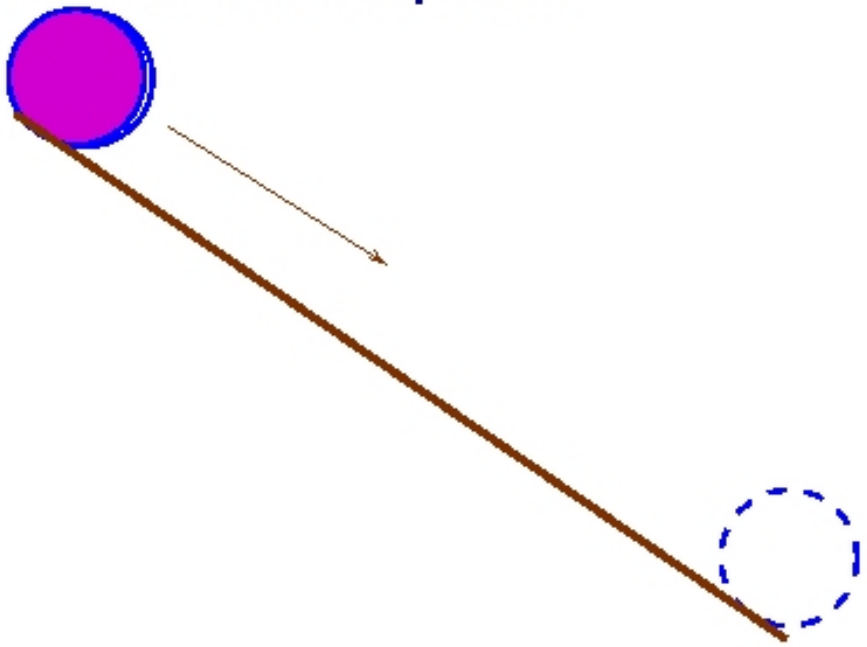
Physics 121 Concept Questions

Cycle 3

A hoop and a disk have a race down a ramp. The roll without slipping. They have the same mass and the same radius. Which one arrives to the bottom of the ramp first?



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(B) The Disk arrives first.

(C) It's an exact tie.

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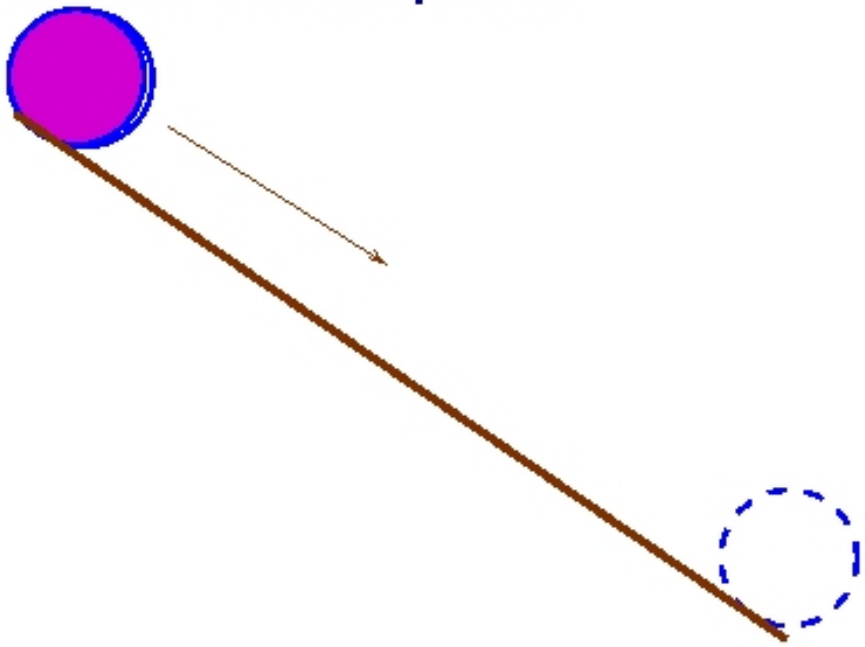

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The hoop has a larger rotational enertia.

