

Rolling & kinetic energy

I. Kinetic energy clarified

This section clarifies when an object does and does not possess kinetic energy.



A. (*Work together*) A hockey puck is a rubber disk. On an ice-covered pond, a puck is spinning in place; it's not going anywhere.

1. Why might a smart student say the puck does *not* have kinetic energy?
2. Why might a smart student say the puck *does* have kinetic energy?
3. Which argument do you think is correct? Does the spinning puck have kinetic energy? Why is the *other* argument flawed?

★ *POLLING: 1 = no it doesn't have kinetic energy, 2 = yes it does. Discussion.*

B. (*Work together*) On the pond, two identical pucks move across the ice at the same speed. But one of them slides while the other rolls. Which puck, if either, has more kinetic energy? Explain.



★ *RAD poll: 1 = sliding puck has more, 2 = rolling puck has more, 3 = it's a tie. Discussion.*

II. Race: Rolling vs. sliding

A sliding block and a rolling disk of equal mass are released from rest from the top of a ramp. They “race” each other down. Let's figure out which object, if either, is moving faster at the bottom.

A. (*Work alone*) What's your initial guess about which object has more speed at the bottom? Explain.

B. (*Work together*) Now we'll help you think through this problem in terms of energy.

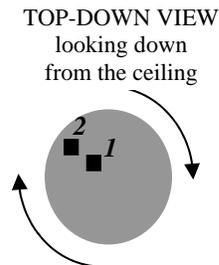
1. Which object, if either, has more gravitational potential energy at the top of the ramp? Why?
2. So, which object, if either, has more total kinetic energy at the bottom? Explain.
3. Using those insights about energy, figure out which object, if either, has more speed at the bottom. Reconcile with your part A answer, if needed.

★ *POLLING: 1 = block is faster, 2 = disk is faster, 3 = it's a tie. Experiment. Discussion.*

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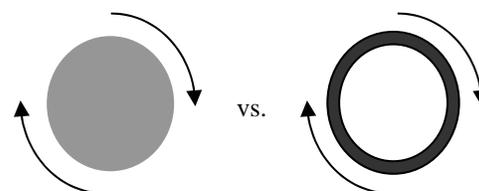
III. Rotational kinetic energy and mass distribution

- A. (*Work together*) Again consider a hockey puck spinning in place on ice. In this diagram, we've labeled two equally-massive "pieces" of the puck, 1 and 2. Which of those two pieces, if either, "contributes" more to the puck's rotational kinetic energy? In other words, which piece (if either) has more kinetic energy? Explain.



★ *POLLING: 1 = piece 1 has more KE, 2 = piece 2 has more, 3 = it's a tie. Discussion.*

- B. (*Work together*) Next to the spinning hockey puck we place a spinning metal ring (hoop), like Dr. Redish has up front. Even though the ring is "hollow," it has the same mass as the puck because the metal is denser. Both objects spin at the same rate (angular speed). Which object, if either, has more rotational kinetic energy? Explain.



★ *POLLING: 1 = puck has more KE, 2 = ring has more KE, 3 = it's a tie. Discussion.*

IV. Another race: Solid disk vs. ring

A plastic solid disk and a metal ring of equal mass and equal radius are released from rest from the top of a ramp. They both roll down, racing each other.

- A. (*Work together*) Which object, if either, has more speed at the bottom? Explain. Hint: Use everything you've learned in this ILD.

★ *POLLING: 1 = solid disk is faster, 2 = ring is faster, 3 = it's a tie. Experiment. Discussion.*

- B. (*Work together*) What do you see as the benefit, if any, of *predicting* which object would reach the bottom with more speed, *before* doing the experiment? In other words, why didn't we just do the experiment and *then* have a class discussion to explain the results? If you think doing the experiment first would have better, please say so and explain why.