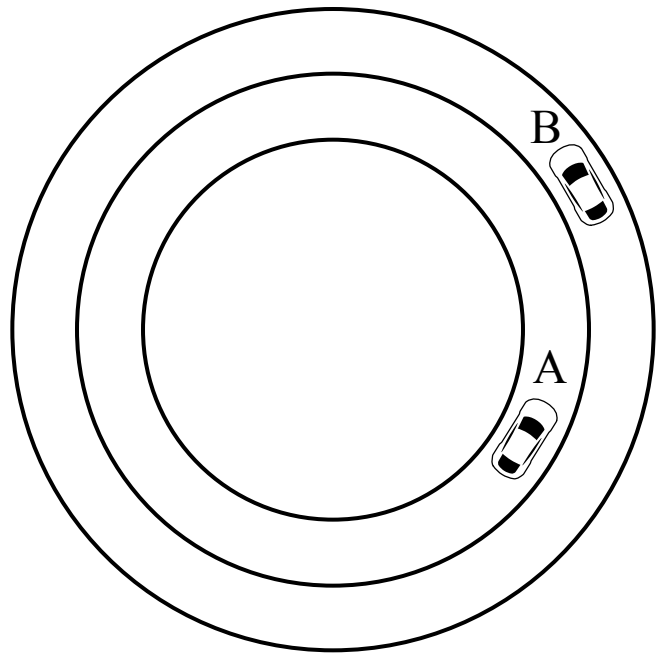
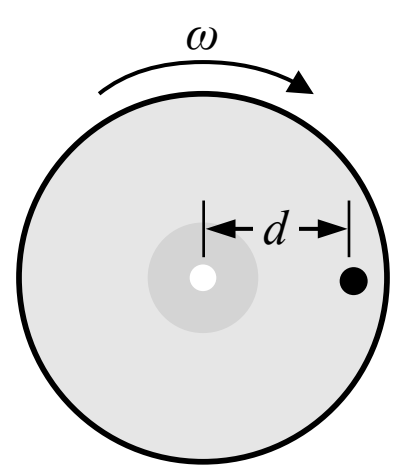
CONNECTING CIRCULAR AND ROTATIONAL MOTION



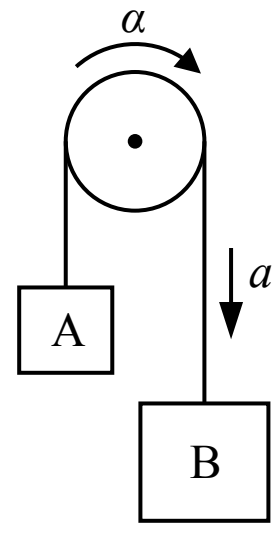
1. Car A and car B are driving around concentric circular tracks as shown in the figure above. Car B is on a track with a larger radius than the track car A is driving on. If both cars have the same speed, which car completes one full lap around its track in less time?

(A) Car A
(B) Car B
(C) Both cars complete one lap in the same amount of time
(D) Cannot be determined without knowing the radius of each track



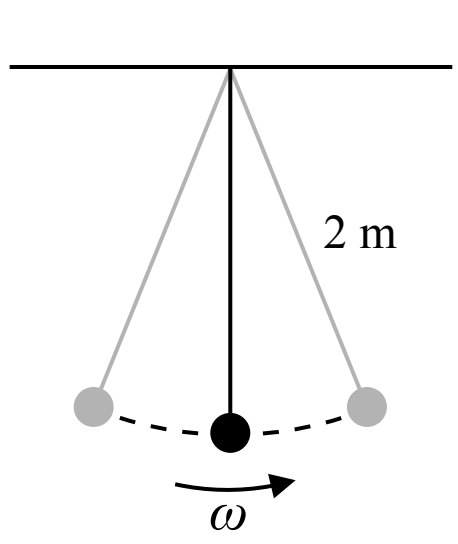
2. A fly is sitting near the edge of a spinning vinyl record, represented as a dot in the figure above. If the fly is a distance d from the center of the record, the speed of the fly is

