a constant velocity of 2 m/s. Which one of the following horizontal forces is necessary to maintain this state of motion?
   c. 0N
   d. .5N
   e. 2N
   f. 8N
   g. Depends on the speed

6. Mac and Tosh are arguing in the cafeteria. Mac says that if he flings the Jell-O with a greater speed it will have a greater inertia. Tosh argues that inertia does not depend upon speed, but rather upon mass. Who do you agree with? Explain why.

7. Supposing you were in space in a *weightless environment*, would it require a force to set an object in motion?



8. A group of physics teachers is taking some time off for a little putt-putt golf. The 15th hole at the Hole-In-One Putt-Putt Golf Course has a large metal rim that putters must use to guide their ball towards the hole. Mr. S guides a golf ball around the metal rim. When the ball leaves the rim, which path (1, 2, or 3) will the golf ball follow?

9. 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

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