MISSION POSSIBLE

DESCRIPTION: Prior to the competition the participants will design, build, test and document a "Rube Goldberg@-like Device" that completes a required task using consecutive Energy Transfers including five allowable Basic Energy Forms.

A TEAM OF: up to 3 IMPOUND: No

TIMES: Set-up: 30 min., Running: up to 3 min., Optimum 60 sec.

SAFETY: All team members must properly wear safety splash-chemical goggles. Each device must pass a safety inspection before operation. Uncontrolled projectiles, uncontained spills, hazardous materials and flammable substances are not permitted (e.g. unshielded razor blades, large rat traps, model rocket engines, cigarette lighters, fireworks, gunpowder, gasoline, acetone). Matches, candles or small rocket igniters may be used. No single source or connected group of sources used within the device may have or use a no-load electrical potential greater than 14 volts. Homemade batteries must be safe and an environmentally proper disposal must be provided. All other batteries must be sealed cells and have a manufacturer's label clearly indicating their voltage. Automotive or similar type batteries must have an insulated positive terminal and all current from the battery must pass through a single 30-amp fast blow fuse. Potential hazards or violation of this safety procedure may be cause for disqualification as determined by the Event Supervisor.

DEFINITIONS: Top of the device: The imaginary plane parallel to the base of the device that intersects the highest vertical extent of the device. The five Basic Energy Forms are: electrical, mechanical, thermal, chemical, and electromagnetic spectrum (radio, infrared and visible light). Batteries, candles, rocket igniters, etc., may receive points determined by the resulting action. For example, if a candle melts wax restraining a string, it is thermal energy; if the candle trips a photo gate, it is electromagnetic spectrum; if the candle oxidizes the string, it is chemical energy.

COMPETITION OVERVIEW: A team member will start the device by dropping a playing card into a slot in the top of the device, starting the first in a series of Energy Transfers. To achieve Task Completion, the device must: Light a candle using thermal energy then extinguish the candle. There must be at least 1 Energy Transfer separating the lighting and extinguishing of the candle, or task completion and timing points will not be awarded.

1. All parts of the device must fit within an imaginary box of 50 cm x 50 cm x 80 cm. in any orientation.

2. The Energy Transfer List (ETL) must be submitted to the Event Supervisor by a specified time/date prior to the tournament. This list will detail each Energy Transfer in the sequence in which it will occur durin the 0 eration of the device. The ETL must use this exact format:

No.	Action	Endin Ener	Points	Bonus
1	Playing card trips microswitch	Electrical	10	15
2	Light shines on photocell	EMS	10	15
3	Photocell actuates solenoid	Mechanical	10	15
4	Solenoid tips baking soda into vinegar	Chemical	10	15
5	Balloon inflates, tripping mousetrap	Mechanical	10	
	Mousetrap flip s marble down ramp	Mechanical		
6	Marble completes circuit	Electrical	10	
7	Circuit heats igniter	Thermal	10	
8	Igniter lights match	Chemical	10	

Scoring will be based only on the Energy Transfers listed in the ETL. The ETL must be legible, neat and an accurate documentation of the device's operation. If the device includes extra Transfers that do not count for points, they must be documented in the list, but they shall not be numbered.

3. Each Energy Transfer in the device will be labeled with a number matching the ETL entry for the Energy Transfer. This helps the Event Supervisor match failed transfers to the ETL claims.

4. A Basic Energy Form can receive points up to three times when it is transferred from a different Energy Form or Demonstration, but only if it is successful and is listed in the ETL. Such a change is called an Energy Transfer and must contribute toward the completion of the task. For example: electrical to mechanical is counted as a change to mechanical and is eligible for a 10 point mechanical score.
5. The same form of energy may be used consecutively in two or more sequential actions, but will not receive points. These unnumbered transfers must be documented in the ETL.
6. Energy devices may be activated prior to starting the device. For example, candles may be lit, motors started.
7. The device must account for non-ideal ambient conditions. If the device is sensitive to light, air currents, radio waves, etc. the team must provide all necessary shielding.
8. All sources of energy and actions must be contained within the imaginary box before, during and after the device's operation. Remote control is not allowed.

