Marble Launcher Lab

**Purpose:**

1. Use conservation of energy to estimate K for a marble launcher.
2. Establish a mathematical relationship between potential energy and compression of a spring.
3. Derive an equation for spring force vs. compression distance.

**Procedure:**

Equipment needed: Marble launcher, marbles, means of measurement (we used a meter stick.), place marker

1. Load the marble into the launcher.
2. Pull the spring back to the first setting and release to launch.
3. Measure distance traveled by marble and repeat at each setting.

**Data:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | X(m) | Range(m) |

|  |
| --- |
| T(s) |
|

 | V(m/s) range/time |

|  |
| --- |
| KE(J) |
|

 | PEs (J) |
| (compression) |
| 1a | 0.047 | 0.75 | 0.227 | 3.3 | 0.1375 | 0.1375 |
| 1b | 0.047 | 0.93 | 0.227 | 4.1 | 0.2102 | 0.2102 |
| 2a | 0.063 | 1.15 | 0.227 | 5.07 | 0.3234 | 0.3234 |
| 2b | 0.063 | 1.09 | 0.227 | 4.8 | 0.2916 | 0.2916 |
| 3a | 0.079 | 1.58 | 0.227 | 6.96 | 0.6104 | 0.6104 |
| 3b | 0.079 | 1.2 | 0.227 | 5.29 | 0.353 | 0.353 |
| 4a | 0.095 | 2.11 | 0.227 | 9.3 | 1.0886 | 1.0886 |
| 4b | 0.095 | 1.59 | 0.227 | 7 | 0.6181 | 0.6181 |
| 5a | 0.111 | 2.23 | 0.227 | 9.82 | 1.216 | 1.216 |
| 5b | 0.111 | 1.91 | 0.227 | 8.41 | 0.8874 | 0.8874 |

Measured Constants

 mmarble=0.0063kg

∆y= 0.253m

**Calculations:**

**a**) Calculate the spring constant (K).

Y= 91.197x2-0.0244x-0.0403

U= 91.196x2-0.0244x-0.0403

U=1/2kx2

91.197x2=1/2kx2

K= 2(91.197)= 182.394

**b**) Relate the spring force (Fs) to the compression distance of the spring.

Fs= -dU/dx

Fs= -d/dx(91.197x2-0.0244x-0.0403)

Fs= -182.34x+0.0244

**Conclusion:**

 We were able to accomplish all three goals set forth in in our purpose. We used our data to calculate the total energy of the system, which we were able to use to find the spring force constant. Using Excel, we charted and graphed our data, finding the relationship (best-fit line) between the compression and potential energy of the spring. That relationship was then used to relate the spring force to compression distance. There may have been some error because we did not account for non-conservative forces, such as air resistance and friction between the spring and the launcher, and also because the ground we used was not a perfectly horizontal surface. There was also probably error in our distance measurements because we were not able to accurately determine where the marble first landed.