Physics 200 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Newton’s Laws

*Newton Sled* Experiment

Question: What is the effect (if any) of varying projectile mass on the force applied by a rubber band launcher?

Independent Variable:

Dependent Variable:

Hypothesis:

Important Variables to Control:

Data Collection and Calculations:

Fill in the table below by sliding the sled by hand. Record the time and distance of the slide. Make sure that you only count *good slides*. Repeat for greater accuracy.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finding Coefficient of Kinetic Friction of PVC on Tile | | | | | | |
| Trials | Sled Sliding Distance (m) | Sled Sliding Time (s) | Sled Sliding Acceleration (m/s2) | Sled Mass (kg) | Kinetic Friction Force (N) | µk of PVC on Tile (no units) |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
|  |  | Average |  |  |  |  |

Fill in the table below by launching the empty PVC projectile. Record the total displacements of the sled and projectile. Make sure that you only count *good launches*. Repeat for greater accuracy. *These data are all that you will need in order to perform your calculations, but you may choose to simplify the calculation process by collecting even more data (I’m not providing hints on what type of data).*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Data: **Lower** Mass Projectile | | | | | | |
| Trials | Sled Total Displacement (m) | Projectile Total Displacement (m) | Rubber Band Stretch Distance (m) | Number and Type of Rubber Bands (none) | Sled Mass (kg) | Projectile Mass (kg) |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |

Use the data above to perform the calculations below. You will probably have to do a little bit of estimation, but your answers should be close to their actual values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Calculations -- **Lower** Mass Projectile | | | | |
| Sled Deceleration Distance (m) | Projectile Deceleration Distance (m) | Rubber Band Average Force (N) | Sled Acceleration Distance (m) | Projectile Acceleration Distance (m) |
|  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Higher** Mass Projectile | | | | | | |
| Trials | Sled Total Displacement (m) | Projectile Total Displacement (m) | Rubber Band Stretch Distance (m) | Number and Type of Rubber Bands (none) | Sled Mass (kg) | Projectile Mass (kg) |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Calculations -- **Higher** Mass Projectile | | | | |
| Sled Deceleration Distance (m) | Projectile Deceleration Distance (m) | Rubber Band Average Force (N) | Sled Acceleration Distance (m) | Projectile Acceleration Distance (m) |
|  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Very High** Mass Projectile = EHS + Earth | | | | | | |
| Trials | Sled Total Displacement (m) | Projectile Total Displacement (m) | Rubber Band Stretch Distance (m) | Number and Type of Rubber Bands (none) | Sled Mass (kg) | Projectile Mass (kg) |
| 1 |  |  |  |  |  | 6x1024 |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Calculations -- **Earth** Mass Projectile | | | | |
| Sled Deceleration Distance (m) | Projectile Deceleration Distance (m) | Rubber Band Average Force (N) | Sled Acceleration Distance (m) | Projectile Acceleration Distance (m) |
|  |  |  |  |  |

**Conclusion**:

**Practice Problem: Newton Sled calculations in reverse**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sled Total Displacement (m) |  |  | Sled Mass (kg) | 0.2 |  | Sled Deceleration Distance (m) |  |
| Projectile Total Displacement (m) |  |  | Sled Friction Force (N) |  |  | Projectile Deceleration Distance (m) |  |
| Rubber Band Stretch Distance (m) | 0.8 |  | Projectile Mass (kg) | 0.1 |  | Rubber Band Average Force (N) | 30 |
| Number and Type of Rubber Bands (none) |  |  | Projectile Friction Force (N) |  |  | Sled Acceleration Distance (m) |  |
| µk of PVC on Tile (none) | 0.3 |  |  |  |  | Projectile Acceleration Distance (m) |  |