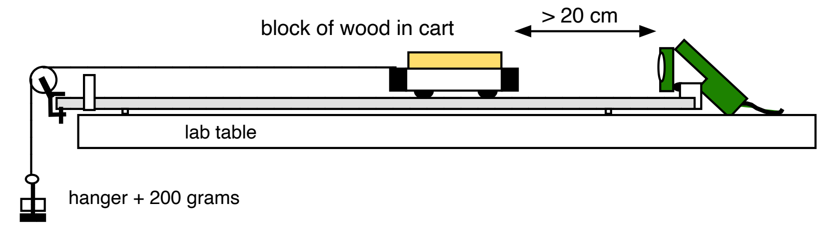
Lab 5-2: Newton's Second Law

Purpose: To examine the acceleration and net force on a system when there is no friction and compare it to the acceleration and net force on the same system when there is friction.

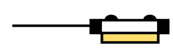
Materials: 1 string (~75 cm) 1 pulley 1 hanger (50 grams) 1 cart (500 grams)
1 block of wood slotted masses (200 grams)

Procedure:

1. Set up the track, cart, block of wood, pulley, hanger and motion detector as shown in the diagram below.



2. Record the mass of the cart, block of wood and hanger+200 grams in the data section. Also add up all the masses to find the total mass.
3. Make sure the track is level. The cart should not be rolling in either direction. Also, make sure that the string is attached to the pulley horizontally.
4. Start *LoggerPro*. Open up the file "02 Cart.cmbl". Make sure the bottom graph is velocity vs. time.
6. Pull the cart/block of wood back and hold it. Make sure that there is at least 20 cm between the cart and the motion detector. Start collecting data. When you hear the motion detector, release the cart. **Don't let the cart slam into the end of the track!**
7. To determine the acceleration of the cart, measure the slope of the best fit line of the velocity graph. You will have to highlight the portion of the graph that shows the cart speeding up.
8. Repeat steps **6** and **7** above for two more trials then calculate the average of the three accelerations.
9. Flip the cart/block of wood upside down, so that the felt is on the table and the wheels are up in the air. Repeat steps 6 to 8 three times and record your results in the table.



Data:

Masses:

Hanger: ________ kg Cart: _________ kg Block: ________ kg TOTAL: ________ kg

Part 1: Acceleration without Friction:

Trial 1: ___________ m/s^2 Trial 2: ___________ m/s^2 Trial 3: ___________ m/s^2

Acceleration (frictionless): ___________ m/s^2

Part 2: Acceleration with Friction:

Trial 1: ___________ m/s^2 Trial 2: ___________ m/s^2 Trial 3: ___________ m/s^2

Acceleration (with friction): ___________ m/s^2

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Questions:

1. How much does the 250 gram hanger weigh?

2. If you just dropped the hanger, what would be its acceleration? What would be the net force on the hanger?

3. In both cases in this lab, the acceleration was a lot less than your answer to the previous question. Why is that?

4. How much does the cart and block of wood combined weigh?

5. If the cart / wood were just sitting on the track, they would not be accelerating. In that case what would the net force on the cart / wood be?

6. What happens to the weight of the cart / wood? Why doesn't the cart / wood accelerate down?

7. In both cases in this lab, why does the cart / wood accelerate along the track?

8. We often use the word *system* to indicate when we have multiple objects that are connected / combined and have the same motions. While there are a lot of individual masses involved in this lab, they all combine to make a system because they always have identical speeds and accelerations. What was the mass of the system in this lab?

9. In the first part of this lab (when there was no friction), what was the net force on the system?

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10. How does that compare to the weight of the hanger?

11. In the second part of this lab (when there was friction), what was the net force on the system?

12. How does that compare to the weight of the hanger?

13. Why should the net force in the first part of the lab be equal to the weight of the hanger?

14. Why should the net force in the second part a lot less than the weight of the hanger?

15. What was the magnitude of the force of friction in the second part of this lab?