INTERNAIONAL BACCAULAUREATE

PHYSICS INTERNAL ASSESSMENT

The fractional loss of kinetic energy on the first bounce of a ball

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Candidate session number: 006047 -0038

Session: MAY 2016

School number: 006047

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INTRODUCTION

This experiment involved investigating the fractional loss of kinetic energy on the first bounce of a ball. When a ball is bounced against a floor or wall, it rebounds off at a speed relative to the speed at which it was thrown or dropped. The ball possesses different kinds of energy including potential energy and kinetic energy. Potential energy is measured based on the height of the ball above the ground and kinetic energy is measured based on the velocity of the ball. Potential energy, PE = mgh (where m = mass of ball, g = gravitational acceleration, and h = height of ball above the ground); and kinetic energy, KE = ½ mv^2 (where m = mass of the ball, and v is velocity of the ball). Therefore as the ball is dropped and bounces off, its energy is transformed between these two kinds of energy i.e. PE and KE. This is because according to the energy conservation law, energy is neither be created nor destroyed but it is transformed. In this experiment, the main focus was on the kinetic energy.

Some of the dependent variables of the experiment include mass of the ball and velocity at which the ball is dropped. Examples of independent variables include the height the ball is dropped from, temperature of the room and ball, air density or resistance, material of which the ball is made from, type of surface on which the ball falls and type of ball.

In this experiment, air resistance and temperature were neglected and therefore total energy was conserved by the ball as it dropped and bounced. Nevertheless, the floor on which the ball was dropped was not totally elastic meaning that some energy was lost. In this regard, the kinetic energy lost was observed as a function of time without going into details on whether

the loss was due to air resistance or inelastic surface. This experiment only focused on the loss of kinetic energy in the first bounce of the ball.

DESIGN

Materials and Equipment:

Some of the equipment and materials used in the experiment included: tennis ball, meter stick, tape measure, calculator

Procedure:

The tennis ball was lifted up from the floor to a height of about one meter. The ball was dropped onto the floor and its bouncing height was measured with time. The kinetic energy of the ball was also recorded in the respective table.

DATA AND ANALYSIS

Time (s)	KE (J)
0.1	0.18
0.2	0.30
0.4	0.24
0.6	0.02
0.8	0.04
1.0	0.15
1.2	0.00
1.4	0.08
1.6	0.00
1.8	0.10
2.0	0.08
2.2	0.05
2.4	0.01
2.6	0.10

Table 1: Experimental data of time and kinetic energy

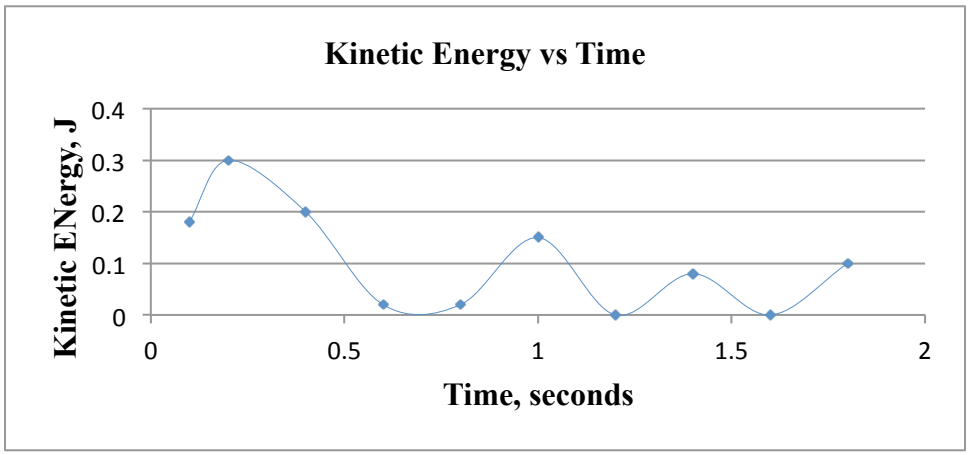

Figure 1: Graph of Kinetic Energy vs Time

Figure 1 above shows that there the ball lost kinetic energy when it hit the floor, which was non-elastic. The KE energy reduced to zero when the ball hit the floor because the KE was converted into other forms of energy including thermal/heat energy and elastic potential energy. There was relatively sharp decrease in KE when the ball hit the floor. From Figure 1 above, the ball hit the floor at time 0.8 seconds, in the first bounce.

