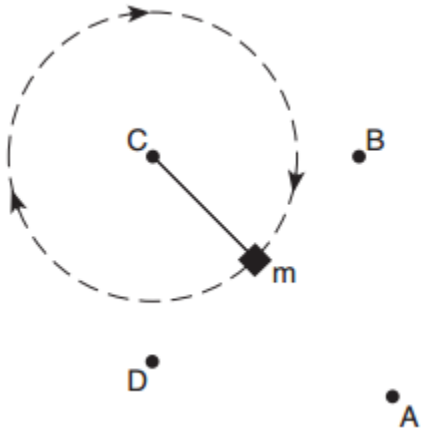
$$Centripetal\ Force\ =\ F_C = \frac{mv^2}{r}$$

$$frequency = f\ = \frac{1}{Period\ (T)}$$

$$F_G = G\frac{m_1 m_2}{r^2} \quad where\ G =\ 6.67\ \text{x}\ 10 - 11\ \text{N} \cdot m^2/kg^2$$

**Questions 1-3 refer to the diagram below. The diagram represents a mass, m, being swung clockwise at a constant speed in a horizontal circle.**

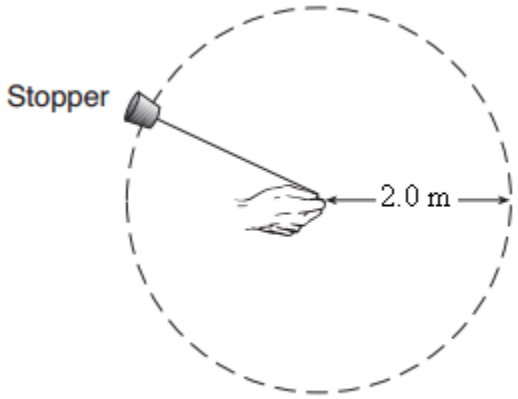



1. What point shows the direction of the net force acting on the mass?
   (A) Point A
   (B) Point B
   (C) Point C
   (D) Point D

2. What point shows the direction of the velocity of the mass?
   (A) Point A
   (B) Point B
   (C) Point C
   (D) Point D

3. What point shows the acceleration acting on the mass?
   (A) Point A
   (B) Point B
   (C) Point C
   (D) Point D

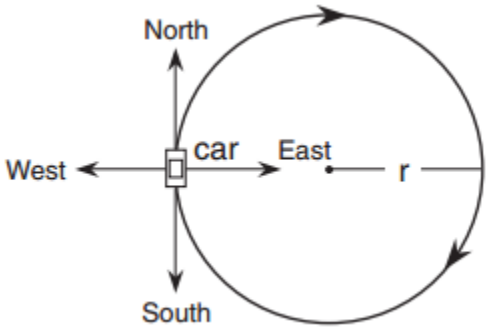
Questions 4-6 refer to the diagram below. The diagram represents a student whirling a stopper attached to the end of a 2.0 m string overhead in a horizontal circle.




(Not drawn to scale)

4. If the stopper has a mass of 0.05 kg and is whirled at a constant speed of 5 m/s on the 2.0 m string, what is the force of tension on the string?
   (A) 0.125 N
   (B) 0.625 N
   (C) 1.25 N
   (D) 1.75 N

5. If the stopper is moving at an orbital period of 2.5 seconds, what is its frequency in cycles per second?
   (A) 0.1 cycles/second
   (B) 0.2 cycles/second
   (C) 0.3 cycles/second
   (D) 0.4 cycles/second

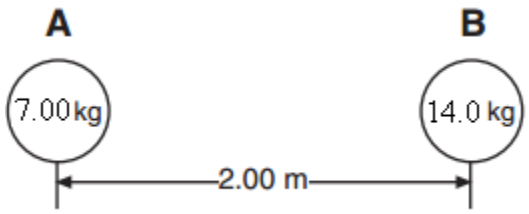



6. A car is traveling a constant speed and makes a clockwise turn as shown above, around a circular path. Where is the direction of the car's acceleration?
   (A) North
   (B) South
   (C) West
   (D) East

7. A 0.50-kilogram object moves in a horizontal circular path with a radius of 0.25 meter at a constant speed of 4.0 meters per second. What is the magnitude of the object's centripetal force?
   (A) 32 N
   (B) 24 N
   (C) 16 N
   (D) 8 N

8. A 2.0 kg ball is attached to a 3.0 meter long string and is moved at a constant speed in a horizontal and circular motion. The force on the string is measured to be 24 N. What speed is the ball moving at?
   (A) 3 m/s
   (B) 6 m/s
   (C) 18 m/s
   (D) 36 m/s

**Questions 9-10 refer to the diagram below of the two bowling balls, A and B.**




9. A bowling ball labeled A of mass 7.00 kg is placed 2.00 m away from a 14.0 kg bowling ball labeled B. What is the gravitational force that bowling ball A experiences due to bowling ball B?
   (A) $8.17 \times 10^{-9}$ N
   (B) $1.63 \times 10^{-9}$ N
   (C) $8.17 \times 10^{-10}$ N
   (D) $1.17 \times 10^{-10}$ N

10. What is the gravitational force that bowling ball B experiences due to bowling ball A?
   (A) $8.17 \times 10^{-9}$ N
   (B) $1.63 \times 10^{-9}$ N
   (C) $8.17 \times 10^{-10}$ N
   (D) $1.17 \times 10^{-10}$ N