Group Members: Yasha Saxena, Zibo Yu, Helen Bian, Angel Gallegos
Physics 235
Project Outline
due March 17, 2015

Project:

A **rube goldberg** machine is a contraption that performs a simple task in a complicated way.

Physics Concept:

The main physics concept that will be captured here is the **conservation of energy**. One action by the user will trigger a series of other actions performed by the machine caused by the transfer of energy from object to object collisions.

Our analysis will focus on describing key moments during the particles' journey through the contraption, so we can identify transfers of energy and overall conclude that energy has been conserved.

Guiding Equations

TE = KE + PE, where TE is constant for a closed system

KE = ½ m*v^2

PE = mgh

$F_{net} = \Sigma F = m*a$

Important Forces: free fall, tension

Presentation:

We hope to provide a live demonstration of our machine for the class on the day of our presentation along with a power point including relevant formulas and calculations.

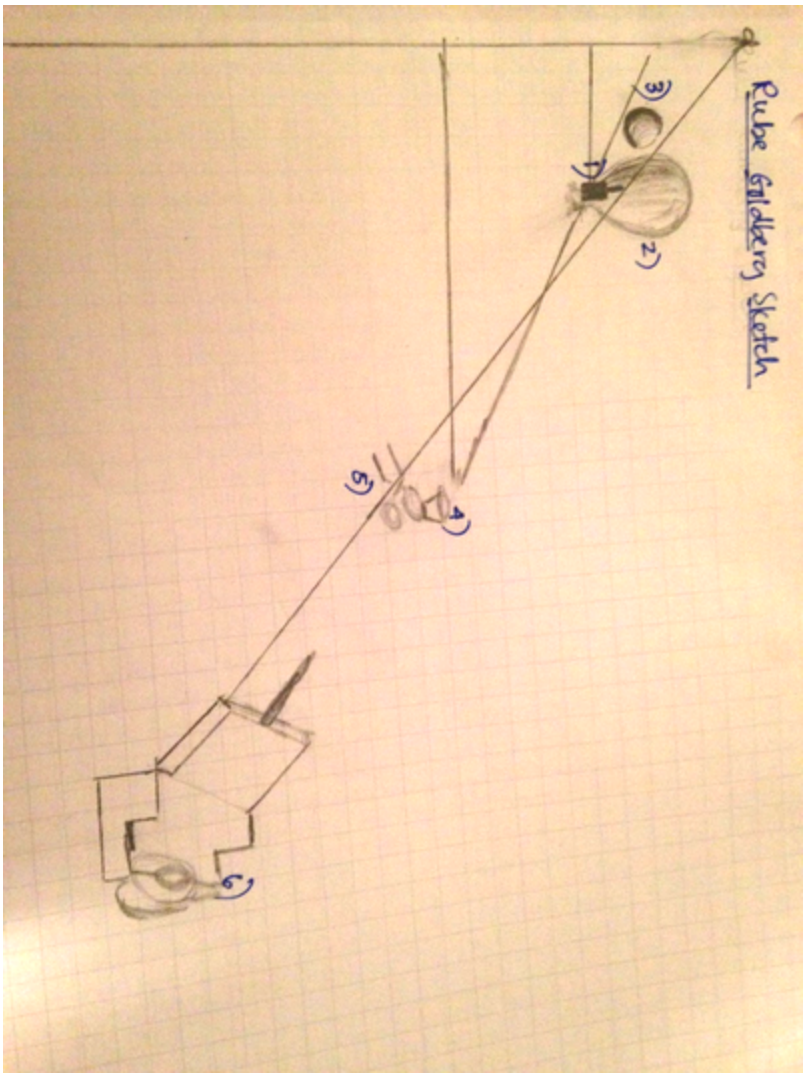
Machine Original idea

1. Experimenter will knock down a series of dominoes.
    a. *KE added to first domino, PE from other dominoes converted to KE*
2. The final domino will have a needle attached to it.
3. The needle will puncture a balloon that is blocking a billiards ball from a ramp.
4. The newly released billiards ball will move down the ramp and land in a paper bowl that is attached to an open pair of scissors.
    a. *PE of ball (m*9.8*h) converted to KE as ball slides down ramp*
5. The scissors will shut from the weight of the ball.

    a. *KE from falling ball closes scissors, PE from height of the open scissors converted to KE in order to close the scissors*
6. The scissors will cut a string that is holding up a knife attached to a shoe box.
    a. *PE from tension force in the string released*
7. The knife will fall down onto an egg.
    a. *tension force in the string combines with free fall force of knife, PE of knife converted to KE*
8. The egg will crack open onto a pan.
    a. *PE from holstered egg converted to KE as egg falls, energy from eating egg converted to PE for whoever is willing to eat the experimental egg*

Desired Result: If all goes according to plan, the only additional energy required to crack the egg will be the beginning push of the domino. The rest will be the result of transfers of the built in potential energy to kinetic energy.

