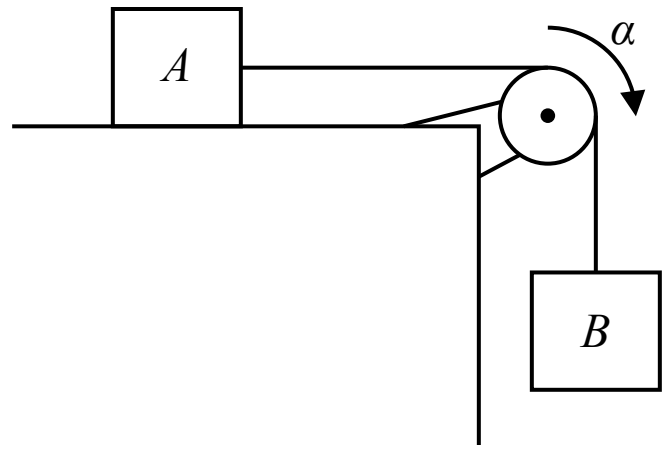
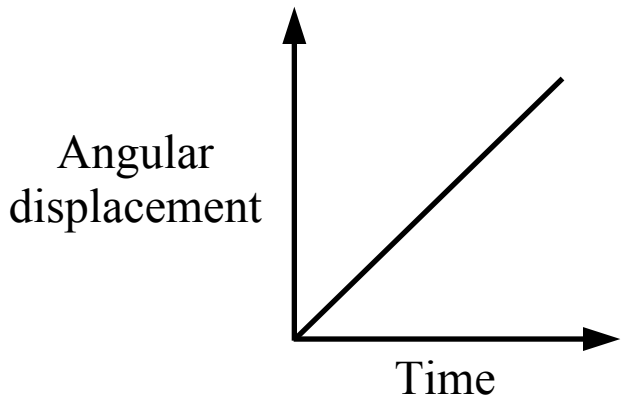
ROTATIONAL MOTION

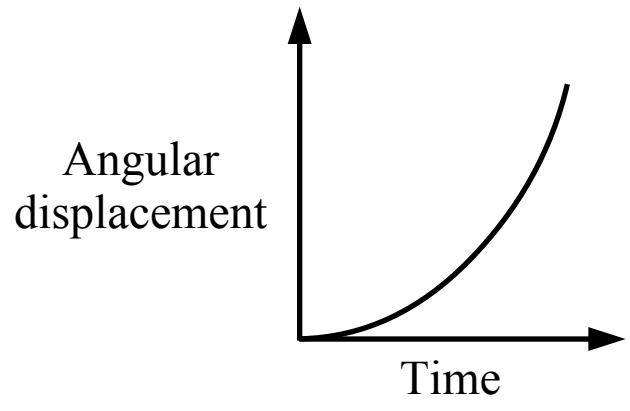


1. Two blocks are connected by a string that passes over a pulley as shown in the figure above. The blocks are released from rest, block B falls and the pulley experiences an angular acceleration. Which of the following graphs could represent the magnitude of the angular displacement of the pulley over time?

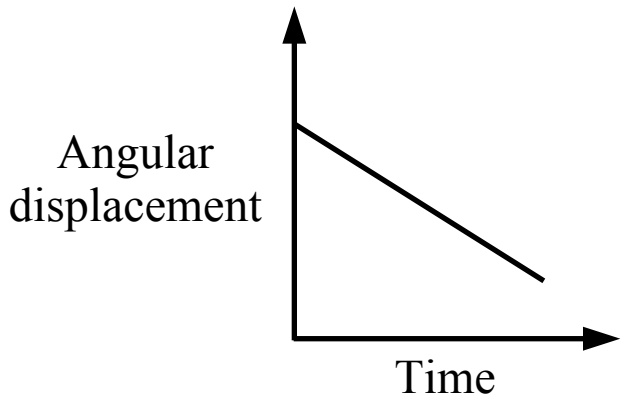
(A)



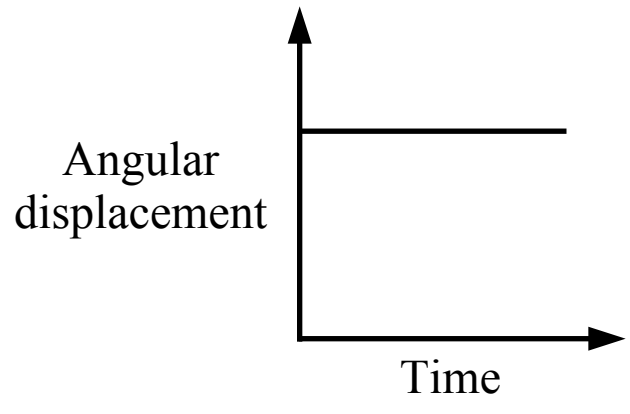
(B)

