

# PrintACar

# 2020



A Centre of Excellence & Innovation in Science & Mathematics

# PrintACar

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## Overview

The PrintACar challenge engages teams of 2-4 students in the racing of 3D printed cars designed by the students. A school may enter a maximum of 2 teams into the competition from primary year levels (3-6) and 2 teams from secondary year levels (7 – 12), with the possibility of an additional team upon written request.

## Qualifying Day/s

Qualifying will take place at Quantum Victoria. Each team must bring 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 must produce a portfolio that details their team, the design and printing process as well some of the relevant physics. (Please refer to portfolio specifications, see page 5).

Feedback on how a team performed will be provided at the end of the Qualifying Day.

## Racing (20 Marks)

Each car will race 3 times and 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.

The fastest final time will receive full racing marks, with each team racing after that point, receiving less marks. Any car that races and completes the race, will still receive marks, however, it will be 1 mark less than the slowest race time. Any car that does not race 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

The team with the fastest car (including reaction time and penalties) and the team with the best portfolio will automatically proceed to the finals. Each team will be marked out of 40. The teams with the highest overall scores will be receive entry into the finals.

## Finals Day

Each qualifying team must bring **1** car, a portfolio **AND** a poster to be eligible to compete on finals day.

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

## Racing (15 Marks)

Cars will compete in time trials to determine which cars progress to the semi-finals and then to the final. Each car will receive a mark based on their position in the time trials (this is determined by the average race time), with the winning car receiving full race marks.

## Portfolio (15 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 encourage teams to submit unique car designs, in particular, teams competing again. This criterion will be judged both on the appearance of the car, and through the process of how the final design was reached, as described in the portfolio.

## Winners

There will be an **overall Primary** and an **overall Secondary** winner. The team with the highest combined scores for each category, will be the PrintACar Champions. Each winning team will receive a 3D printer for their school and a trophy.

In addition to the overall prizes, the following prizes will be awarded to the winning Primary and Secondary teams:

- Fastest Time Trial Race
- Faster Time Trial Reaction
- Best Portfolio
- Best Poster
- Most Original Car Design

**Please note: As a condition of entry into the PrintACar competition, the prize must be located within a school. Quantum Victoria reserves the right to reclaim the prize should any requirement be compromised. Quantum Victoria's decision is final and no correspondence will be entered into.**

# Qualifying Portfolio Specifications

## Portfolio Requirements

### Qualifying Day

Teams are required to produce a physical portfolio that is **4-8 pages long and A3 in size** with the following information:

- **Team Profile** (1-2 pages)
  - Name of School
  - Name of team
  - Team Logo
  - Name of team members
  - Roles of team members
  - Photos of team members
- **The Design Process and Physics** (including aerodynamics) (2-4 pages)
  - What 3D modelling software did you use?
  - Where did you draw inspiration for your design from? Explain how these were reflected in your design.
  - 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 this will make your car faster.
  - Detail the steps involved to get to your final design.
  - What modifications were made as you progressed and why were they made?
  - Include a minimum of 3 images of your car design throughout the 3D modelling process. These images must illustrate (as a minimum) the beginning, middle and the end of the process.
  - Images of the car from at least 3 angles showing:
    - Exact measurements of the car. These must be in **millimeters**.
    - Different feature measurements of at **least 3 different features**.
    - Features that have changed (these should explicitly be pointed out on the image).
- **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 did you have when you printed the car(s)?  
For example:
    - Print quality challenges.
    - Software challenges.
    - Team dynamics.
  - Pictures of any prototype cars.

- Pictures of final car(s) straight from the printer **AND** 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 Portfolio / Poster Requirements

### Finals Day

Teams are required to produce a physical portfolio that is 6-12 pages long, in A3 size **AND** a poster of A2 size.

### Portfolio Requirements

The portfolio may add additional information to the Qualifying Day portfolio and must include all the information required on the Qualifying Day (see page 4) 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 didn't you change your car?
  - Discuss any finishing you have done to your car and how this will make your car faster
  - Were you able to improve your print quality since Qualifying Day? If so, how?
  - Pictures of any prototype cars and the 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.

