



A Centre of Excellence & Innovation in Science & Mathematics

**2024**

**PrintACar  
Challenge**

# PrintACar

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### Overview

The PrintACar challenge is a statewide event that engages teams of 2-4 primary and secondary students in the design and racing of 3D printed cars. The objective of the challenge is to provide an authentic application of the design process and engage students in the processes of 3D Printing technologies. A school may enter a maximum of two teams into the competition from primary year levels (3-6) and two teams from secondary year levels (7-12), with the possibility of an additional team upon written request.

Students are eligible to compete in no more than two years of PrintACar challenges in primary and two years of challenges in secondary levels.

The design criteria for this year's PrintACar challenge have changed from last year, so those schools/teams/students who may have competed previously should check the design criteria starting on page 151 carefully.

In addition, this year we have also included marks for car finish and car marking self-evaluation for both qualifying and finals days. These are detailed below.

### Qualifying Days

For 2024, there will be a hybrid model for the Qualifying Days. Quantum Victoria will be running four sessions over two days for qualifying trials. Teams may elect to be **onsite** at Quantum Victoria and participate in the racing and activities or watch their race **virtually** as all sessions will be live streamed to the competing schools.

Morning sessions will run between 9:30 am – 11:30 am and afternoon sessions will run between 1:00 pm – 3:00 pm.

Teams will be asked to nominate their session preference and Quantum Victoria will then allocate you to a session. If you are unable to attend your session, please contact the admin team and if we are unable to accommodate then you will have the option of watching it virtually.

Each team must send one car but may send up to two different cars to race on the day (we highly recommend sending two different car designs so that they can both be tested on the track). To be accepted into the qualifying trials **each car must** have a completed **car marking self-evaluation** submitted. See appendix 1 on page 24 for the rubric and instructions on how to do this.

Each school must send their cars to Quantum Victoria at their expense, so cars are received by Thursday 8<sup>th</sup> August at the absolute latest. The school must provide a copy of the courier tracking number to Quantum Victoria within one business day of dispatching the car package.

If Quantum Victoria receives your car by the 26<sup>th</sup> of July (four weeks before the Qualifying Day), we will check the car against the disqualification criteria and check for the car being raceable and allow you to resubmit the car if necessary. Cars received after this date will not be able to be resubmitted.

Teams must produce a portfolio that provides information on the team and its members, the design and the printing process of their car(s), and the relevant physics associated with their design(s). (Please refer to portfolio specifications on page 12).

An electronic copy of the portfolio must be submitted prior to the Qualifying Day. (See page 22 for dates) For each team who enters the competition, a unique link to a Google Drive folder will be provided for submission of the portfolio.

Feedback on how a team performed will be provided following the completion of the Qualifying Days.

**Original car designs must be used** during the Qualifying Day to be considered for qualification for the Finals Day (i.e. **not the same design used in previous years** if a team has competed before).

### Qualifying Day Marking

PrintACar Points Allocation 2024 - Qualifying	
Portfolio	50 points
Team Profile and reflection	10 points
Design Process and Physics	25 points
Printing Process	15 points
Car Quality	10 points
Quality of Printing	5 points
Finishing	5 points
Racing Results	35 points
Car Marking Self- Evaluation	5 points
<b>TOTAL</b>	<b>100 points</b>

#### Portfolio (50% of total Qualifying 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**. Teams are encouraged to invest in presenting a portfolio that addresses **all sections**. A rubric for the portfolio will be sent to registered teams.

#### Racing (35% of total Qualifying marks)

Each car will be marked by Quantum Victoria staff with reference to the rules in this field guide (see page 15). **Cars that do not meet the specifications in each rule will either be allocated a time penalty or may be disqualified from racing.**

Each car will race three times and will receive a **final time** which will be based on their fastest race time with any time penalties that may have been incurred for breaching car rules added.

The fastest final time will receive full racing marks, with each team racing after that point receiving fewer marks. Any team that races but does not complete a race will still receive marks; however, it will be 1 mark less than the slowest race time. Any car that does not race will receive 1 mark less than all other cars that raced.

#### 3D Print Quality (10% of total Qualifying marks)

Each car will be judged on the quality of 3D printing and assembly.

Marks will be awarded for the final 3D finish of the car when received by Quantum Victoria.

For Qualifying Day, no sanding, painting or other decoration should be applied to the car.

Print Quality may include things such as:

- The degree of removal of support material (Finishing)
- The assembly of the car and wheels, including parts glued together (Finishing)
  - Please note that this mark may be changed during racing if glued parts of your car require re-gluing.
- Accuracy of fit of 3D printed parts to other parts (3D printed parts or axles) (Finishing)
- 3D printed layer smoothness (Quality of Printing)
- Lack of any 3D printing artifacts (Quality of Printing)
- Selection of filament type (Quality of Printing)

See Car Marking on page 18 on 3D print quality and how you might be able to resolve printing issues. You may also want to do a Google search for “3D printing artifacts” to find ways to improve your 3D prints.

### Car Marking Self-Evaluation (5% of total Qualifying marks)

Each car must be submitted with a completed car marking self-evaluation sheet. Your team will be sent a fillable PDF version, and this will also be in the Rubric document which will be sent out to registered teams.

You must fill in details of your school and team, and circle if you are a Primary or Secondary team on the marking sheet.

You must measure each of the specified dimensions of your car and record this in the measurement column of the marking sheet. You must also indicate if your car meets the relevant criteria in the “Criteria Met?” column using letter “Y” for yes and “N” for no.

Teams submitting fully completed sheets for each car will be awarded the full 5%. Teams who do not fully complete the sheet will be given proportionately fewer marks.

