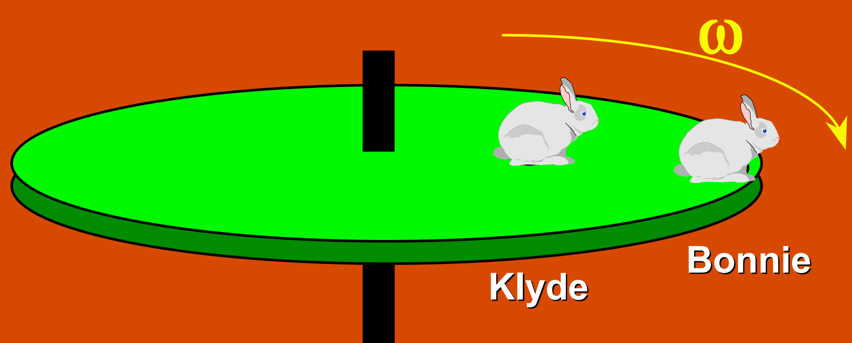
ConcepTest 9.1b Bonnie and Klyde II

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 two seconds. **Who has the larger linear (tangential) velocity?**

1) Klyde
2) Bonnie
3) both the same
4) linear velocity is zero for both of them



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3) both the same
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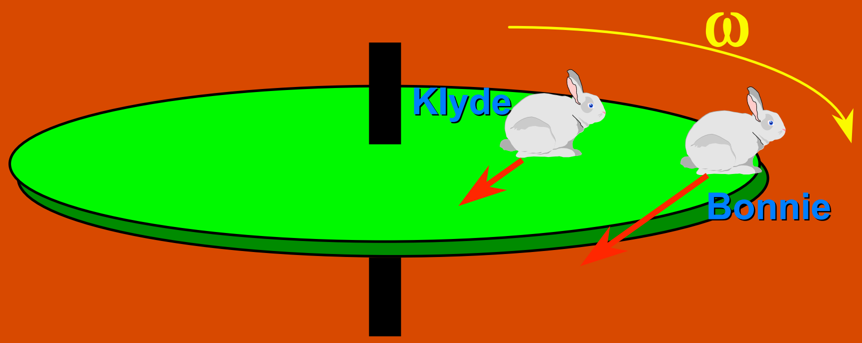
Their **linear speeds *v*** will be different since $v = R\omega$ and **Bonnie is located further out** (larger radius *R*) than Klyde.

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



Follow-up: Who has the larger centripetal acceleration?

ConcepTest 9.3a Angular Displacement I

An object at rest begins to rotate with a constant angular acceleration. If this object rotates through an angle q in the time *t*, through what angle did it rotate in the time 1/2 *t*?