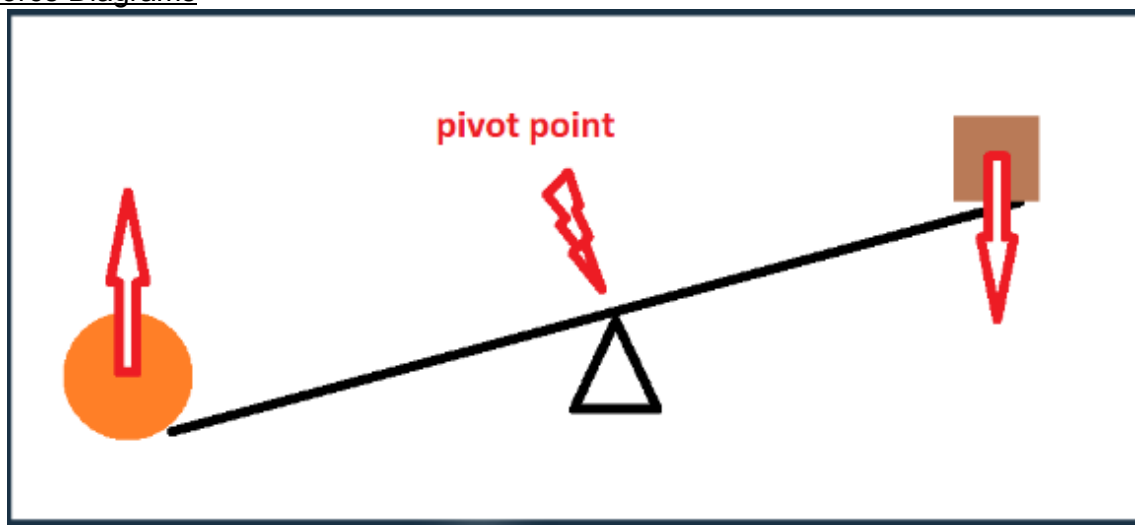
Sketch

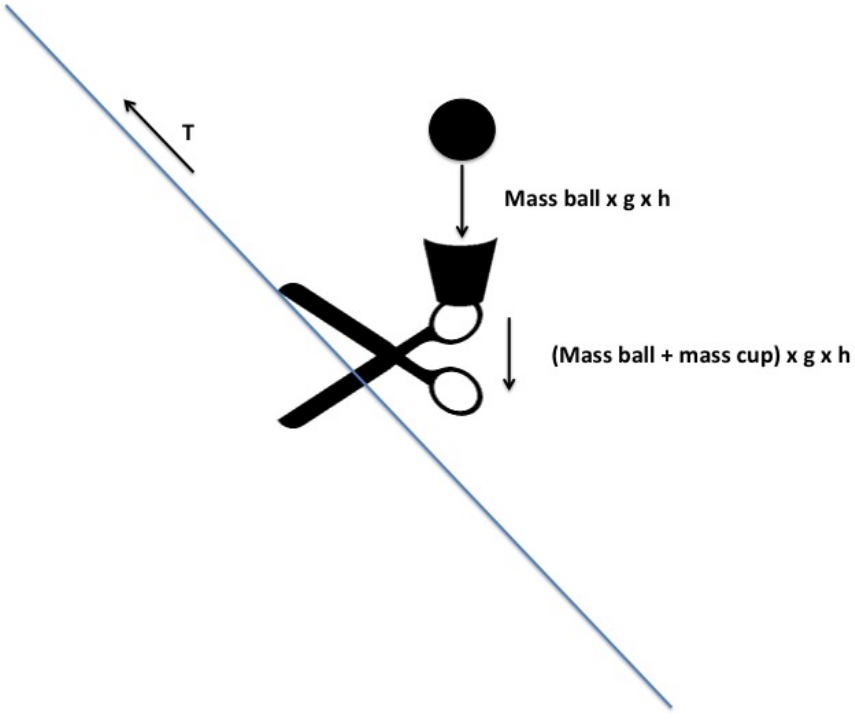


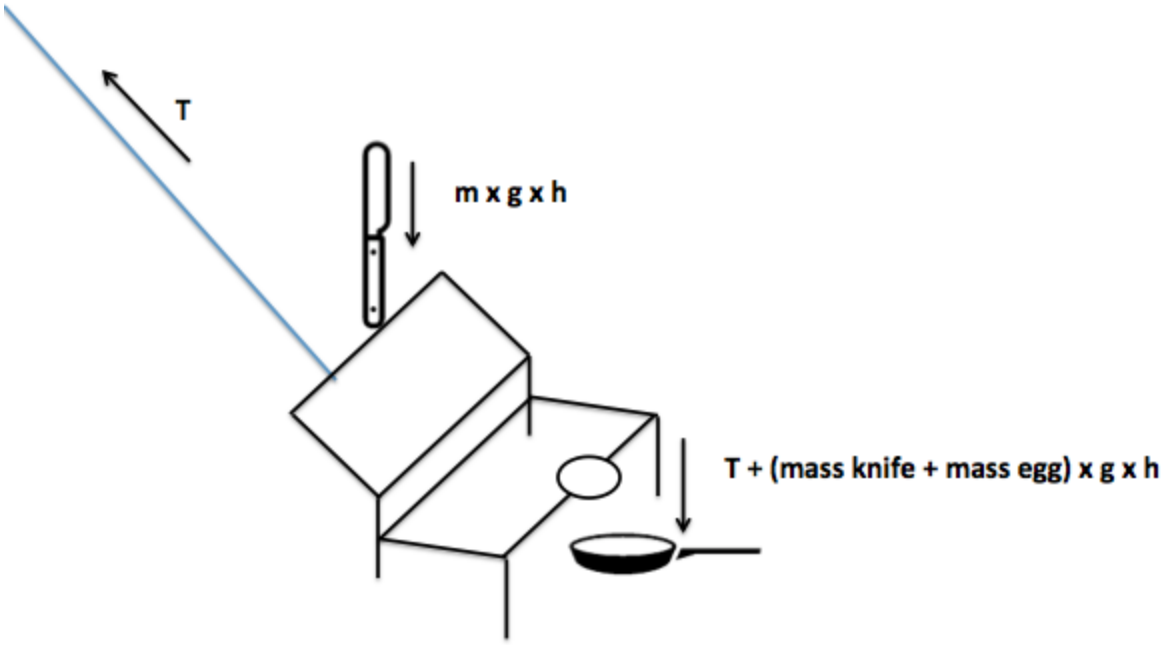
Final Machine

1. Experimenter will lower a domino with a pulley
2. Domino will fall on one side of a cardboard seesaw and lift the other side
3. Cardboard seesaw will push a rubber ball to roll forward
4. Rubber ball will fall down ramp and land into a paper cup
5. Paper cup will push down a pair of scissors
6. Scissors will cut a string holding up a cardboard flap
7. Cardboard flap will shut bringing down butter knife attached to it
8. Butter knife will land on a mentos and push it down a hole into a glass of diet coke

Force Diagrams







Experimental Errors

Our original plan had to be altered while we were at the park because of physical phenomena that we did not take into account when we were designing our machine.

1) The dominoes were not able to knock each other down and puncture the balloon because of a wind force in the opposite direction that weakened the free-fall force of the dominoes.
2) Puncturing the balloon manually also caused some difficulty because the rubber remnants of the balloon blocked the heavy ball from moving forward.
3) Hitting the egg with the free-fall force of the knife was still not enough to crack the egg shell. Having a heavier knife or elevating the knife at a higher position might have done the trick.
4) The final “task” of exploding the diet coke would most likely have been possible if we had used a 2-Liter bottle and dropped ALL of the mentos into the bottle itself. Our experimental set up did not have enough elevation to place our apparatus over the diet coke bottle, so the mentos had to fall into a cup instead. Once soda is poured into a cup, the gas molecules will expand and bubble away leaving them in a less volatile setting for the reaction to take place. Because this was a last minute fix, we did not

have the capacity to incorporate these important factors into the physics of our machine, but it would definitely be fascinating to see it be done!