If a team submits two cars, but only submits the self-evaluation for one car, only that car with the self-evaluation will race.

A car without a self-evaluation will be deemed **ineligible to race**.

**PLEASE NOTE:** The car marking self-evaluation sheet **DOES NOT** constitute the final mark of your car. When cars are received by Quantum Victoria, our team will mark your car separately to determine its suitability to race and any time penalties it must race with.

### Progression to Finals

At the conclusion of both qualifying days, results will be tallied and divided into Primary and Secondary categories. The team with the **fastest car** (including penalties) and the team with the **best portfolio** from each category will automatically proceed to the finals. For the remaining teams, the top teams with the highest overall scores across all Qualifying Days in their category, up to a total of 10 teams, will receive entry into the finals. (A total of 10 Primary and 10 Secondary teams will qualify for the finals)

### Finals Day

Finals Day will be onsite at Quantum Victoria. Each qualifying team is expected to be on site for the Finals Day.

Each qualifying team is expected to bring **one car, a physical copy of their portfolio AND poster/visual display, and a copy of their completed car marking self-evaluation** (see page 24) on Finals Day. You will be required to upload an electronic copy of your portfolio and an electronic copy (or photo) of your poster prior to finals day (see page 22 for dates).

It is **expected** that teams will **re-print** their car, even if they have elected not to make changes to the design. This is to make sure that you have the opportunity to improve the 3D print result, and to make sure that the car has no damage or wear from Qualifying Day. Historically all cars have at a minimum some wear from Qualifying Day on the wheels/axles and where the guide wires pass through the eyelets.

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

Note: Feedback will be given in the form of the marking criteria in the week after Finals Day. All marking is final.



### Finals Day Marking

PrintACar Points Allocation 2024 - Finals	
Portfolio	45 points
Team Profile and reflection	5 points
Design Process and Physics	12.5 points
Printing Process	7.5 points
Improvements from Qualifying	20 points
Car Quality	10 points
Quality of Printing	3 points
Finishing	3 points
Painting & Branding	4 points
Visual Display	15 points
Racing Results	25 points
Self-Marked Racing Checklist	5 points
<b>TOTAL</b>	<b>100 points</b>

#### Portfolio (45% of total Finals 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.

Please note that the Finals Portfolio will be a continuation of the Qualifying Portfolio, with the addition of the information indicated in the Finals Portfolio Requirements (page 13)

Those teams who proceed to the finals from qualifying day will be sent a marking rubric for the portfolio reflecting the additional requirements shown in the section below - Finals Portfolio Requirements

#### Racing (25% of total Finals marks)

Cars will compete in time trials to determine the race marks awarded to each team. Teams will race 4 times and the fastest penalty corrected time will be used to determine their ranking (penalty corrections are added based on Quantum Victoria car marking).

NOTE: There will be semi-finals and grand-final racing rounds. These races will pit the top four cars based on corrected race times from the heats (race time with the penalty time added) against each other for the semi final, and then the top two teams from those races for the grand final. These races are for glory and to possibly secure the fastest race time or reaction time for the day. The race times in these rounds **will not be included in marks** determining the overall winner for the day.

#### Poster/Visual Display (15% of total Finals marks)

Teams will be awarded marks for their poster/visual display based on the inclusion of the required information, the level of detail, and the visual presentation of the display. See page 13 for details of these requirements.

### 3D Print Quality and Finish (10% of total Finals marks)

Each car will be judged on the quality of 3D printing, finishing and assembly.

Marks will be awarded for the final 3D finish of the car when received by Quantum Victoria. For Finals Day cars should be appropriately sanded, painted, and/or have decals and decorations applied.

- The degree of removal of support material (3D Printing)
- The assembly of the car and wheels, including parts glued together (Assembly)
  - Please note that this mark may be changed during racing if glued parts of your car require re-gluing.
- Accuracy of fit of 3D printed parts to other parts (3D printed parts or axles) (Assembly)
- Smoothness of finished car (Finishing)
- Lack of any 3D printing artifacts (3D Printing)
- Selection of filament type (Finishing)
- Painting and decoration (Finishing)
  - Please note that this mark may be changed during racing if paint or decorations cause issues with racing your car.

Please note that any paint and/or decoration **must be firmly fixed** to the car and not impede the racing of the car. All paints and glues **must** be dry.

### Car Marking Self Evaluation (5% of total Finals marks)

Each car must be submitted with a completed Car marking self-evaluation sheet. A copy of this sheet is included in Appendix 1 (page 24).

You must fill in details of your school and team, and circle if you are a Primary or Secondary team on the marking sheet.

You must measure each of the specified dimensions of your car and record this in the measurement column of the marking sheet. You must also indicate if your car meets the relevant criteria in the "Criteria Met?" column using letter "Y" for yes, and "N" for no.

Teams submitting fully completed sheets for each car will be awarded the full 5%. Teams who do not fully complete the sheet will be given proportionately fewer marks.

Teams who **do not submit** the marking self-evaluations sheet for their car will be deemed **ineligible to race**.

**PLEASE NOTE:** The car marking self-evaluation sheet **DOES NOT** constitute the final mark of your car. When cars are received by Quantum Victoria, our team will mark your car separately to determine its suitability to race and the time penalties it must race with.

### Winners

There will be an **overall Primary** and an **overall Secondary** winner. The winning teams will have the **highest total scores** and will receive a **prize and trophy** for their school.

In addition to the overall prizes, awards will be given to one eligible Primary and one eligible Secondary team in the following categories:

- Best Portfolio
- Best Poster/Visual Display
- Fastest Penalty Adjusted Race Time for the day
- Fastest Reaction Time for the day
- Most Original Design
- Flair and Effort for Portfolio or Poster/Visual Display.

