Super Shot

Our Rube-Goldberg device, Super Shot, uses three different energy changes. In order to compensate for the three energy changes, we used different heights and a pendulum. The purpose of our project is to shoot a ball into a basket that is located a certain distance away from the device. We used a pendulum, dominoes, wood, tubing, and a marble to accomplish an energy transfer from the pendulum to the dominoes, from the dominoes to the marble, and from the marble out of the tube to the basket.

Before we knew what to do for our project, we used several brainstorming strategies. We looked online at what students from previous semesters did for their project. Also, we were able to use some of our group members’ previous knowledge on the subject of energy transfer. We gathered further information from a pool trick show on ESPN. With all of this complied knowledge, we were able to come up with the idea that would give us enough energy to accomplish our desired task. In order to keep our design simple, we discarded several ideas that would complicate the project. We had original ideas to use a fish bowl, mouse trap, and sling shot that were more complicated than necessary.

Through these previously stated ideas, we all agreed that a pendulum and dominoes would be the simplest way to achieve the final goal of making energy transfers in order to have a meaningful outcome. We bought a two-by-four that was cut into two three-foot sections and one two-foot section. We also used piping insulation as a ramp to transport the marble from the top, through the tunnel, and into the basket. Lastly, recycled cardboard was used to build a staircase that would accommodate for an energy transfer due to a height change. Our original idea had the piping going in the same direction as the device. However, we were required to alter this idea
and now the tubing is facing opposite the direction of original motion. (Our preliminary sketch is in Appendix A.)

Our group understands that in our project there are energy losses and calculations that we cannot yet account for. We are assuming negligible friction and air resistance in our calculations because we have no way to account for those losses. Conservation of momentum was used that was not able to be calculated. However, we did calculate the energy conversions that we could solve for. These calculations can be found in Appendix A, which is attached to this file.

A majority of our materials were bought from Home Depot, however, some of our materials did not need to be calculated. Our items consisted of:

- Wood (2X4)- $2.29
- One tube of piping insulation- $1.69
- Recycled cardboard- $0.50
- Plastic cup- $0.10
- Pack of Pencils- $1.90
- Dominoes- $4.38
- Dental Floss- $0.50
- Grand Total- $11.26

One of the materials that was to be discarded was the marble, because we did not alter it in anyway. This marble was only used to show a transfer of energy due to height and the dominoes. The rest of our materials were transformed in some manner, which required us to calculate it into our cost.
Our project was successful due to our ability to work well together as a team. When something in our design and project went wrong, we worked together to take each one's individual knowledge, and complied it into one solution. Certain team members were previously friends, but not the whole team. However, we realized that we were compatible to work well together even with our individual thought processes being very different. Through this, we learned how to apply our book knowledge to a real life situation. Each of us had our own ideas and ways of thinking about things, but together we came up with an ultimately successful device. Our busy schedules forced us to be unable to meet as many times as we intended, and we had to sacrifice our individual daily activities. Even with this obstacle, we were still able to make a successful device. Lack of meeting time led us to do more individual work than we had planned on. However, when we would meet at later times, we would compile our work together. If we had to do this project again, we would schedule more organized meeting times, so that we would be more efficient when we met.

References were used that helped us produce our ideas. Some of the references consisted of verbal communication, television, past experience, and previous models. We had some members of our group, Lauren and Jason, with previous physics experience that contributed ideas of past projects that they did in other classes. One member, Alaa, saw a show on ESPN that dealt with dominoes, which gave us the idea of using them for an energy transfer. Danielle and Lauren talked to Caroline Anderson and Elizabeth Brandon, and they suggested that we look at the gallery from past semesters. The main part of our idea, however, came from group discussions and a mutual agreement on what should be done.
1st Energy Transfer:
- pendulum height = 5 inches
  * the height is about 5 inches, depending on how far we pull it back.

\[ mg \frac{h}{2} = \frac{1}{2} m v^2 \]

\[ \frac{1}{2} (32.2) \frac{1}{2} (\frac{3}{2}) = (32.2) (\frac{10}{12}) + \frac{1}{2} m v^2 \]

\[ 13.4162 + 99.2833 = 107.333 + \frac{1}{2} v_f^2 \]

\[ \frac{112.6995}{107.333} = \frac{5.3 v_f}{2} + \frac{1}{2} v_f^2 \]

\[ v_f = 3.28 \text{ ft/s} \]

2nd Energy Transfer:
- dominos = (stairs) 37 inches
  from ground to top: 37 inches
  of dominos: 40 inches

\[ \frac{1}{2} m v_i^2 + m g h_1 = m g h_2 + \frac{1}{2} m v^2 \]

\[ \frac{1}{2} (5.18)^2 + (32.2) \left( \frac{37}{12} \right) = (32.2) \left( \frac{49}{12} \right) + \frac{1}{2} m v_2^2 \]

\[ 13.4162 + 99.2833 = 107.333 + \frac{1}{2} v_2^2 \]

\[ \frac{112.6995}{107.333} = \frac{5.3 v_2}{2} + \frac{1}{2} v_2^2 \]

\[ v_2 = 3.28 \text{ ft/s} \]

* We are aware that the velocity of the domino on the pendulum is an estimate because the velocity, of course, depends on how far we pull back the pendulum. (Because this would slightly change the initial height.) This in turn effects what our calculated final velocity would be.

3rd Energy Transfer
- ball starts from rest; and \( h_i = 40 \) inches \( h_f = 6 \) inches

\[ m g h_i = m g h_f + \frac{1}{2} m v_f^2 \]

\[ (32.2) \left( \frac{49}{12} \right) = (32.2) \left( \frac{16}{12} \right) + \frac{1}{2} v_f^2 \]

\[ v_f = 13.5 \text{ ft/s} \]

* We are aware that there is energy loss due to friction in the tube. However, we have no way of accounting for the coefficient of kinetic friction, the loss due to heat, noise, etc.

* Preliminary Picture *

![Diagram showing pendulum and dominos setup with measurements and calculations.]