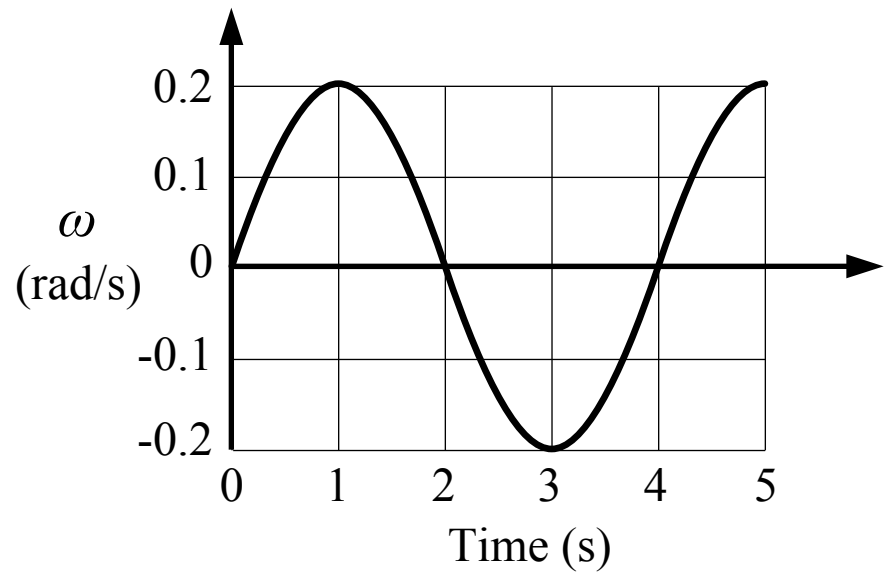
(A) d/ω
(B) $d\omega^2$
(C) ω
(D) $d\omega$



3. Two blocks are connected by a cable that is wrapped around a pulley as shown in the figure above. Block B has a greater mass than block A so the blocks accelerate and the pulley experiences an angular acceleration (the cable turns the pulley without slipping). If the diameter of the pulley is 0.2 m and the angular acceleration of the pulley is 15 rad/s², the magnitude of the acceleration of the blocks is most nearly

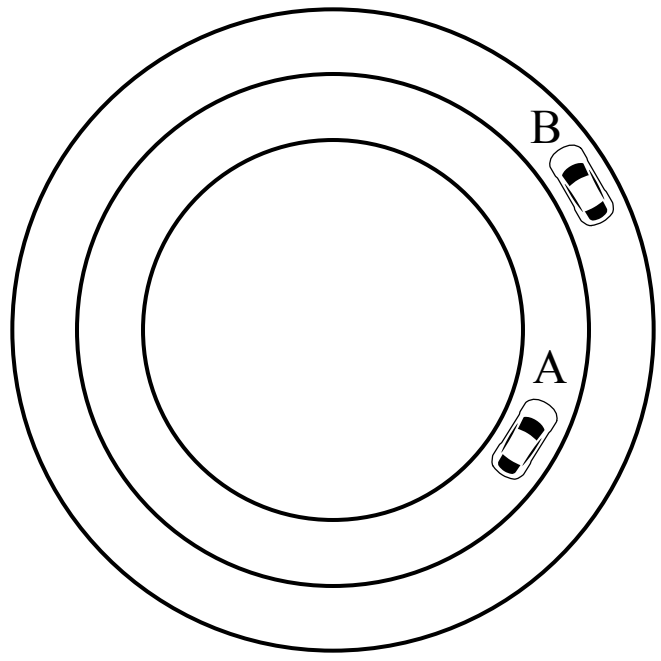
(A) 0.75 m/s²
(B) 150 m/s²
(C) 1.5 m/s²
(D) 3.0 m/s²





4. A 2 m long string is attached to the ceiling and a small sphere is attached to the bottom of the string. The sphere swings back and forth and a graph of the angular velocity of the sphere is shown in the figure above. The speed of the sphere at 1 second is most nearly

(A) 0.4 m/s
(B) 0.8 m/s
(C) 0.1 m/s
(D) 0.2 m/s



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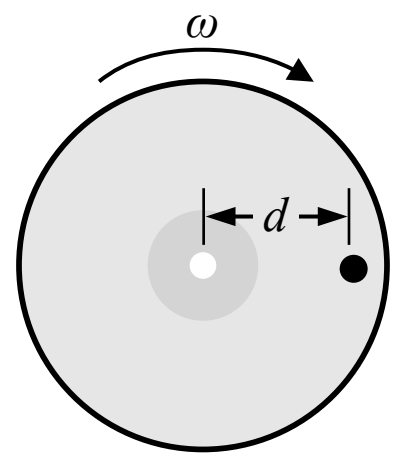
(A) Car A
(B) Car B
(C) Both cars complete one lap in the same amount of time
(D) Cannot be determined without knowing the radius of each track

A **Correct**
Car A is on a track with a smaller circumference (and has less distance to travel) than car B because the radius is smaller. If both cars have the same speed then car A will complete one lap (one circumference) in less time.