### Poster Requirements

The **purpose** of your poster is to promote your team and your car.

The A2 poster must include the following information:

- School name
- Year Level(s)
- Name of team
- 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
- Inclusion of all the required elements, level of detail in responses and creative flair in the presentation

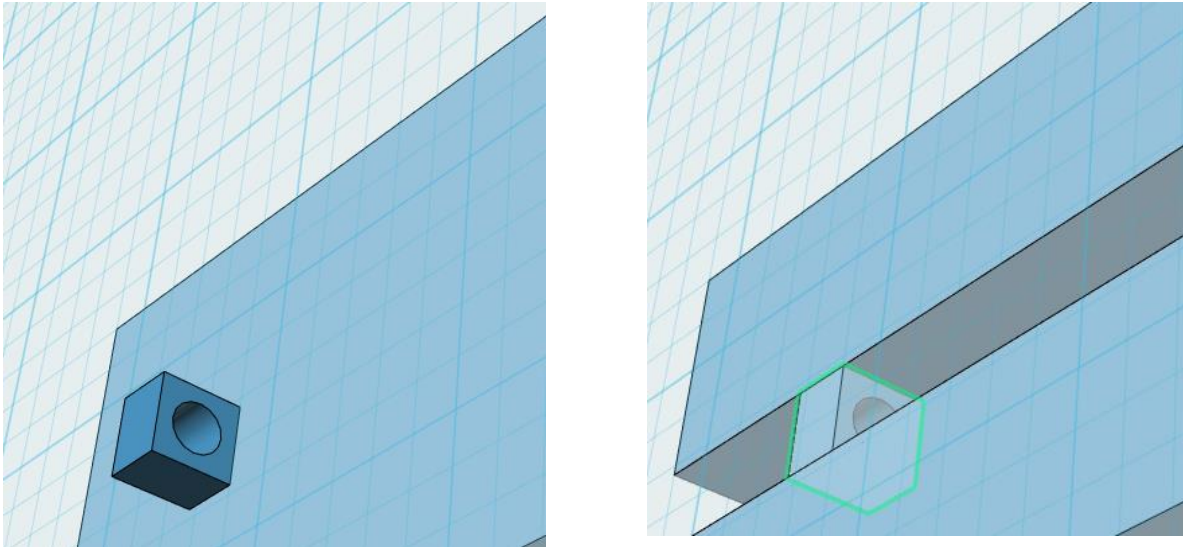
## Car Rules and Regulations

**Note: penalties that may result in your car being disqualified are shown in red, all other time penalties are shown in blue.**

