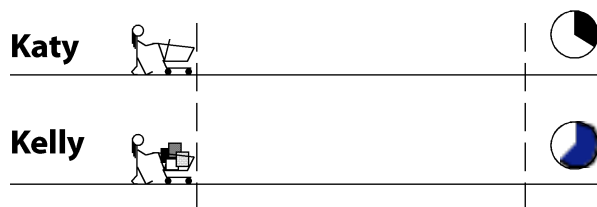# PhyzJob: Kinetic Energy-Momentum Conundrums

Felix

Race I: Equal Distance

1. Katy and Kelly are identical twins who enjoy grocery cart races. Suppose Katy pushes an empty cart and Kelly pushes a loaded cart, and they both push their carts through an equal distance.

a. Whose cart crosses the distance in the least time?

√ Katy's
___ Kelly's
___ It's a tie

Katy

Kelly

b. A clock showing the time it took for Katy to complete the distance is shown above. Draw a clock showing how long it took for Kelly to complete the distance.

c. Whose cart has more kinetic energy at the finish line? Whose cart has more momentum at the finish line? To assist in your decision-making process, complete the table below by placing a check mark in each column indicating whether a given quantity is greater for Katy, Kelly, or if it's the same for both.

	F	d	Δt	ΔKE	Δp
Katy					
Kelly			√		√
Same	√	√		√	

d. Whose cart crosses the finish line with more kinetic energy? Justify your response *without* reference to mass or speed.

Same for both! Same force and same distance, so same work thus same kinetic energy.

e. Whose cart has more momentum at the finish line? Justify your response without any direct reference to mass or speed.

Kelly. She pushes for a longer interval of time. Same force for more time means more impulse. More impulse means more momentum.

f. Upon reaching the finish line, Katy and Kelly release their respective carts. Each cart collides with a nail half driven into a wood board. Which cart—if either—will drive the nail farther into the board?

Same for both! Ability to drive the nail is a question of energy. Since both carts end up with the same energy, both carts can drive a nail to an equal depth.

db

Race II: Equal Time

2. Suppose Katy pushes an empty cart and Kelly pushes a loaded cart, and they both push their carts for an equal amount of time.

a. Whose cart goes farther during the interval?
√ Katy's
___ Kelly's
___ It's a tie

Katy

Kelly
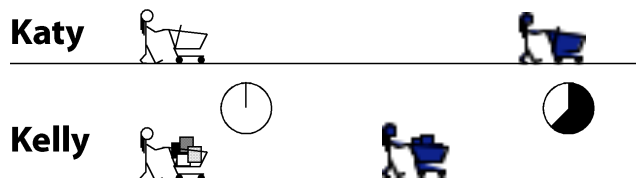
b. Draw the scene at the end of the interval by adding to the illustration above.

c. Whose cart has more kinetic energy at the end of the interval? Whose cart has more momentum at the finish line? To assist in your decision-making process, complete the table below by placing a check mark in each column indicating whether a given quantity is greater for Katy, Kelly, or if it's the same for both.

	F	d	Δt	ΔKE	Δp
Katy		√		√	
Kelly					
Same	√		√		√

d. Whose cart has more kinetic energy at the end of the interval? Justify your response *without* reference to mass or speed.

Katy. She pushes through a greater distance. Same force and greater distance means more work. More work means more kinetic energy.

e. Whose cart has more momentum at the end of the interval? Justify your response without any direct reference to mass or speed.

Same for both! Same force and same time, so same impulse thus same momentum.

f. When the time interval has elapsed, Katy and Kelly release their respective carts. Each cart collides with a nail half driven into a wood board. Which cart—if either—will drive the nail farther into the board?

Katy's! Ability to drive the nail is a question of energy. Since Katy's cart ends up with more kinetic energy, it can drive a nail to an equal depth.