#### Please note:

- A school **cannot** be awarded an overall winner prize two years in a row.
- Each team is only eligible to receive one award on Finals Day. The next eligible team will be allocated the award if the higher placed team has already received an award.
- **As a condition of entry into the PrintACar competition, any prizes/awards will only be awarded to schools, not individual students. 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

Teams are required to produce a **digital portfolio** that is **4-8 pages long** with the following information:

Team Profile	<b>Section 1 - Team Profile (1 to 2 pages)</b>	
		<ul style="list-style-type: none"> <li>Name of School</li> </ul>
		<ul style="list-style-type: none"> <li>Name of team (displayed in addition to the logo)</li> </ul>
		<ul style="list-style-type: none"> <li>Team Logo</li> </ul>
		<ul style="list-style-type: none"> <li>Names of team members</li> </ul>
		<ul style="list-style-type: none"> <li>Roles of team members</li> </ul>
Design Process and Physics	<b>Section 2 - The Design Process and Physics (including aerodynamics) (2 to 4 pages)</b>	
		<ul style="list-style-type: none"> <li>State the 3D modelling software used and why it was used.</li> </ul>
		<ul style="list-style-type: none"> <li>Describe the inspiration for your final design? Explain the features of your design that reflect your inspiration.</li> </ul>
		<ul style="list-style-type: none"> <li>Discuss design features of your car that you feel will make it faster.</li> </ul>
		<ul style="list-style-type: none"> <li>Discuss the relevant physics which supports the design features you listed.</li> </ul>
		<ul style="list-style-type: none"> <li>Discuss your wheel design and how this will make your car faster.</li> </ul>
		<ul style="list-style-type: none"> <li>Detail the steps involved to get to your final design.</li> </ul>
		<ul style="list-style-type: none"> <li>What modifications were made after initial drafts and why were they made?</li> </ul>
Design Process and Physics		<ul style="list-style-type: none"> <li>Include images of your car design throughout the <b>3D modelling process</b>. These images must illustrate (as a minimum) <b>the beginning, middle and the end of the process</b>. These should include hand drawn sketches and/or images from design/printing software. (<b>minimum 3 images</b>).</li> <li>Highlight features that may have changed from an earlier stage</li> </ul>
		<ul style="list-style-type: none"> <li>Include additional images of the <b>final car</b> labelled with the exact measurements in <b>millimeters</b> for the following features:                             <ul style="list-style-type: none"> <li>The car height, width, and depth from <u>at least 3 angles</u> (<b>minimum 3 images</b>)</li> <li>The cylinder hole (<b>1 image</b>)                                     <ul style="list-style-type: none"> <li>Diameter, depth, and Width of material around the hole</li> </ul> </li> <li>The eyelets (<b>1 image</b>)                                     <ul style="list-style-type: none"> <li>Distance between each eyelet, depth of each eyelet and width of material around the hole.</li> </ul> </li> <li>The wheels (<b>1 image</b>)                                     <ul style="list-style-type: none"> <li>Diameter of the wheels</li> </ul> </li> </ul> </li> </ul>
The Printing Process	<b>Section 3 - The Printing Process (1 to 2 pages)</b>	
		<ul style="list-style-type: none"> <li>What model printer did you use?</li> </ul>
		<ul style="list-style-type: none"> <li>What type of material did you use and why did you choose this material?</li> </ul>
		<ul style="list-style-type: none"> <li>What properties of this material made it suitable for printing your model?</li> </ul>
		<ul style="list-style-type: none"> <li>What printing/slicing (not 3D modelling) software did you use?</li> </ul>
		<ul style="list-style-type: none"> <li>What challenges did you encounter when you printed the car(s)?</li> <li>For example:                             <ul style="list-style-type: none"> <li>Print quality challenges</li> <li>Software challenges</li> </ul> </li> </ul>
		<ul style="list-style-type: none"> <li>Pictures of any printed prototype cars.</li> </ul>
	<ul style="list-style-type: none"> <li>Pictures of final car(s) <b>straight from the printer AND before any finishing including any supports that may be on the model</b>.</li> </ul>	

Reflection	<b>Section 4: Reflection (paragraph)</b>
	Describe your experience of preparing for the PrintACar Challenge. Include answers to the following questions. <ul style="list-style-type: none"><li>• What was the best bit?</li><li>• What was the worst bit?</li><li>• How well did you work as a team?</li></ul> What would you do differently next time?



### Finals Portfolio & Poster/Visual Display Specifications

For 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 OR a visual display**.

#### Finals Portfolio Requirements

The **portfolio must** include **all the information required on the Qualifying Day (see page 11)** as well as the **following information:**

- Clearly indicate changes from the Qualifying Day portfolio (2 to 4 pages)
  - What changes did you make to your car design from Qualifying Day?
    - How and why did you change it?
    - If you didn't change your design from qualifying day, why didn't you change it?
    - What new challenges did you encounter when you made the changes?
  - Discuss the finishing applied to your car and why this is beneficial.
  - After re-printing your car, what did you do to improve print quality after Qualifying Day? What improvements did you notice?
  - Pictures of any printed 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 **the inclusion of all the required elements, the level of detail in responses and the visual presentation of the portfolio.**

#### Finals Poster/Visual Display Requirements

The **purpose** of your **poster/visual display** is to promote your team and your car. Suitable mediums for this section could be a poster, video, diorama, interactive display, or similar.

If a poster is chosen, then it should be A2 Size. If a video is chosen, then it should be no more than 2 minutes and **must** be playable using VLC Media player\* and a copy should be brought with you on finals day. If other mediums are chosen, then they must be in a format that can be displayed on finals day.

