Q9.1

The graph shows the angular velocity and angular acceleration versus time for a rotating body. At which of the following times is the rotation speeding up at the greatest rate?

A. \( t = 1 \) s

B. \( t = 2 \) s

C. \( t = 3 \) s

D. \( t = 4 \) s

E. \( t = 5 \) s
A9.1

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Q9.2

A DVD is initially at rest so that the line \(PQ\) on the disc’s surface is along the \(+x\)-axis. The disc begins to turn with a constant \(\alpha_z = 5.0\ \text{rad/s}^2\). At \(t = 0.40\ \text{s}\), what is the angle between the line \(PQ\) and the \(+x\)-axis?

A. 0.40 rad  
B. 0.80 rad  
C. 1.0 rad  
D. 2.0 rad
A9.2

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At $t = 0.40 \text{ s}$, what is the angle between the line $PQ$ and the $+x$-axis?

- A. 0.40 rad
- B. 0.80 rad
- C. 1.0 rad
- D. 2.0 rad
A DVD is rotating with an ever-increasing speed. How do the centripetal acceleration $a_{\text{rad}}$ and tangential acceleration $a_{\text{tan}}$ compare at points $P$ and $Q$?

A. $P$ and $Q$ have the same $a_{\text{rad}}$ and $a_{\text{tan}}$.

B. $Q$ has a greater $a_{\text{rad}}$ and a greater $a_{\text{tan}}$ than $P$.

C. $Q$ has a smaller $a_{\text{rad}}$ and a greater $a_{\text{tan}}$ than $P$.

D. $P$ and $Q$ have the same $a_{\text{rad}}$, but $Q$ has a greater $a_{\text{tan}}$ than $P$. 
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A9.3
Q9.4

Compared to a gear tooth on the rear sprocket (on the left, of small radius) of a bicycle, a gear tooth on the front sprocket (on the right, of large radius) has

A. a faster linear speed and a faster angular speed.
B. the same linear speed and a faster angular speed.
C. a slower linear speed and the same angular speed.
D. the same linear speed and a slower angular speed.
E. none of the above
A9.4

Compared to a gear tooth on the rear sprocket (on the left, of small radius) of a bicycle, a gear tooth on the front sprocket (on the right, of large radius) has

A. a faster linear speed and a faster angular speed.
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C. a slower linear speed and the same angular speed.
D. the same linear speed and a slower angular speed.

E. none of the above
You want to double the radius of a rotating solid sphere while keeping its kinetic energy constant. (The mass does not change.) To do this, the final angular velocity of the sphere must be

A. 4 times its initial value.
B. twice its initial value.
C. the same as its initial value.
D. 1/2 of its initial value.
E. 1/4 of its initial value.
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A. 4 times its initial value.
B. twice its initial value.
C. the same as its initial value.
D. 1/2 of its initial value.
E. 1/4 of its initial value.

The correct answer is D. 1/2 of its initial value.
The three objects shown here all have the same mass \( M \) and radius \( R \). Each object is rotating about its axis of symmetry (shown in blue). All three objects have the same rotational kinetic energy. Which one is rotating fastest?

A. thin-walled hollow cylinder
B. solid sphere
C. thin-walled hollow sphere
D. two or more of these are tied for fastest
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C. thin-walled hollow sphere

D. two or more of these are tied for fastest
A thin, very light wire is wrapped around a drum that is free to rotate. The free end of the wire is attached to a ball of mass $m$. The drum has the same mass $m$. Its radius is $R$ and its moment of inertia is $I = (1/2)mR^2$.

As the ball falls, the drum spins.

At an instant that the ball has translational kinetic energy $K$, the drum has rotational kinetic energy

A. $K$.  
B. $2K$.  
C. $K/2$.  
D. none of these
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B. $2K$.  
C. $K/2$.  
D. none of these