Appendix : see presentation slides attached on following pages

Rube Goldberg: Breakfast & a Demonstration of Newton's Laws

by Angel Gallegos,
Yasha Saxena,
Zheng Bian,
Zibo Yu

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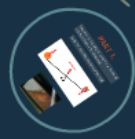
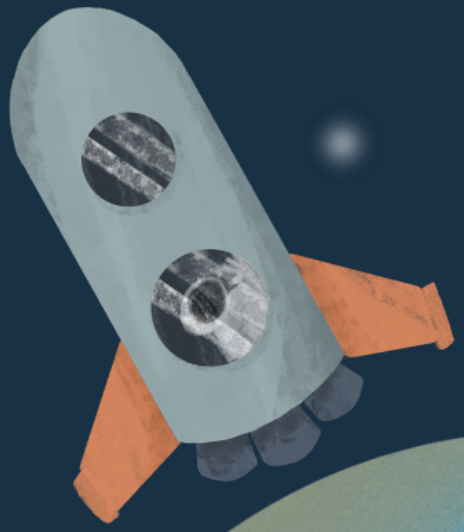


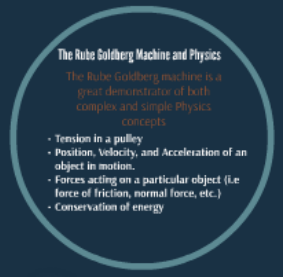


$$TE = KE + PE$$

"The conservation of energy is a fundamental concept of physics along with the conservation of mass and the conservation of momentum. Within some problem domain, the amount of energy remains constant and energy is neither created nor destroyed."
- NASA

Rube Goldberg Machine: Background Information

- An idea of an Engineer, Sculptor, Author, Inventor, and Cartoonist Reuben Garrett Lucius Goldberg (1883-1970)
- Originally a drawing for the San Francisco news paper
- Drawing depicted a contraption undergoing numerous stages to complete a simple task. (i.e crack an egg, toast bread)
- Introduced the idea but did not bring any inventions to life
- Today there is an innumerable fan base world wide that encourages competition to see who can build the best Rube Goldberg machine.



The Rube Goldberg Machine and Physics

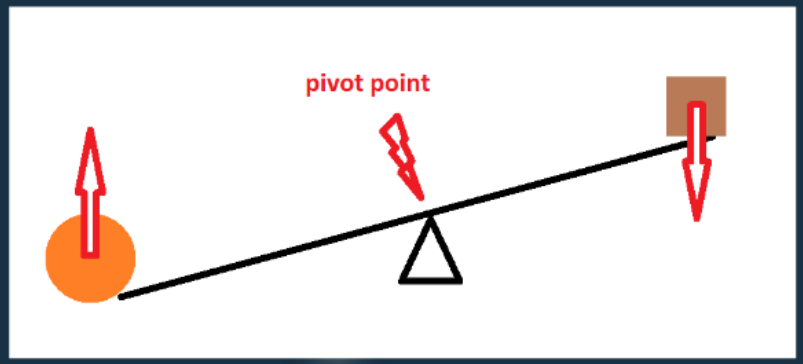
The Rube Goldberg machine is a great demonstrator of both complex and simple Physics concepts

- **Tension in a pulley**
- **Position, Velocity, and Acceleration of an object in motion.**
- **Forces acting on a particular object (i.e force of friction, normal force, etc.)**
- **Conservation of energy**

PART 1.

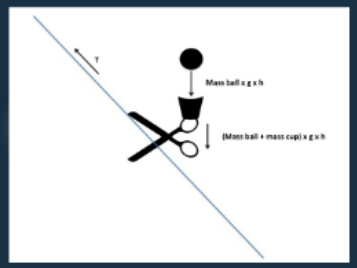
Purpose: To be able to operate a chemical reaction from a far distance.