The poster/visual display **must include** the following information:

- School name
- Year Level(s) of team members
- Name of team (separate from the logo)
- Team Logo
- Name of team members
- Roles of team members
- Pictures of team members
- Pictures of your car
- Brief summary of unique/important features of your car

Marking will be based on Inclusion of all the required elements, level of detail in responses and creative flair in the presentation.

\*VLC media player is a free, open source video player for all platforms. It is available at <https://www.videolan.org/>

## Car Rules and Regulations

**Note:** Penalties that may result in your car being deemed **not raceable** are shown in **red**, all other time penalties are shown in **blue**.

**Note:** Quantum Victoria at any time has the right to refuse the racing of any car deemed to be unsafe to race or cause damage to the track. This includes the situation where a car becomes unsafe during racing.

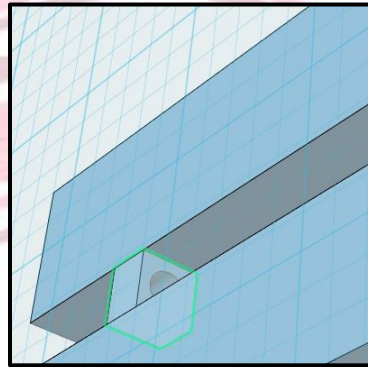
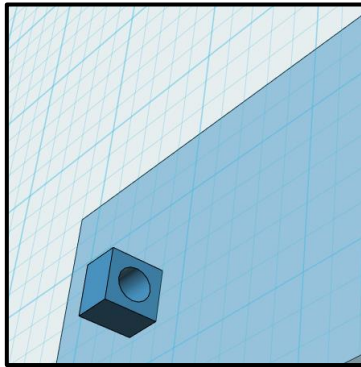
	Criteria Number	Criteria	Penalty
Assembly	1	All components of the car must <b>be manufactured using 3D Fused Deposition Modeling (FDM) printing technology with ABS or PLA filaments.</b> EXCEPTIONS: <ul style="list-style-type: none"> <li>a. Axles (we recommend the use of brass rod).</li> <li>b. Adhesives (used to stick wheels to axles or parts of the car together). Please refer to the adhesives section below for acceptable adhesives.</li> <li>c. Paints, sealants and stickers (<b>Paints and sealants must be dry and any stickers must not fall off</b>).</li> </ul>	<b>Car not raceable.</b>
	2	The car must have axles that are fixed to the car with wheels that rotate freely on the axle.	<b>2.0s time penalty.</b>
	3	Assembly and finishing of the car must be done <b>before</b> race day. This includes gluing pieces of the car together, attaching of wheels or painting (paint must be dry by race day).	<b>1.0s time penalty.</b> <b>Cars deemed unsafe will not be raceable.</b>
Dimensions	4	The <b>completed car</b> must have a <b>mass of 100g or greater</b> (fully assembled, without the CO <sub>2</sub> canister).	<b>2.0s time penalty</b>
	5	Length of the car <b>must</b> be between 100 mm – 150 mm.	<b>0.2s time penalty</b>
	6	Height of the car <b>must</b> be between 55 mm – 90 mm.	<b>0.2s time penalty</b>
	7	The widest part of the car <b>must</b> be between 55 mm – 90 mm.	<b>0.2s time penalty</b>
	8	The diameter for each wheel <b>must</b> be between 20 – 50 mm.	<b>0.5s time penalty</b>
Cylinder Hole	9	Cars <b>must</b> have a cylindrical hole/opening for the CO <sub>2</sub> canister to be inserted in.	
	9a	The hole <b>must</b> run parallel to the ground (once the wheels are attached) and in-line with the center of the car.	<b>0.2s time penalty</b>
	9b	The hole <b>must</b> have a diameter between 19 and 20 mm.	<b>0.2s time penalty</b> <b>Holes outside these limits may not be raceable</b>
	9c	The hole <b>must</b> have a depth between 50 – 52 mm.	<b>0.2s time penalty</b> <b>Holes &lt;45mm or &gt;55mm will not be raceable</b>
	9d	The hole <b>must</b> have a minimum measurement around any part of the cylinder/canister hole of no less than 3 mm around the entire cylinder (no holes/openings except in the rear).	<b>Car not raceable.</b>
	9e	The cylinder hole/opening <b>must</b> be circular (and not oval).	<b>0.2s time penalty</b>