More kinetic energy goes into rotation, leaving less for translation.

An ball is placed near the edge of a circular bowl and allowed to roll dow to the bottom. Which of these are are true statements? Ignore friction altogether here.

(A) When the ball gets to the bottom of the bowl, the Normal force on the ball will have a magnitude that is greater than the weight of the ball.

(B) When the ball gets to the other side and comes to zero velocity, at that point the Normal force will have a magnitude that is less than the weight of the ball.

(C) Both of these are true.

(D) None of these are true.

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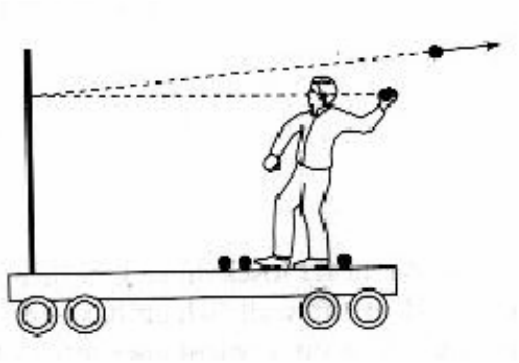
You stand on a cart at rest with frictionless wheels and you throw a ball against a wall that is attached to the cart as shown. Which way is the cart moving after the ball rebounds from the wall?



(A) The cart moves to the right.

(B) The cart moves to the left.

(C) The cart will be at rest.

(D) It depends on the mass of the ball, the mass of the cart, and the thrown velocity.

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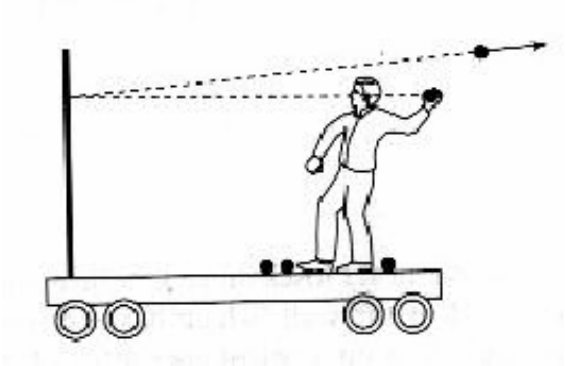
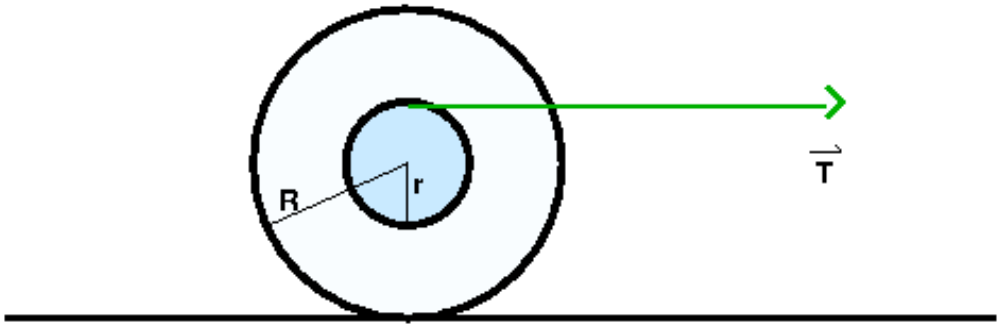


(A) The cart moves to the right.

(B) The cart moves to the left.

Conservation of linear momentum. System of cart and ball. Before = 0. After, ball goes to right so cart must go to left so that total momentum is still zero.

A spool is pulled across the table as show with a given small tension force. Which way will the spool roll?