Time, s	Bounce height, m
0.2	1.0
1.0	0.8
1.4	0.6
1.8	0.4

Table 2: Experimental data of tie and bounce height

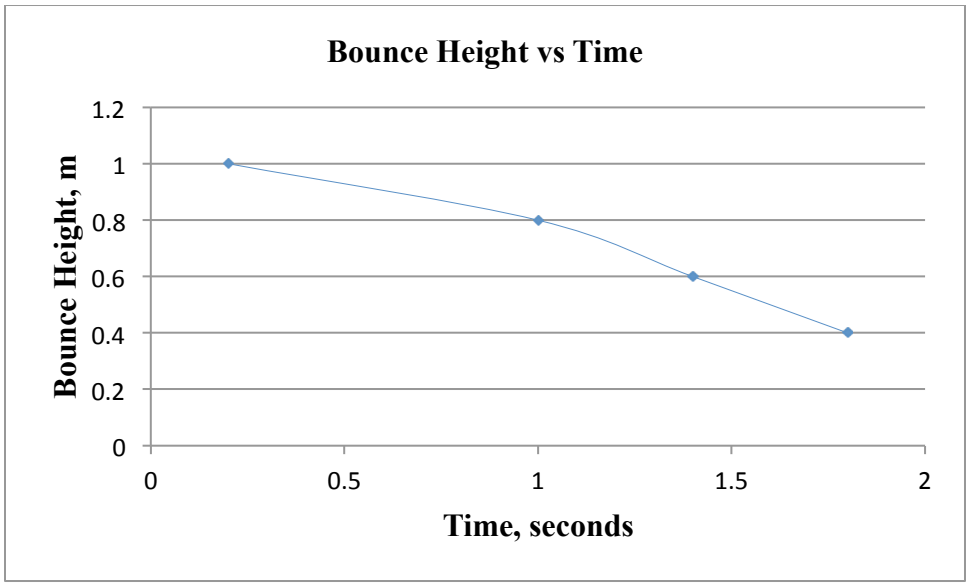

Figure 2: Graph of Bounce height vs time

Figure 2 above shows that the bounce height of the ball reduced with subsequence bounces. This was due to continuous reduction in potential energy of the ball.

When the tennis ball was lifted up, it gained more gravitational potential energy (GPE). This energy depends on the mass of the ball and the height to which the ball is lifted from the ground. Immediately the ball was dropped, it started moving downwards faster as it was accelerated by gravity. The GPE started being converted into KE. The high speed of the ball also meant that the amount of KE of the ball was high. As the ball moved towards the floor, some thermal energy was also released due to friction between the ball and the air. When the ball hits the floor, its GPE reduces and the energy is stored in form of elastic potential energy because the ball becomes deformed instantaneously. It is this elastic potential energy that makes them ball to bounce. Also when the ball hit the floor, there was loss of kinetic energy because the friction

between the ball and the floor slowed down the ball. The friction also heat up the ball making the ball to gain some thermal or heat energy.

After bouncing, the ball had less PE and that is why it bounced back to a lower height than the height where it started. The elastic PE was converted into KE as the ball moved up. However, the ball could not have as much KE as it had during the first fall and that is also the reason why it could not bounce to the same height as the original height. The ball slowed down and KE started being converted into GPE and at the same time giving out thermal energy and sound energy. At the very top of the bounce, there was no KE since the ball was stationary meaning that KE had been converted to thermal energy or GPE.

PROBLEMS

There were no major problems encountered when performing the experiment. This is because there was no significant change in air density to affect the results; the experiment was carried out at room temperature hence the floor's temperature did not change meaningfully; and the surface of floor remained the same throughout the experiment.

CONCLUSION

The results obtained from this experiment were similar to expected results because the kinetic energy of the ball reduced with time. Throughout the motion of the ball, energy was converted from one form to another. This complies with the law of energy conservation which states that energy is neither created nor destroyed but it is converted from on form to another. In addition, the loss of kinetic energy following each bounce also caused the ball to gradually lose the bounce height. Some possible sources of error in the experiment include: parallax error

resulting from imprecise position of eye level when measuring bounce height of the ball; neglecting the effect of air resistance or air density during the experiment; and neglecting temperature changes during the experiment. However, the effects of these factors were negligible and therefore the accuracy of results obtained was within acceptable limits.

Bibliography

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