Overview

The Bottle Opener is a Rube-Goldberg device that converts gravitational Potential energy to kinetic energy that upon impact opens a bottle.

Design Process

In the designing process, many ideas were discarded, which includes egg smashing, egg boiling, chemical reaction with an explosion, because of the potential for hazardous effect. After several hours of discussion, the team finally decided on the bottle-opening idea, because it is both safe and simple.

The following are the original sketches before the building process began:
Descriptions of Device

- Device was constructed on a plywood base
- The base supports the levers and enables the device to use gravitational potential energy
- Wood was used to create slopes which balls could slide down
• Wooden levers were attached to the slopes to transfer the energy of the balls
• Flathead screwdriver was used as a bottle opening device
Assumptions

The device depends mainly on the transfer of potential energy into a force great enough to pop the cap off a bottle. In calculating the energy transferred, the following assumptions are made:

1. No energy loss when PE converts to KE (conservation of energy)
2. The mass of bowling ball is large enough compared to the billiard ball that after the billiard ball hits, bowling ball is set in motion at initial velocity of zero.
3. The impact between the last lever and bowling ball stops the bowling to rest.

Calculation

1st energy conversion:
- Mass of billiard ball = 0.17 kg = 0.3748 lb
- Height of billiard ball = 18 inches
  - KE = \( \frac{1}{2}mv^2 = mgh = \left( \frac{0.3748 \text{ lb}}{32.2 \text{ ft/lb}} \right) \left( 32.2 \text{ ft/lb} \right) \left( \frac{18 \text{ in}}{12 \text{ in}} \right) \)
  - KE = 0.5622 lb-ft
  - \( v = 7.8285 \text{ ft/s} \)

2nd energy conversion:
- Mass of bowling ball = 14 lb
- Height of bowling ball = 10.5 inches
  - KE = \( \frac{1}{2}mv^2 = mgh = \left( \frac{14 \text{ lb}}{32.2 \text{ ft/lb}} \right) \left( 32.2 \text{ ft/lb} \right) \left( \frac{10.5 \text{ in}}{12 \text{ in}} \right) \)
  - KE = 12.25 lb-ft
  - \( v = 7.5067 \text{ ft/s} \)

3rd energy conversion:
- Difference in momentum (Impulse) = \( MV_f - MV_i = \left( \frac{14 \text{ lb}}{32.2 \text{ ft/lb}} \right) (7.5067) \)
  - Impulse = \( F \cdot t = 3.2638 \text{ lb-sec} \)
  - Time between contact to when bowling ball stops = \( \frac{1}{1000} \text{ sec} \)
  - So the force the lever put on the cap that opens the bottle is \( F = 3.2638 \times 3.77 \text{ lb} \).
Bill of Materials

A sheet of Plywood $4.00
2 ten-foot two by four $4.00
Screws $3.00
1 screw driver $1.00
Bolt $1.50
Bowling Ball ~ $100.00
Billiard Ball ~ $190.00/set
Soda $1.00
Hinge $1.00

Total $15.50

Conclusion

The Bottle Opener works successfully without fail the day the team finished building. However, to our surprise the repeating process wears the lever to a degree that on the day of the presentation, the Opener failed for the very first time. And although the device works during the second attempt, it did not work as glamorously as it did by shooting the cap flying in the air. The team learned that repair and maintenance are just as important as how successful the device works since those were not taken into consideration during the designing process. Meeting countless difficulties throughout the process the Bottle Popper presents the Billiard ball+bowling ball+lever+screwdriver= Flying bottle cap!