B Incorrect

C Incorrect

D Incorrect



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(A) d/ω

(B) $d\omega^2$

(C) ω

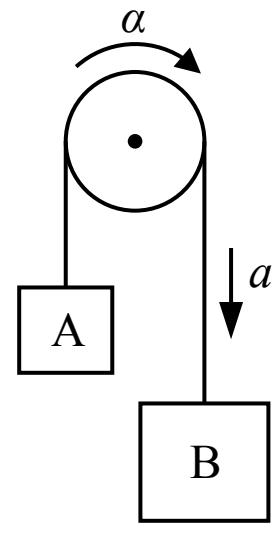
(D) $d\omega$

A Incorrect

B Incorrect

C Incorrect
This is the angular speed of the fly. The term “speed” by itself refers to the linear or tangential speed.

D Correct
The fly has the same angular speed as the record and travels one circumference (of its own circular path) in the time it takes the record to rotate one revolution. The linear or tangential speed is equal to the radius of the circular path multiplied by the angular speed.
$v = r\omega = d\omega$



3. Two blocks are connected by a cable that is wrapped around a pulley as shown in the figure above. Block B has a greater mass than block A so the blocks accelerate and the pulley experiences an angular acceleration (the cable turns the pulley without slipping). If the diameter of the pulley is 0.2 m and the angular acceleration of the pulley is 15 rad/s², the magnitude of the acceleration of the blocks is most nearly

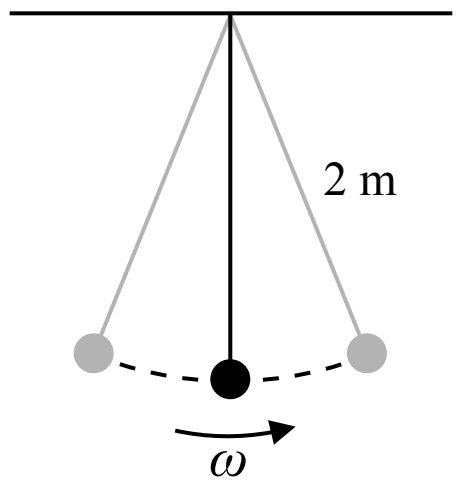
(A) 0.75 m/s²
(B) 150 m/s²
(C) 1.5 m/s²
(D) 3.0 m/s²

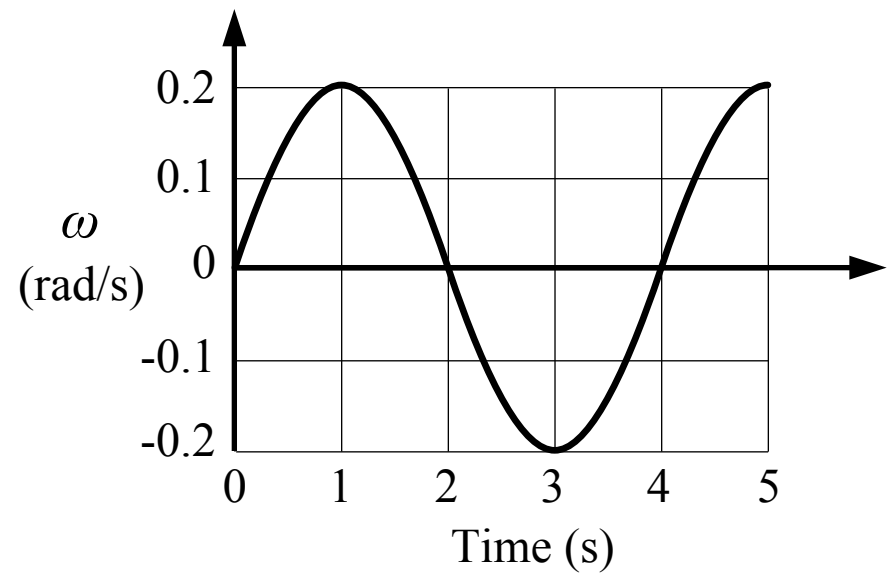
A Incorrect

B Incorrect
This answer incorrectly divides the angular acceleration by the radius instead of multiplying them.

C Correct
The cable is wrapped around the outer edge of the pulley so the linear or tangential acceleration of the cable and the blocks is equal to the radius of the pulley multiplied by the angular acceleration.
$a = r\alpha = (0.1\text{ m})(15\text{ rad/s}^2) = 1.5\text{ m/s}^2$

D Incorrect
This answer incorrectly uses 0.2 m as the radius of the pulley instead of 0.1 m.





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(B) 0.8 m/s
(C) 0.1 m/s
(D) 0.2 m/s

A **Correct**

As the sphere swings back and forth it follows a segment of a circular path which has a radius of 2 m (the length of the string). At 1 second the angular speed is 0.2 rad/s and the linear or tangential speed is equal to the radius of the circular path multiplied by the angular speed.

$v = r\omega = (2\text{ m})(0.2\text{ rad/s}) = 0.4\text{ m/s}$

B Incorrect

C Incorrect

D Incorrect