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| PHYS 101 – Wed class |
| Conservation of Energy |
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| Alcides Segovia, Mari Martin, Derek Swaidner10-22-2014 |

Conservation of Energy

Objective:

 The purpose of this experiment is to determine the spring constant and to study the conservation of energy concept.

Theory:

 “The total energy is neither increased nor decreased in any process. Energy can be transformed from one form to another, and transferred from one object to another, but the total amount remains constant.” (p156)

Procedure:

Determine the spring constant:

1. Measure the equilibrium of the spring
2. Suspend 50g from the spring and measure the distance from equilibrium.
3. Place 100g, 150g, 200g, and 250g on the spring and measure displacement x of the spring.
4. Calculate F=mg
5. Calculate k from F=kx
6. Graph F versus x and find the slope
7. Find the percentage of error between the slope and the average of k
8. Find the standard deviation for k. $σ=1/N\sum\_{i=0}^{n}\left(x+µ\right)^{2}$

Data:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Run #** | **m** | **x** | **F** | **k** | **(k-Ave)** | **Slope** |
| 1.000 | 0.050 | 0.077 | 0.490 | 6.364 | 0.319 | 5.506 |
| 2.000 | 0.100 | 0.166 | 0.980 | 5.904 | 0.011 | 5.506 |
| 3.000 | 0.150 | 0.255 | 1.470 | 5.765 | 0.001 | 5.444 |
| 4.000 | 0.200 | 0.345 | 1.960 | 5.681 | 0.014 | 4.118 |
| 5.000 | 0.250 | 0.464 | 2.450 | 5.280 | 0.269 |   |
| **Average of k** | 5.799 |  |  |
| **Sum of k averages** | 0.614 |  |  |
| **Average of Slope** | 5.143 |  |  |
| **Percentage Error (Slope and k)** | 11.978 |  |  |
| **Standard Deviation** | 0.350 |  |  |

Conservation of Energy:

1. Measure and record the equilibrium.
2. Place 200g on the spring
3. Hold it 4 cm below the equilibrium and record the value as x1.
4. Release the mass and see how far it falls. (Release the mass several times until you have accurately located the lowest point of the motion.)
5. Record this as x2 in the table.
6. Repeat the procedure for values of x1 = 8cm, 12cm, and 16cm.
7. Calculate the change in gravitational potential energy ∆PEg = mg(X2-X1). Record this value in the table.
8. Calculate the change in the spring potential energy ($∆PEs = (1/2) k (X2^{2}-X1^{2})$. Record this value in the table.
9. Find the percentage of error between ∆PEg and PEs

Data:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **m** | **k** | **x1** | **x2** | **PEg** | **PEs** | **% of Error** |
| 0.200 | 5.800 | 0.040 | 0.645 | 1.186 | 1.202 | 1.343 |
| 0.200 | 5.800 | 0.080 | 0.545 | 0.911 | 0.843 | 7.820 |
| 0.200 | 5.800 | 0.120 | 0.465 | 0.676 | 0.585 | 14.413 |
| 0.200 | 5.800 | 0.160 | 0.390 | 0.451 | 0.367 | 20.534 |

1. Let the 200g mass hang freely on the spring. Pull the mass down 4cm below this point and record the X2 from the equilibrium point.
2. Release the mass and see how high it rises. Record this value as X1 from the equilibrium.
3. Repeat step #10 and #11 for 8cm, 12cm, and 16cm.
4. Calculate the change in gravitational potential energy ∆PEg = mg(X2-X1). Record this value in the table.
5. Calculate the change in the spring potential energy ($∆PEs = (1/2) k (X2^{2}-X1^{2})$. Record this value in the table.
6. Find the percentage of error between ∆PEg and PEs

Data:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **m** | **k** | **x1** | **x2** | **PEg** | **PEs** | **% of Error** |
| 0.200 | 5.800 | 0.315 | 0.475 | 0.314 | 0.367 | 15.573 |
| 0.200 | 5.800 | 0.080 | 0.515 | 0.853 | 0.751 | 12.726 |
| 0.200 | 5.800 | 0.120 | 0.555 | 0.853 | 0.852 | 0.128 |
| 0.200 | 5.800 | 0.160 | 0.595 | 0.853 | 0.952 | 11.062 |

Results:

 Energy is being conserved. The energy is transferred from the mass to the spring.

Error Analysis

 Some of the errors may have come from the experiment, not being able to clearly identify the measurement for where the spring stopped, visual inspection.

Conclusion

 In conclusion we see that energy is conserved. When pulling the spring and then releasing it the energy from the mass is transferred to the spring allowing it to retract or extend.