Project 1.1.6 Compound Machine Design – VEX

Equipment

- VEX POE kit, including gears (sprockets), chains, belts, axles, and support pieces
- Rope for pulley systems (masonry line works well)

Design Constraints

- The applied effort force may only be provided by a single human input.
- The final design must include a minimum of three mechanisms including any of the simple machines: a gear system; a pulley and belt system; and/or a sprocket and chain system.
- The compound machine must have a mechanical advantage greater than 1.

Procedure

1. Determine the instructor-assigned task in detail, including all required operations and time constraints.
2. Investigate available equipment components and possible configurations.
3. Brainstorm ideas for accomplishing the assigned task, and record at least three ideas in your engineering notebook.
4. Using isometric grid paper or 3D modeling software, sketch and annotate a preliminary design solution including the individual mechanism's mechanical advantage and the drive ratios.
5. Build, test, and modify your compound machine design.
6. Using isometric grid paper or 3D modeling software, sketch and annotate your final design solution including the individual mechanism's mechanical advantage and the drive ratios.
7. Use the tables below to document and illustrate the mechanical advantage and drive ratios of the individual mechanisms utilized within your final compound machine solution. Show work and units throughout.

Mechanism 1 Type	
Illustration: ***Include proper documentation such as force, distance, direction, and key mechanism features.***	

Mechanical Advantage / Ratio Calculations		
Formula	**Substitute / Solve**	**Final Answer**

8. Calculate total/overall system mechanical advantage.

Formula	Substitute / Solve	Final Answer

Project 1.1.6 Compound Machine Design

Design

Topics	4 points	3 points	2 points	1 point
Brainstorming Ideas	Generates at least three viable concepts. Selects most appropriate concept and clearly justifies the choice using the appropriate criteria.	Generates three concepts. Selects an appropriate concept and is somewhat able to justify the choice using marginally acceptable criteria.	Generates two concepts. Selects one concept using inadequate criteria.	Generates one concept.
Final Design Images	Produces accurate pictorial sketches or electronic 3D models that meet the required design concepts.	Produces marginally sufficient pictorial sketches or electronic 3D models of required design concepts.	Produces pictorial sketches or electronic 3D models that are difficult to visualize. Sketches lack details.	Produces incomplete pictorial sketch or electronic 3D model. Does not present concept.
Final Design Written Communication	Is properly detailed for effective communication including labels, descriptions, signatures, and dates.	Is marginally detailed for effective communication including labels, descriptions, signatures, and dates.	Lacks many details for effective communication including missing labels, descriptions, signatures, and dates.	Lacks most details for effective communication including missing labels, descriptions, signatures, and dates.
Design Requirements	Fully meets design requirements.	Meets most design requirements and supports the design function.	Meets some requirements but not enough to support the design function.	Does not meet any requirements.
Teamwork	Team members worked well together and settled differences in a positive manner.	Demonstrated good team working skills the majority of the time.	Demonstrated good team working skills part of the time.	Demonstrated few team working skills.

Mechanism 1

Topics	4 points	3 points	2 points	1 point
Design Requirements	Mechanism is clearly identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio is accurately calculated.	Mechanism is identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio is calculated but not very accurately.	Mechanism is marginally identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio is calculated but not very accurately.	Mechanism is difficult to identify as one that manipulates force or distance. Mechanical advantage and/or ratio is not calculated.
Quality and Functionality	Mechanism functions consistently and the chosen parts are appropriate.	Mechanism functions most of the time, and the chosen parts are appropriate.	Mechanism sometimes functions, and the parts are not chosen appropriately.	Mechanism rarely functions, and the parts are not chosen appropriately.

Mechanism 2

Topics	4 points	3 points	2 points	1 point
Design Requirements	Mechanism is clearly identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be accurately calculated.	Mechanism is identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be calculated but not very accurately.	Mechanism is marginally identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be calculated but not very accurately.	Mechanism is difficult to identify as one that manipulates force or distance. Mechanical advantage and/or ratio cannot be calculated
Quality and Functionality	Mechanism functions consistently and the chosen parts are appropriate.	Mechanism functions most of the time, and the chosen parts are appropriate.	Mechanism sometimes functions, and the parts are not chosen appropriately.	Mechanism rarely functions, and the parts are not chosen appropriately.

Mechanism 3

Topics	4 points	3 points	2 points	1 point
Design Requirements	Mechanism is clearly identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be accurately calculated.	Mechanism is identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be calculated but not very accurately.	Mechanism is marginally identifiable as one that manipulates force or distance. Mechanical advantage and/or ratio can be calculated but not very accurately.	Mechanism is difficult to identify as one that manipulates force or distance. Mechanical advantage and/or ratio cannot be calculated
Quality and Functionality	Mechanism functions consistently and the chosen parts are appropriate.	Mechanism functions most of the time, and the chosen parts are appropriate.	Mechanism sometimes functions, and the parts are not chosen appropriately.	Mechanism rarely functions, and the parts are not chosen appropriately.

Compound Machine Assembly

Topics	4 points	3 points	2 points	1 point
Mechanical Efficiency	The overall machine lost very little efficiency due to slippage and friction.	The overall machine lost some efficiency due to slippage and friction.	The overall machine lost most of its efficiency due to slippage and friction.	The overall machine barely functioned due to slippage and friction.
Quality and Functionality	Mechanisms function together consistently and accomplish the identified task.	Mechanisms function together most of the time and accomplish the identified task.	Mechanisms function together sometimes but do not always accomplish the identified task.	Mechanisms functions rarely and cannot accomplish the identified task.