

ROLLER COASTER



SOSI 2019

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Courtesy of:
Patrick Chalker

WHAT IS A ROLLER COASTER?

- Device that transports a coaster to the end of a track
 - Coasters are small spherical objects i.e. (marble, ping pong ball, bearing)
 - Specific target time



CONSTRUCTION RULES

- 50 cm length x 50 cm width x 60 cm height (~20"x~20"x~24")
- Coaster must be visible at all times
- All power for the device has to be from position due to gravity – no springs, magnets, electrical power, ...

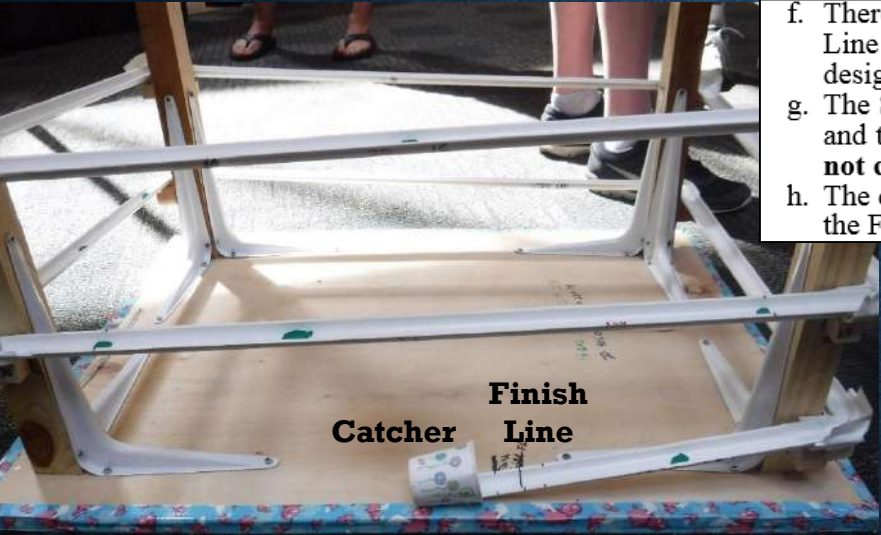


- b. At all times during the competition the device, excluding the ball/sphere, must fit into 50 cm wide x 50 long x 60 cm high box sitting flat on the ground.
- c. The ball/sphere must be visible at all times.

CONSTRUCTION RULES (CONT.)

- Exactly one Start Line and one Finish Line
 - MAY NOT be adjusted during competition
 - MUST BE designated during impound – BEFORE TIME TARGET IS ANNOUNCED
 - MUST catch the coaster at the end

- 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 Start Line and Finish Line positions may not be adjusted **after Impound**. Parts and track can be added or removed, but **the overall dimensions of the device may not change during the competition**.
- h. The device must include a mechanism that safely stops the **ball/sphere** after it crosses the Finish Line.



