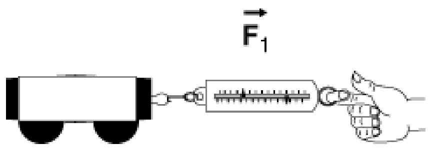
Activity 2-1: Do One-Dimensional Forces Behave Like Vectors?

This activity is a section from RealTime Physics Lab 4. Students have already done expirements in which a cart was pulled by a string, with graphs of force, velocity and acceleration displayed on the computer screen From this they have already concluded that acceleration (the amount something is speeding up or slowing down) is proportional to force. This activity will reinforce that understanding with a kinesthetic experience, tie those observations with the concept of vectors introduced earlier with velocity and acceleration graphs, and begin exploring the addition of forces.

1. Observe what happens when you hook a spring scale to one end of the cart and extend it in a horizontal direction so that its force is equal to 1.0 N in magnitude. Be sure to keep the spring scale extended to 1.0 N during the entire motion of the cart. It will work best to place one or two cart masses in the cart. (This is a casual observation – no need to take any data.) You may need to take several practice runs.

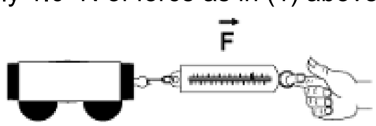


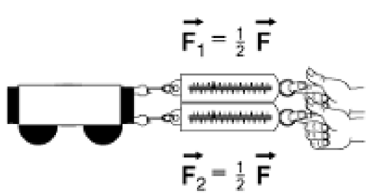
Question 2-1: Does the cart move? If so, how? Does it move with a constant velocity or does it accelerate?

Question 2-2: Draw an arrow next to the diagram above that represents a scale drawing of the magnitude and direction of the force you are applying. Let 5.0 cm of arrow length represent each newton of force. Label the arrow with an $\vec{F}_1$.

2. Examine what kind of motion results when two identical spring scales are displaced by the same amount in the same direction (for example, when each spring is displaced to give 0.5 N of force). Again keep the springs stretched throughout the entire motion.

Compare this motion to that when one spring scale is displaced by twice that amount (for example so that it can apply 1.0 N of force as in (1) above).





Question 2-3: Describe what you did, and compare the motions of the cart.

Question 2-4: Draw arrows next to the diagram above that represent a scale drawing of the magnitudes and directions of $\vec{F}_1$, $\vec{F}_2$ and $\vec{F}$.. Again let 5.0 cm of arrow length represent each Newton of force.

3. Observe what kind of motion results when two spring scales are hooked to opposite ends of the cart and extended in a horizontal direction so that each of their forces is equal to 1.0 N in magnitude, but they are opposite in direction.

Question 2-5: Does the cart move? If so, how? What do you think the combined or net applied force on the cart is equal to in this situation?

Question 2-6: Draw arrows next to the diagram above that represent a scale drawing of the magnitudes and directions of the forces you are applying. Let 5.0 cm of arrow length represent each newton of force. Label each arrow appropriately with an $\vec{F}_1$ or an $\vec{F}_2$.

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