1.1.6 Compound Machine Design Project

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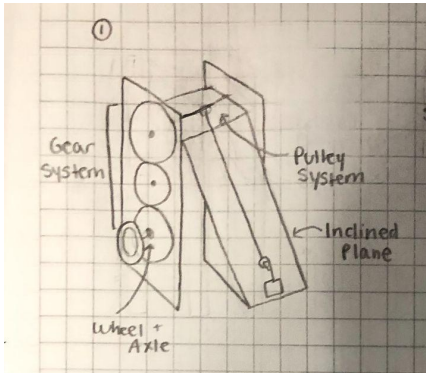
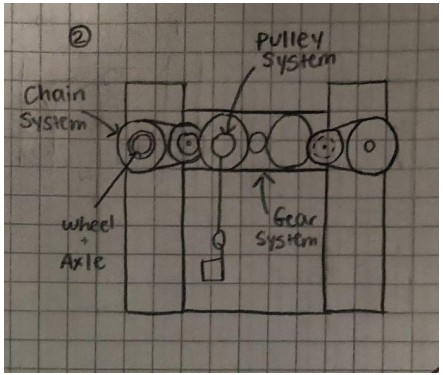
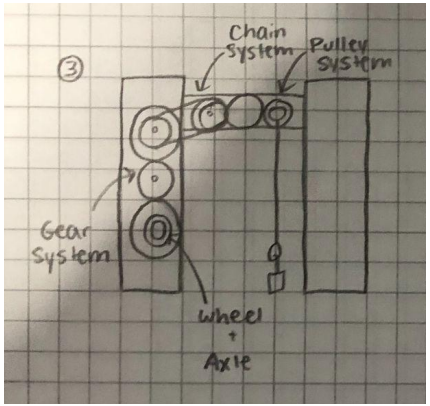
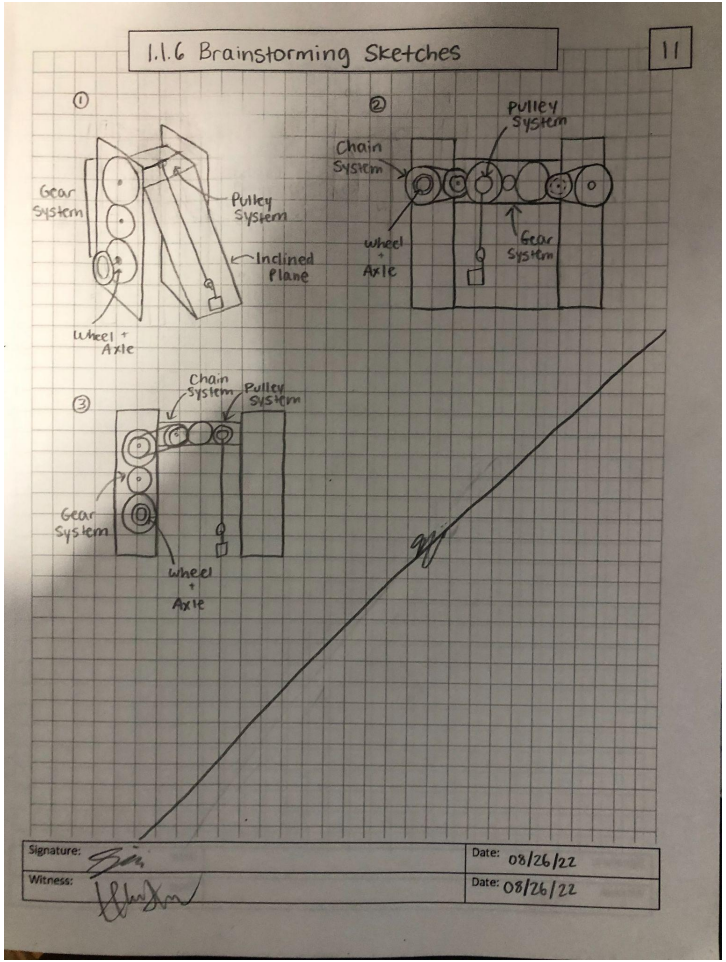
Brainstorming Sketches