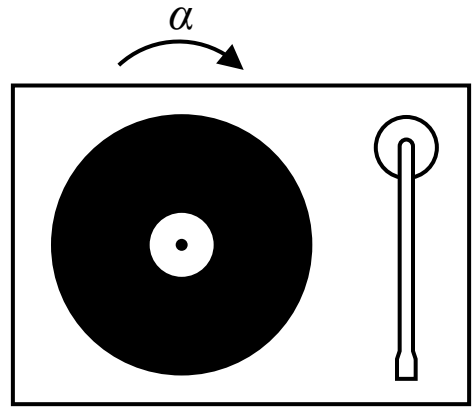


(C)



(D)





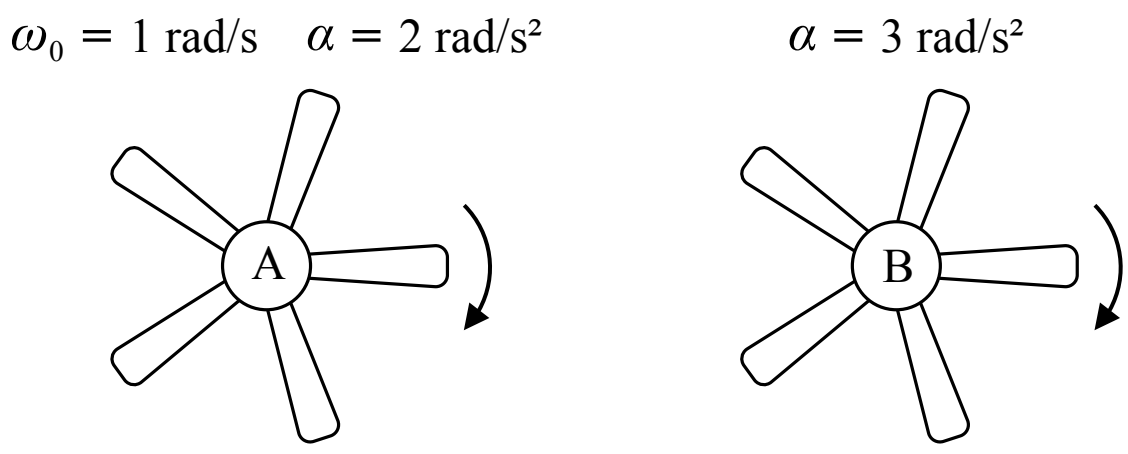
2. A vinyl record begins at rest and then experiences an angular acceleration of α. What is the angular displacement of the record after a period of 3 seconds?

(A) 6α

(B) 9α

(C) 3α

(D) $9\alpha/2$



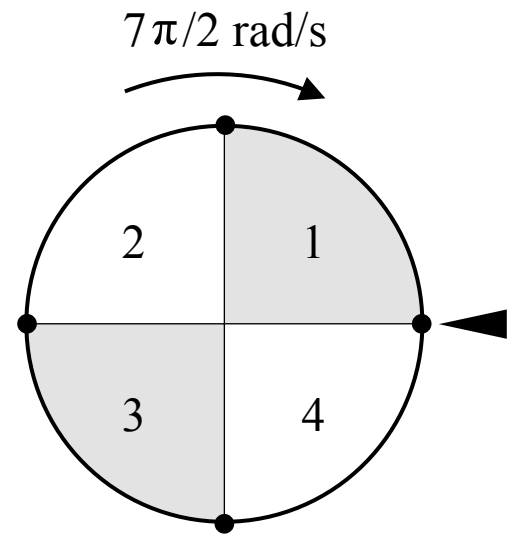
3. Two ceiling fans are shown in the figure above. At time t_0 , fan A is spinning at 1 rad/s and begins accelerating at 2 rad/s², while fan B starts from rest and accelerates at 3 rad/s². What is the relationship between the angular speed of the fans after a period of 5 seconds?

