ROLLER COASTER B

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.



1. **DESCRIPTION:** Prior to the competition, teams design, build, and test a Roller Coaster track to guide a ball/sphere that uses gravitational potential energy as its means of propulsion to travel as close as possible to a Target Time.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 12 minutes

   EYE PROTECTION: B **IMPOUND:** Yes

2. **EVENT PARAMETERS:**
   a. Participants must bring and impound one Roller Coaster (a track that guides a ball/sphere), at least one ball/sphere, non-electronic tools, and spare parts before the start of the competition.
   b. Participants may bring and impound additional balls/spheres, but only one will be used during a given run.
   c. Participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection, if time allows.
   d. The Event Supervisor will provide an unsharpened #2 pencil with an unused eraser, all measurement tools for scoring purposes, and timers.
   e. If the device is deemed unsafe, it will not be allowed to run until safety concerns are resolved to the Event Supervisor's satisfaction.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. The Roller Coaster must be designed so that a single ball/sphere will travel from a Start Line to a Finish Line in as close to the given Target Time as possible.
   b. At all times during the competition the device, excluding the ball/sphere, must be no larger than 30.0 cm wide x 80.0 cm long x 60.0 cm high sitting flat.
   c. The ball/sphere must be at least 1 cm in diameter and must remain visible at all times.
   d. The ball/sphere must be held in the ready-to-run position by an unsharpened #2 pencil held only in the participant's hand. The pencil is provided by the Event Supervisor. The ball/sphere is released when the participant removes the pencil from the track.
   e. The ball/sphere must travel using only its own gravitational potential energy available at the ready-to-run position with the exception of the simple machines required for the Elevators. No added energy by use of stored potential energy is allowed (e.g., no springs, rubber bands, etc.).
   f. There must be exactly one clearly labeled Start Line and one clearly labeled Finish Line running perpendicular to the direction of ball/sphere travel on the track designated before the Target Time is released.
   g. The relative positions of the Start Line and the Finish Line must not change after impound.
   h. The device must include a mechanism that safely stops the ball/sphere after it crosses the Finish Line.
   i. Magnets, electrical, and electronic devices may not be used for any part of the Roller Coaster.
   j. Elevators: Up to 2 distinct types of clearly labeled Elevators may be included to earn points.
      i. Types of Elevators may be in any order.
         (1) Type 1: A first-class lever combined with a wheel and axle with an IMA of less than 1 must raise the ball/sphere vertically at least 10 cm.
         (2) Type 2: A second-class lever combined with a pulley with an IMA of less than 1 must raise the ball/sphere vertically at least 10 cm.
      ii. Counterweights are allowed in the operation of the elevator.
      iii. Parts of the track can be reused by the ball/sphere after being lifted vertically.
      iv. Gates/barriers may be activated/put in place as part of Elevator actions.
      v. Each type of Elevator may earn points only once.
   k. Loop: The device may contain one Loop in the track to earn a Loop Score. A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI).
      i. The Loop begins and ends when the ball/sphere reaches the POI.
      ii. The track must not be fully enclosed at any point in the Loop (i.e., the ball/sphere could be easily removed by the Event Supervisor).



iii. The height of the Loop is defined as the vertical distance from the POI to the highest inside point of the Loop.
iv. The measurement from the POI to the highest inside point of the Loop must be clearly labeled for the Loop to count for points.
v. The two sections of track at the POI must touch and have a clearly labeled point that the Event Supervisor can measure from.
vi. The ball/sphere must remain in contact with the track as it traverses the Loop. When the ball/sphere is in contact with the highest point of the Loop, the ball/sphere must be completely unsupported from below.