## 2024 PrintACar

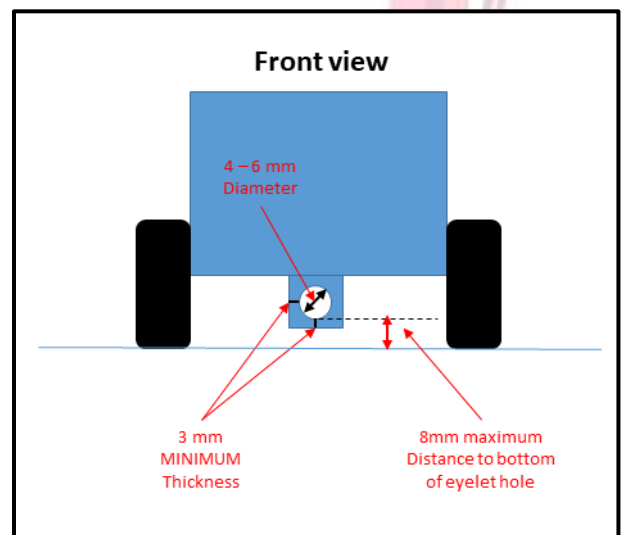
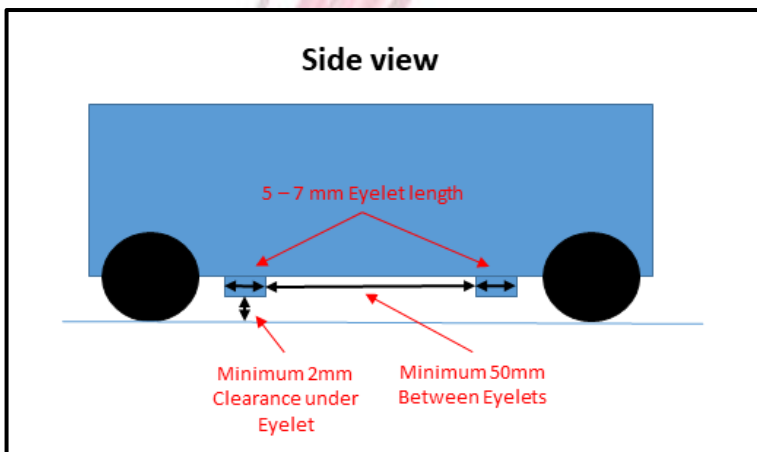
	<b>9f</b>	The inner end of the cylinder <b>must</b> be flat (not curved).	<b>0.2s time penalty</b>
	<b>10</b>	To facilitate launching, the entrance to the CO <sub>2</sub> canister hole/opening <b>must</b> :	
	<b>10a</b>	Be the rearmost point of the car (no part of the car, including wheels, should stick out behind the canister entrance point).	<b>0.2s time penalty</b> <b>Parts sticking out more than 20mm will cause the car to be not raceable.</b>
	<b>10b</b>	Have its lowest point between 20 mm and 35 mm from the ground (fully assembled).	<b>Car not raceable.</b>
<b>Eyelets</b>	<b>11</b>	The car will race along a guide wire; therefore, eyelets <b>must</b> be included in your print so that your car can be threaded onto the wire. Any car that is <b>unable</b> to be threaded on the guide wire will be deemed <b>unraceable</b> (see page 17 for images of typical eyelets).	
	<b>11a</b>	Your car <b>must</b> have exactly two distinct eyelets.	<b>1.0s time penalty.</b> <b>Cars deemed unsafe will not be raceable.</b>
	<b>11b</b>	The eyelets <b>must</b> be at least 50 mm distance between the rearmost point of the front eyelet and the foremost point of the back eyelet.	<b>0.2s time penalty.</b> <b>Cars unable to be threaded will not be raceable.</b>
	<b>11c</b>	The eyelets <b>must</b> be in-line with the centre of the car.	<b>0.1s time penalty.</b>
	<b>11d</b>	The eyelets <b>must</b> have a hole/opening between 4 - 6 mm in diameter.	<b>0.2s time penalty.</b> <b>Holes &lt;4mm diameter will not be raceable.</b>
	<b>11e</b>	The eyelets <b>must</b> have the bottom of the hole/opening <b>no more</b> than 8 mm off the surface of the track when fully assembled (including wheels).	<b>2.0s time penalty.</b>
	<b>11f</b>	The eyelets <b>must</b> have the depth/length of the hole/opening (along the direction of the hole) between 5 - 7 mm.	<b>0.2s time penalty.</b> <b>Holes &lt;3mm length will not be raceable.</b>
	<b>11g</b>	The eyelets <b>must</b> have a minimum measurement around the hole/opening of 3 mm.	<b>0.1s time penalty.</b> <b>Holes &lt;1.5mm thickness will not be raceable.</b>
	<b>11h</b>	The eyelets <b>must</b> have a clear path between the eyelet holes and the front and back of the car. <b>Note: Axles must not impede the path of the guide wire.</b>	<b>Car not raceable.</b>
<b>Safety</b>	<b>12</b>	No part of the car including the eyelet (except the wheels) can be closer than 2 mm from the surface of the track when car is fully assembled	<b>Car not raceable.</b>
	<b>13</b>	The car <b>MUST NOT</b> cause or potentially cause damage or breakage to any part of the track including the guide wire, or have the potential to cause damage to any person or object (as judged by Quantum Victoria staff).	<b>Car not raceable.</b>



Visual guides for car design



The diagrams above illustrate an eyelet 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. **Note:** the image only shows one eyelet, your design must have two.



The diagram above shows the dimension ranges for the eyelets as stated in rule 11.

**Note:** The above diagram shows eyelets protruding from the bottom of the car; however, the same rules apply if the eyelets are embedded into the body of the car.