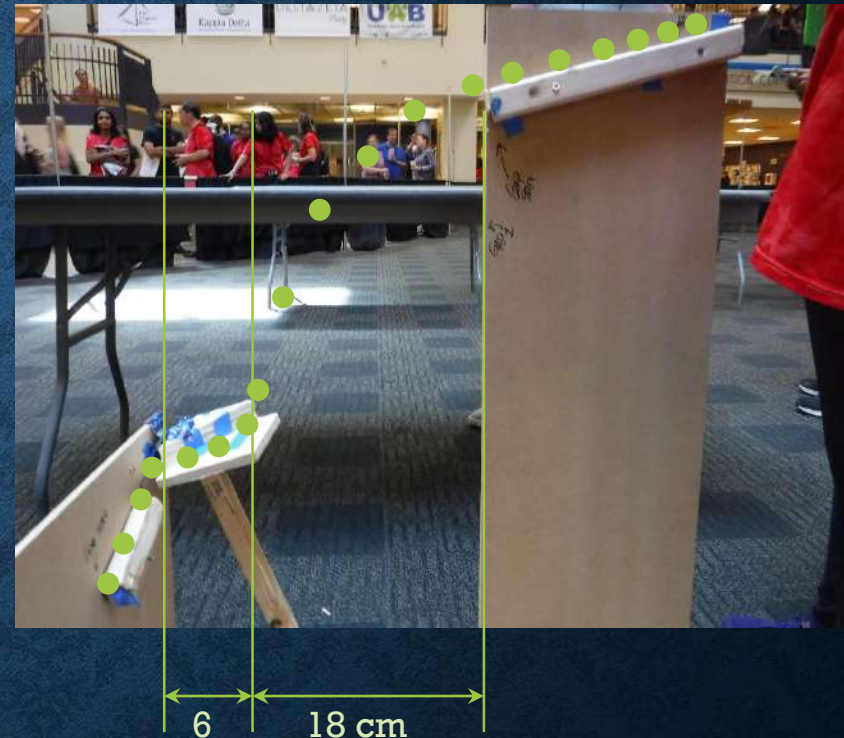
Catcher Finish
Line

CAN'T CHANGE START OR FINISH LINE AFTER IMPOUND

APPARENTLY CAN RAISE OR LOWER START LINE

GAPS

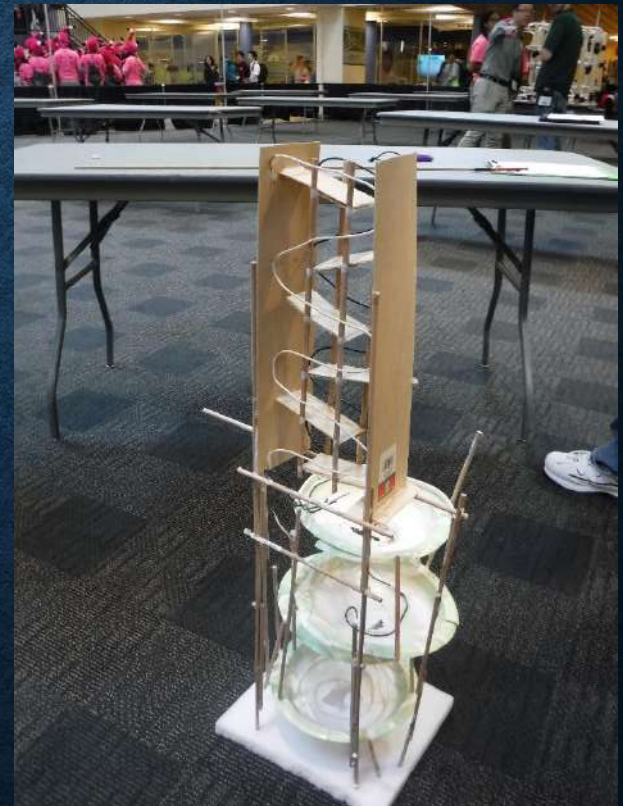
- Open span without track that the vehicle must pass to continue with its run
 - Minimum of 5 cm
 - Measured from end of track to beginning of track – HORIZONTALLY!!
 - Must be LABELED!!
- Vehicle must travel completely unsupported to count for points
 - Can't "bounce" a gap
- Up to 3 distinct gaps can count



Note: Vehicle MUST Continue for 5 cm Past the Gap for the Score to Count
(Can't use a wall to end a gap)

NOT ALLOWED

- Magnets, electrical and electronic devices
- Moving or adjusting the start and finish lines
 - The internal track may be adjusted/modified
- Bouncing the vehicle as part of a gap
- ~~Funnels~~
- Springs/rubber bands
 - No potential energy sources



COMPETITION

- Impound
 - After impound the Supervisor announces the target time of the competition
- Target time
 - Between 10 and 60 seconds
 - 5s intervals for regionals and invitationals
 - 2s for state, 1s for nationals
- 8 minutes to compete
 - Team can START up to 2 scorable runs in the 8 minutes
 - Run time is NOT part of the 8 minutes



- e. Participants may adjust their Roller Coaster (e.g., modify the track, swap the ball/sphere) before each run.
- f. Participants may make as many practice runs as they want in their 8 minutes of competition.

COMPETITION (CONT.)

- Scorable Runs

- Declared by the participants whenever they're ready, i.e.,
"I'm ready for a scored run now."

- h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run. The **ball/sphere** must cross the Finish Line within **two (2) minutes or the run will be declared over and no time points will be awarded.**
- i. **The ball/sphere must cross the Finish Line for a scorable run to receive time points. If the ball/sphere fails to cross the Finish Line on a scorable run, that run will still receive Height and Gap Bonus scores. Only Gaps that are successful during a run may receive a Gap Bonus.**
- j. **Any scorable run beginning within the 8-minute period will be permitted to run to completion.**
- k. 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 middle 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.
- l. Timing begins on the word "Go" and ends when any of the following happens:
 - i. The complete **ball/sphere** crosses the Finish Line.
 - ii. **Two** minutes have elapsed since the word "Go".
 - iii. The **ball/sphere** travels outside the boundary of the device.
 - iv. The **ball/sphere** stops moving. A **ball/sphere** may pause briefly, but timing stops if movement does not begin within 3 seconds.