   (A) $\omega_A < \omega_B$

   (B) $\omega_A > \omega_B$

   (C) $\omega_A = \omega_B$

   (D) Cannot be determined



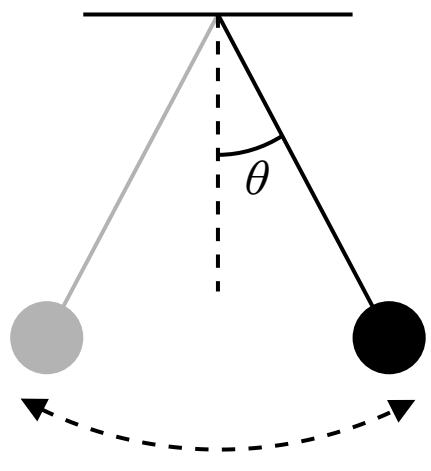
4. A wheel is divided into 4 equal sections as shown in the figure above. The wheel is given a spin and released so that the initial angular speed of the wheel is 7π/2 rad/s when the wheel is in the orientation shown above. The wheel slows down at a rate of -π/2 rad/s². What numbered section is the arrow on the right pointing to when the wheel stops?

   (A) 1

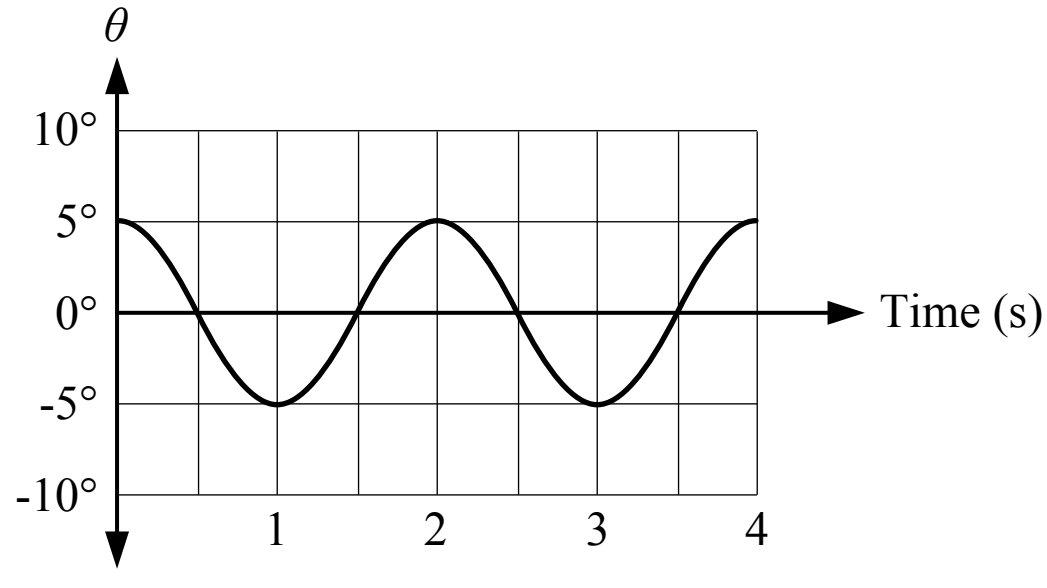
   (B) 2

   (C) 3

   (D) 4



Note: Figure not drawn to scale



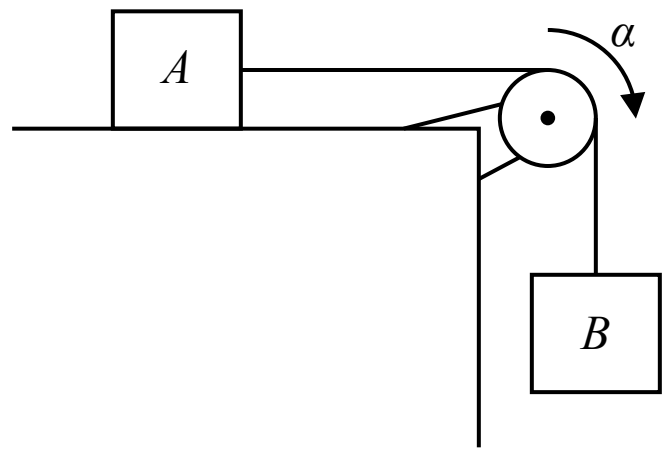
5. A graph of the motion of a pendulum is shown in the figure above. The angle of the pendulum is measured relative to the vertical. Which of the following is true about the motion of the pendulum?