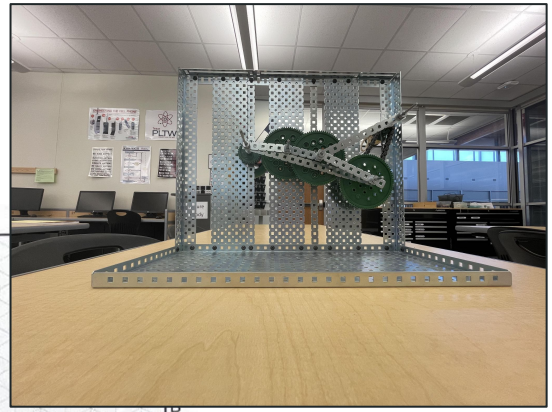


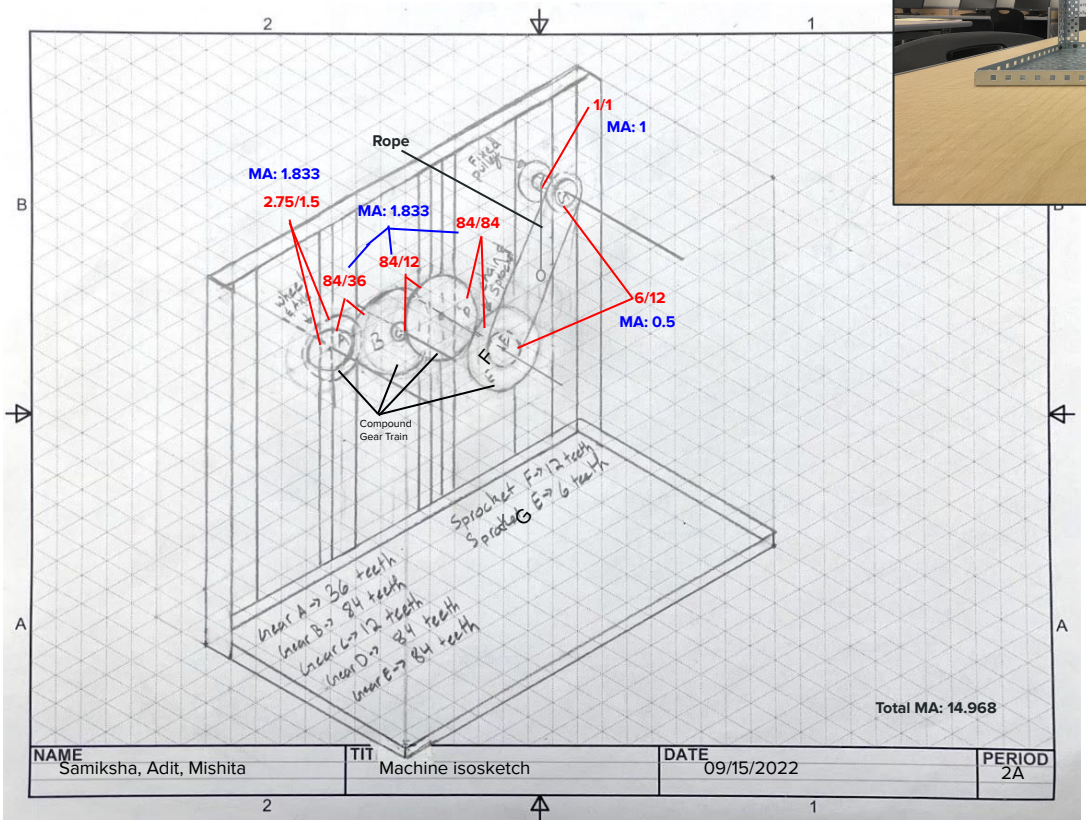


Isometric Sketch

= Ratios

= Mechanical Advantage (MA)





