Mario Kart!

You're competing in Mario Kart!! Except you'll be programming a microprocessor to do the driving, and you'll be designing and building the Kart!

Collect mystery blocks along the track and do as many laps of the track as you can in two minutes. Don't forget to take some shortcuts! If your Kart is equipped to fly, you'll save some time.

You'll be racing head-to-head with your competition so don't forget to drop a banana or a bomb to slow them down!

Good luck!!

Revision History:

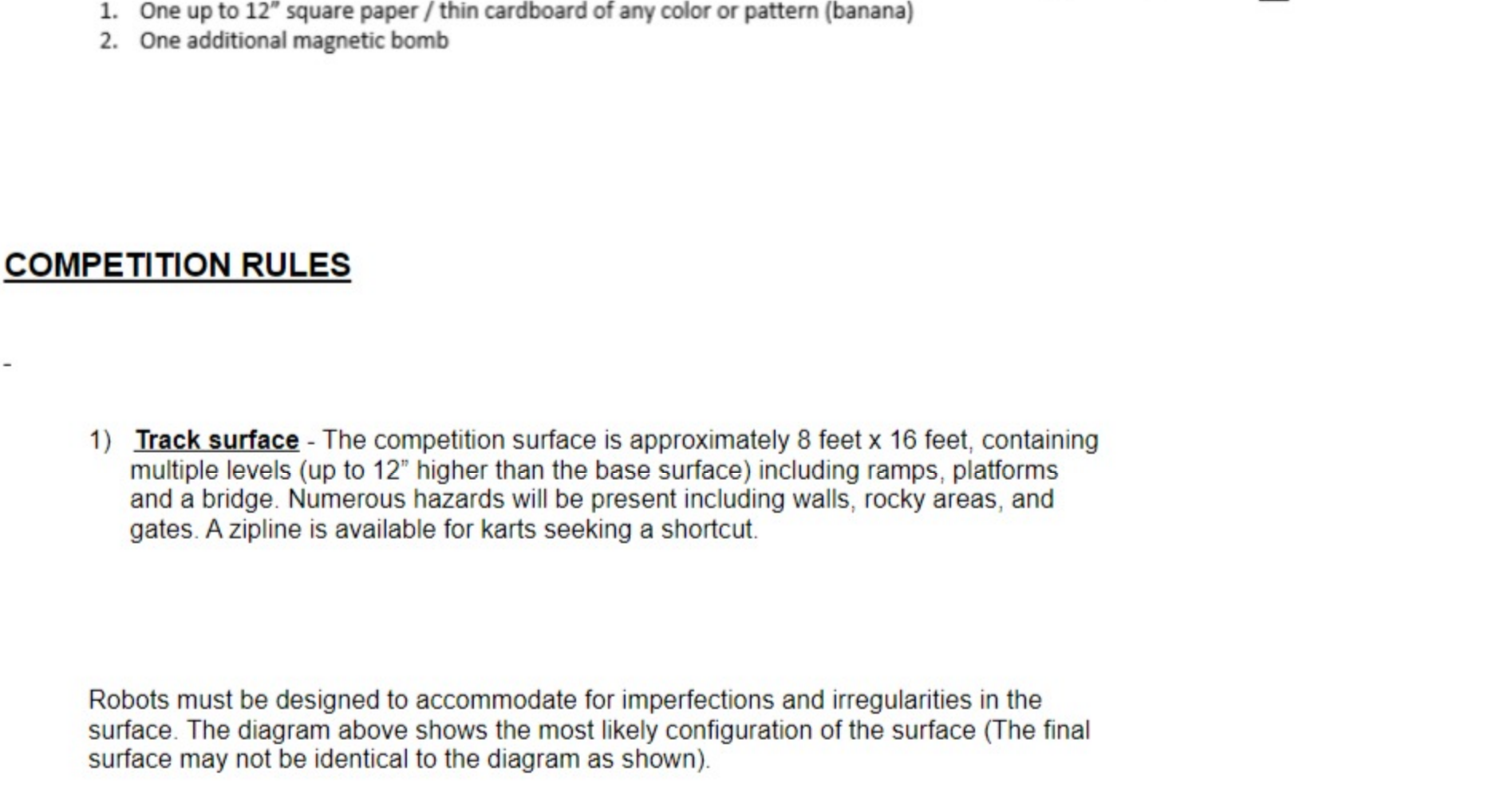
1.0 AM initial draft (after class edits)

2.0 AM revisions of bomb and restart location, ramp dimensions

3.0 AM, minor revisions, location of mystery blocks

4.0 AM minor revisions, start and restarts

Competition Surface (Approximate! Will evolve during construction)



Robots may drop:

1. One up to 12" square paper / thin cardboard of any color or pattern (banana)
2. One additional magnetic bomb

COMPETITION RULES

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1) **Track surface** - The competition surface is approximately 8 feet x 16 feet, containing multiple levels (up to 12" higher than the base surface) including ramps, platforms and a bridge. Numerous hazards will be present including walls, rocky areas, and gates. A zipline is available for karts seeking a shortcut.

