

Energy Transformation Design Challenge

Objective:

Design and construct a device to include as many energy transfers as possible for moving one ping pong ball at least 30 centimeters within a given area.

General Design and Operation Rules:

1. The device must be safe. Safety goggles must be worn when working with the device.
2. The device will have no single voltage source above 9 Volts. The total voltage of all batteries cannot exceed 36 Volts. All power must be self-contained within the device. Under no circumstances are lead-acid batteries allowed.
3. The device will fit within a maximum space 75 cm x 75 cm x 75 cm.
4. The device must use at least one ping pong ball that will be moved 30 cm.
5. The starting point of the ping pong ball to be moved 30 cm must be on one outside side of the device.
6. The ping pong ball must be in a cup when the device process is finished.
7. The device can have no devices that are controlled by the team or by anything outside the device boundaries.

Scoring:

1. The device will be scored based on its achievements and penalties based on the scoring rubric. The following are a summary of most (but, not all) of the scoring criteria. (See the rubric for all the scoring criteria)
2. The objective should be completed as close to 2 minutes (120 sec) as possible, without going over 2 minutes. However, the objective *must* be reached in 3 minutes. When 3 minutes elapses, any further energy transfers occur, they are not counted.
3. For each energy transfer, 10 points will be gained. Note: An energy transfer is defined as a point at which the form of energy being used changes within the device. For example, a ball has mechanical energy as it rolls down a track. When it hits the end of the track, it flips a switch which turns on a light...The change from kinetic energy to light (electromagnetic spectrum) energy was an energy transfer. Note: transfers between devices that are the same form of energy do not count as an energy transfer. For example, activating a series of five levers counts as one energy transfer, not five.
4. For the purpose of this competition, the five energy forms are mechanical, chemical, electrical, electromagnetic spectrum (radio, infrared, visible waves, not electromagnets), and thermal. Batteries will be considered electrical energy.
5. Each energy transfer in the device must be documented in a table as to the beginning energy form and the changed energy form for each step. The documentation must be submitted with the device to the judge(s) before running the device.
6. Causing a bell to ring will earn an additional 5 points. A maximum of three rings will be awarded the bonus
7. A maximum of three additional items not available in the kit, may be used in the device. These items should be identified in energy transformation table.
8. The team starts the device at the judge's signal. The start mechanism may be a switch, lever, or other action. This initial action is not counted as an energy transfer for points.
9. If the device stops, time keeps going, and the team may start the device from that point with a penalty of 5 points. The team may also elect to restart and/or adjust the device for a penalty of 5 points.
10. If the device successfully moves one ping pong ball from its starting position on the edge to a cup positioned at least 30 cm away within the 3-minute time limit, then an additional 100 points will be added to the score.

Energy Transformation Design Challenge Scoring Rubric

Team Name: _____

Team Members: _____

Task Completion Time: (m:ss) _____ : _____ = _____ sec

Achievements (additions to score)	Qty	Multiplier	Points
Energy Transfer Table in format specified	0 or 1	75	
Energy Transfer Table is a 100% accurate documentation of device operation	0 or 1	25	
Successful Task Completion if all these conditions are met: <input type="checkbox"/> Time ≤ 180 sec <input type="checkbox"/> A ping pong ball is moved at least 30 cm to a cup	0 or 1	100	
Time Optimization Bonus: Enter qty in seconds (120 max) If time > 120 sec, enter 120 In no task completion in ≥ 180 sec, enter 0		2	
Energy Transfers to Mechanical		10	
Energy Transfers to Chemical		10	
Energy Transfers to Electrical		10	
Energy Transfers to Thermal		10	
Energy Transfers to Electromagnetic Spectrum		10	
Bonus: Bell is rung (maximum of 3 times)		5	
Achievements Sub-Total			
Penalties (subtractions from score)	Qty	Multiplier	Points
Size Violation , where the length, width, and/or height of the device exceeds 75 cm	0 or 1	-50	
Restarts/Touches/Adjustments		-5	
Extra Item Violation , where more than 3 items not provided in the kit are used in the device. Qty = [(number of items -3)]. If 3 or less are used, enter 0		-20	
Parallel Paths, Dead-End Path or More Than 1 Ping Pong Ball Moving at a Time , per occurrence		-50	
Safety Violation , where an object leaves the device boundary, sharp objects are not safely confined, chemical reactions are not safely controlled, and/or more than 9 Volt sources are used (no more than 36 Volts total)		-100	
Time Optimization Penalty: If > 120 sec, qty = [(completion time)-120] If time ≤ 120 sec, enter 0 In no task completion in ≥ 180 sec, enter 0		-1	
Penalties Sub-Total			
TOTAL SCORE			
(Achievement Sub-Total)-(Penalties Sub-Total)			

Tie Breakers: 1. Closest to 120 sec 2. Least Penalty Points

Energy Transfer Table

#	Input Energy Form	Description of Action	Output Energy Form
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			