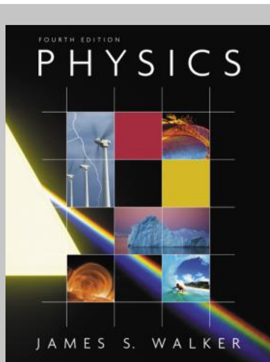


ConcepTest Clicker Questions

Chapter 10

Physics, 4th Edition

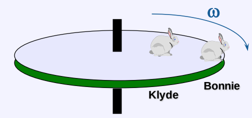
James S. Walker

Question 10.1a Bonnie and Klyde I

Bonnie sits on the outer rim of a merry-go-round, and Klyde sits midway between the center and the rim. The merry-go-round makes one complete revolution every 2 seconds.

Klyde's angular velocity is:

a) same as Bonnie's
b) twice Bonnie's
c) half of Bonnie's
d) one-quarter of Bonnie's
e) four times Bonnie's



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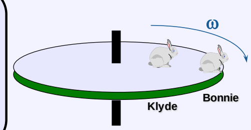
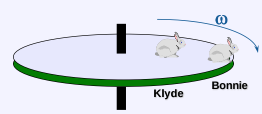
The angular velocity ω of any point on a solid object rotating about a fixed axis *is the same*. Both Bonnie and Klyde go around one revolution (2π radians) every 2 seconds.



Question 10.1b Bonnie and Klyde II

Bonnie sits on the outer rim of a merry-go-round, and Klyde sits midway between the center and the rim. The merry-go-round makes one revolution every 2 seconds. Who has the larger linear (tangential) velocity?

a) Klyde
b) Bonnie
c) both the same
d) linear velocity is zero for both of them



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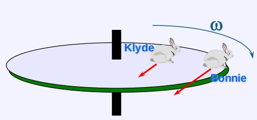
c) both the same
d) linear velocity is zero for both of them

Their linear speeds v will be different because $v = r\omega$ and Bonnie is located farther out (larger radius r) than Klyde.

$$v_{Klyde} = \frac{1}{2} v_{Bonnie}$$



Follow-up: Who has the larger centripetal acceleration?

Question 10.2 Truck Speedometer

Suppose that the speedometer of a truck is set to read the linear speed of the truck but uses a device that actually measures the angular speed of the tires. If larger diameter tires are mounted on the truck instead, how will that affect the speedometer reading as compared to the true linear speed of the truck?

a) speedometer reads a higher speed than the true linear speed
b) speedometer reads a lower speed than the true linear speed
c) speedometer still reads the true linear speed

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c) speedometer still reads the true linear speed

The linear speed is $v = \omega R$. So when the speedometer measures the same angular speed ω as before, the linear speed v is actually higher, because the tire radius is larger than before.

Question 10.3a Angular Displacement I

An object at rest begins to rotate with a constant angular acceleration. If this object rotates through an angle θ in the time t, through what angle did it rotate in the time $\frac{1}{2}t$?

a) $\frac{1}{2}\,\theta$

b) $\frac{1}{4}\,\theta$

c) $\frac{3}{4}\,\theta$

d) $2\,\theta$

e) $4\,\theta$

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The angular displacement is $\theta = \frac{1}{2}\alpha t^2$ (starting from rest), and there is a quadratic dependence on time. Therefore, in half the time, the object has rotated through one-quarter the angle.

Question 10.3b Angular Displacement II

An object at rest begins to rotate with a constant angular acceleration. If this object has angular velocity ω at time t, what was its angular velocity at the time $\frac{1}{2}t$?

a) $\frac{1}{2}\,\omega$

b) $\frac{1}{4}\,\omega$

c) $\frac{3}{4}\,\omega$

d) $2\,\omega$

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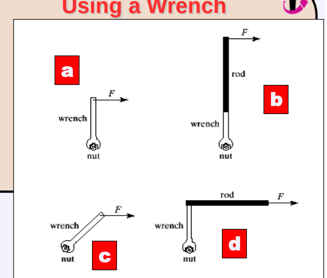
d) $2\,\omega$

e) $4\,\omega$

The angular velocity is $\omega = \alpha t$ (starting from rest), and there is a linear dependence on time. Therefore, in half the time, the object has accelerated up to only half the speed.

Question 11.1 Using a Wrench

You are using a wrench to loosen a rusty nut. Which arrangement will be the most effective in loosening the nut?



e) all are equally effective

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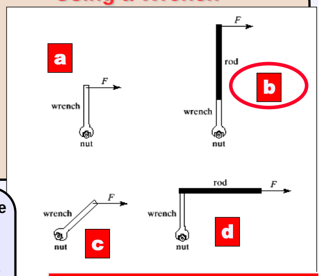

e) all are equally effective

Because the forces are all the same, the only difference is the lever arm. The arrangement with the largest lever arm (case #2) will provide the largest torque.

Follow-up: What is the difference between arrangement 1 and 4?

Question 11.2 Two Forces

Two forces produce the same torque. Does it follow that they have the same magnitude?

a) yes
b) no
c) depends

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b) no
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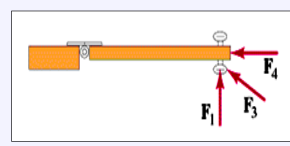
Because torque is the product of force times distance, two different forces that act at different distances could still give the same torque.

Follow-up: If two torques are identical, does that mean their forces are identical as well?

Question 11.3 Closing a Door

In which of the cases shown below is the torque provided by the applied force about the rotation axis biggest? For all cases the magnitude of the applied force is the same.

a) F_1
b) F_3
c) F_4
d) all of them
e) none of them



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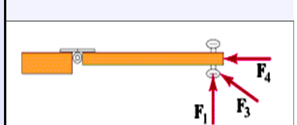
The torque is $\tau = rF\sin\phi$, and so the force that is at 90° to the lever arm is the one that will have the largest torque. Clearly, to close the door, you want to push perpendicularly!!



Follow-up: How large would the force have to be for F_4?

Question 11.4 Cassette Player

When a tape is played on a cassette deck, there is a tension in the tape that applies a torque to the supply reel. Assuming the tension remains constant during playback, how does this applied torque vary as the supply reel becomes empty?

a) torque increases
b) torque decreases
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As the supply reel empties, the lever arm decreases because the radius of the reel (with tape on it) is decreasing. Thus, as the playback continues, the applied torque diminishes.