Robots must be designed to accommodate for imperfections and irregularities in the surface. The diagram above shows the most likely configuration of the surface (The final surface may not be identical to the diagram as shown).

Robots will race head to head on this surface, starting in the two locations shown on the diagram.

2) **Path** – There is a continuous black electrical tape path on the surface, which will be generally laid on top of white paint for contrast. The tape will be no less than 6" away from any obstacle (except mystery blocks and coins). Short pieces of orthogonal tape will be available for navigation as shown in the figure. These will run from the tape to 1.5" away and from 2" to 3" away, or from the tape to 3" to implement a sort of binary code.

3) **Start Areas** - The robots will start in one of the designated corners of the track, within the prescribed lines.

4) **Ramp** – The ramps are 24" wide and 62" long with an incline of about 7 degrees, reaching a height of 8". Note that there is a significant discontinuity in slope at the beginning and end of the ramp, which leads to difficulties tape following.

5) **Archway** - The path goes through archways that have an opening measuring at least 12" wide by 12" high.

6) **Beacons** - Navigation and shortcuts may be assisted by following an IR beacon which emits a 1kHz sine wave.

7) **Mystery blocks** - Mystery blocks are grey plastic blocks with question marks on their side, measuring approximately 1.5" cube. Blocks will be placed such that their centroid is placed within approximately 2" of the center of the tape

8) **Coins** – Coins are orange rounds about 1" diameter and 0.15" thick, with a thin metal wire protruding from them to allow them to be hung on the zipline.

9) **Magnetic Bomb** - Looks like a mystery block but black with a red face, and with permanent magnets in the center of the red face. The bomb will be located on the surface with the red face up.

10) **Rainbow road** – A curved bridge spans the two plateaus, with a maximum height of 10". Robots must be able to pass underneath this to complete the circuit. The bridge has no railings, and will be painted in rainbow colors, making tape following difficult.

11) **Zipline** – There is a zipline connecting the top of one ramp and the surface as shown. It is 12" above the plateau and ends 12" above the surface. The Zipline is made of a 29.5mm diameter steel tube.

12) **Rocks and Rubble** – Small rocks (<1") will be glued to the surface in the areas shown. The height of this surface will range from 0 to 1" depending on rock placement.

13) **Dropping Bananas and Bombs** – each kart will have one banana of their own design and one magnetic bomb (supplied by us) to drop at the competition. The banana will be an 8 ½ x 11 or smaller piece of paper of any color or design and may have electrical tape on it as long as it does not render the paper sticky (i.e. tape must be fully taped down to paper). Karts may drop this anywhere and anytime.

Karts may also drop a magnetic bomb which will be similar to the one on the course. One bomb will be available for each competing robot but will only be supplied in the moments before the beginning of the heat. Tipping or picking up this bomb (whether by the kart that dropped it or its opposition) will have the same effect as written below.

Bombs only become "Armed" when stationary and located on the surface with the red face pointing up. Throwing a bomb at another robot will not cause them to explode, unless the bomb lands on the surface in the "armed" position, becomes stationary, and it is then picked up or tipped over by the other robot.

14) **Scoring** - Scoring is as follows:

+ 1 point for every mystery block or coin picked up by the robot and present in the robot at the end of their run.

+3 points for every lap of the surface completed. For a lap to count, the kart must:

- Climb the uphill ramp AND
- Take the zipline, cross Rainbow Road, or jump off the top of the ramp or Rainbow Road to reach the left side of the surface AND
- Cross under Rainbow Road and cross the Finish Line

The lap is scored as complete when the Finish Line is crossed EXCEPT for the first crossing at the start.

15) **Exploding the Magnetic Bomb** – Tipping over a bomb, or picking it up off the surface will make it explode (not for real. If this occurs, the robot must be placed back to starting position START(1), and the lap that it is on will not count (Previously completed laps do count). Points from coins and bonuses accumulated during the heat will be reduced by 3 (but the coins and bonuses will be left in the robot). This will also affect coins and bonuses picked up after the bomb has been triggered if none were in the robot at that time.

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If a robot slides a bomb off the surface, bridge or ramp without tipping it over or picking it up, it will either: 1. Explode harmlessly on the ground or surface or 2. Land in the "armed" position on the surface and be still active.

Event staff will attempt to remove any exploded or "unarmed" bombs on the surface. If your robot has been blown up by a bomb, please remove the bomb from the table when your robot is restarted.

16) **Restarting Robots** - Robots may be rescued by the team and restarted as many times as desired during the heat, for any of the following reasons.