COMPETITION (CONT.)

- Violations
 - Vehicle stops moving for 3 seconds
 - Vehicle leaves the boundaries of the device
 - Vehicle fails to cross the Finish Line in two minutes



- f. Tiers:
- i. Tier 1: A run with no violations
 - ii. Tier 2: A run with any violations
 - iii. Tier 3: A team with a Roller Coaster not impounded during the impound period

~~• NOTE: the funnel in this picture is not legal this year!~~

SCORING

- Score = Height Score + Gap Score + Time Score – Time Penalty

- Height Score = $3 \cdot (60 \text{ cm} - \text{device height})$

- Measured from the uppermost part of the device to the floor
- Includes pieces of track that are not used

c. Height Score = $3 \times (60 - \text{device height})$. The device height is measured in cm from the highest part of the device measured to the floor or the table (if used), rounded down to the cm.

- Gap Score = 5 pts for each whole centimeter of each gap

- Measured horizontally from start of gap to end of gap
- 5.9 cm is considered a 5 cm gap

e. Gap Bonus = 5 points for each whole cm measured horizontally from the end of the track the **ball/sphere** leaves, to the closest part of the track the **ball/sphere** lands on. Points are only awarded if the **ball/sphere** successfully reaches the **track on the other side of the Gap** and fulfills all requirements in (3.j.).

SCORING (CONT.)

- Time Score = $5 \cdot \text{Min}(\text{Run Time}, \text{Target Time})$
 - Target Time is 45 seconds, 41.8 is considered 41 seconds
 - $5 \cdot 41 = 205$ points
 - Target Time is 45 seconds, 49.8 is considered 49 seconds
 - $5 \cdot 45 = 225$ points
- Time Penalty = $1 \cdot [\text{Max}(\text{Run Time}, \text{Target Time}) - \text{Target Time}]$
 - Target Time is 45 seconds, 49.3 is considered 49 seconds
 - $1 \cdot 4 = 4$ penalty points
- d. Time Score = 5 points for every full second of Run Time, rounded down, up to the Target Time, minus the Time Penalty (1 point for every full second of Run Time, rounded down, past the Target Time).
- Better to be over time than under time

MORE EMPHASIS ON TIME AND HEIGHT THAN LAST YEAR!!!

HEIGHT VS. GAPS

- Start lower, more height points, but
- Less energy to power gap jumps
 - 5 points per horizontal centimeter, no points for vertical distance

No Gaps On This Coaster



TIME ADJUSTMENTS

- LOWER SPEED
 - Angling the roller coaster
 - More angle on a board – higher start means more energy due to gravity
 - Speedbumps
 - Flaps, notches of wood, pieces of clay
 - Swap vehicle
 - Marble vs. steel bearing vs. ping pong ball
- MORE DISTANCE
 - Alternate track parts
 - Add or remove whole sections of track
 - “Funnels” (round or lateral) or spirals, or just longer/shorter sections

CAREFUL NOT TO STOP THE BALL ON THE TRACK!!!

TIMING EXAMPLES

- Angling the coaster
 - More angle on a board, the higher a vehicle is, more energy due to gravitational position



CAREFUL NOT TO STOP THE BALL ON THE TRACK!!!