(A) The angular velocity of the pendulum at 1.5 seconds is zero

(B) The angular velocity of the pendulum at 3 seconds is zero

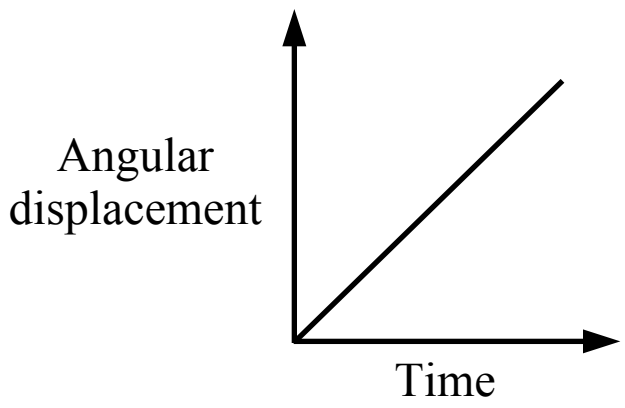
(C) The angular velocity of the pendulum is never zero

(D) The angular velocity of the pendulum is always zero

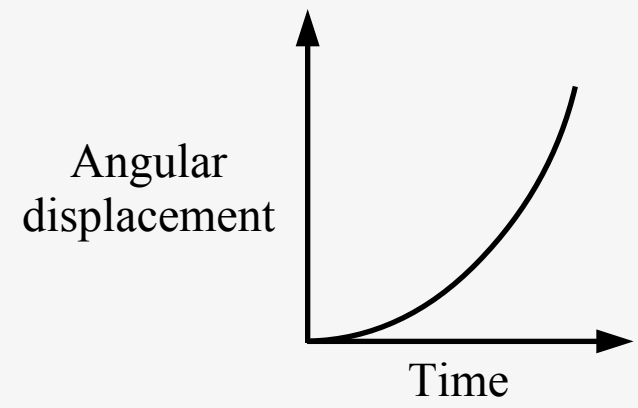


1. Two blocks are connected by a string that passes over a pulley as shown in the figure above. The blocks are released from rest, block B falls and the pulley experiences an angular acceleration. Which of the following graphs could represent the magnitude of the angular displacement of the pulley over time?

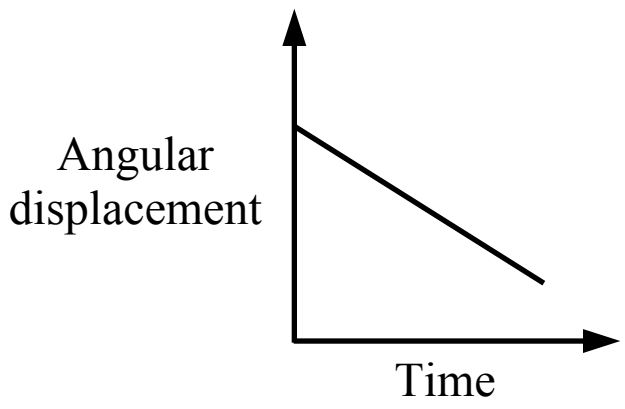
(A)



(B)



(C)



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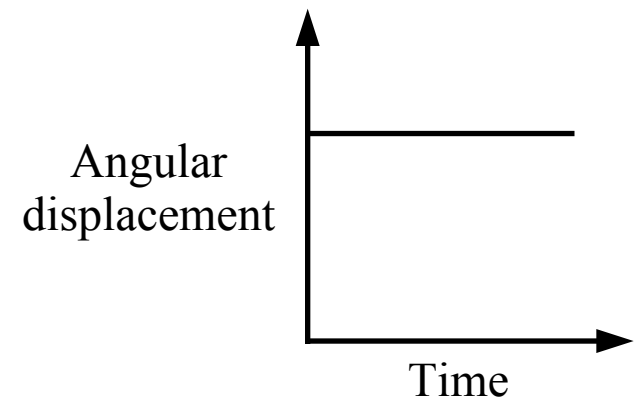
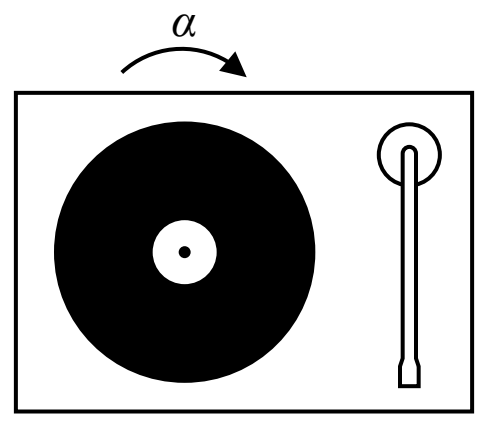


A Incorrect
This graph is a straight line with a non-zero slope which represents a constant angular velocity with zero acceleration.