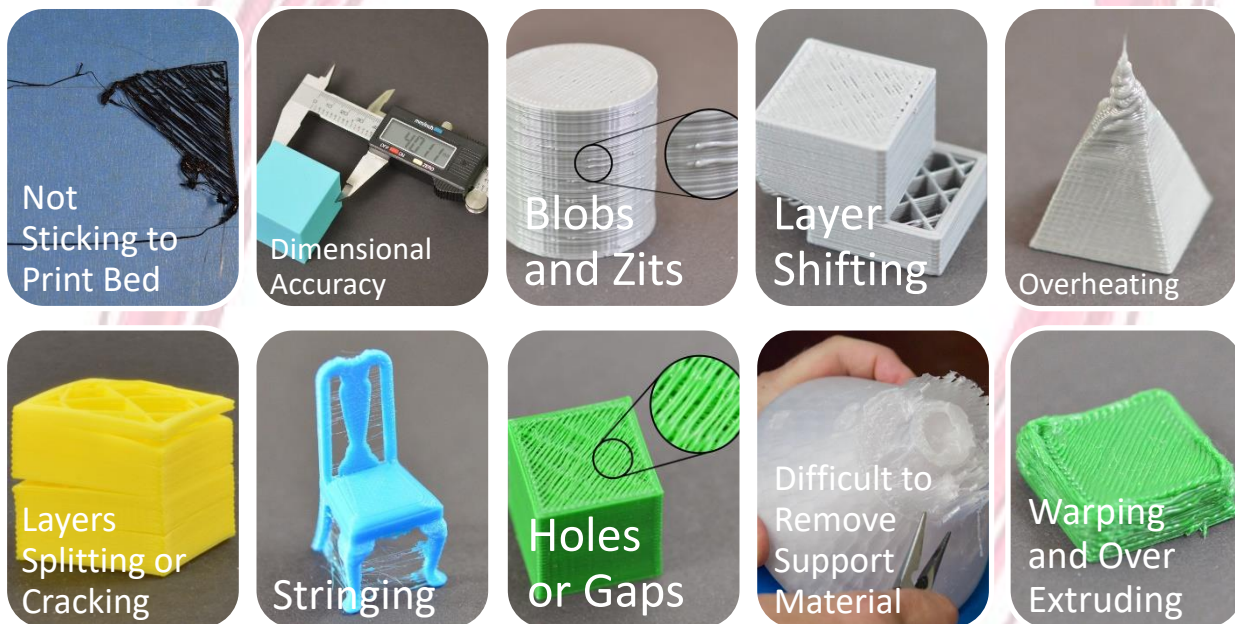
## Car Marking

### Car Finishing

1. **Qualifying Day** – You must **NOT** sand, paint or apply stickers/decals to your cars.
  - a. Finishing marks for qualifying day will be based on the quality of the 3D printing which makes up your car as well as the quality and completeness of assembly of the different parts to make the car (eg wheels, axles, etc)
2. **Finals Day** - Your car **MUST** have some finishing applied. This could include sanding, painting, and/or applying stickers/decals to your car.
  - a. Finishing marks for finals day will be based on the quality and attractiveness of the finishing applied to the car as well as the quality and completeness of assembly of the different parts to make the car (eg wheels, axles, etc)

### Examples of print quality issues

The following images are from the Simplify3D and Matterhackers web site links shown below. They illustrate some of the issues you might see when you 3D print your car for this competition. The sites linked below offer some advice on how to correct these 3D printing issues and more.



### 3D Printing Artifacts Links

<https://www.simplify3d.com/resources/print-quality-troubleshooting/>

<https://www.matterhackers.com/articles/3d-printer-troubleshooting-guide>

<https://realvisiononline.com/blog/the-12-most-common-problems-in-3d-printing-and-how-to-fix-them>

[https://help.prusa3d.com/category/print-quality-troubleshooting\\_225](https://help.prusa3d.com/category/print-quality-troubleshooting_225)

<https://additive-x.com/blog/7-common-3d-printing-problems-with-solutions/>

## Other Information

### Frequently Asked Questions

**Q. What glue can I use to assemble my car?**

A. You should research the best glue to use for the material you have chosen (this might be a good thing to add to your portfolio).

You must **NOT** use hot melt glue to attach eyelets to your car or wheels to the axles.

Below we have provided some suggestions.

Body of Car	<ul style="list-style-type: none"><li>• PVA</li><li>• Super glue (Cyano acrylate)</li><li>• UV curable resin</li></ul>
Wheels	<ul style="list-style-type: none"><li>• 5-minute epoxy resin e.g. araldite</li><li>• UV curable resin</li></ul>

**Q. Are we allowed to use lubricant on the axles?**

A. No.

**Q. If my car breaks during racing can I fix it?**

A. This will depend on how much the car breaking affects its safety. We will allow you (or a Quantum Victoria staff member) to repair your car if it is safe to do so. However, if the car breaks in the same way again, it will not be allowed to race further on that day. If the break is a result of something you have assembled coming loose (e.g. wheel(s) falling off), then this will affect the mark you will receive for the 3D Print Quality section.

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

A. We want teachers to act as a guide to their teams. Teachers can discuss and clarify the requirements as listed in *This field guide* and also teach skills needed to complete the tasks required for the students to compete. **However**, students **MUST design** and **create** their **cars, portfolio** and **poster/visual display** themselves. Teachers can provide access to the use of the 3D printer, but the students **MUST** print their designs themselves. You need to show evidence of this in your portfolio.

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

A. The Quantum Victoria PrintACar Challenge has been designed to engage students in **authentic experiential learning** through 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 at your school or your printer is **unable** to print anything of reasonable quality, you **MUST** notify us before proceeding.

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

A. Students can use any 3D printer that uses filament. Note that only one of **ABS** or **PLA filament** can 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 15).

**Q. What are the tolerances for printed shapes?**

*Tolerance refers to the difference between the 3D model in the modelling software and the printed product.*

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** use the tolerances on the marking sheet in Appendix 1 (page 24).

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

A. A CO<sub>2</sub> canister is inserted into the canister hole at the back of the car. A launch pod is placed behind the car, then a firing pin is triggered to puncture the CO<sub>2</sub> canister. The release of the CO<sub>2</sub> from the canister accelerates the car.

**Q. Does the portfolio and/or poster/visual display need to be printed or can it be handwritten for the Finals?**

A. Portfolios need to be **digital for both the Qualifying and Finals Day** and need to be uploaded to a specified online folder provided by Quantum Victoria by the due date as identified in key dates and Submissions Check List (page 22).

Additionally, we ask that for **Finals Day**, teams provide a physical copy of the portfolios and posters which can be **printed or handwritten**. However, the design, neatness, appearance, and the information included in both will be taken into consideration when marked.