4. **THE COMPETITION:**
   a. The Roller Coaster, ball(s)/sphere(s), tools, spare parts, and data/notes must be impounded before the start of the competition.
   b. Only the participants and Event Supervisor will be allowed in the impound and event areas during the competition. Once the participants enter the event area to compete, they must not leave the area or receive outside assistance, materials, or communications.
   c. The exact Target Time is between 30 s and 60 s (in 5 s intervals for Regional, 2 s intervals for State, and 1 s intervals for National tournaments) and will be chosen by the Event Supervisor. The Target Time will be the same for all teams at the tournament and will be revealed just before the team sets up the device.
   d. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants may make as many practice runs as they want during the 8 minutes.
   e. Participants may adjust their Roller Coaster (e.g., modify the track, add/remove parts of track, swap the ball/sphere, leveling) before each run. They are not allowed to change the start and finish lines.
   f. Time used by the Event Supervisor for measuring will not be included in the 8 minutes. A scorable run that begins before the end of the 8-minute time period will be allowed to run to completion.
   g. Prior to conducting a scorable run, the participants must place the Event Supervisor provided #2 pencil on the Start Line of the device. The ball/sphere must be placed completely behind the Start Line.
   h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run.
   i. Prior to each scorable run, the Event Supervisor will verify that the timekeepers and participants are ready. Three timekeepers are suggested to be used with the median time recorded as the Run Time, in seconds to the precision of the timing device used. The Event Supervisor will then count aloud "3, 2, 1, Go". On the word "Go" the participants will remove the pencil from the track such that the pencil does not exert a force on the ball/sphere.
   j. On the word "Go", the pencil is removed and timing begins. Timing ends when any of the following happens:
      i. The ball/sphere completely crosses the Finish Line.
      ii. Twice the Target Time has elapsed since the word "Go".
      iii. The ball/sphere travels outside the boundary of the device.
      iv. The ball/sphere stops moving. The ball/sphere may pause briefly, but timing stops if movement does not begin within 3 seconds.
   k. If the ball/sphere fails to cross the Finish Line on a scorable run, that run will have a Time Score of Zero (0). However, the time of the run when it stopped or left the device may be used as the final Tie Breaker (if needed) with the longer time being preferred. It will still receive scores for the Height, Elevator(s), and Loop. Only the Elevator(s) and Loop that are successful before timing stops may receive their respective points.
   l. The Roller Coaster's height will be measured at the conclusion of each scorable run.
   m. The Event Supervisor will review with teams the data recorded on their scoresheet.
   n. Teams filing appeals must leave all impounded materials with the Event Supervisor.

5. **SCORING:**
   a. High Score wins.
   b. The higher of the 2 Run Scores is used as the Final Score.



c. Run Score = Size Score + Time Score + Elevator Score + Loop Score
d. Size Score = (60 - Roller Coaster height) + (30 – Roller Coaster width) + (80 - Roller Coaster length). The Roller Coaster height/width/length is measured in 0.1 cm increments.
e. Time Score = Time Bonus - Time Penalty
   i. Time Bonus = 5 points for every full second of Run Time up to the Target Time.
   ii. Time Penalty = 5 points for every full second of Run Time past the Target Time up to the 2 x the Target Time.
f. Elevator Score = 50 points for each first successful use of each type of Elevator. Points are only awarded if the ball/sphere successfully reaches the track at the top of the Elevator, fulfills all requirements in (3.j.), and continues traveling on the track.
g. Loop Score = 3 points for each whole cm of the height of the Loop, measured vertically from the POI to the highest inner point of the Loop. Points are only awarded if the ball/sphere successfully completes the Loop and fulfills all requirements in (3.k.).
h. Tiers:
   i. Tier 1: A run with no violations
   ii. Tier 2: A run with any construction or competition violations
   iii. Tier 3: A team with a Roller Coaster or ball/sphere not impounded during the impound period
   iv. Participation points are awarded to teams who cannot start any run within the 8 minutes or have unresolved safety issues.
i. Ties are broken in this order:
   i. Highest Loop Score
   ii. Highest Size Score
   iii. Highest Time Score
   iv. The longest time the sphere ran before leaving the device or stopping

6. **DEFINITIONS:**

a. *Event Supervisor (ES):* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.
b. *Gravitational Potential Energy:* stored energy an object possesses due to its position.
c. *Roller Coaster:* Track to guide a ball/sphere.
d. *Ball/Sphere:* Object that uses gravitational potential energy as its means of propulsion to travel as close as possible to a Target Time down the Roller Coaster track.
e. *Elevator:* Device used to lift the Ball/Sphere from a lower level within the Roller Coaster to a higher level in the Roller Coaster.
f. *Loop:* A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI). The track for the loop may not be enclosed.
g. *Track:* A surface that the ball/sphere travels along. Materials used must not create a safety concern. If the Track is enclosed, it must be clear.