Force investigation

These examples may help you to plan and conduct investigations that explore effects of balanced and unbalanced forces on the motion of objects.

Equipment

carts
pulleys
stopwatch
metre rule
string
50 g, 100 g, 150 g, 200 g, 250 g masses
masking tape
graph paper

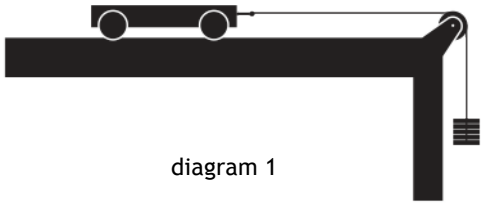

diagram 1

Investigation 1: The effect of unbalanced forces on motion of a cart

Procedure

1. Set up equipment as shown in diagram 1 but don't add masses.
2. Stick two pieces of masking tape on desk, 0.50 m apart, to mark distance cart will travel.
3. Add one 50 g mass to string, and pull back cart until level with first piece of masking tape.
4. Release cart and simultaneously start stopwatch.
5. Stop the watch when cart reaches second piece of masking tape. (Be sure to stop your cart before it runs off the desk!)
6. Record time in Results table (see example below).
7. Repeat procedure using 100 g, 150 g, 200 g, and 250 g masses.

Results table

FORCE ON CART (mass added)	TIME FOR CART TO TRAVEL 0.50 m (seconds)
50 g	
100 g	
150 g	
200 g	
250 g	

Questions

1. On a separate piece of graph paper, graph mass added to cart (on the x-axis) against travel time for cart (on the y-axis).
2. What does the graph tell you about the motion of the cart?
3. As you added more masses to the string, what did you observe about the cart's motion? Does your answer to this question match your answer to question 2?
4. How could you increase the accuracy of your distance and time measurements?
5. The force on the cart, due to the masses, is unbalanced. What relationship is there between the cart's speed and the unbalanced force acting on it? Does this match your answer to questions 2 and 3?

Challenge questions

6. For each set of results, calculate the cart's average speed using the formula: average speed = distance / time. Explain any pattern in your answers.
7. Would the speed of the cart be different if the cart was heavier? (If you have time, test this by adding masses to the cart and repeating some of your earlier test runs).

Investigation 2: The effect of balanced forces on motion of a cart

A motion trolley, pulleys and masses were assembled as in the diagram below. The masses at end A and B are equal. The forces are balanced because they are equal in magnitude (strength) but opposite in direction.

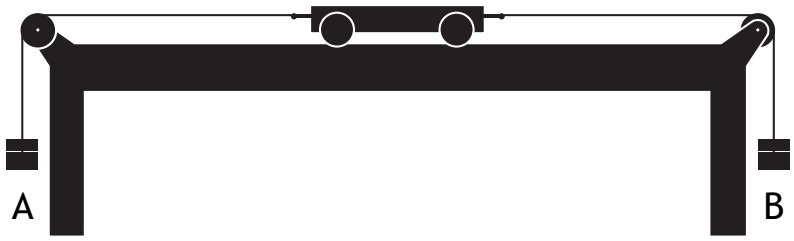

diagram 2

Questions

1. Describe what you think will happen in the experiment above.

2. William thinks that adding a small mass (10 g) to one side won't cause the cart to move while Katie thinks it will. Who is correct? Explain your answer.

3. What will happen to the cart if 50 g is removed from end A? Explain your answer.

4. What happens to the speed of the cart as more masses are removed from end A? Explain your answer.

5. If the cart is stationary, are the forces on it balanced or unbalanced? Explain your answer.

Discussion question

6. Equal masses are placed on ends A and B, then the cart given a gentle push. The cart moves in the direction of the push, then slowly comes to a stop. William thinks the cart comes to a stop because the forces are balanced so there will be no motion. Katie thinks that the cart comes to a stop because of friction. Who is correct? Explain your answer.

If the equipment is available, students may undertake the investigation to check their answers to these questions.