Get Energized

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1 Aim

The aim is to determine the transform of E_k and E_p when tossing a ball.

2 Apparatus

See lab sheet.

3 Procedure

See lab sheet.

4 Data Collection

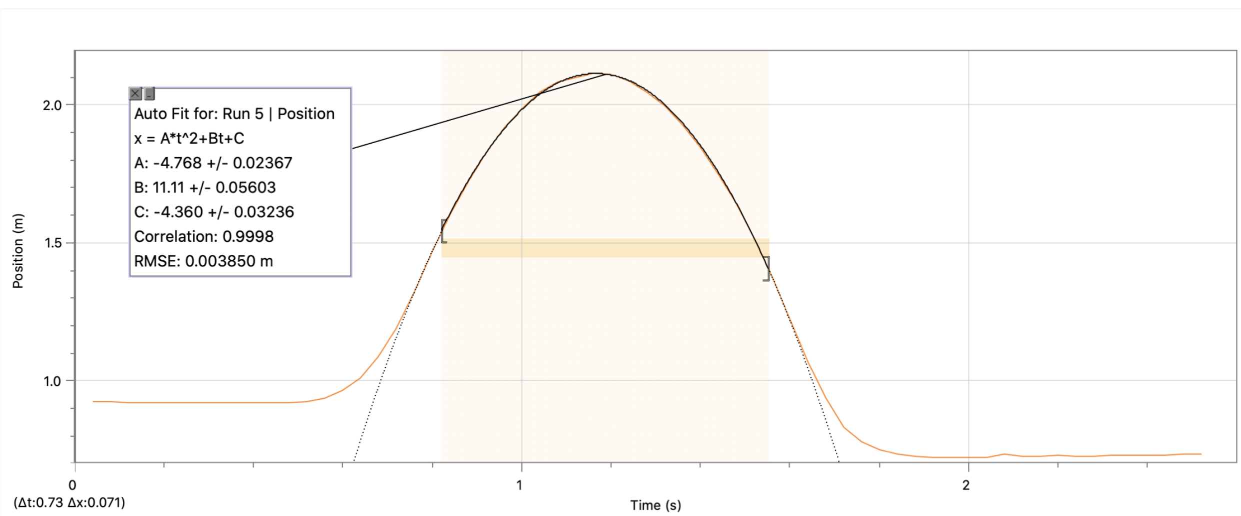

Figure 1: Time vs. Position

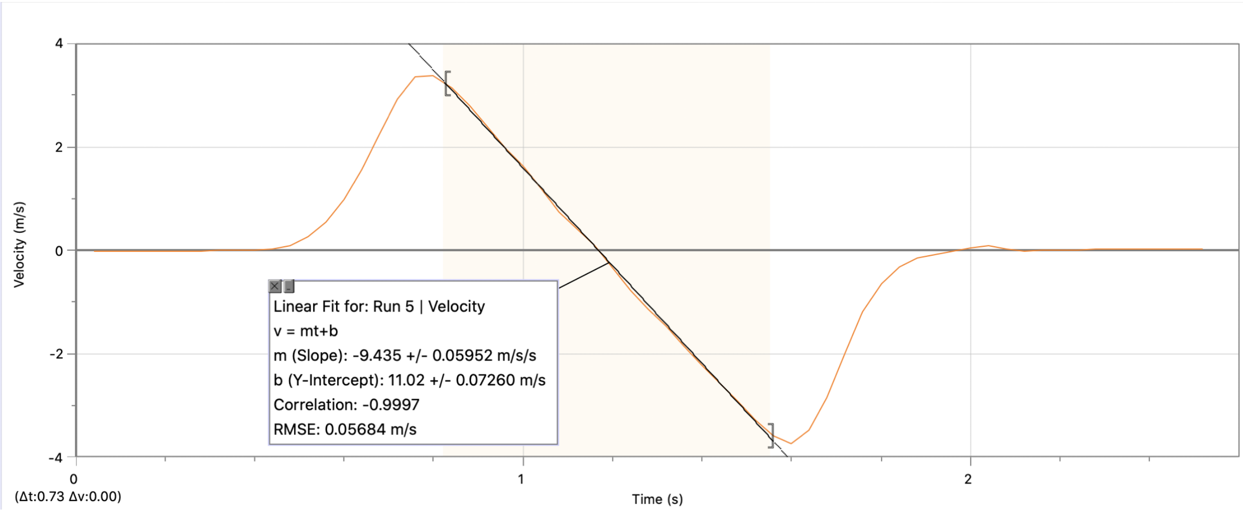

Figure 2: Time vs. Velocity

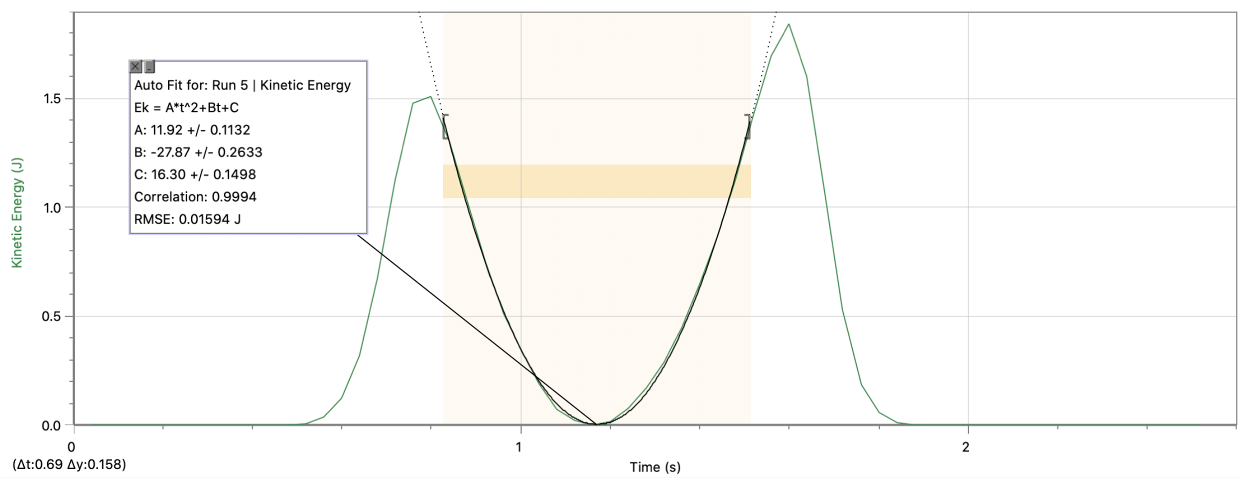

Figure 3: Time vs. Kinetic Energy

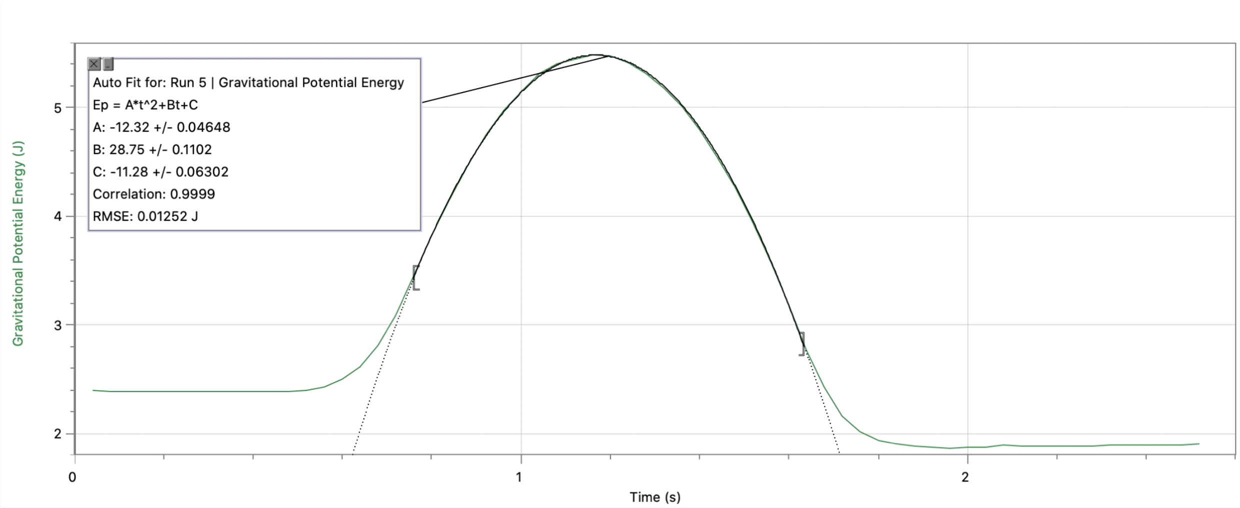

Figure 4: Time vs. Gravitational Potential Energy

5 Data Analysis

m, mass of the ball, by measuring, gives 0.26457kg

Position	t (s)	h (m)	v ($\mathrm{m\,s^{-1}}$)	E_p (J)	E_k (J)	E_{total} (J)
After release	0.92	1.829	2.385	4.747	0.752	5.500
Top of path	1.20	2.112	-0.388	5.481	0.015	5.496
Before catch	1.48	1.644	-2.919	4.268	1.127	5.395

Table 1: Data Table

where:

t : time
h : height
v : velocity
E_p : gravitational potential energy
E_k : kinetic energy
E_{total} : total energy

From the Table 1 we can calculate E_p, E_k, and E_{total} for the position where the ball has just released accordingly:

$$\begin{aligned}
E_p &= mgh \\
&= 0.26457\text{kg} \times 9.81\text{m}\,\text{s}^{-2} \times 1.829\text{m} \\
&= \boxed{4.747\text{J}} \\
E_k &= \frac{1}{2}mv^2 \\
&= \frac{1}{2} \times 0.26457\text{kg} \times (2.385\text{m}\,\text{s}^{-1})^2 \\
&= \boxed{0.752\text{J}} \\
