PrintACar

2019

Quantum VICTORIA

A Centre of Excellence & Innovation in Science & Mathematics

PrintACar

Contents

Overview

The PrintACar challenge sees teams of 2-4 students racing 3D printed cars that they have designed themselves. A school may enter a maximum of 2 teams into the competition from primary year levels (P-6) and 2 teams from secondary year levels (7 – 12).

Qualifying Day/s

Qualifying will take place at Quantum Victoria. Each team will need to bring at least 1 car, but may bring up to 2 different cars to race on the day (we highly recommend bringing two different car designs so that they can both be tested on the track).

Teams will also need to produce a portfolio that details their team, the design and printing process as well some of the relevant physics.

Racing (20 Marks)

Each car will race down our track 3 times with one person from the team being nominated to launch the car. Each car will receive a final time based on their fastest race time (including their reaction time for launching the car) plus any time penalties for breaking car rules.

As for marking, the fastest final time will receive full marks with each team after that receiving less marks. Any car that races but does complete the race will still receive marks however it will be 1 mark less than the slowest race time. Any car that does not race at all will not receive any marks.

Portfolio (20 Marks)

Teams will be awarded marks for their portfolio based on the inclusion of all the required information, the level of detail of the information and the presentation of the information.

Winners

Once every team has been marked out of 40, the team with the fastest car (including reaction time and penalties) and the team with the best portfolio will automatically proceed to the finals. Then the teams with the highest overall scores will be awarded a spot in the finals until our team quota is filled.

Finals Day

On finals day, all teams who made it through will need to bring 1 car, a portfolio AND a poster in order to compete.

Teams will receive marks for their race times, their portfolio and poster, the originality / creativity of the car and the print quality of the car.

Racing (10 Marks)

Cars on finals day will compete in a knock out final. If necessary a time trial, similar to the qualifying day, will be conducted at the start of the day to reduce numbers to a knock out format. Each car will receive a mark based on their position in the knock out final and average race time with the winning car receiving full marks.

Portfolio (10 Marks)

Teams will be awarded marks for their portfolio based on the inclusion of all the required information, the level of detail of the information, and the presentation of that information.

Poster (5 Marks)

Teams will be awarded marks for their poster based on the inclusion of the required information, the level of detail, and the visual presentation of the display.

Originality / Creativity (5 Marks)

Teams will be awarded marks based on the originality / creativity of their car design. We want to encourage teams to try out unique and exciting designs each year. This will be judged both on how the car looks, and how they reached their final design (as described in their portfolio).

Print Quality (5 Marks)

Teams will be awarded marks based on how well their car is printed. One of the driving factors of this competition is to make sure schools know how to use their 3D printers well, therefore we will be looking for evidence of layer delamination, print warping, etc to see if the students / teachers know how to overcome these issues.

Car Finishing (5 Marks)

Teams will be awarded marks for the processes they apply to their cards after it is finished printing, this includes cleanly removing support material, sanding away any imperfections and the quality of painting the car.

Winners

Once every team has been marked out of 40, the primary team and the secondary team with the highest scores will be the PrintACar Champions and receive the grand prizes.

In addition, awards will be given out for the following categories: Fastest Time Trial Race, Faster Time Trial Reaction, Best Portfolio, Best Poster, Best Car Finishing, and Most Original Car Design. Like the overall winner, there will be a separate primary and secondary award for each category.

Poster / Portfolio Specifications

Qualifying Portfolio

On qualifying day, teams are required to produce a physical portfolio that is **4-8 pages long, A3 size** with the following information:

- Team Profile (1-2 pages)
  - Name of team.
  - Name of School
  - Team Logo.
  - Name of team members.
  - Roles of team members.
  - Photos of team members.
- The Design Process and Aerodynamics (2-4 pages)
  - What 3D modelling software did you use?
  - Where did you draw inspiration for your design from?
  - Discuss design features of your car that you think will make it faster in terms of the relevant Physics.
  - Discuss your wheel design and how you think it will make your car faster.
  - What were the steps involved to get to your final design?
  - What modifications were made as you progressed and why were they made?
  - Images of your car design throughout the 3D modelling process.
  - Images of car from at least 3 angles showing exact measurements in millimeters of different features.
- The Printing Process (1-2 pages)
  - What model printer did you use?
  - What type of material did you use? Why did you choose this?
  - What printing software did you use?
  - What challenges were there in printing the car(s)?
  - Pictures of any prototype cars.
  - Pictures of final car(s) (before any finishing).
- Pages exceeding the page limits for each of the above sections WILL NOT be marked.
- Portfolios will be marked for both inclusion of all the required elements, the level of detail in responses and the visual presentation of the portfolio.

Finals Poster & Portfolio Requirements

On finals day, teams are required to produce a physical portfolio that is **6-12 pages long, A3 size** as well as a poster of **A2 size**.