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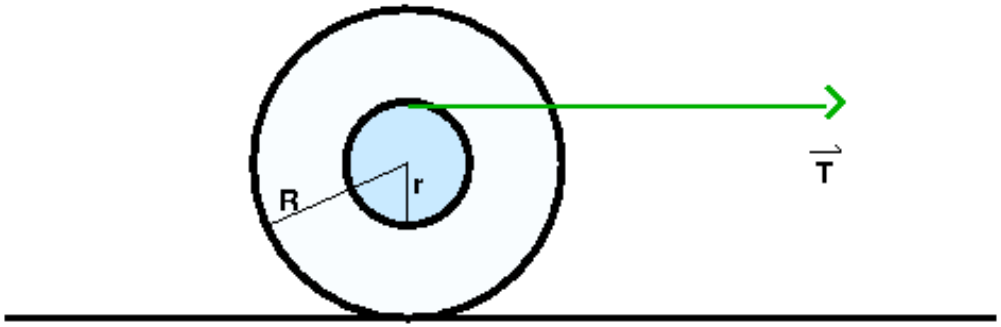

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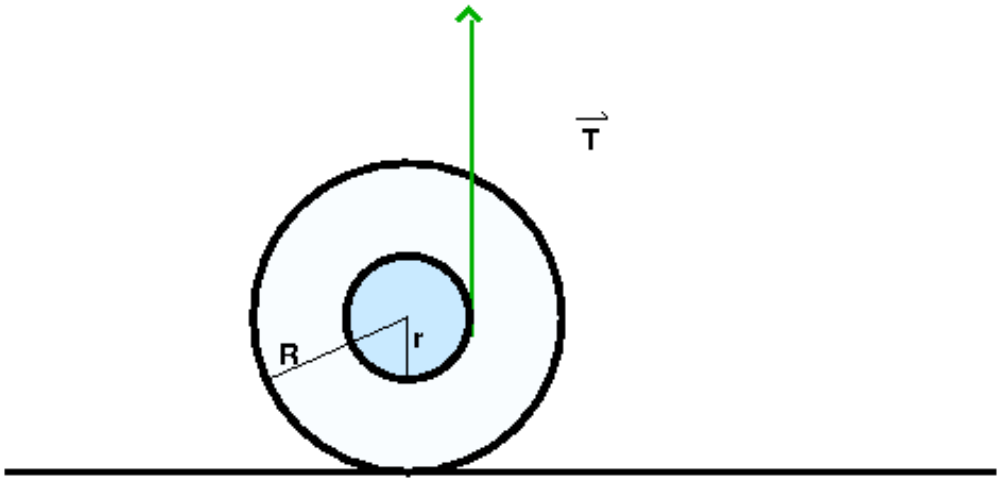
A spool is pulled on a string straight up as shown.
Which way will the spool roll?



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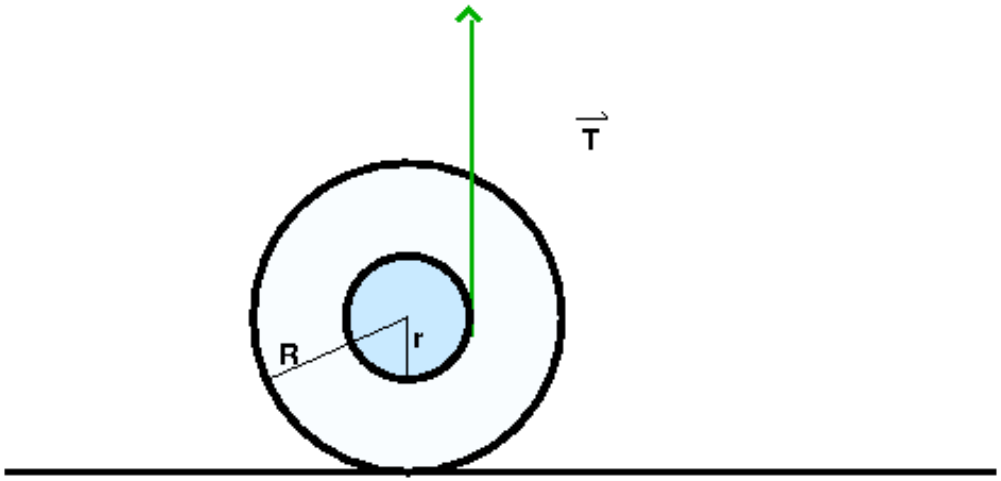