TIMING METHODS

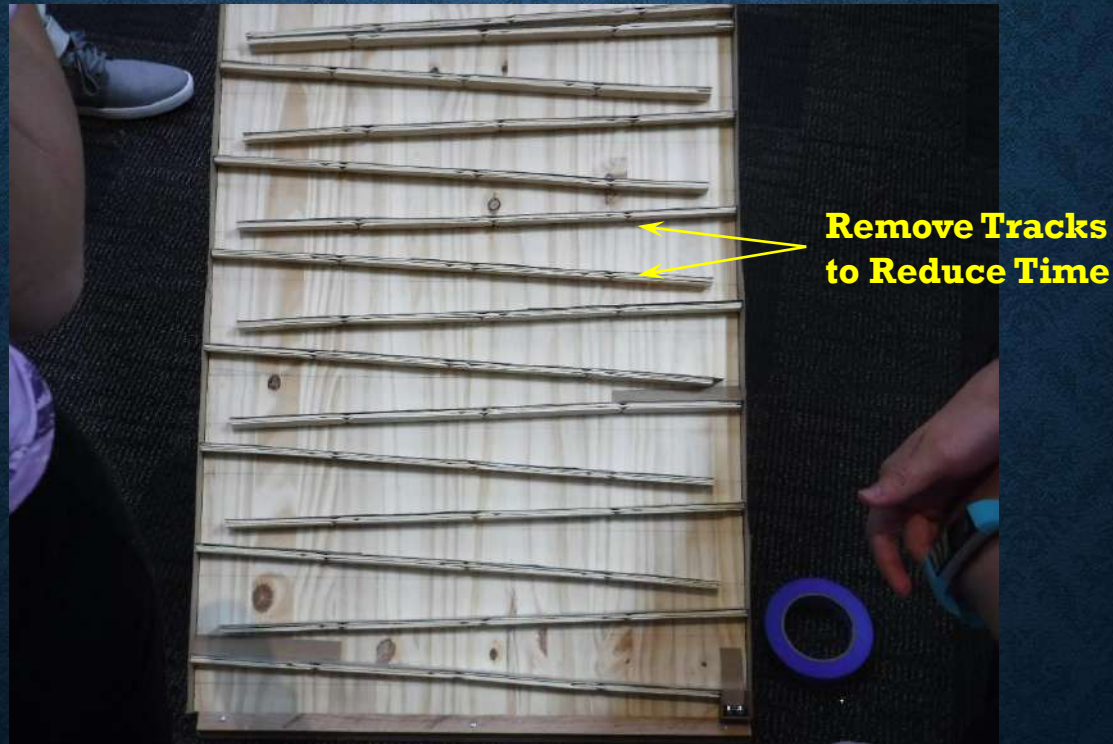
- Speedbumps
 - Flaps, notches of wood, pieces of clay



CAREFUL NOT TO STOP THE BALL ON THE TRACK!!!

