QUESTIONS: GROUP A

1. (a) What is meant by the term *center of gravity*? (b) Where is the center of gravity of a meterstick? A bowling ball? An ice cube? A doughnut? A banana?
2. (a) What are the conditions for equilibrium? (b) Explain how they apply to children attempting to balance a seesaw.
3. How is torque calculated?
4. Why is it easier to loosen the lid from the top of a can of paint with a long-handled screwdriver than with a short-handled screwdriver?
5. How would the force needed to open a door change if you put the handle in the middle of the door?

GROUP B

6. How does an orthodontist use torque in realigning teeth?
7. What factor determines the location of the pivot point in a torque problem?
8. How can an object on which a couple is acting be placed in equilibrium?
9. What must be true for a moving object to be in equilibrium?
10. A twirler throws a baton straight up into the air. (a) Describe the motion of the ends of the baton. (b) Describe the motion of the center of gravity of the baton.

GROUP B

6. A 30.0-N fishing pole is 2.00 m long and has its center of gravity 0.350 m from the heavy end. A fisherman holds the end of the pole in his left hand as he lifts a 100.0-N fish. If his right hand is 0.800 m from the heavy end, how much force must he exert with his right hand to maintain equilibrium?
7. A uniform 2.50-N meterstick is hung from the ceiling by a single rope. A 500.0-g mass is hung at the 25.0-cm mark and a 650.0-g mass at the 70.0-cm mark. (a) What is the tension in the rope? (b) Where is the rope attached to the meterstick?
8. An 850-N painter stands 1.20 m from one end of a 3.00-m scaffold supported at each end by a stepladder. The scaffold weighs 250 N and there is a 40.0-N can of paint 0.50 m from the end opposite the painter. How much force is exerted by each stepladder?
9. A 10.0-N meterstick is suspended by two spring scales, one at the 8.00-cm mark and the other at the 90.0-cm mark. If a weight of 5.00 N is hung at the 20.0-cm mark and a weight of 17.0 N is hung at the 55.0-cm mark, what will be the reading on each scale?

PROBLEMS: GROUP A

Note: For each problem, draw and label an appropriate force diagram. Unless otherwise noted, the center of gravity is at the geometric center of the object.

1. A 400.0-N child and a 300.0-N child sit on either end of a 2.00-m-long seesaw. Where along the seesaw should the pivot support be placed to ensure rotational equilibrium?
2. Based on the information in Problem 1 and its solution, suppose a 225-N child sits 0.200 m from the 400.0-N child. Where must a 325-N child sit to maintain rotational equilibrium?
3. A uniform meterstick, supported at the 30.0-cm mark, is balanced when a 0.50-N weight is hung at the 0.0-cm mark. What is the weight of the meterstick?
4. A 650-N boy and a 490-N girl sit on a 150-N porch swing that is 1.70 m long. If the swing is supported by a chain at each end, what is the tension in each chain when the boy sits 0.750 m from one end and the girl 0.500 m from the other?
5. A uniform bridge, 20.0 m long and weighing 4.00×10^5 N, is supported by two pillars located 3.00 m from each end. If a 1.96×10^4-N car is parked 8.00 m from one end of the bridge, how much force does each pillar exert?
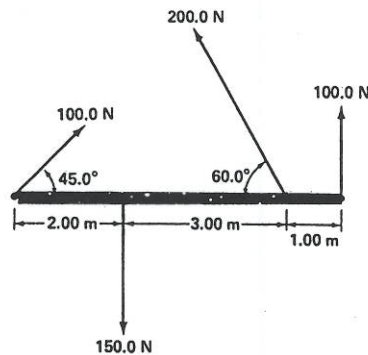
Figure 4-29.

10. (a) Find the torques exerted on the rod in Figure 4-29. (b) Find the magnitude and direction of the additional force that must be exerted at the right end, perpendicular to the rod, to maintain rotational equilibrium.

PHYSICS ACTIVITY

(a) Find the center of gravity of a broom by balancing it lengthwise on your hand. Is the center of gravity closer to the bristles or to the end of the handle?

(b) Balance the broom vertically on the palm of your hand, first with the top of the handle and then with the bristles. Which way is easier? Explain.