1) 1/2 ω
2) 1/4 ω
3) 3/4 ω
4) 2 ω
5) 4 ω

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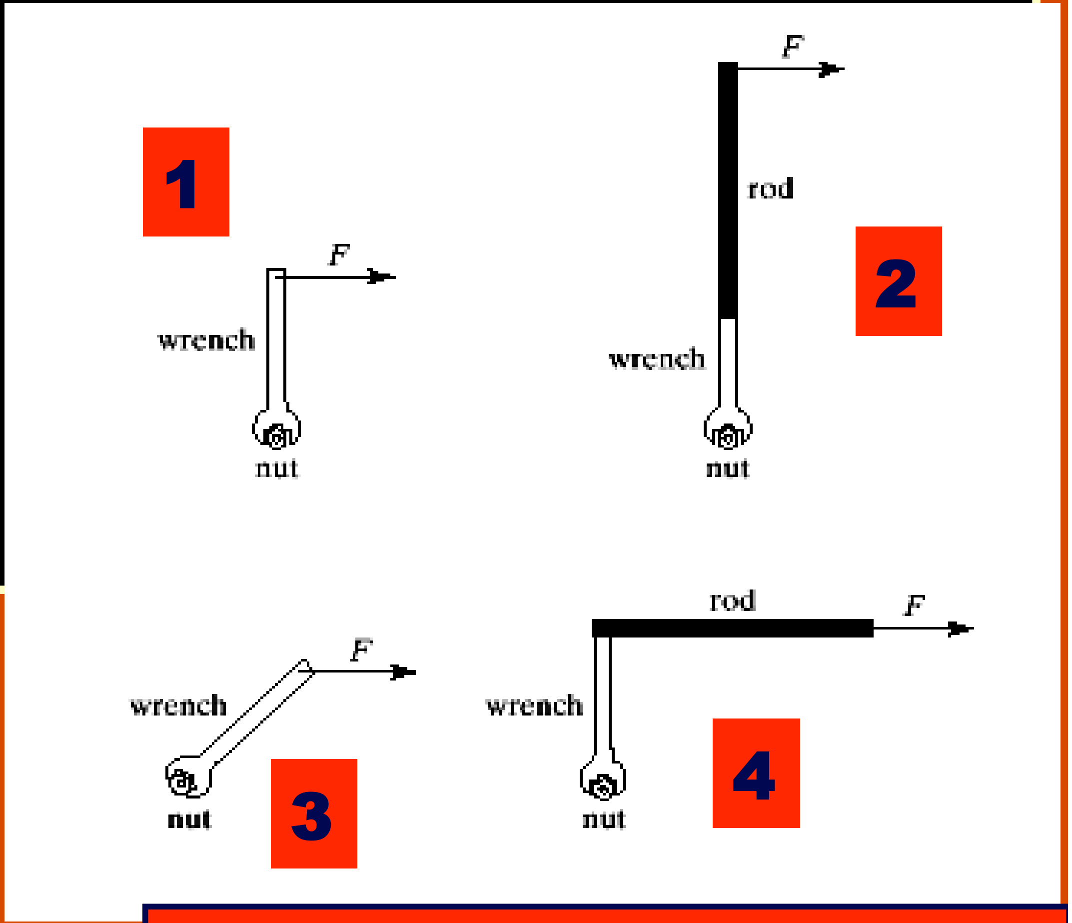
2) 1/4 θ
3) 3/4 θ
4) 2 θ
5) 4 θ

The angular displacement is $\theta = 1/2\ \alpha t^2$ (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**.

ConcepTest 9.4 Using a Wrench

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



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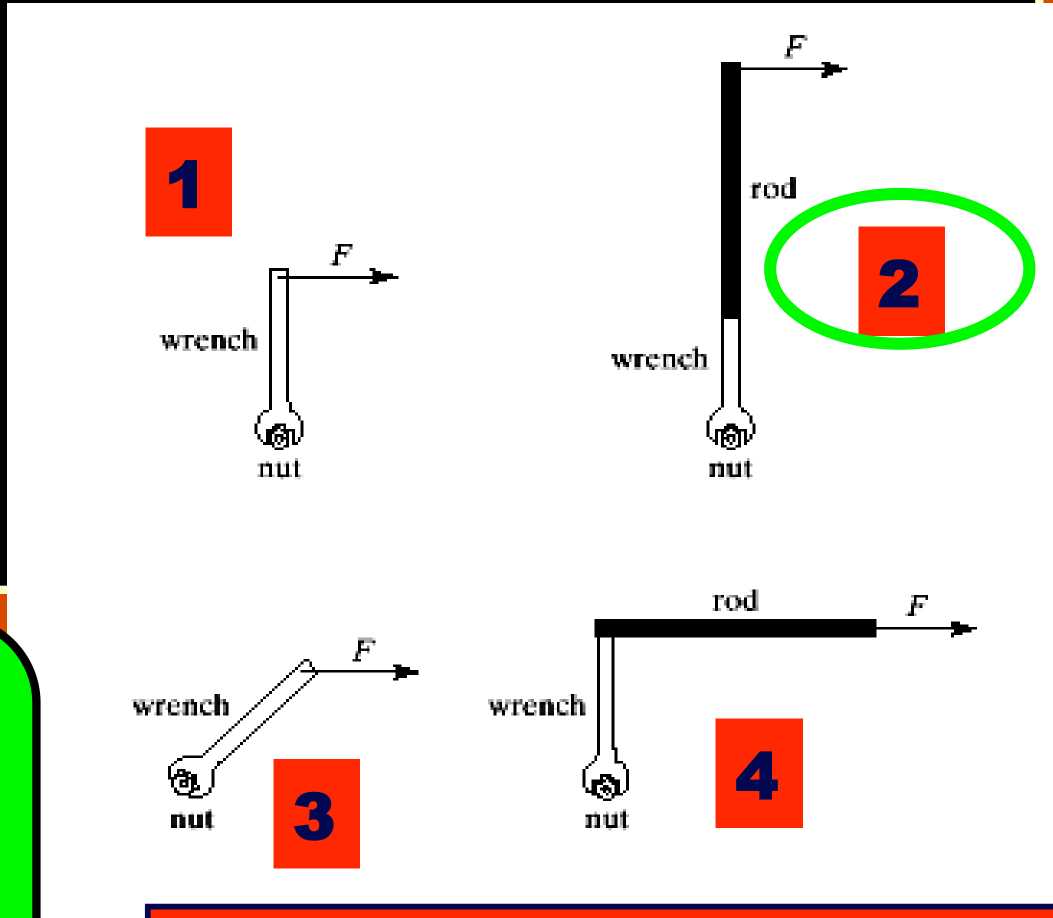

