

## Centripetal Acceleration

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### Concepts

- A. If you are going in a circle with a constant speed, why are you accelerating?
- B. If you are going in a circle with a constant speed, in what direction do you accelerate?
- C. If you are going in a circle with a constant speed, describe the direction of your velocity.

### Calculations

1. A car is traveling in a circle with a radius of 20 meters.
  - a. If it has a speed of 5 m/s, what is the acceleration of the car?
  
  
  
  
  
  
  
  
  
  
  - b. If it has a speed of 10 m/s, what is its acceleration?
  
2. A plane is flying at 125 m/s when it begins to travel in a circle. If its centripetal acceleration is  $2 \text{ m/s}^2$ , what is the radius of the circle?
  
  
  
  
  
  
  
  
  
  
3. A girl is sitting on a merry-go-round 2 meters from the center.
  - a. If she has an acceleration of  $1 \text{ m/s}^2$ , how fast is she going?
  
  
  
  
  
  
  
  
  
  
  - b. If she has an acceleration of  $2 \text{ m/s}^2$ , how fast is she going?
  
  
  
  
  
  
  
  
  
  
4. A person is driving in a circle with a centripetal acceleration of  $2 \text{ m/s}^2$ .
  - a. What would be the acceleration if they went twice as fast, but kept the radius the same?
  
  
  
  
  
  
  
  
  
  
  - b. What would be the acceleration if they went three times as fast, but kept the radius the same?
  
  
  
  
  
  
  
  
  
  
  - c. What would be the acceleration if they doubled the radius, but kept their speed the same?
  
  
  
  
  
  
  
  
  
  
  - d. What would be the acceleration if they tripled the radius, but kept their speed the same?
  
  
  
  
  
  
  
  
  
  
5. A car is traveling in a circle of radius 15 meters. It takes 9 seconds to go once around the circle. What is the centripetal acceleration? (*Hint: Find the speed first.*)

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6. A ball is swung on a string in a circle of radius 1.3 meters. If the centripetal acceleration of the ball is  $15 \text{ m/s}^2$ , how long does it take the ball to go around once? (*Hint: Find the speed first.*)
7. While flying in circles, a plane has a centripetal acceleration of  $5 \text{ m/s}^2$ . If the radius of the turn is 8000 meters, how many seconds does it take to go around once? (*No more hints!*)
8. A person is spinning on the Turkish Twist, which has a radius of 5 meters. If it takes 2.5 seconds to go around once, what is the centripetal acceleration of the person?
9. A ball on the end of a string is being spun in a circle of radius 2.3 meters. It is spinning at a rate of 45 rpm. What is the centripetal acceleration of the ball?
10. A person on a 10 meter radius Ferris wheel is rotating with a centripetal acceleration of  $4 \text{ m/s}^2$ . What is the rate of rotation in rpm?

Answers: 1. a)  $1.25 \text{ m/s}^2$    b)  $5 \text{ m/s}^2$                       2) 7800 m                      3. a) 1.4 m/s                      b) 2 m/s  
 4. a)  $8 \text{ m/s}^2$                       b)  $18 \text{ m/s}^2$                       c)  $1 \text{ m/s}^2$                       d)  $0.67 \text{ m/s}^2$   
 5)  $v = 10.5 \text{ m/s}$  &  $a = 7.3 \text{ m/s}^2$                       6)  $v = 4.42 \text{ m/s}$  &  $t = 1.85 \text{ s}$                       7)  $v = 200 \text{ m/s}$  &  $t = 251 \text{ s}$   
 8)  $v = 12.6 \text{ m/s}$  &  $a = 31.6 \text{ m/s}^2$                       9)  $v = 10.8 \text{ m/s}$  &  $a = 51 \text{ m/s}^2$                       10)  $v = 6.32 \text{ m/s}$  &  $T = 9.93 \text{ s}$  &  $f = 6.04 \text{ rpm}$