In our project, our goal was to create a device that would perform a simple task for us through a series of energy conversions in the style of a Rube Goldberg machine. Through a series of conversions, we successfully dropped two Alka-Seltzer tablets into a cup of water in order to sure a hangover. Also, we completed our task while staying under the 20 dollar budget.

In the process of coming up with the idea of what device we should build for our project we had to decide what type of device would satisfy the Rube Goldberg standards as well as a device that would not be so complicated that it did not work correctly. Also, we wanted to create a device that was simple enough yet was virtually fail proof so our device could work every time without a second doubt. After debating, we narrowed it down to two main ideas for the device for our project. One, which we ended up throwing out, was a device that, through a series of reactions and energy conversions, would knock a bottle of milk over into a funnel aimed above a bowl a cereal and the milk would pour into the bowl and you would be ready for breakfast. We discarded this idea because we were unsure of the repeatability and reliability of the device and wanted to make sure we could complete our task multiple times without fail. The second idea we had, and the idea we choose to use, was the idea that through a series of reactions and energy changes, we would knock two Alka-Seltzer tablets into a cup of water. This idea was brought up due to a common belief that Alka-Seltzer tablets can cure a hangover. We decided we
would find a way for those suffering from a hangover to take their tablets through the use of a Rube Goldberg device.

After deciding on this idea, we had to determine the correct way for this device to work. We chose to undergo a series of 4 energy conversions in order to complete this task. Our device set up consisted of the use of a Newton’s Cradle, a wooden ramp, a foosball, four dominoes, two Alka-Seltzer tablets, and one cup of water. The device was set up with the Newton’s Cradle at one end of a large plank so that the steel ball of the Cradle would hit the foosball positioned at the top of the wooden ramp. The objective of this step was to start the initial energy conversion and being the reaction to get to our goal. After contact is made and energy was transferred, the foosball would go down the ramp and hit the first domino of the four in a line causing the first to start a chain of reactions in the dominoes. The ball stops at the end of the ramp when it comes in contact with the first domino and this causes the other three dominoes to fall. After the last domino has been hit, the two Alka-Seltzer tablets, positioned at the edge of the board, would be knocked over into the cup of water that was fastened to the end of our board. This is the final energy conversion and this brings us to our final product. The overall concept of this device was to create a simple enough design that would accomplish our task while conforming to the correct number of energy conversions.

As simple as the design and device is, there were still problems that we encountered. These seemed to be problems at the beginning of our project but as time went on, they proved not to be that hard to fix or move away from. One of the problems we encountered was trying to find the correct heights for position of the ramp and the position of the first ball of the Newton’s Cradle. These were problems because if there
was not enough velocity behind the foosball or behind the Newton’s Cradle ball, the
device could never have been started. Another problem was the positioning of the
dominoes. The dominoes had to be positioned so they fell at the right speed and distance
and also so they fell and did not crush or prevent the Alka-Seltzer from falling in the cup.
The biggest problem we had was making the foosball stop when it hit the first domino.
The reason the foosball had to stop was because we did not want a stray ball to fall off of
the project or cause an unseen energy conversion. At the end of the project we fixed all
of the problems and made the device to work every time.

The energy conversions in our device were the most important part of this project.
The first energy conversion we see is between the Newton’s Cradle and the transfer
between the first ball and the ball that hits the foosball is a potential to kinetic back to
potential energy conversion. The conversions between the steel ball of the Cradle and the
foosball as well as the foosball to the domino are potential to kinetic conversions. These
conversions are all relatively the same and use the same energy transfer principles. At
the end of conversions the domino to the Alka-Seltzer is also potential to kinetic and
when the Alka-Seltzer hits the water, we see a chemical reaction. The chemical reaction
at the end is not an energy conversion but the visible evidence of it should be included in
the project report.

At the end of this project we found ourselves to be very successful in the device
and its function. We satisfied all of the requirements of the project description and had a
working project model. On the point of the overall function of the device, we were
pleased to find the device worked and accomplished its goal every time that we tested the
device and its abilities. Also, we felt the energy conversions went over smoothly and felt
good about how they transferred enough energy to complete the task. As a whole, we learned that energy conversions and reactions like this are responsible for many of the devices we as a people use and take advantage of everyday. If we were to attempt another project of this kind again, I feel that we would have made the device accomplish something more difficult and increase the difficulty of the energy conversions themselves. Our device was a simple device that accomplished a simple task and we would love to complete something that is more of a challenge than the device we created. Overall, as a group, we are very satisfied with the turnout and design of our project.
Project Data

2 in = 0.0254 m

Steel ball = 40 g  Alka-Seltzer = 2.5 g

Soccer ball = 20 g  Domino = 20 g

Steel to soccer impact height 2 1/2 in

Steel ball to 2 1/8 in to 1 1/2 in soccer ball on ramp 90 degrees

Domino 3/8 in thick 5/8 in x-distance between Domino impact

2 in tall 2 in distance between Domino Alka-Seltzer 1 in wide

\[
\text{Steel ball:} \quad v = 2.25 \text{ in} \times \frac{0.0254 \text{ m}}{1 \text{ in}} = 0.125 \text{ m/s}
\]

\[
0.04 \text{ kg} \times 9.81 \text{ m/s}^2 \times 0.085715 \text{ m} = \frac{1}{2} \times 0.04 \text{ kg} \times v^2 + 0.04 \text{ kg} \times 9.81 \text{ m/s}^2 \times (0.02175 \text{ m}) \quad v^2 = 0.7059 \text{ m/s}
\]

\[
0.04 \text{ kg} \times 0.7059 \text{ m/s} = -0.04 \text{ kg} \times (v_1 + v_2) \quad v_1 = -0.7059 \text{ m/s}
\]

\[
0.04 \text{ kg} \times 0.7059 \text{ m/s} + 0.04 \text{ kg} \times 9.81 \text{ m/s}^2 \times (0.05356 \text{ m}) \quad v^2 = 0.1765 \text{ m/s} \quad \text{Steel ball at impact}
\]

\[
0.04 \text{ kg} \times 0.1765 \text{ m/s} = -0.04 \text{ kg} \times v_1 + 0.02 \text{ kg} \times v_2^2 \quad v_2 = 0.1765 \text{ m/s}
\]

\[
0.02 \text{ kg} \times 0.1765 \text{ m/s} + 0.00353 \text{ kg} \times v_1 \times (0.064) \quad v_1 = 0.05893 \text{ m/s} \quad \text{Steel ball}
\]

\[
0.00306 \text{ kg} \times 9.81 \text{ m/s}^2 \times 0.06 \text{ kg} \times 0.05893 \text{ m/s} \quad v_2 = 2.353 \text{ m/s} \quad \text{Soccer ball}
\]

\[
\frac{1}{2} \times 0.02 \text{ kg} \times (2.353 \text{ m/s})^2 + 0.02 \text{ kg} \times 9.81 \text{ m/s}^2 \times (0.05356 \text{ m}) = \frac{1}{2} \times 0.02 \text{ kg} \times v^2 + 0.02 \text{ kg} \times 9.81 \text{ m/s}^2 \times 0.03 \text{ m}
\]

\[
v = 0.701 \text{ m/s} \quad \text{Soccer ball}
\]

\[
0.02 \text{ kg} \times 0.701 \text{ m/s} = 0.02 \text{ kg} \times (v_1 + v_2) \quad v_1 = 0.701 \text{ m/s} = -(v_1', v_2')
\]

\[
0.701 \text{ m/s} + v_1' = v_2'
\]
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