B Correct
The pulley experiences an angular acceleration so the angular position-time graph and the angular displacement-time graph is a curved line. The slope of the angular displacement-time graph is the angular velocity, which is changing because there is an angular acceleration.

C Incorrect
This graph is a straight line with a non-zero slope which represents a constant angular velocity with zero acceleration.

D Incorrect
This graph is a straight line with zero slope which represents an angular velocity of zero.



2. A vinyl record begins at rest and then experiences an angular acceleration of α. What is the angular displacement of the record after a period of 3 seconds?

(A) 6α

(B) 9α

(C) 3α

(D) $9\alpha/2$

A Incorrect

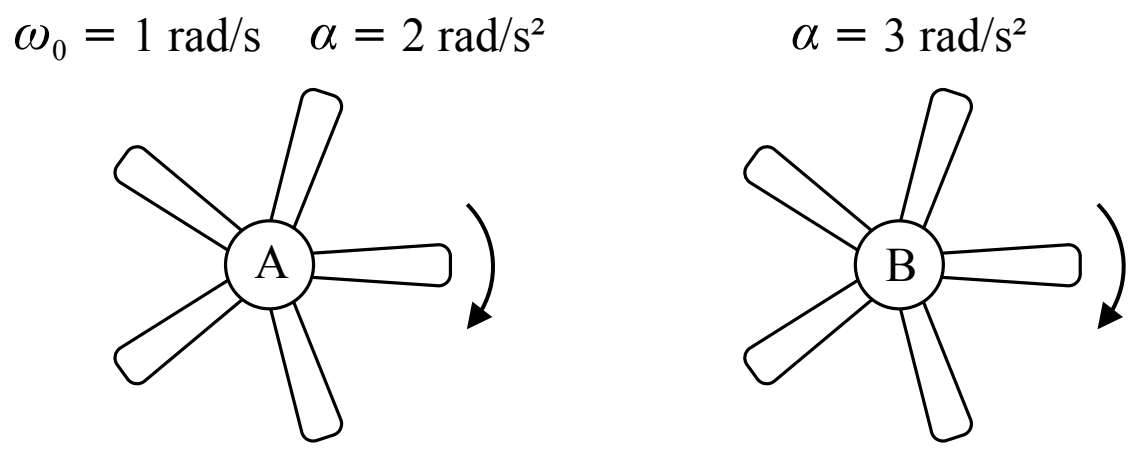
B Incorrect

C Incorrect

D Correct

The angular displacement can be found using the kinematic equation below.

$$\Delta\theta = \omega_0 t + \frac{1}{2}\alpha t^2 = (0\ \text{rad/s})(3\ \text{s}) + \frac{1}{2}\alpha(3)^2 = 9\alpha/2$$



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(A) $\omega_A < \omega_B$

(B) $\omega_A > \omega_B$

(C) $\omega_A = \omega_B$

(D) Cannot be determined

A **Correct**

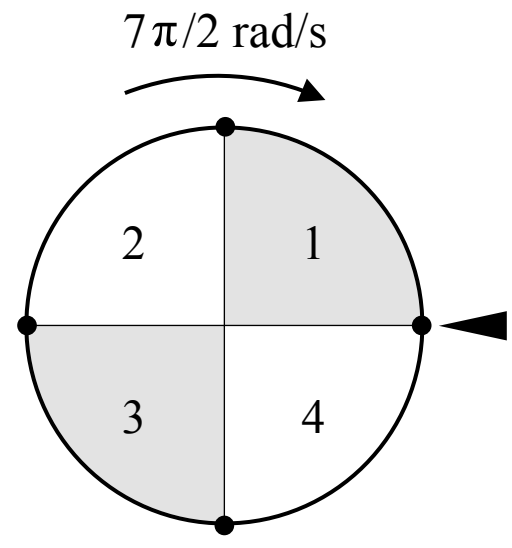
Fan A: $\omega = \omega_0 + \alpha t = (1 \text{ rad/s}) + (2 \text{ rad/s}^2)(5 \text{ s}) = 11 \text{ rad/s}$

Fan B: $\omega = \omega_0 + \alpha t = (0 \text{ rad/s}) + (3 \text{ rad/s}^2)(5 \text{ s}) = 15 \text{ rad/s}$

B Incorrect

C Incorrect

D Incorrect



4. A wheel is divided into 4 equal sections as shown in the figure above. The wheel is given a spin and released so that the initial angular speed of the wheel is $7\pi/2$ rad/s when the wheel is in the orientation shown above. The wheel slows down at a rate of $-\pi/2$ rad/s^2. What numbered section is the arrow on the right pointing to when the wheel stops?