The portfolio may build off the Qualifying Day portfolio and must include all the information required on the Qualifying Day (see previous page) as well as following information:

- Changes from Qualifying Day (2-4 pages)
  - Did you change your car from Qualifying Day?
    - If so why did you change it and what changes were made?
    - If not, why did you keep your car the same?
  - Discuss any finishing you have done to your car and how that will make your car faster
  - Were you able to improve your print quality since qualifying day? If so how?
  - Pictures of any prototype cars.
  - Pictures of final car straight from the printer (before any finishing).
- As before, pages exceeding the page limits for each section (including the Changes from Qualifying Day) WILL NOT be marked
- Portfolios will be marked for both inclusion of all the required elements, the level of detail in responses and the visual presentation of the portfolio

The A2 poster must include the following information:

- Name of team.
- School name.
- Team Logo.
- Name of team members.
- Roles of team members.
- Pictures of team members.
- Pictures of your car.
- Summary of unique / important features of your car.
- Posters will be marked for both inclusion of all the required elements, level of detail in responses and creative flair in the presentation.

Car Rules and Regulations

1. All components of the car must manufactured using 3D printing technology with ABS or PLA filaments. **0.2 s time penalty**

   EXCEPTIONS

   a. Axels (We recommend the use of brass rod)

   b. Adhesives (Used for example to stick wheels to axels or parts of the car together)

   c. Paints, Sealants and Stickers **(FINALS DAY ONLY)** (You may finish your car with paint or sealant for finals ONLY)

2. The car must have a minimum of 4 wheels that freely rotate. **0.05s time penalty**

3. Assembly and finishing of car must be done before Race-day. This includes gluing pieces of the car together, attaching of wheels or painting (paint must be dry by race day). **0.5 s time penalty**

4. The completed car must have a mass of 45g or greater (fully assembled, without the CO_2 canister) **0.3 s time penalty**

5. Length of car MUST be between 100 mm – 200 mm **0.1 s time penalty**

6. Height of car MUST be between 45 mm – 75 mm **0.1 s time penalty**

7. The widest part of the car MUST be between 40 mm – 75 mm **0.1 s time penalty**

8. Cars must have a cylindrical hole for the CO_2 canister to be inserted in.

   a. The hole must run parallel to the ground (once the wheels are attached) and in-line with the center of the car. **0.1 s time penalty**

   b. The hole must have:

      i. A diameter between 19 and 20 mm **0.1 s time penalty**

      ii. A depth between 50 – 52 mm **0.1 s time penalty**

      iii. A minimum wall thickness of 3 mm. **0.1 s time penalty**

   c. So the car can be launched correctly entrance to the CO_2 canister hole must:

      i. Be the most rear point of the car (no part of the car including wheels should stick out behind the canister entrance point) **0.05 s time penalty**

      ii. Have its centre between 25mm and 50mm from the ground (fully assembled). **0.05 s time penalty**

9. The car will race along a guide wire, therefore eyelets will need to be included in your print such that your car can be threaded onto the wire.

   a. Your car must have exactly two distinct eyelets. **0.1 s time penalty**

   b. The eyelets must:

      i. Be at least 50 mm apart. **0.05 s time penalty**

      ii. Be in-line with the center of the car. **0.05 s time penalty**

      iii. Have a hole between 4 - 5 mm in diameter. **0.05 s time penalty**

      iv. The center of the hole cannot be more than 10mm off the ground when fully assembled (including wheels) **0.05 s time penalty**

      v. The depth of the hole (along the direction of the hole) must be between 5 - 7 mm. **0.05 s time penalty**

      vi. Have a minimum wall thickness around the hole of 3 mm. **0.05 s time penalty**

