Name ________________ Class ____________ Date ____________

Concept-Development Practice Page **10-1**

Acceleration and Circular Motion

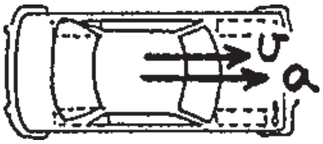
Newton's second law, $\boldsymbol{a} = \boldsymbol{F}/m$, tells us that net force and its corresponding acceleration are always in the same direction. (Both force and acceleration are vector quantities.) But force and acceleration are not always in the direction of velocity (another vector).

1. You're in a car at a traffic light. The light turns green and the driver "steps on the gas."

   a. Your body lurches (forward) (not at all) (backward).

   b. The car accelerates (forward) (not at all) (backward).

   c. The force on the car acts (forward) (not at all) (backward).

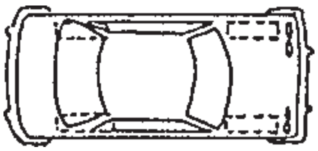
   The sketch shows the top view of the car. Note the directions of the velocity and acceleration vectors.

2. You're driving along and approach a stop sign. The driver steps on the brakes.

   a. Your body lurches (forward) (not at all) (backward).

   b. The car accelerates (forward) (not at all) (backward).

   c. The force on the car acts (forward) (not at all) (backward).

   The sketch shows the top view of the car. Draw vectors for velocity and acceleration.

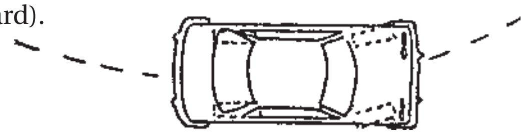
3. You continue driving, and round a sharp curve to the left at constant speed.

   a. Your body leans (inward) (not at all) (outward).

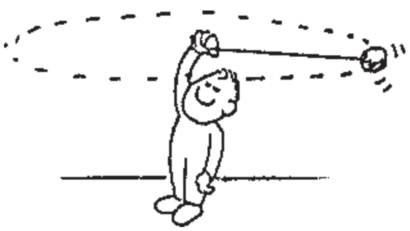
   b. The direction of the car's acceleration is (inward) (not at all) (outward).

   c. The force on the car acts (inward) (not at all) (outward).

   Draw vectors for velocity and acceleration of the car.

4. In general, the directions of lurch and acceleration, and therefore the directions of lurch and force, are (the same) (not related) (opposite).



5. The whirling stone's direction of motion keeps changing.

   a. If it moves faster, its direction changes (faster) (slower).

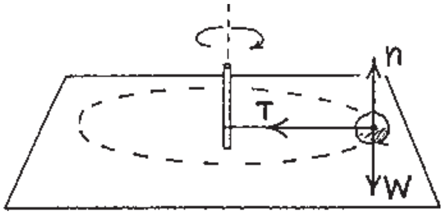
   b. This indicates that as speed increases, acceleration (increases) (decreases) (stays the same).

6. Consider whirling the stone on a shorter string—that is, of smaller radius.

   a. For a given speed, the rate that the stone changes direction is (less) (more) (the same).

   b. This indicates that as the radius decreases, acceleration (increases) (decreases) (stays the same).

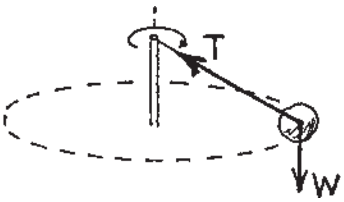
Centripetal Force



1. A rock tied to a post moves in a circle at constant speed on a frictionless horizontal surface. All the forces acting on the rock are shown: Tension **T**, support force **n** by the table, and the force due to gravity **W**.

   a. The vector responsible for circular motion is ________.

   b. The net force on the rock is ________.



2. In this case the rock is tied to a string and swings in a circular path as shown. It is not resting on a surface so there is no friction. Use the parallelogram rule and find the resultant of vectors **T** and **W**.

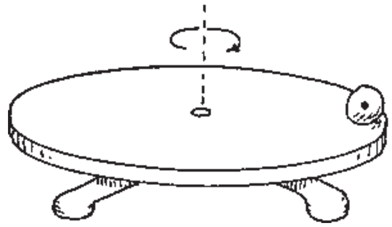
   a. What is the direction of the resultant of **T** and **W**? ____________________

   b. Does this resultant lie in the plane of the circular path? ________

   c. Is this resultant also the horizontal component of **T**? ________

   d. Is the resultant **T** + **W** (or the horizontal component of **T**) a centripetal force? ________

3. In the case shown at the right, the rock rides on a horizontal disk that rotates at constant speed about its vertical axis (dotted line). Friction prevents the rock from sliding.

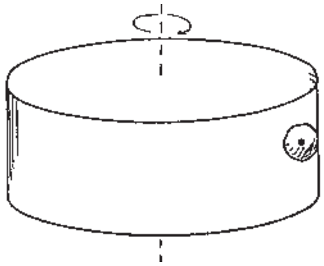


   a. Draw and label vectors for all forces that act on the rock.

   b. Which force is centripetal? ________

   c. Which force provides the net force? ________

   d. Why do we *not* say the net force is zero? ________________________________

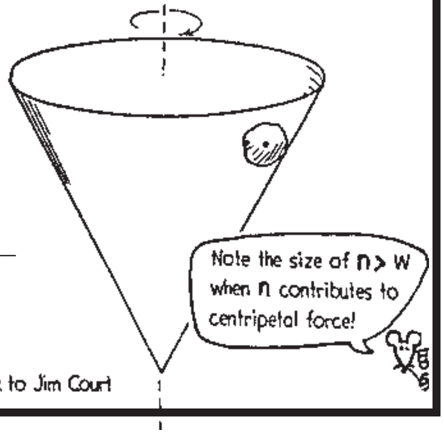


4. Now the rock is held in place by friction against the inside wall of the rotating drum. Draw and label vectors for all forces that act on the rock.

   a. Which force is centripetal? ________

   b. Which force provides the net force? ________

5. More challenging: This time the rock rests against the frictionless inside wall of a cone. It moves with the cone, which rotates about its vertical axis (dotted line). The rock does not slide up or down in the cone as it rotates. Draw and label vectors for all forces that act on the rock.



Should the resultant force lie in the plane of the circular path? ________

Why? ________________________________

thanx to Jim Court