(A) 1

(B) 2

(C) 3

(D) 4

A **Correct**

The angular displacement of the wheel can be found using the kinematic equation below. The wheel turns 6 full revolutions and then 1/8 of a revolution so it ends at the middle of section 1.

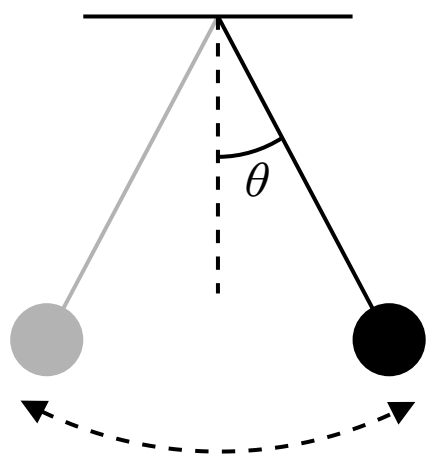
$\omega^2 = \omega_0^2 + 2\alpha\Delta\theta \qquad (0\text{ rad/s})^2 = (7\pi/2\text{ rad/s})^2 + 2(-\pi/2\text{ rad/s}^2)\Delta\theta \qquad \Delta\theta = 49\pi/4\text{ rad}$

$$\Delta\theta = \frac{49\pi/4\text{ rad}}{} \times \frac{1\text{ rev}}{2\pi\text{ rad}} = 6\ 1/8\text{ rev}$$

B Incorrect

C Incorrect

D Incorrect



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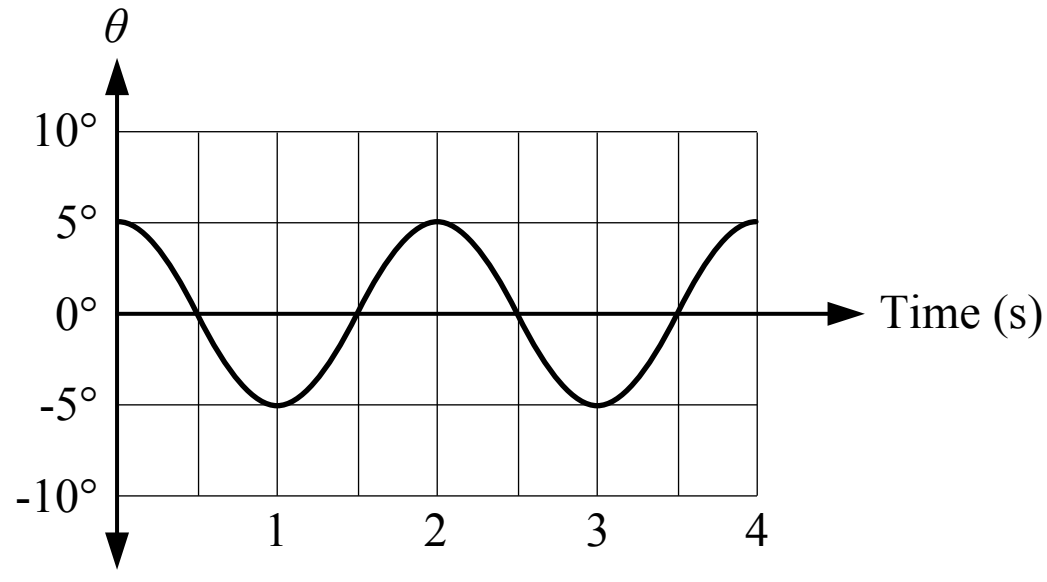

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(C) The angular velocity of the pendulum is never zero

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A Incorrect

The angular position is zero at 1.5 seconds but the angular velocity (the slope) is not zero.

B Correct

The graph is an angular position-time graph so the slope of the graph is the angular velocity. The slope of the graph and the angular velocity are zero at 3 seconds.

C Incorrect

The angular velocity (the slope) is zero at 0, 1, 2, 3 and 4 seconds.

D Incorrect

The angular velocity (the slope) is not always zero.