Date of Lab____________ Date of Submission 1/8/18

Laboratory Report

Title Conservation of Mechanical Energy

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Summary

We used pendulum & spring to examine whether mechanical energy is conserved or not. In the 1st exp, we changed the height of pendulum and compared the potential energy at highest point and the kinetic energy at lowest point. In the 2nd experiment, we changed weight on the spring to get the spring constant. In the 3rd experiment, we changed the elongation of the spring and compared the elastic potential energy of spring & kinetic energy of weight. As a result in both 1 & 3 exp, mechanical energy was conserved. Therefore we proved that K=E+U is completed

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words

Teacher's Comments

Good summary. Beautiful tables and graphs.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method.	Results	Table/Fig.	Discussion	Clearness	General
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* Use this form as a cover sheet.

* Submit your reports by the seventh day after your lab.

2. Introduction

Objective
Investigate whether the mechanical energy is conserved in the motion of (1) pendulum and (2) spring

Theory
The sum of kinetic energy (K) and potential energy (U) is always constant, which means that the total energy (= mechanical energy (E)) of before and after is same.

$$E = K + U = K' + U'$$

Hypothesis
(1) In the motion of the pendulum, the potential energy at the maximum height is equal to the kinetic energy (+ the potential energy) at the minimum height
(2) The elastic potential energy of a spring is equal to the kinetic energy of a object attached to the spring

3. Experimental

Apparatus
Wooden Board, Metal Stick, Weight, String, Speed Meter, Graph Paper, Hooke's Law Apparatus, Spring

Method
Exp1)

1. Measure the mass of weight
2. Set up wooden board with metal stick at the top right hand and put the graph paper on the board
3. Tie string on the metal stick and and make circle that we can hang the weight
4. Hang the weight to the string and make sure that the string is not too long that the weight will not hit the ground
5. Set the speed meter at the point where the weight takes it lowest point (h0)
6. Lift up the weight and measure the height (h1)
7. Release the weight and read the value shown by speed meter
8. Repeat this process by changing the height (h1)

Exp2)

1. Set up all Hooke's Law apparatus
2. Add weight on the string and measure the elongation
3. Increase the mass of weight and record its data
4. Draw a graph and determine the spring constant

Exp3)

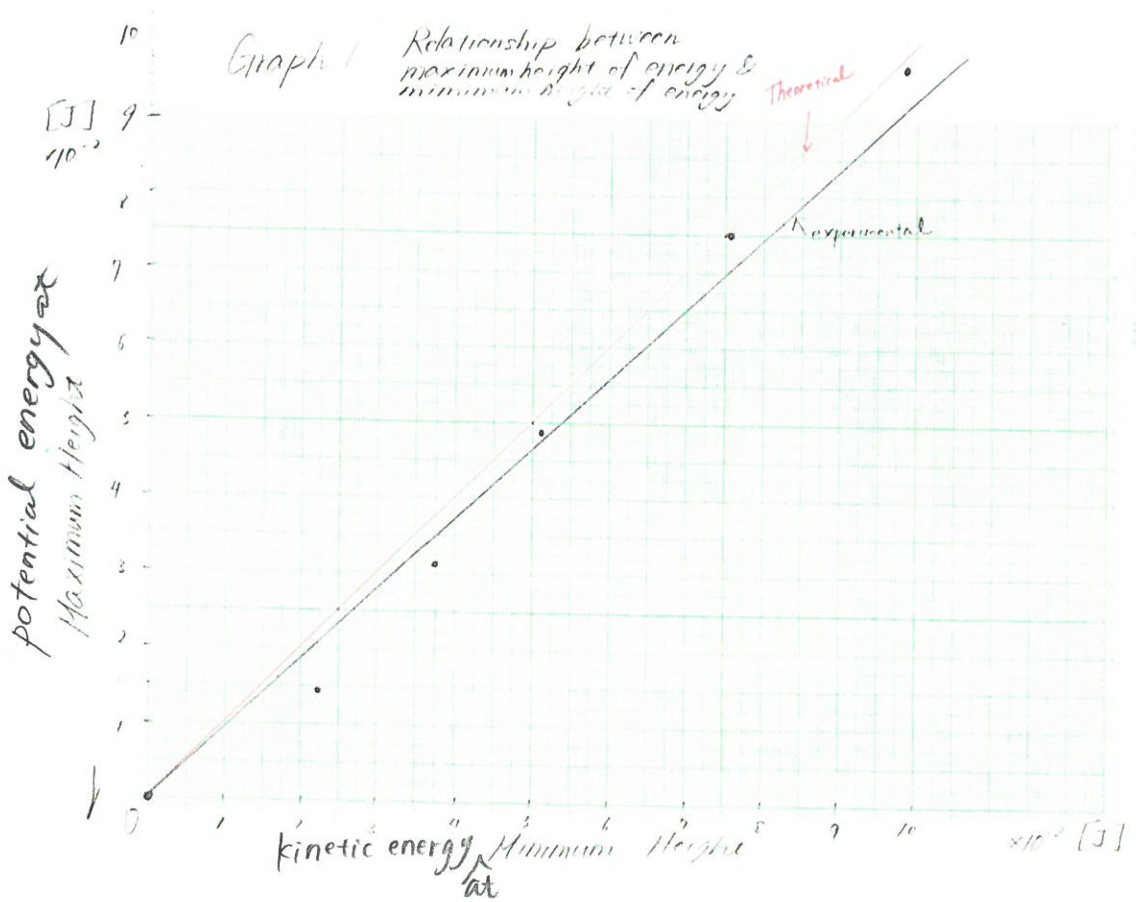
1. Set up the C-cramp on the edge of the table
2. Set the ruler on the table
3. Connect a spring and weight with string
4. Let the center of weight place on zero when the spring is at natural length
5. Start speed meter and release the weight and read the value

