Physics Happenings with Amusements, Newton's Laws, Triangulation, and Other Magic Park (PHANTOM Park)

SAMPLE DATA

Students of Shadowville General High School have collected the following data for the rides at PHANTOM Park. Some of this information was measured, while other data were gathered from the ride operators.

SAMPLE DATA (continued)

Merry-Go-Round

Riding a lion on the outer ring of PHANTOM Park's historic merry-go-round, a 200 g mass was found to weigh 2.4 N on ascent and 1.5 N on descent. The horizontal accelerometer gave a reading of about 4°. The time of rotation was 18 s, while one gallop of the lion was about 7 s. The inner ring of animals was 2.5 m from the outer edge of the ride. One quarter of the circumference was found to be 7.8 m. The lion galloped vertically about 0.6 m. The ride turned counterclockwise, as viewed from the top, and we noted that the animals and sleighs on the outside half were quite ornate, while the inside ones tended to be very plain.

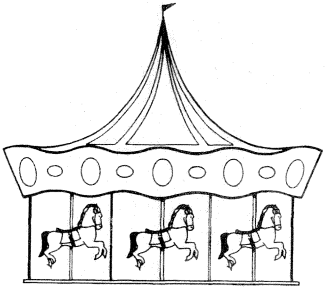


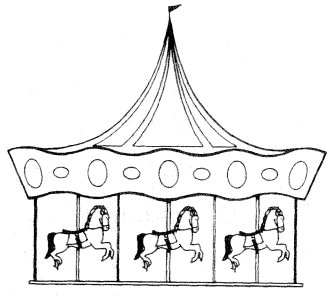
Figure 41.
Merry-Go-Round

MERRY-GO-ROUND

Requirements:
CP: 9 points
AP: 12 points

Group A *1 point problems*

1. Measure the diameter of the wheel.
2. Describe the *g*-factors experienced by a person riding on the merry-go-round. Check your answers by using both the horizontal accelerometer and the spring accelerometer.
3. Record the vertical spring accelerometer readings when ascending and descending.
4. Record the horizontal accelerometer reading as directed along a radius of the ride. Is this acceleration inward or outward?
5. How does the centripetal acceleration depend on the distance from the center of the apparatus?
6. How does the centripetal acceleration depend on the height you are above the ground?
7. Measure the period of motion of:
   a. one trip around the merry-go-round.
   b. one up-and-down cycle of a horse.



Merry-Go-Round

8. At what point in their motion do the passengers on the carousel obtain their maximum speed? Please explain.
9. Explain how the ride might be altered to achieve a greater velocity without using a more powerful motor.
10. Imagine that once the merry-go-round is turning, the motor is suddenly turned off. Pretend that the merry-go-round continues to turn freely with no frictional loss. If the riders moved from the inside horses to empty outside horses, what effect would this have on the motion of the carousel? Why?
11. From the horse's point of view, what is its motion while the ride is in motion?
12. From the frame of reference of the axis of rotation of the merry-go-round, describe the shape of the path of the horse's motion as the platform turns.
13. From an outsider's point of view, determine the shape of the horse's path as it proceeds on the merry-go-round:
    a. when viewed in the plane of motion.
    b. when viewed perpendicular to the plane of motion.

(continued)

MERRY-GO-ROUND (continued)

Group B *2 point problems*

14. Determine the circumference of the merry-go-round measured from:
    a. the outer ring of horses.
    b. the inner ring of horses.
15. Determine the tangential velocity of the outer ring of horses and the inner ring of horses.
16. Find the vertical accelerations as a function of position on the ride. Is the acceleration up the same as the acceleration down? Please explain.
17. Find the centripetal accelerations as a function of position on the ride.
18. Assuming your mass to be 50 kg, calculate your kinetic energy while the ride is moving.
19. By how much does your potential energy change as the horse goes up and down? Assume your mass to be 50 kg.

Group C *3 point problems*

20. Write an equation of motion for one of the horses as it goes up and down. Do this from the frame of reference of:
    a. the horse.
    b. an observer not on the merry-go-round but in the plane of motion.
    c. an observer not on the merry-go-round and perpendicular to the plane of motion.