The Fresh-Maker

Final Project for Engineering Fundamentals 151 Section A2

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**Project Description**

By now, everyone is familiar with the Mentos and Diet Coke reaction thanks to viral videos posted on the Internet. Our team decided that it was far too simple to drop a handful of Mentos into a bottle of Diet Coke, and decided to make the process a little more...”interesting”. The object of this assignment is to create a Rube Goldberg device to make our simple task more difficult. We are limited to a budget of twenty dollars, and everything must be original. In completion of the project, we will have successfully worked as a team to incorporate what we have learned in EF151 to perform the task.

**Project Design**

Our team used the time immediately before and after recitations to serve as planning meetings. Once we had a plan, we all went to a teammates home to do the actual construction and modifications. The original design called for a car with a razor blade attached to roll down a track, cutting a string to release a weight to fall on a lever, launching a marble into a funnel, dropping a ball onto a mouse trap, initiating the release of Mentos into the Diet Coke. The team democratically decided that there were too many steps to set up, and that some segments may be too unreliable. After approximately an hour of design changes, a final design was set and construction began.

The final design incorporates three measurable energy changes, and one unmeasurable with our current knowledge. The three changes are potential to kinetic, potential to kinetic, and potential to kinetic. The final unmeasurable change is the energy released by the carbonation in the coke. The explosive reaction is caused by the constituents of the cola reacting on the microscopic nucleation sites of the candy, causing an instantaneous carbon dioxide release.
The Process

1. A car with a razor blade attached is placed at the top of a PVC pipe serving as a ramp. The car is then released without adding any additional energy.

2. Once the car reaches the bottom of the ramp, the razor blade cuts a string which is attached to a dangling brick, causing it to drop to the ground.

3. When the brick is released, a slack rope that is attached to the brick and to a valve is pulled taught, opening the valve.

4. Once the valve is opened, 3 Mentos drop into a bottle of Diet Coke through a funnel.

5. When the Mentos fall into the Coke, all of the carbonation in the Coke is instantly released by nucleation sites on the candy, forming a geyser of cola.
Calculations and Data

Assumptions: friction and air resistance are negligible

Initial height of PVC stand: 0.273 meters

Distance from impact to release point: 0.864 meters

PVC pipe length: \( \sqrt{(0.273^2+0.864^2)} = 0.906 \text{ meters} \)

Angle of Pipe: \( \arctan \left( \frac{0.273}{0.864} \right) = 17.54 \text{ degrees} \)

Mass of Car: 0.038 kilograms

Mass of Brick: 0.640 kilograms

Height of Release: 0.273 meters

Distance Traveled: 0.906 meters

Velocity of car:

\[
\begin{align*}
\text{PE}_1 + \text{KE}_1 &= \text{PE}_2 + \text{KE}_2 \\
\text{mgh} + 0 &= 0 + (0.5)(\text{m})(v^2) \\
(0.038)(9.81)(0.273) &= (0.5)(0.038)(v^2)
\end{align*}
\]
• Velocity = 2.31 meters per second

Acceleration of car:
• \( \sin(\theta) \cdot g = a \)
• \( \sin(17.54) \cdot (9.81) = a \)
• acceleration = 2.94 m/s\(^2\)

Tension in string before being cut:
• Down is positive
• \( T + F = 0 \)
• \( -T = F \)
• \( -T = ma \)
• \( -T = (0.640)(9.81) \)
• Tension = -6.28 Newtons

Materials and Costs

List of materials used and their cost in US Dollars (items owned are considered free):

1. PVC Piping $0
2. All Wood Used $0
3. Hot Wheels Car $0
4. Rubber Bands $0
5. Razor Blade $0
6. String $0
7. Brick $0
8. Thread $0
9. Metal Strip $0
10. Corrugated Board $0
11. 3 2-Liter Bottles of Sam's Choice Diet Cola $1.91
12. 2 boxes Mint Flavored Mentos $2

Budget: $20    Total Cost: $3.91    $16.09 Remaining

**Conclusion**

During the course of the project, there were several problems that had to be overcome. First, we had to make sure that the correct number of energy transfers took place. Next, we had to make sure that each of these transfers was repeatable. During the design process, we were forced to scrap several more elements that would have been more difficult to repeat. These included mouse trap controlled valves, launching marbles, striking matches, and other complicated functions.

If the team was to do anything over again, we would have started actual work on the device sooner, as to allow ourselves more freedom to incorporate our design ideas. Unfortunately, with our late start, we were forced to scrap favorable components for time friendly ones. If the original steps were all included, the final device would have been much more interesting.

As a team, we functioned very well and were able to resolve any debates very quickly, and without conflict. We all contributed to the design, aided in the construction, and divided the remaining tasks fairly amongst us. Everyone contributed a significant amount, and pulled their weight on the team. Without any one member, the device would not have turned out as it did.
The “Fresh-Maker” is able to repeat it's intended function every time, and performs it very well. We were able to design and construct the device such that all of the intermediate steps are repeatable and can be reset in a minimal amount of time. The success of the device is a result of our teams ability to thoughtfully design and build it using all of the knowledge we gained in EF151. The project taught us how to work in teams, incorporate learned material, and complete every step in the design and construction of a functioning engineering device.