4. Results

Exp1) Table 1 mass of weight m = 0.0321kg

	Maximum Height		Minimum Height					(A-B)/Ax100
	h1	A=mgh1	h0	v	mgh0	½ mv²	B=mgh0+½ mv²	
Exp#	m	J	m	m/s	J	J	J	%
1	0.05	1.44x10 $^{-2}$	0.03	0.90	9.44x10 $^{-3}$	1.30x10 $^{-2}$	2.24x10 $^{-2}$	55.6
2	0.10	3.15x10 $^{-2}$	0.03	1.32	9.44x10 $^{-3}$	2.80x10 $^{-2}$	3.74x10 $^{-2}$	18.7
3	0.15	4.72x10 $^{-2}$	0.03	1.61	9.44x10 $^{-3}$	4.16x10 $^{-2}$	5.10x10 $^{-2}$	8.05
4	0.24	7.55x10 $^{-2}$	0.03	2.05	9.44x10 $^{-3}$	6.75x10 $^{-2}$	7.69x10 $^{-2}$	1.85
5	0.30	9.44x10 $^{-2}$	0.03	2.36	9.44x10 $^{-3}$	8.94x10 $^{-2}$	9.88x10 $^{-2}$	4.66

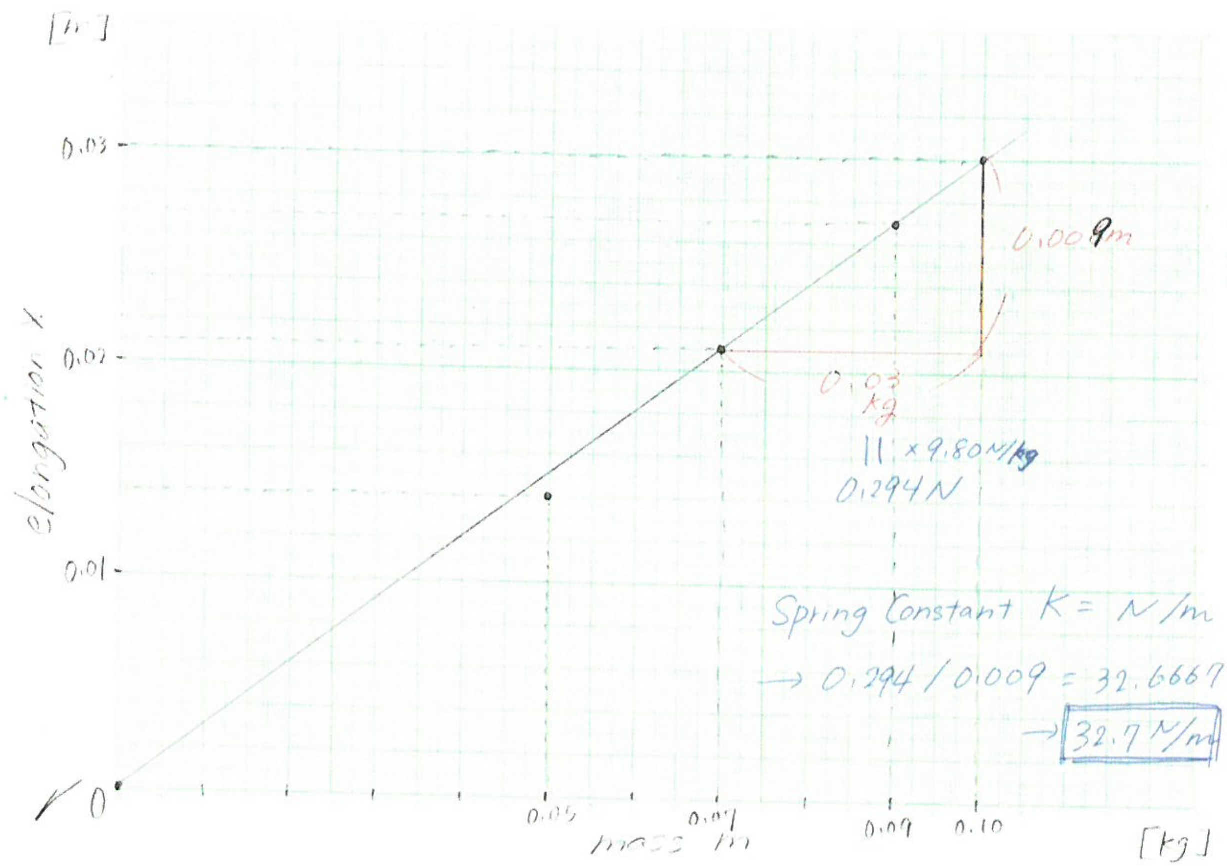
Graph 1 Relationship between maximum height of energy and minimum height of energy



Exp2) Table 2 *gravity of the wight* $F = kx$ *(k - spring constant x - elongation)*

m [kg]	0.05	0.07	0.09	0.10
F [N]	0.137	0.206	0.265	0.294
x [m]	0.014	0.021	0.027	0.030