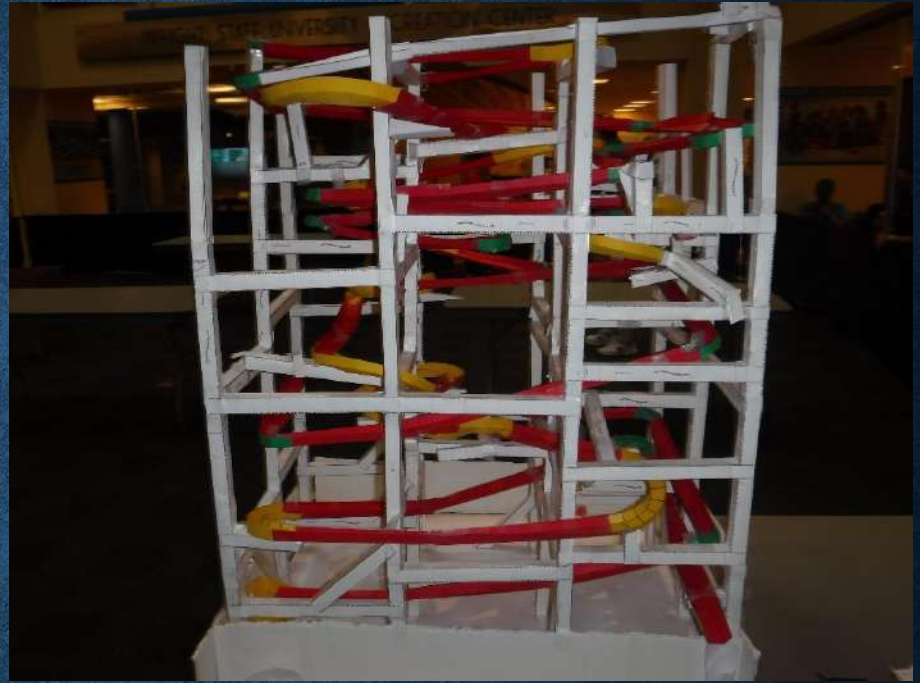
TIMING METHODS

- Alternate track parts
 - Swap out whole sections of track

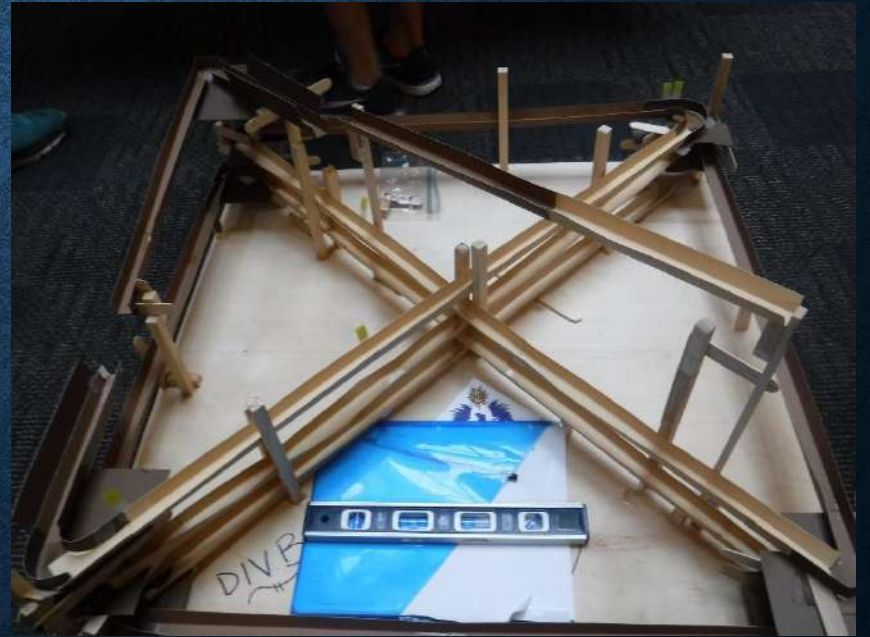
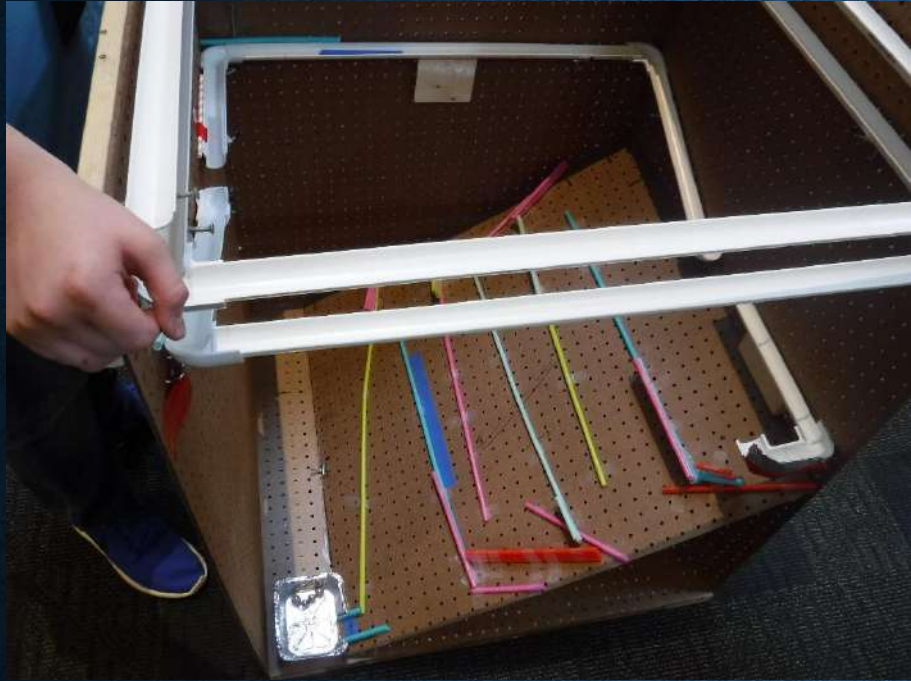