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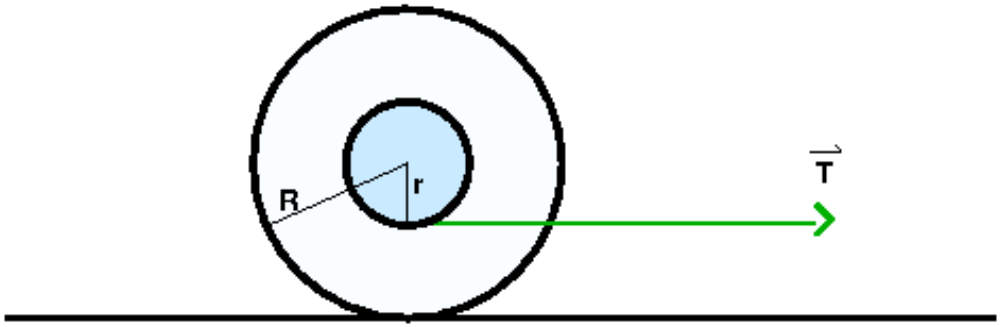

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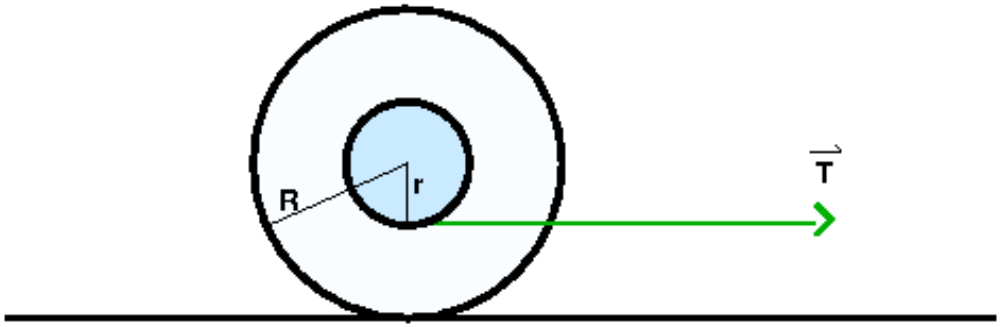

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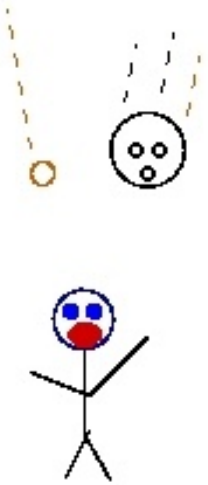
Think Fast!



Two adversaries are taking aim at you.

The first is trying to hit you with a bowling ball.

The second is trying to hit you with a ping–pong ball.

It is the case that the ping pong ball and the bowling ball arrive at your position with equal linear momentum.

You can move to avoid either the ping–pong ball OR the bowling ball but not both.

What do you chose to minimize the risk of personal injury?

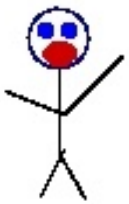
(1) Avoid the bowling ball.

(2) Avoid the ping–pong ball.

(3) It doesn't matter, they will both hurt the same.

(4) Avoid the ping–pong ball as if your life depended on it!

(5) Insist on more details.



(4) Avoid the ping–pong ball as if your life depended on it!

Explanation:

Both balls have the same linear momentum, so:

$mv = MV$

The mass of a ping pong ball is about a gram.
The mass of a bowling ball is about 5 kg.

So the ratio of velocities of the bowling ball to the ping pong ball v/V is M/m -- 5000 to one.

So if the bowling ball is moving a few miles per hour the ping pong ball will be moving at ultra–sonic speeds!

Under any conceivable circumstances, the ping pong ball will be much more dangerous than the bowling ball.

FURTHER THOUGHTS:

For two objects with the same linear momentum the one with the lower mass will always have the higher kinetic energy!

$$K = \frac{p^2}{2m}$$