**Lab** –Constant Mass – Changing Force

**Purpose:** To investigate the how increasing the applied force affects the acceleration of a systems .

**Materials:**

|  |  |  |
| --- | --- | --- |
| Meterstick | Pasco dynamic cars | 500 g masses |
| 6 qty 20g hook mass | Pulley with table clamp | Scale |
| String | Small weights | Stopwatch |

**Discussion:**

Have you ever noticed when an elevator cage at a construction site goes up that a large counterweight (usually made of concrete) comes down? The elevator and the counterweight are connected by a strong cable. Thus, the elevator doesn’t move without the counterweight moving the same amount. Since the electric motor can’t move one without moving the other, the two so connected together for a *system*. In the last activity, “Constant Force and Changing Mass” you learned how the acceleration of a dynamic cart was affected by increasing the mass of the cart. But the cart is really part of a *system* consisting of the *cart and the falling weight.*

Adding mass to the cart rather than to the falling weight was not accidental; however, in doing so, you changed only one variable – mass – to see how it affects the acceleration of the entire system. In this experiment you will investigate how increasing the applied force on a cart and falling weight system affects its acceleration while keeping the mass of the system constant. The applied force is increased without changing the mass by removing mass from the cart and placing it on the hanging weight.

**Procedures:**

**Step 1 -** See example set up**. (load the dynamic cart with 5 hook mass)**

**Step 2 –** Set up table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mass of falling weight | **TIME TO COVER THE SAME DISTANCE** | | | | **ACCLERATION**  **M/S** |
| Trial 1 (s) | Trial 2 (s) | Trial 3 (s) | Average |  |
| 20 g |  |  |  |  |  |
| 40 g |  |  |  |  |  |
| 60 g |  |  |  |  |  |
| 80 g |  |  |  |  |  |
| 100 g |  |  |  |  |  |

**Step 3** – Record Data

Time the cart with different mass for 3 trials (distance must remain the same) then average the time. Calculate the acceleration. Use the equation ∆x = Vit + ½ at2

**Step 4** – Graph

Make a graph of acceleration, mass on horizontal axis and acceleration on vertical axis.

**Analysis**

1. Describe your graph of acceleration vs force. Do your data points produce a straight line graph or curved.
2. Does the acceleration of the cart increase or decrease as the force increases?
3. Was the mass of the accelerating systems (cart + falling weight) the same in each case?
4. In the last activity, you learned (or should have) that when a constant force applied, the acceleration or the systems decreases as it mass increases. The acceleration is inversely proportional to the mass of the system. Now the acceleration of the systems increases as the force applied to it (the weights of the falling masses) increases. That is the acceleration is directly proportional to the applied force. Combine the results from the last two activities and come up with a general relationship between force, mass and acceleration.