OPERATION OF DEVICE:

1. The device (and the timing of it) begins when the Event Supervisor says, "Go". At this time a team member will drop (not push) a playing card into a slot in the top of the device, starting the first Energy Transfer. The team member may not touch the device nor may any part of the team member cross the top of the device. Once the device has been started, penalty points will be deducted each time a team member touches the device. If the device is timed or controlled remotely by any means, it will be disqualified.
2. There is a maximum time limit of three (3) minutes. If the device is running when the three-minute time expires, the points earned at the three-minute mark will detennine the score. No completion points or timing points can be awarded in this case. Once started, the clock is never stopped for any reason.
3. If the device stops, jams or fails, the team will be allowed to "adjust" the device to continue operation, and penalty points will be deducted. Any obvious stalling during adjustments to gain a time advantage may result in disqualification.
4. If the team completes the task themselves or makes an adjustment that leads directly to task completion in the very next action, task completion and timing points will not be awarded.
5. Timing stops when the lit candle is extinguished. If the candle is not extinguished, task completion and timing points are not awarded.

SCORING:

Points will be awarded based on the following criteria: 10 points for each successful Energy Transfer to a different form, up to 3 times for each energy form, provided the transfer appears in the ETL
For example, a device can earn points 3 times for transferring from any other fonn of energy to mechanical energy for a total of 30 points. If the maximum number of transfers to all five forms of energy is accomplished, the maximum number of points is 150.

- 100 points for successful task completion within the three (3) minute time limit.
- 2 points for each second that the device operates before task completion up to 60 seconds for a total of 120 points; any obvious stalling during restarts or adjustments to gain points can result in disqualification. Timing points are not awarded if the device does not complete the task.
- 75 points if the ETL is submitted on-time and uses the exact fonnat specified.
- 25 points if the ETL is a 100% accurate documentation of device operations.
- 50 points if the Team is ready to submit their device to the Judging Team after 30 minutes of setup time.

ENERGY DEMONSTRATION BONUSES:

- 15 points for the first Energy Transfer to demonstrate one of the following: mechanical pneumatics, mechanical hydraulics, a home-made electromagnet (not from a kit), a permanent magnet, a home-made battery, chemical precipitation, a transfer caused by increasing heat, a transfer caused by decreasing heat, reflection of light, diffraction of light, energy released from a spring (other than a mousetrap).

- 30 points for the first Energy Transfer to demonstrate one of the following: static electricity, electric current passed through a transformer, storing energy in a spring (not releasing energy from the spring).
- 15 points if the demonstration of mechanical hydraulics uses a toy that squirts water.
- 50 points if the device uses a single electrical energy source for all transfers, except for the homemade battery demonstration.
- (State and National tournaments only) 50 points if the demonstration of mechanical pneumatics includes playing any two notes at the same time on a harmonica. An additional 50 points will be awarded if the two notes are played consecutively rather than simultaneously.
- (National tournament only) 100 points for drawing a figure of an "eight" on a piece of paper that is easily removable from the device after it completes its operations.

PENALTIES:

- 100 points for parallel design or dead-end paths, except for the transfers acting as part of task completion
- 1 point for each second that the device operates over 60 seconds, up to 120 points maximum deduction. No deduction is taken ifthe task did not complete.
- 50 points, one time, for any substance that leaves the boundary of the device. Small amounts of smoke, odors, light, radio waves, etc. may leave the device as long as none of these pose a hazard to anyone or the facility. If a hazard occurs, the device may be disqualified.
- 25 points for each time the device is touched, adjusted, or restarted.

Ties will be broken by the following sequence: 1. Least number of penalty points, 2. Closest to 60.0 seconds, 3. Greatest variety of design .

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