Graph 2 Relationship between elongation and mass



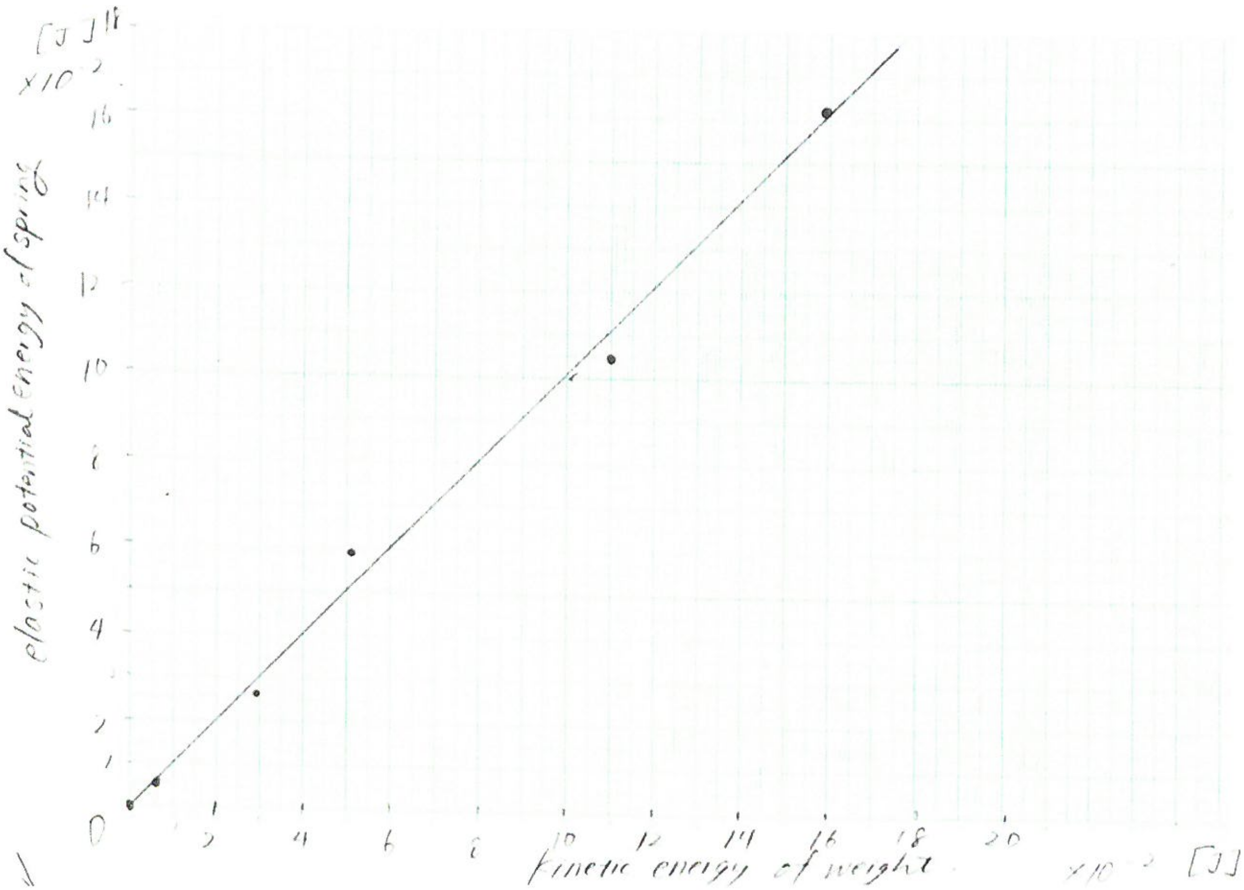
Spring Constant K=N/M

→ 0.294/0.009=32.67 → 32.7N/M

Exp3) Table 3 Spring Constant k = 32.7N/m Mass of Weight m = 0.0321kg

	Spring		Weight		
	x	A=½ kx^2	v	B=½ mx^2	(A-B)/Ax100
Exp#	m	J	m/s	J	%
1	0.02	6.35×10^{-3}	0.62	6.17×10^{-3}	5.50
2	0.04	2.61×10^{-2}	1.36	2.97×10^{-2}	13.8
3	0.06	5.88×10^{-2}	1.79	5.14×10^{-2}	12.5
4	0.08	1.05×10^{-1}	2.62	1.10×10^{-1}	4.80
5	0.10	1.63×10^{-1}	3.15	1.59×10^{-1}	2.50

Graph 3 Relationship spring and weight



5. Discussion

As you can see from graph 1, potential energy at maximum height and kinetic energy at minimum height is not in 1:1 proportion to each other. Essentially, they have to be 1:1 proportion to each other based on the theory, but in the experiment, some error is sure to happen. I think because we are not able to measure the height correctly and the could not use the speed meter skillfully, so this error was produced. From table 1, the biggest error is 55.6%. The error is easy to be happened in the small value. However, in the graph of average data, it is not a huge error. From the graph's angle, the theoretical line have slope with 45°, and our result have 43°, and the total error was 4.4%. This number is less than 10%, so we can say that the potential energy at maximum height and kinetic energy at minimum height is same.

Before we did the third experiment which uses spring to prove law of conservation of mechanical energy, we needed to get the spring constant of the spring. we change the weight on the spring. From graph 2, the spring constant was 32.7N/M. In third experiment, as you can see from graph 3, elastic potential energy of spring and kinetic energy of weight is almost in 1:1 proportion to each other. Also, from table 3, the biggest error is 13.8%, the smallest error is 2.50%, and average error was 7.82. Therefore, we can say that elastic potential energy of spring and kinetic energy of weight are contant.

6. Conclusion

Kinetic energy and potential energy is always constant, so the mechanical energy is conserved in any moving object.

7. Opinion

In any experiments, the error is sure to happen. However, I found that the error is more likely to be produced in the experiment that requires the small experimental value because these experiments can have huge error by a little difference. Therefore, I think we need to conduct the experiments carefully especially in the smallest one. Also, I used the speed meter for first time, it was very difficult to master it because we had different results each time we used.

8. Reference

Taiga Seri's Lab Report
Saori Shiba's Lab Report