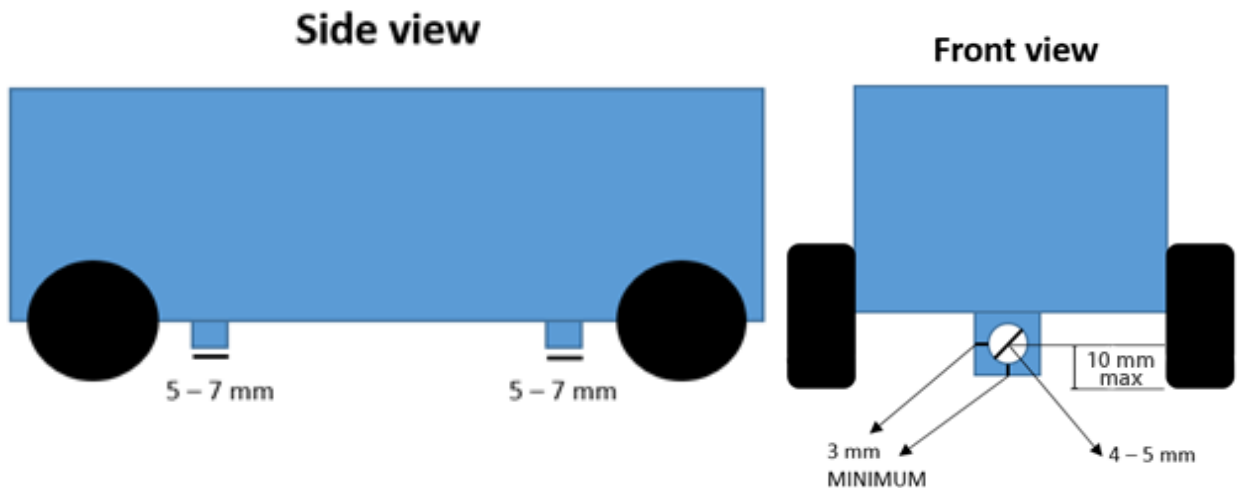
1. All components of the car must be manufactured using 3D Fused Deposition Modeling (FDM) printing technology with ABS or PLA filaments. **0.2s time penalty**  
**EXCEPTIONS**
  - a. Axels (We recommend the use of brass rod)
  - b. Adhesives (Used to stick wheels to axels or parts of the car together)
  - c. Paints, Sealants and Stickers (**FINALS DAY ONLY**) (You may finish your car with paint or sealant for finals ONLY and these **must be dry**)
2. The car must have exactly 4 wheels and 2 axles that freely rotate. **0.05s time penalty**
3. Assembly and finishing of the 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). **0.5s time penalty**
4. The completed car must have a mass of 50g or greater (fully assembled, without the CO<sub>2</sub> canister) **0.3s time penalty**
5. Length of car **MUST** be between 100 mm – 200 mm **0.1s time penalty**
6. Height of car **MUST** be between 45 mm – 75 mm **0.1s time penalty**
7. The widest part of the car **MUST** be between 40 mm – 75 mm **0.1s time penalty**
8. Cars **MUST** have a cylindrical hole for the CO<sub>2</sub> 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. To facilitate launching, the entrance to the CO<sub>2</sub> 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 **MUST** be included in your print so 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. Have the center of the hole **no more** than 10mm off the ground when fully assembled (including wheels) **0.05 s time penalty**



- v. Have the depth of the hole (along the direction of the hole) 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. Have a clear path between the eyelet holes and the front and back of the car.
- Note: axles must not impede the path of the guide string. 0.3s 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 the racing of any car deemed to be unsafe to race or cause damage to the track.**

## Other Information

### Frequently Asked Questions

**Q. How many axles are we allowed per car?**

A. Two (dual axle car).

**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 can discuss and clarify the requirements as listed in *'The Field Guide'* and also teach skills needed to complete the tasks required for the students to compete, **HOWEVER**, students **MUST** design and creating their cars, portfolio and poster themselves. Teachers can familiarise the students with the use of the 3D printer, but the students **MUST** print their designs themselves.

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

A. Students can use any 3D printer available at their school. Note that **ABS** or **PLA filament** **MUST** be used.

**Q. Do the wheels need to be printed?**

A. **YES**, all parts of the car **MUST** be manufactured with a 3D printer except for the exceptions listed in rule 1 of the Car Rules and Regulations (see page 7).

**Q. Do we have to use our school printer to print our car?**

A. The PrintACar Challenge has been designed to create an opportunity for schools to engage students in the disciplines of **Science, Technology, Engineering and Mathematics (STEM)** and for schools to use their printers with their students to help spark ideas for future projects. If you **DO NOT** have access to a printer or your printer is **unable** to print anything of reasonable quality, you **MUST** notify us before proceeding.

**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. You can initially allow for up to 1mm variance in your printed objects. However, judging **WILL NOT** take tolerances into account.

**Q. How does the car launch?**

A. A CO<sub>2</sub> 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<sub>2</sub> canister is placed inside the launch pod and then a firing pin is triggered to puncture the CO<sub>2</sub> canister.

**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 appearance of both will be taken into consideration when marked.

## Register

**Teams must register by Friday 8<sup>th</sup> of May.** A waiting list will be created if the competition numbers reach capacity. Places are limited and we encourage you to register your teams as soon as they have been created.

Please include the following information to register:

- School name
- Team name
- Team members
- Year level of each student
- Teacher's name
- Teacher's contact details (email and mobile number)

Email this information [admin@quantumvictoria.vic.edu.au](mailto: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](mailto:admin@quantumvictoria.vic.edu.au)