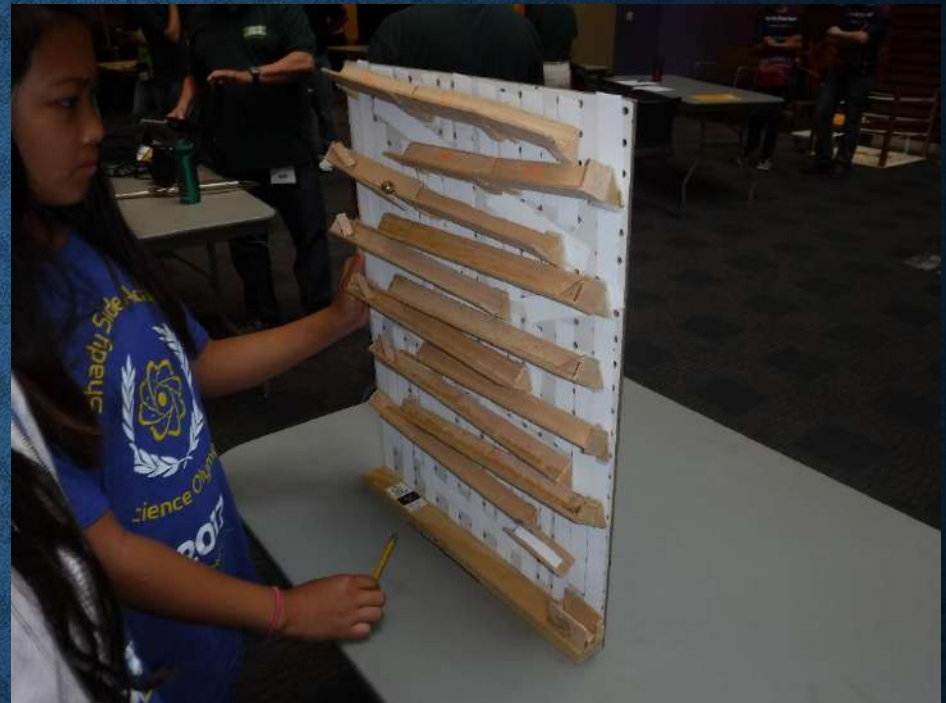
CAREFUL NOT TO STOP THE BALL ON THE TRACK!!!

MATERIALS



- Scrap!
 - Paper (flimsy), wood (sturdy), split sprinkler line, HotWheels track, anything
 - Consistency in entire coaster
 - Adjustable segments to match the **TARGET TIME**
- Strength in Transport and Setup
 - Reliable and **STURDY** for transportation
 - Avoid overly sensitive parts – want **REPEATABLE PERFORMANCE**





GENERAL TIPS

- Coasters are hands on and inexpensive
 - Build many! Try different designs
 - Vary vehicles, different sizes/masses/materials
- Vary methods of slowing down vehicles, be consistent in methods



SCORING EXAMPLES

Time Target	35 sec	Time Target	35 sec	Time Target	35 sec	Time Target	35 sec
Performance		Performance		Performance		Performance	
Track Height	55.0 cm	Track Height	30.0 cm	Track Height	59.0 cm	Track Height	45.0 cm
Time	33.60 sec	Time	33.60 sec	Time	37.00 sec	Time	50.00 sec
Gap 1	6.2 cm	Gap 1	0.0 cm	Gap 1	11.0 cm	Gap 1	7.0 cm
Gap 2	5.1 cm	Gap 2	0.0 cm	Gap 2	0.0 cm	Gap 2	0.0 cm
Gap 3	0.0 cm	Gap 3	0.0 cm	Gap 3	0.0 cm	Gap 3	0.0 cm
Gap 4	0.0 cm	Gap 4	0.0 cm	Gap 4	0.0 cm	Gap 4	0.0 cm
Gap 5	0.0 cm	Gap 5	0.0 cm	Gap 5	0.0 cm	Gap 5	0.0 cm
Scores		Scores		Scores		Scores	
Height Score	15	Height Score	90	Height Score	3	Height Score	45
Time Score	165	Time Score	165	Time Score	175	Time Score	175
Time Penalty	0	Time Penalty	0	Time Penalty	-2	Time Penalty	-15
Gap 1 Bonus	30	Gap 1 Bonus	0	Gap 1 Bonus	55	Gap 1 Bonus	35
Gap 2 Bonus	25	Gap 2 Bonus	0	Gap 2 Bonus	0	Gap 2 Bonus	0
Gap 3 Bonus	0	Gap 3 Bonus	0	Gap 3 Bonus	0	Gap 3 Bonus	0
Total Score		Total Score		Total Score		Total Score	
235		255		231		240	

2 Medium Gaps

**Shorter,
No Gaps**

**Higher,
1 Big Gap**

**Over Time
1 Medium Gap**