Scale
1 box : 1 inch

Mechanical Advantage (MA) Calculations

Wheel and Axle

2.75 in= 1.833 (Wheel and Axle MA)
1.5 in

1.833 (Total MA)

Chain and Sprocket

6 teeth= 0.5 (Chain and Sprocket MA)
12 teeth

0.5 (Total MA)

Compound Gear Train

84 teeth = 2.333 (Gears B:A)
36 teeth

84 teeth = 7 (Gears D:C)
12 teeth

84 teeth = 1 (Gears E:D)
84 teeth

2.333 * 7 * 1 = 16.331 (Total MA)

Pulley

1 (Fixed Pulley/Total MA)

Total MA

1.833 * 16.331 = 29.935

29.935 * 0.5 * 1 = 14.968

Total MA = 14.968

Conclusion Questions

Describe the objective of this project

For this project, we had to design a compound machine with a minimum of three simple machines. Our task was to ensure that the machine could move a 500g mass vertically 3 inches, while maintaining a mechanical advantage (MA) that was greater than or equal to 5 but less than or equal to 15. The applied effort force was to be provided from a single human input, and we were only allowed to use one base plate.

Was the objective accomplished?

The objective was accomplished as we were successfully able to create a machine with at least three simple machines, with an MA between the given range, and by also lifting 1000g of mass 6 inches vertically. We included a wheel and axle system, chain and sprocket system, compound gear train, and pulley system. Our total MA came to a total of 14.968.

What did you learn by completing this project?

By completing this project I was able to learn more about calculating the MA for different simple machines as well as learning how VEX parts work. I've never used VEX pieces before, so it was definitely a good experience learning how to assemble the different gears, pulleys, and systems.

If you had to do it all over, what would you do differently?

If I had to do it all over, I would try to plan out everything more thoroughly as me and my team spent a lot of time just trying to decide what systems to start with and where we would place everything. I would also spend more time checking over our MA calculations as we did make a few mistakes, and had to redo them a couple of times. Instead of rushing those calculations and making those mistakes, we could have gone through each one thoroughly and prevented them. If I had to design it differently, I would try using an inclined plane as that could have possibly reduced the number of gears needed to pull all of that mass up vertically. Our machine took quite a while to pull up the mass, so this could have made it more efficient.

For which mechanism was it easiest to determine the mechanical advantage or drive ratio? Why was it the easiest?

It was easiest to determine the mechanical advantage for the pulley system as it was a single fixed pulley; there was only one string pulling up the 1000g of mass, which made the MA 1.

For which mechanism was it the most difficult to determine the mechanical advantage or drive ratio? Why was it the most difficult?

Calculating the MA for the compound gear train was the most difficult because it required several steps. We had to calculate the MA using three different ratios. There was B:A * D:C * E:D, and it was difficult because we had to ensure that all the ratios and calculations were accurate, otherwise the MA would be inaccurate.

Collaboration: Equal Participation. Which one of these best describes YOUR performance in your group?

C. Encourages equal participation by asking clarifying or probing questions, paraphrasing ideas, and synthesizing group thinking. This one best describes my performance because I was absent on the first day when we started this project, and on the second day my group was still unsure on the task. I asked them questions so that I could understand the task better, and that allowed for all of us to come to a consensus on what we were building and who was in charge of what. Anytime I was unsure on what someone was doing, I asked for clarification which not only helped me but ensured that we were on track.

Collaboration: Team Support. Which one of these best describes YOUR performance in your group? Give an example of why you selected this choice.

D. Actively checks in to understand how others are progressing and how they can be of help. This one best describes me because I would start the day asking for an update from my teammates to see what was going on. Anytime my partners expressed exhaustion or frustration, I would jump in to help. For example, one of my partners was having trouble assembling the gears in the compound gear train, so I offered support and helped to hold up the gears in place, tighten the screws, and assist in gathering the required materials.