**Q. Do I need to remove any 3D printed support material?**

A. Yes, you need to remove **all** support material (including in the **eyelet holes** and **the canister hole**).

**Q. My school is in Melbourne close to Quantum Victoria. Do I have to send my car(s) by courier or can I hand deliver it?**

A. You can hand deliver your car as long as it is delivered and handed in to Quantum Victoria by the date mentioned in key dates (page 22).

**Q. How can we learn more about how to use 3D Design and Printing?**

A. Teachers can book their classes into one of our 3D Modelling and Printing programs to upskill their students (subject to availability for onsite and synchronous programs). Visit <https://www.quantumvictoria.vic.edu.au/programs?features%5B%5D=3d-modelling> for more information on the Primary and Secondary 3D Printing programs.

### Register

Teams must register by **Friday 31<sup>st</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 complete the online form via the below link to register your interest:

[Registration Form](https://forms.gle/AZAfGinMa9mi4A2k9) (direct link: <https://forms.gle/AZAfGinMa9mi4A2k9>)

Once registration is confirmed, you will be asked to fill out another Google form with the following information:

- School name
- Team name
- Team members
- Year level of each student
- Supervising teacher(s) names
- Supervising teacher(s) contact details (email and mobile number)
- School contact telephone number and email address

**2024 Qualifying Days** will be held both onsite and virtually on **Thursday the 22<sup>nd</sup>** and **Friday the 23<sup>rd</sup> of August 2024** during National Science Week. Competing teams will be allocated a day and morning or afternoon session upon confirmation.

The **PrintACar Final** will be held **Friday the 29<sup>th</sup> November 2024 at Quantum Victoria**.

**Quantum Victoria reserves the right to amend these rules at any time should circumstances warrant this. Dates may also vary beyond the control of Quantum Victoria. Competing teams will be informed if this occurs.**

### Contact Details

If you have any further questions or queries, please contact us at: [admin@quantumvictoria.vic.edu.au](mailto:admin@quantumvictoria.vic.edu.au)

### Key Dates and Submission Checklist

Google Drive will be used to upload all the relevant designs and documentation. A link will be sent to each competing team with a folder where the documents/designs are to be uploaded.

A photography/video permission form will be sent out to schools as the event is live streamed. Student and adult forms can be found [here](#) and [here](#), respectively (see below for URL). Those students who don't have permission will not have their introductory video shown (if submitted).

- Registrations open on **Wednesday 14<sup>th</sup> February 2024**
- Registrations close **Friday 31<sup>st</sup> May 2024**
- To take advantage of our offer to check if your car is raceable we need to receive your car at Quantum Victoria before **Friday 26<sup>th</sup> July 2024**
- Qualifying Day cars to be sent by the competing schools **to be received by** Quantum Victoria by **Thursday 8<sup>th</sup> August 2024**
- Notification of courier tracking details for Qualifying Day cars to be received by Quantum Victoria within one business day after sending car(s)
- Car Marking self-evaluation submitted by **Thursday 8<sup>th</sup> August 2024**
- 3D Design of car/s submitted by **Friday 9<sup>th</sup> August 2024** via a designated Google Drive folder
- Qualifying Day Portfolio to be submitted by **Friday 9<sup>th</sup> August 2024** via a designated Google Drive folder.
- Submission of student 'Recording - Authorisation and Privacy Consent Form' for use in live streaming submitted by **Thursday 15<sup>th</sup> August 2024** via a designated Google Drive folder
- Qualifying Day 1 is **Thursday 22<sup>nd</sup> August 2024** (schools will be allotted a day and session)
- Qualifying Day 2 is **Friday 23<sup>rd</sup> August 2024** (schools will be allotted a day and session)
- Uploading of portfolio, and CAD car design by **Monday 18<sup>th</sup> November 2024** via a designated Google Drive folder
- Finals Day is **Friday 29<sup>th</sup> November 2024**

### Qualifying day submission checklist

- Make sure the car is fully assembled.
- Complete the car marking self-evaluation and submit with your car or via the Google Drive
- Deliver or send car to Quantum Victoria and send us the tracking details.
- Submit portfolio online via the Google Drive

