Student's Name

Professor's Name

Course

Date

Lab Report: Newton's First Law of Motion

Introduction

Newton's first law of motion states that objects oscillating back and forth experience forces. In the absence of these forces, the objects will move in a straight path with constant oscillations. The pogo spring experiment entails compressing a spring course deformation with an opposing force in the opposite direction, termed the restoring force. On release, the restoring force moves the spring backwards to the equilibrium position. Before the spring gains its equilibrium state, it gains momentum and moves up and down with the opposite deformation.

The forces release mechanical energy and gradually decrease motion until the spring comes to rest. In this experiment, different masses were placed on the pogo spring, the different distance variations were recorded, and the spring constant was determined using the generated results through graphs by the use of the line of best fit for the different scattering of the plots.

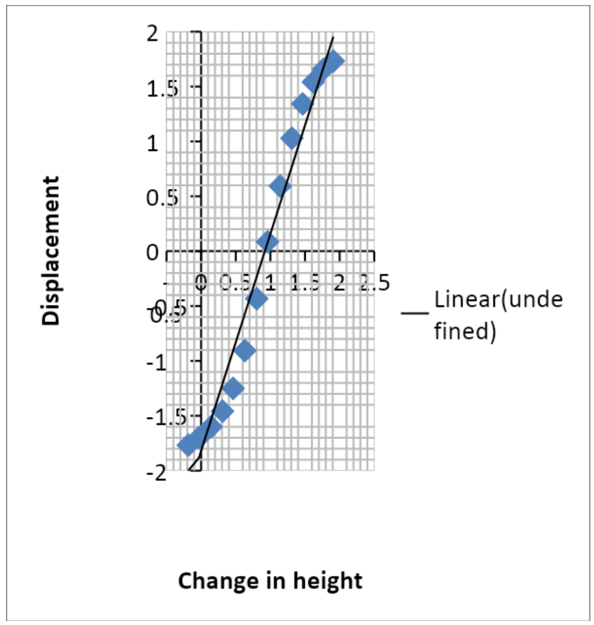
Experiment 1

Load (N)	Displacement(M)
-0.185	-1.768
-0.033	-1.7
0.145	-1.6
0.309	-1.458
0.462	-1.251
0.632	-0.907
0.803	-0.434
0.96	0.085

1.141	0.593
1.31	1.029
1.467	1.342
1.62	1.542
1.77	1.659
1.909	1.733
-	1.797

Experiment 1: Results

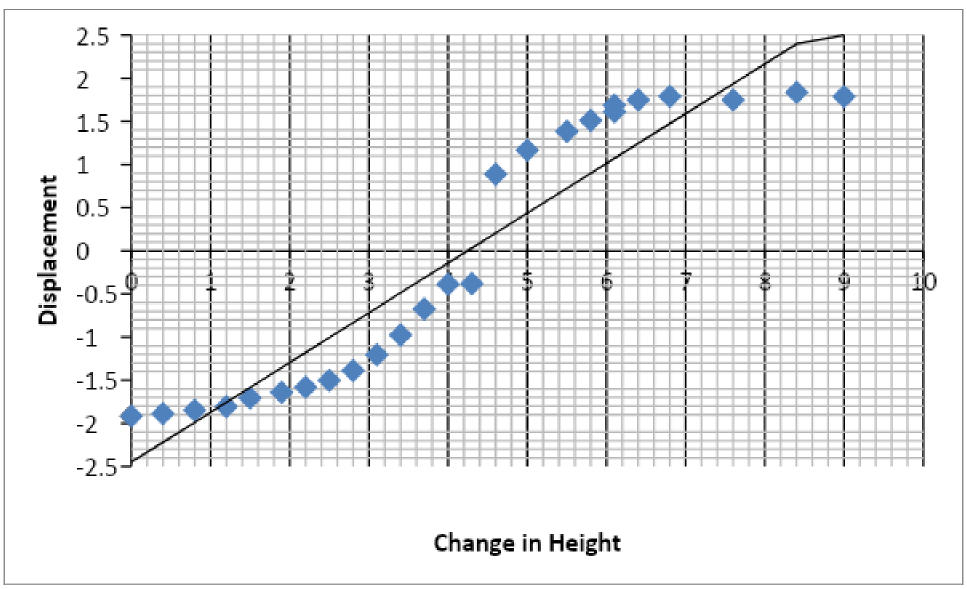
Initial Height	Change of Height	Displacement
20.2	0	-1.914
20.6	0.4	-1.887
21	0.8	-1.85
21.4	1.2	-1.808
21.7	1.5	-1.708
22.1	1.9	-1.643
22.4	2.2	-1.581
22.7	2.5	-1.501
23	2.8	-1.387
23.3	3.1	-1.207
23.6	3.4	-0.975
23.9	3.7	-0.674
24.2	4	-0.39
24.5	4.3	-0.38



