NEWTON'S LAWS

Practice

1. 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.
        i. Answer: According to Newton's first law, the rock will continue in motion in the same direction at constant speed.
2. A 2-kg object is moving horizontally with a speed of 4 m/s. How much net force is required to keep the object moving at this speed and in this direction?
        i. Answer: 0 N
        ii. An object in motion will maintain its state of motion. The presence of an unbalanced force changes the velocity of the object.
3. Christopher and Nathan are arguing in the cafeteria. Chris says that if he flings the Jell-O with a greater speed it will have a greater inertia. Nathan argues that inertia does not depend upon speed, but rather upon mass. Who do you agree with? Explain why.
        i. Nathan is correct. Inertia is that quantity which depends solely upon mass. The more mass, the more inertia. Momentum is another quantity in Physics which depends on both mass and speed. Momentum will be discussed in a later unit.
4. Supposing you were in space in a weightless environment, would it require a force to set an object in motion?
        i. Answer: Absolutely yes!
        ii. Even in space objects have mass. And if they have mass, they have inertia. That is, an object in space resists changes in its state of motion. A

force must be applied to set a stationary object in motion. Newton's laws rule - everywhere!

5. Nolan spends most Sunday afternoons at rest on the sofa, watching pro football games and consuming large quantities of food. What effect (if any) does this practice have upon his inertia? Explain.
    i. Answer: Nolan’s inertia will increase!
    ii. Nolan will increase his mass if he makes a habit of this. And if his mass increases, then his inertia increases.
6. Ben is being chased through the woods by a bull moose which he was attempting to photograph. The enormous mass of the bull moose is extremely intimidating. Yet, if Ben makes a zigzag pattern through the woods, he will be able to use the large mass of the moose to his own advantage. Explain this in terms of inertia and Newton's first law of motion.
    i. Answer: The large mass of the bull moose means that the bull moose has a large inertia. Thus, Ben can more easily change his own state of motion (make quick changes in direction) while the moose has extreme difficulty changing its state of motion. Physics for better living!
7. Two bricks are resting on edge of the lab table. Amanda 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 Amanda 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?
    i. The bricks, like any object, possess inertia. That is, the bricks will resist changes in their state of motion. If Shirley gives them a push, then the bricks will offer resistance to this push. The one with the most mass will be the one with the most inertia. This will be the brick which offers the most

resistance. This very method of detecting the mass of an object can be used on Earth as well as in locations where gravitational forces are negligible for bricks.

8. Whiplash sometimes results from an automobile accident when the victim's car is struck violently from the rear. Explain why the head of the victim seems to be thrown backward in this situation. Is it really? Do headrests really help prevent whiplash injuries? Why?
    i. Answer: No, the head is demonstrating Newton's second law, an object at rest tends to stay at rest. The body is strapped to the car seat which is being violently forced forward, whereas the head is free to stay at rest and therefore the body is being flung forward of the head.
    ii. Headrests prevent the head from behaving independently of the body. Therefore as the body is thrust forward by the seat, so to is the head by the headrest preventing whiplash. (Assumes headrest is properly adjusted and head is always touching or very close to the headrest while driving)