      vii. There must be a clear path between eyelet holes as well as to the front and back of the car. **0.1s time penalty**
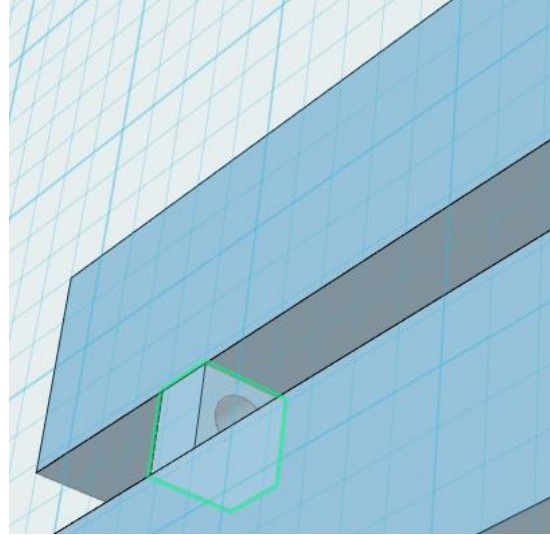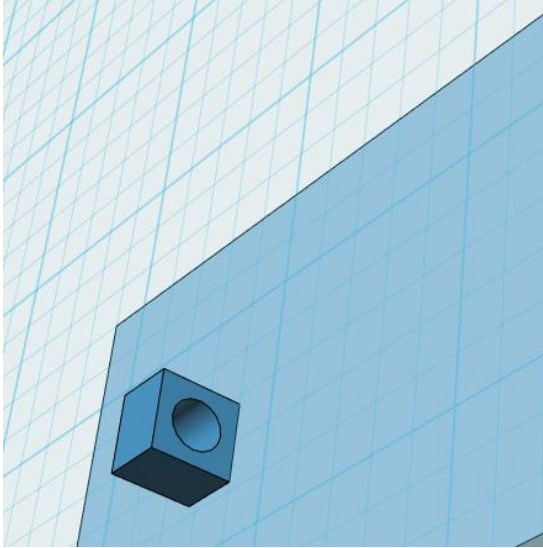
The diagram above shows eyelets protruding from the bottom of the car (left) and embedded into the car (right) with a trench to clearly distinguish that there are two present.
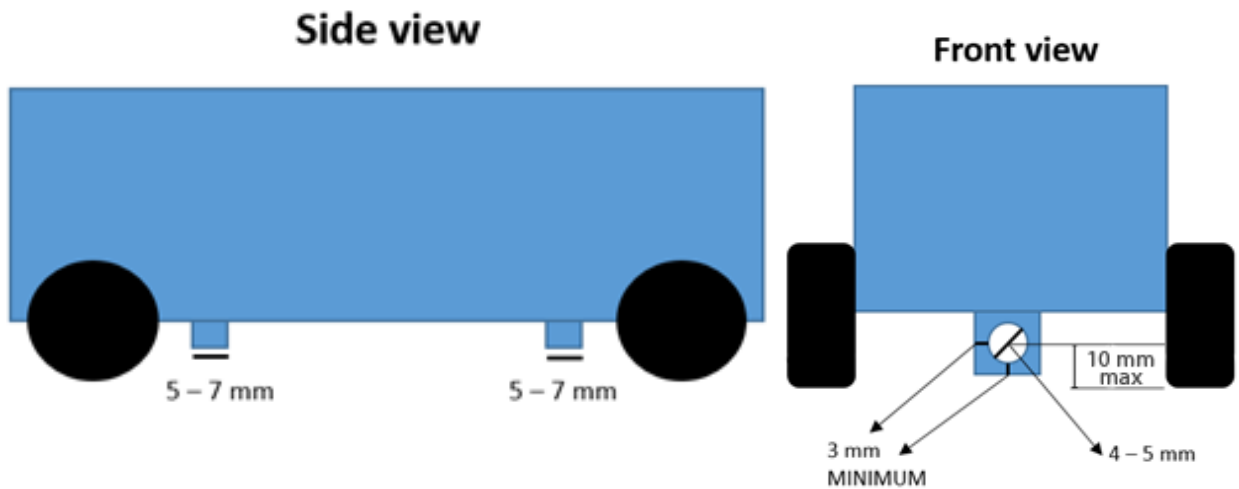
The diagram above shows the dimension ranges for the eyelets as stated in rule 9.

Note: Quantum Victoria has the right to refuse racing of any car they deem unsafe to race or would cause damage to the track.

Other Information

Q. How many axles are we allowed per car?

A. As many as you like.

Q. Are we allowed to use a lubricant on these axles?

A. No.

Q. How much teacher input is allowed, if any?

A. We want teachers to guide their teams. Teachers are free go through and clarify the requirements laid out in this field guide and to teach skills needed to be successful in the competition but we want the students to be designing and creating the cars, portfolio and poster themselves. More assistance may be required in the actual 3D printing process, but getting the students familiar with the printer is a must.

Q. Does it have to be printed on a specific 3D printer? If so, what type?

A. We're happy for you to use any 3D printer you have available at your school. Note that you must use ABS or PLA filament.

Q. Do the wheels need to be printed?

A. Yes, all parts of the car should be manufactured with a 3D printer except for the exceptions listed in rule 1.

Q. Is it within the rules for us to print it off somewhere else or do we have to use our school printer?

A. The driving concept behind the competition is to get schools using their printer with their students to help spark ideas for future projects you could run at school. That being said, if your printer is unable to print anything of reasonable quality, you can use another printer (we'd rather you use similar personal style printer rather than an industrial printer). Though you should endeavor to try and get your printer re-calibrated and printing again before the competition.

Q. What are the tolerances for printed shapes?

A. Tolerances will vary depending on your printer and materials used, some trial and error might be needed, to start with allow for up to 1mm variance in your printed objects.

Q. How does the car launch?

A. A CO_2 canister is inserted into the hole at the back of the car. A launch pod is placed at the back of the car, the CO_2 canister is placed inside the launch pod and then a firing pin is triggered to puncture the CO_2 canister. Following rule 9 ensures the ability to launch on race days.

Q. Does the portfolio / poster need to be printed or can it be hand written?

A. Portfolios and posters can be either printed or handwritten, however the neatness and look of both will be taken into account when they are marked.

Register

Teams must register by Friday 3rd of May unless competition numbers have reached capacity. Places are limited.

Please include the following information to register:

- Team name
- Team members
- Year level of each student
- School name
- Teacher's name
- Teacher's contact details

Email this information admin@quantumvictoria.vic.edu.au to register.

Contact Details

If you have any further questions or would like clarification on any of the points above, please contact admin@quantumvictoria.vic.edu.au