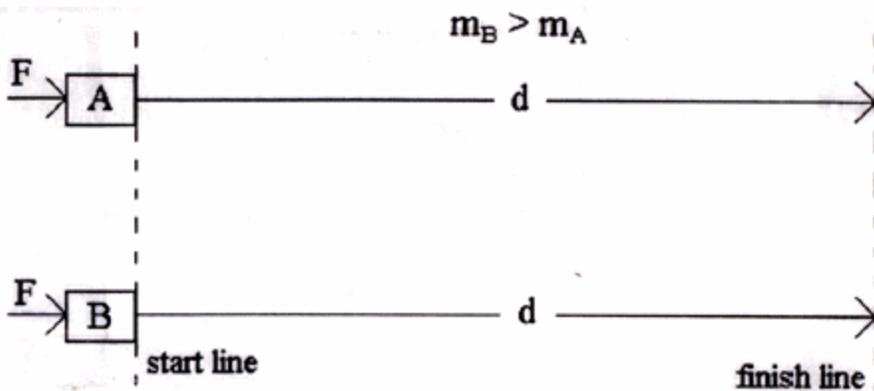


Racing Air Carts (impulse-momentum)

Go to the Physics Exploration Center. Enter through the resource room 311/312 Thaw Hall. Two Blocks A and B are at rest on adjacent horizontal air tracks. The mass of block B, m_B , is greater than the mass of block A, m_A . They have identical masses hanging from them via strings and when the air is turned on (negligible friction) both blocks are pulled forward with approximately the same tension force (Assume that the tension force is nearly the same in both cases since masses m_A and m_B are significantly greater than the hanging mass.).



Suppose you allowed the sliders with different masses to travel the same distance d (the length of the track) while each is pulled by same tension force. PREDICT the following outcomes BEFORE doing the experiment based upon your knowledge of concepts related to energy and momentum.

- (a) Which of the two blocks will take shorter time to travel the full length of the track? Explain your reasoning citing the relevant physics principle you used.
- (b) Which of the two blocks will have a larger acceleration? Explain your reasoning citing the relevant physics principle you used.
- (c) How will the impulse of the forces compare in the two cases? Justify your answer citing the relevant physics principle you used.
- (d) Which of the two blocks will have a larger change in momentum? Justify your answer citing the relevant physics principle you used.
- (e) Does your answer in part (d) imply that the block which has a larger momentum will also have a larger velocity? If not, why not?

(f) How will the work done in traversing distance d compare in the two cases? Justify your answer citing the relevant physics principle you used.

(g) How will the kinetic energies compare in the two cases? Justify your answer citing the relevant physics principle you used.

Now turn on the air. Run the experiment for each mass separately (air cart: m_A and m_B). Watch the motion of the two blocks (air carts) and plot their velocities and accelerations with the computer. *Make sure that both sliders travel the same distance d (the length of the track).* Based upon your observations answer the following questions; submit the plots along with the answers. (Note: For your own benefit, record on each plot which air cart was being observed, when the data was taken.)

(a') Which of the two blocks takes shorter time to travel the full length of the track? If your prediction in (a) did not match your observations, can you reconcile the difference? Explain the reasoning.

(b') Which of the two blocks has a larger acceleration? Consult your acceleration plot to verify your answer. If your prediction in (b) did not match your observations, can you reconcile the difference? Explain the reasoning.

(c') Based upon the definition of impulse, how do the impulses delivered by the forces compare in the two cases? If your prediction in (c) did not match your answer now, can you reconcile the difference? Justify your answer.

(d') Based upon the relation between impulse and change in momentum, which of the two blocks has a larger change in momentum? If your prediction in (d) did not match your answer now, can you reconcile the difference? Justify your answer.

(e') Consult your velocity plot to check if the block which has a larger momentum has a larger velocity? If your prediction in (e) did not match your observations, can you reconcile the difference? Justify your answer.

(f') Based upon the definition of work, how should the work done in traversing distance d compare in the two cases? Justify your answer.

(g') Based upon the relation between work and change in kinetic energy, how should the kinetic energies compare in the two cases? Justify your answer.