1. Falling off the Playing Surface.
2. Getting lost or stuck on the Playing Surface.
3. Getting stuck in a collision
4. Robot malfunction that could lead to damage

Robots may NOT be arbitrarily restarted or their runs terminated as part of a strategy.

Robots will be restarted at their original start position, though care must be taken to not block any running robots. Actively blocking a running robot in a restart will lead to disqualification from the heat. For clarity if a running robot collides with a restarted robot prior to the restarted robot making it past the first tape turn, the restarted robot will be removed from the surface and disqualified.

Teams on the START 2 position may choose to restart from START 1 to avoid this, as long as it is not in use by the other team.

Time during the Heat does not stop for a restart. Any coins and mystery blocks will remain on the robot (and will count toward the final score) but the lap counter will be restarted at zero.

The restart procedure will allow time for both teams to gather their robots, and then "Restart" will be announced and both teams may then start their robots at will.

17) **Robot Collisions** – It is up to each kart to avoid and manage collisions. We encourage ALL karts to have collision sensing and a smooth bumper surrounding the kart. If robots are in a deadlock following a collision, both robots must be restarted.

18) **Aggression – Robots may not have strategies deliberately designed to collide with the competing karts.** All karts must be designed to do their best to avoid collisions. "Rear-ending" karts is expected as potentially unavoidable but action must then be taken to resolve the collision. Strategies designed with the sole purpose of disabling the other kart or otherwise deemed unsportsmanlike will lead to disqualification.

Some examples of disallowed strategies:

- Emitting IR light
- Intentionally stopping or slowing on course to block another robot
- Intentionally driving in reverse to collide with another robot
- Intentionally colliding with another robot

This is not an exhaustive list - please do everything possible to score points but also everything possible to allow a fair race and to enable your classmates to show off their robot to the audience.

19) **Time Limit** – Heats are a maximum of 2 minutes. Additional time may be allowed in the finals at the judges' discretion to resolve close heats. Judges may choose to end a heat early if there is a clear winner during the heat or robots are not performing.

General Rules

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A) **Autonomy:** Robots must be completely autonomous – no form of remote control is allowed.

B) **Size:** The Robot must be small enough to pass through the arch and under rainbow road. The robot may not grow in size beyond a 16" cube. The Robot may not leave any part of itself on the surface or the zipline. Robots dividing into multiple robots are not allowed. Debris left by robots (except for bombs and bananas) must be immediately removed by the team.

C) **Power:** Robots may only be powered by batteries and stored elastic energy.

D) **Components:** All components outside of those provided by the course instructors or listed at the end of this document must be approved by course instructors. Teams that choose to purchase their own items will not be reimbursed and are limited to a maximum of $200 per team.

E) **Damage to the Surface:** Robots may not permanently modify or damage the competition surface or any individual competition piece including the bonuses and coins. No glues, nails, screws or similar "rough measures" are allowed to pick up objects.

F) **Start Mechanism:** Robots will initiate motion only when the START button on their controller is pressed by a team member at the start of the run (signalled by a Judge).

G) **Competition Surface Variations:** The surface is made of wood and will have some warp and slight bumps all over. Robots must be designed to accommodate for imperfections and irregularities, as well as variation between practice and final surfaces. The surface will be painted at the beginning of the course but will not be repainted before competition day to avoid sudden changes in reflectivity. The surface will be fragile this year. NO STANDING OR SITTING ON THE SURFACE! Don't use tools or work on your robot while on the surface. Design your robot in such a way that it won't damage any parts of the surface while navigating it.

H) **Rules Finalization:** Rules and dimensions may change between now and the competition. Finalized rules will be issued as early as possible. Qualifying heats ("Time Trials", with no opponent) will take place 2 weeks prior to the competition on a final version of the surface.

I) **Sportsmanship Rules:** Other strategies or designs that obviate the design elements of the course or that do not follow the intent of the competition will be disallowed whether or not they explicitly break these rules. All strategies which have been designed specifically to come as "close to" violating any of the posted rules as possible must be presented to the course instructors during the design stage of robot building. All decisions are at the discretion of the course instructors.

ALLOWED AND RESTRICTED MATERIALS

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Approved

1. Solenoids (when used with mechanical constraints).
2. Elastic bands.
3. Wheels and hubs from existing RC or other small vehicles.

Must be Reviewed By Course Instructors

1. Springs are generally allowed, but must be reviewed individually for safety.
2. Compressed air may be allowed, but all valves and fittings must be reviewed for safety and a maximum pressure limit will be imposed.

Banned:

1. Discrete H-bridge driver chips.
2. Any components other than wheels and hubs from existing RC or other small vehicle chassis, including (but not limited to) suspensions, differentials, steering mechanisms.