E_{\text{total}} &= 4.747\text{J} + 0.752\text{J} \\
&= \boxed{5.500\text{J}}
\end{aligned}$$

(calculations for other positions have been omitted)

Interpretation

Using Table 1 we can interpret that:

- At the top of the path where the ball has momentarily at rest, its E_p is at maximum, and E_k is at minimum.
- Near the bottom of the path, the E_p of the ball is at minimum, and its E_k is at maximum.
- If there are no frictional forces acting on the ball, then $E_p + E_k = \textbf{const.}$ because the law of conservation of energy.
- In this example the reason of $E_p + E_k \neq \textbf{const.}$ is because the friction where part of the energy has left the system and been converted to internal energy which, by the instrument and procedures we have used, we are unable to measure such type of energy out. But be aware that it does not indicate that they have 'gone': it has just been spread out from the system where it has been out of the range where we can measure them.

Extensions

And we can also make some extensions where:

1. What would change in this experiment if we use a very light ball, like a beach ball?

   The total energy will decrease given by $E_{\text{total}} = mgh + \frac{1}{2}mv^2$, while at the same time because of its small mass, we need to take air resistance in consideration given by it will effect the g and v. Because of air resistance, its actual g and v will actually be lower than the value where air resistance has not been put into consideration.

2. What would happen to the experimental results if we entered the wrong mass for the ball in this experiment?

   E_{total} will be lower than it should be if you input the value lower, and vice versa.

3. Try a similar experiment using a bouncing ball. You should mount the Motion Detector high and pointed downward so it can follow the ball through several bounces.

   The exact same result will occur, except when the ball touches the surface, because of friction, some energy of the ball will convert to internal energy and may release it outside of the system. So the one may observe multiple times where the E_{total} of the system decrease.

6 Conclusion

We can conclude that during the free fall, the ball will continuously convert its E_k to E_p, and completely convert E_k to E_p at the point where the ball momentarily at rest. After that the ball will begin to convert its E_p to E_k until the point where we artificially interfere the action of the system. During this progress, if there's no friction, the $E_{\text{total}} = E_p + E_k$ will be a constant, but in real life we do have friction so the E_{total} will be decreasing during the progress of free fall, given that part of the energy will be convert to internal energy and might also go out of the system.