Experiment 2: Results

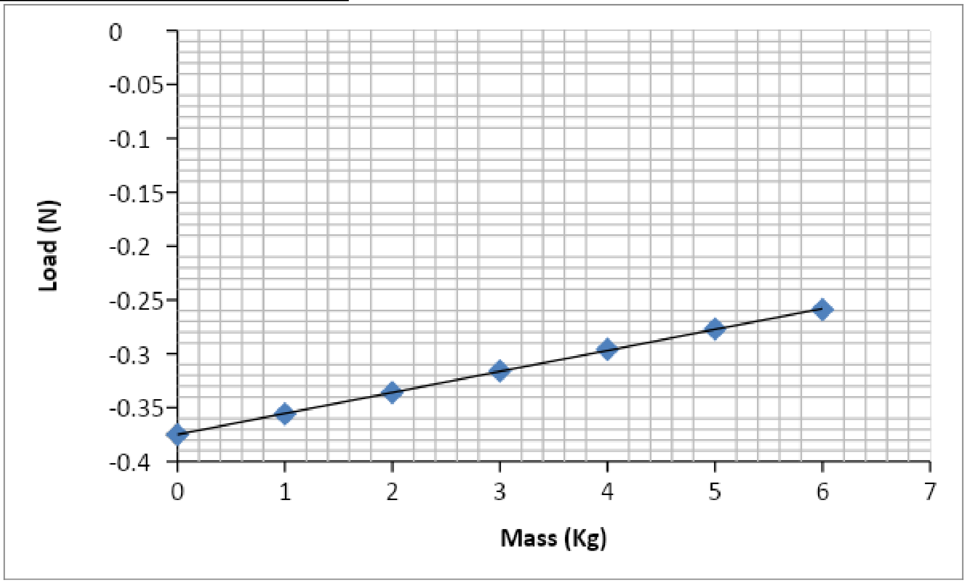
Initial Height	Change of Height	Displacement
24.8	4.6	0.889
25.2	5	1.166
25.7	5.5	1.386

26	5.8	1.511
26.4	6.1	1.611
26.7	6.1	1.688
27.1	6.4	1.749
27.4	6.8	1.789
27.8	7.6	1.749
28.1	9	1.789
28.4	8.4	1.837



Experiment 3: Results

Mass (Kg)	Load (N)
0	-0.375
1	-0.356
2	-0.336
3	-0.316
4	-0.296
5	-0.277
6	-0.259



The constant K is the stiffness and rigidity of the spring. When the force constant is high, the restoring force is also high, and the constant K is evaluated in N/M. The K constant follows Young's modulus compression of springs.

For experiment 1, the spring constant was K=Fx, and the gradient of the graph gives the value of the spring constant.

$$\frac{\Delta yY}{\Delta x} = \frac{(1.310-1.141)}{(1.029-0.593)} = \frac{0.169}{0.436} = 0.38N/M$$

The work done on the spring is = $\frac{1}{2}kx^2$, where K is the spring constant and x the displacement length.

For spring 1; the work done =$\frac{1}{2} \times (0.436)^2$=0.095048 N/M.

The applied graph of the load against the deformation displacement of the system provides a triangular area that, when evaluated, gives the work done on compressing the spring W== $\frac{1}{2}kx^2$

For experiment 2

$$\frac{\Delta y}{\Delta x} = \frac{(1.611-1.511)}{(6.8-6.4)} = \frac{0.1}{0.4} = 0.25N/M$$

For experiment 3

$$\frac{\Delta y}{\Delta x} = \frac{(2-1)}{(-0.336--0.356)} = \frac{1}{0.02} = 50N/M$$

The LVDT transduces the equivalent force to voltage, and the voltage (V) is assimilated with equivalent light (M). The force change is plotted against the change in V, which is assumed to be the equivalent displacement length, to produce the spring constant. Moreover, linking the spring force to the LDVT allows the transformer to produce a linear differential transducer for precise data relevant to the object position. The transformer gives differential linear variables of +150mm stroke lengths with resolutions of 40mV/mm. When the core is moved to 120mm, the output voltage is at a null position; varying the core position from the center, the resultant voltage is 3.75Volts, the variance of the output voltage when the core is displaced from +80mm-80mm.

The maximum voltage produced that is Vout for a 1mm movement gives 40mV, and the movement is 150mm.

Vout = 40mV×150mm-6Volts

The voltage out for a 120mm core displacement is given as

Vout=$\frac{Core\ Displacement\ \times Maximum\ Voltage}{Total\ Lenght}$

Vout=$\frac{120mm\ \times 6V}{150mm}$=4.8 Volts

Conclusion

Displacement transducers exist in different lengths, and when calibrating them, selection should be based on the size of the force to be applied.