Task: To start the motion of the ball

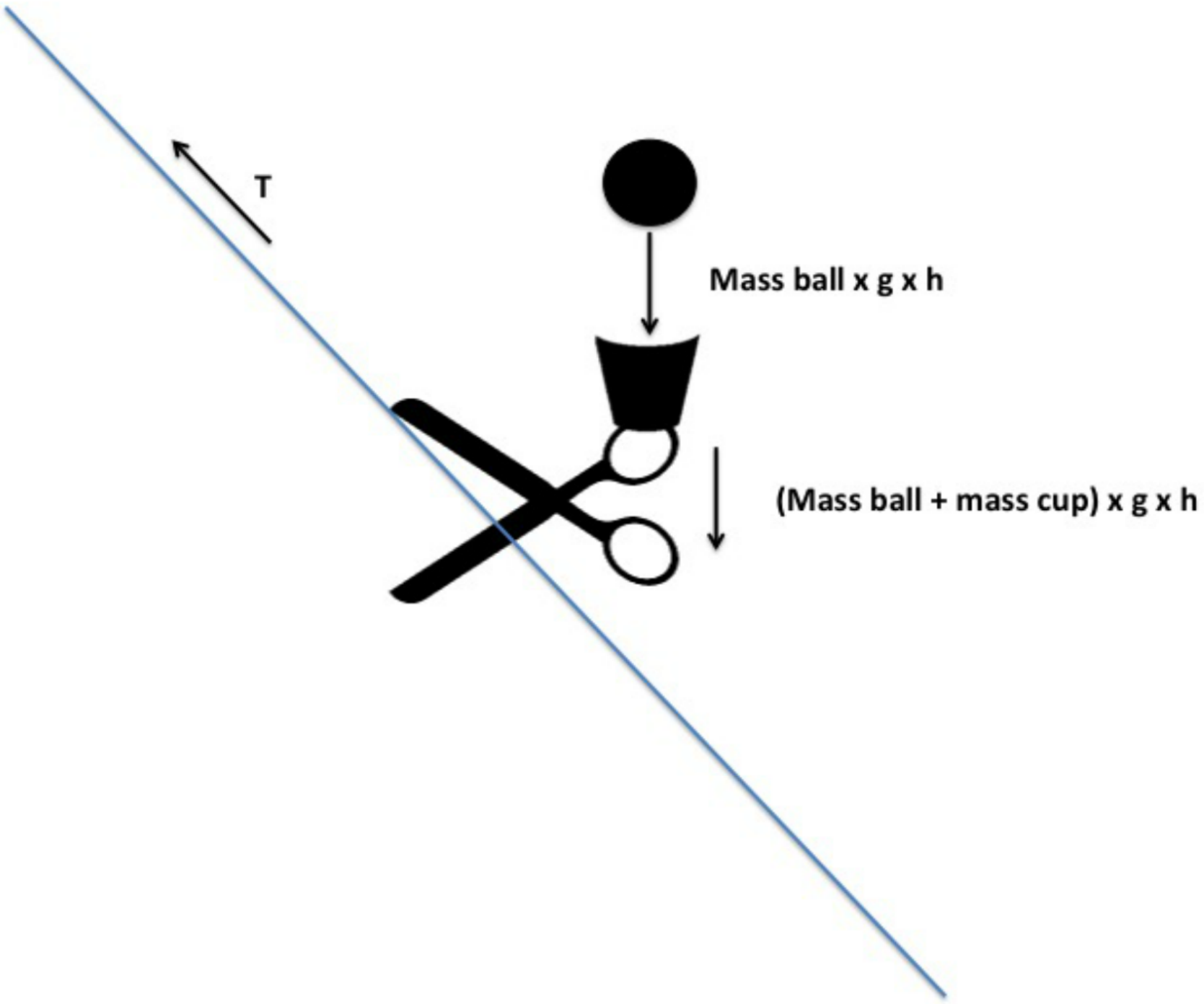


Part 2.

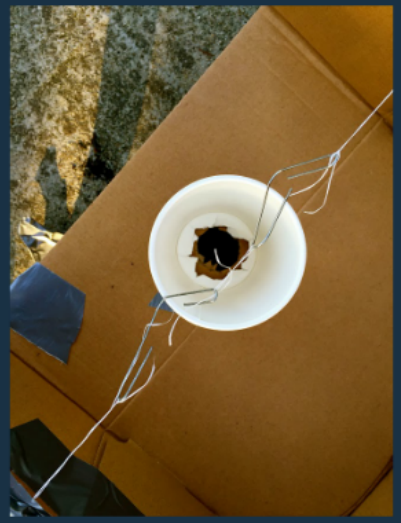
Main task: to cut the string




Cappuccino
knight
adidas
NEO


T
Mass ball x g x h
(Mass ball + mass cup) x g x h

PART 3.



Overall


see the impact
PEARSON
$10.15


mentos
Cheetos


YouTube


Thank you!
Questions?
YouTube

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