5) all are equally effective

Since 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?

ConcepTest 9.7 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?

1) **torque increases**
2) **torque decreases**
3) **torque remains constant**

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1) torque increases
2) torque decreases
3) torque remains constant

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.

ConcepTest 9.9 Moment of Inertia

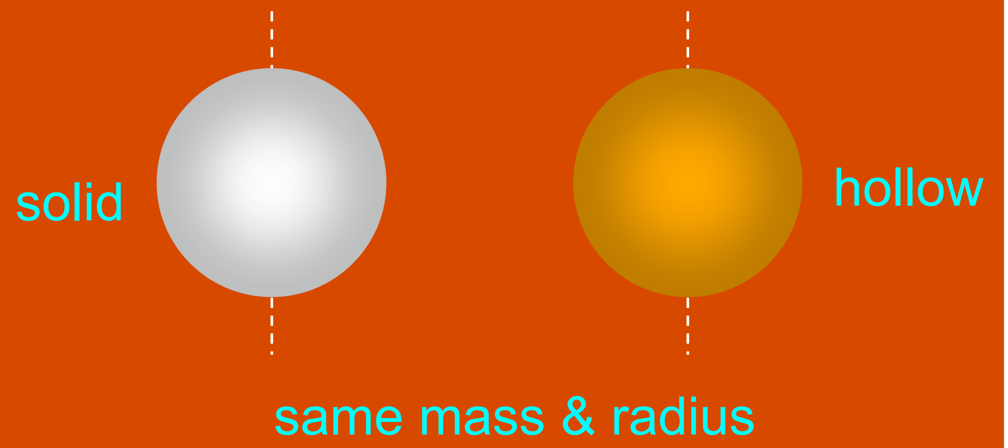
Two spheres have the same radius and equal masses. One is made of solid aluminum, and the other is made from a hollow shell of gold.

Which one has the bigger moment of inertia about an axis through its center?

a) solid aluminum

b) hollow gold

c) same



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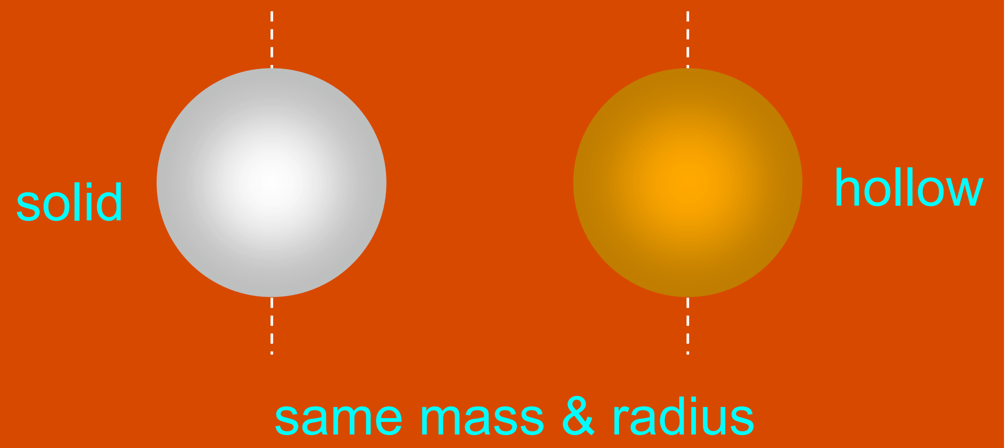
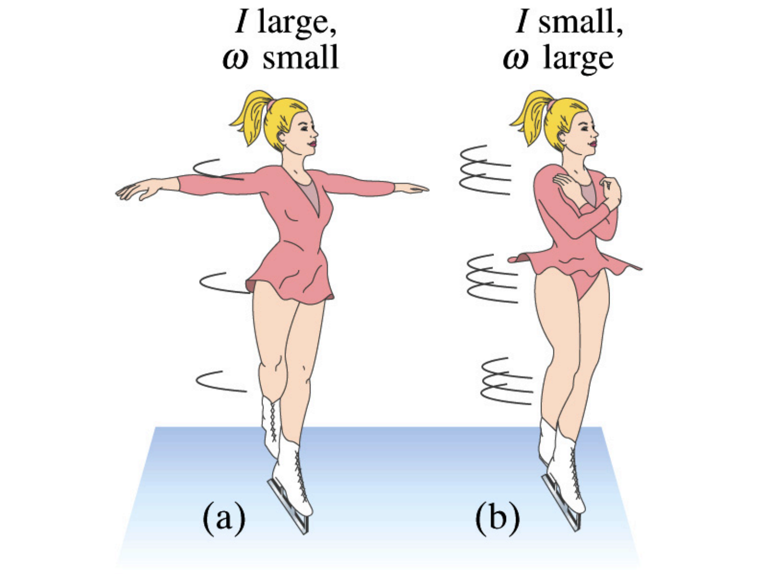
Moment of inertia depends on mass and distance from axis squared. It is bigger for the shell since its mass is located farther from the center.



ConcepTest 9.10 Figure Skater

A figure skater spins with her arms extended. When she pulls in her arms, she reduces her rotational inertia and spins faster so that her angular momentum is conserved. Compared to her initial rotational kinetic energy, her rotational kinetic energy after she pulls in her arms must be

1) the same
2) larger because she's rotating faster
3) smaller because her rotational inertia is smaller



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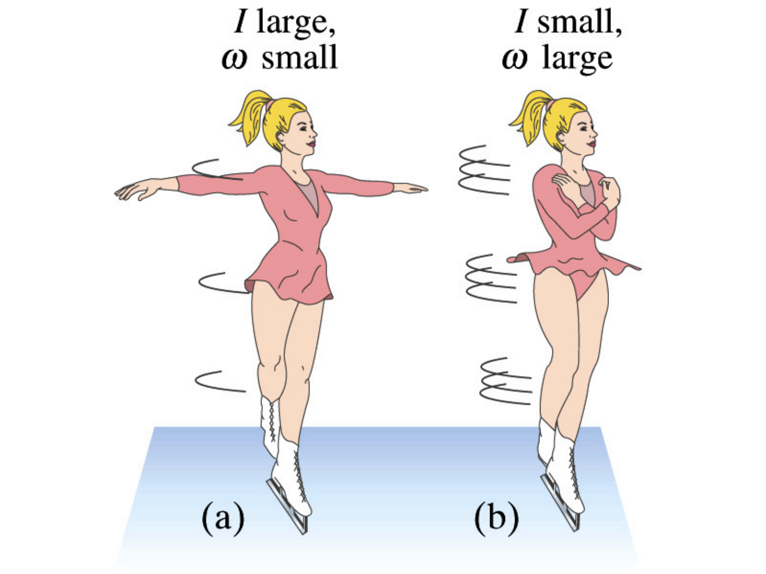
KE_{rot}=1/2 I ω^2 = 1/2 $L\,\omega$ (used $L = I\omega$). Since L is conserved, larger ω means larger KE_{rot}. The "extra" energy comes from the work she does on her arms.



Follow-up: Where does the extra energy come from?