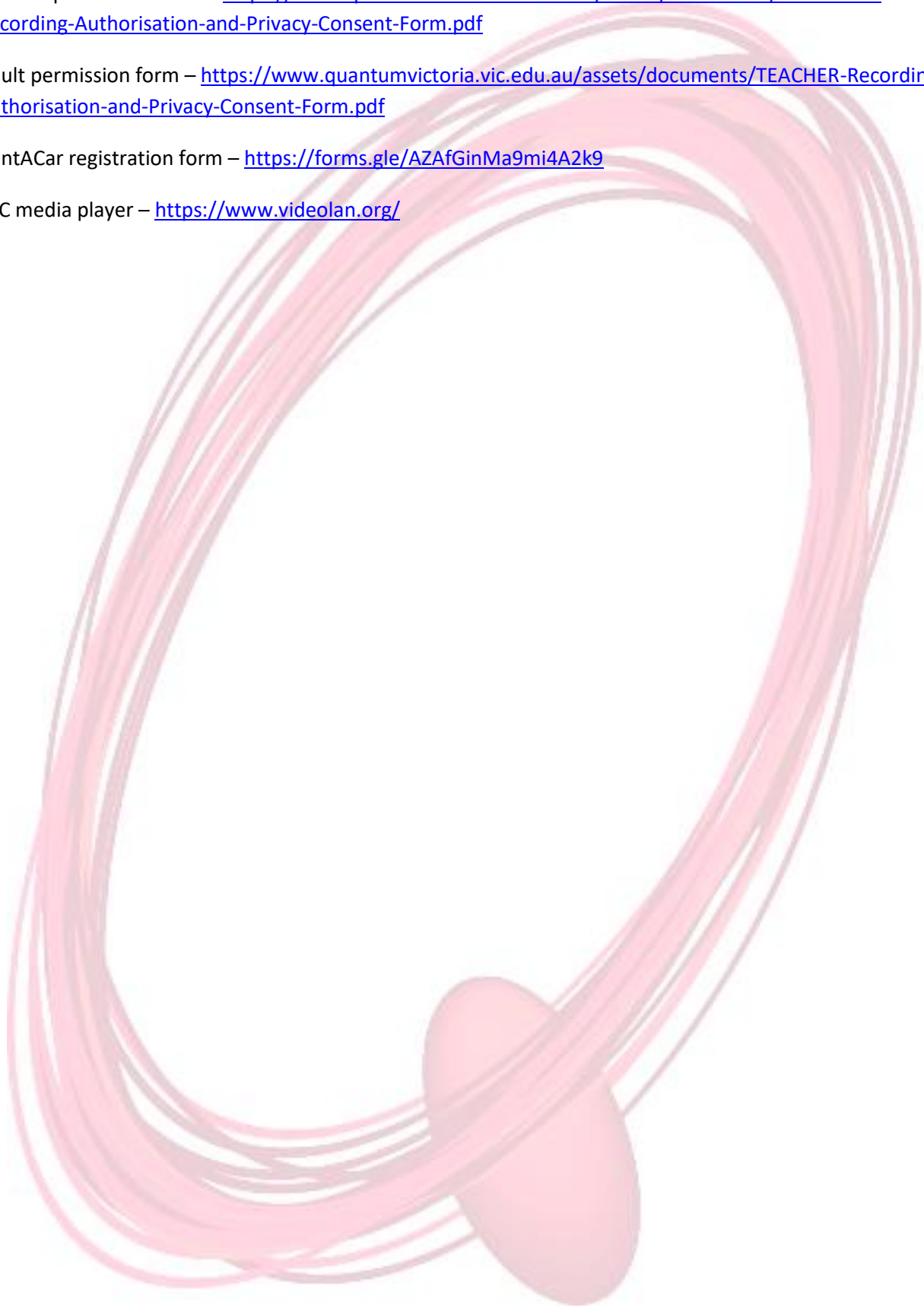
### Links and Forms

Student permission form – <https://www.quantumvictoria.vic.edu.au/assets/documents/STUDENTS-Recording-Authorisation-and-Privacy-Consent-Form.pdf>

Adult permission form – <https://www.quantumvictoria.vic.edu.au/assets/documents/TEACHER-Recording-Authorisation-and-Privacy-Consent-Form.pdf>

PrintACar registration form – <https://forms.gle/AZAfGinMa9mi4A2k9>

VLC media player – <https://www.videolan.org/>



## Appendix 1 – Car marking self-evaluation – to be completed for each car submitted

Please measure your printed car for each criteria and record the measurement where indicated on the Car marking self-evaluation. Please also indicate if your car meets or does not meet each criteria by using a Y or N in the “Criteria met?” column.

Note: If your car does not meet a criteria shaded **red** then your car **will not** be raceable.

If your car does not meet a criteria shaded **orange** then your car **may not** be raceable.

**You MUST send a completed copy of this Car marking self-evaluation to Quantum Victoria with each of your cars for Qualifying Day, and bring a completed copy with your car for Finals Day. If you do not, your car will NOT be able to race on the day.**



**QV PrintACar Finals - Car Marking**

School:

Team:

Primary  
Secondary

		Criteria	Marking Notes	Measurement	Criteria met? Y/N	Penalty (sec)
ASSEMBLY	1	3D printing technology with ABS or PLA				
	2	Fixed axles and wheels rotating				2
	3	Assembly of car (including any paint dry)				1
DIMENSIONS	4	Completed car mass (min 100 g fully assembled without CO2 canister)	-/+ 0.100g tolerance			2
	5	Length of car between 100 - 150 mm	-/+ 1.0 mm tolerance			0.2
	6	Height of car between 55 - 90 mm	-/+ 1.0 mm tolerance			0.2
	7	Widest part of car between 55 - 90 mm	-/+ 0.1 mm tolerance			0.2
	8	Range for wheel diameter 20 - 50 mm	-/+ 1.0 mm tolerance			0.5
CYLINDER HOLE	9a	Cylinder hole must run parallel to the ground (once the wheels are attached) and in-line with the centre of the car				0.2
	9b	Cylinder diameter: 19 - 20 mm (outside these limits may not be raceable)	-/+ 0.1 mm tolerance			0.2
	9c	Cylinder depth: 50 - 52 mm (< 45 mm or > 55 mm not raceable)	-/+ 0.1 mm tolerance			0.2
	9d	Cylinder wall thickness minimum: 3 mm (less than this limit not raceable)	-/+ 0.1 mm tolerance			
	9e	The cylinder hole/opening needs to be circular (and not oval)	-/+ 0.1 mm tolerance			0.2
	9f	The inner end of the cylinder must be flat (not curved)				0.2
	10a	Cylinder must be the rearmost point of the car. No part of the car including wheels should stick out behind the canister entrance point (outside these limits may not be raceable)				0.2
	10b	Have its lowest point between 20 mm and 35 mm from the ground when fully assembled (outside these limits not raceable)	-/+ 1.0 mm tolerance			
EYELETS	11a	Exactly 2 distinct eyelets (if insufficient eyelets, may not be raceable)				1
	11b	Eyelets to be at least 50 mm apart (if eyelets are less than this limit may not be raceable)	-/+ 1.0 mm tolerance			0.2
	11c	Be in-line and angled parallel with the centre of the car	-/+ 1.0 mm tolerance			0.1
	11d	Have a hole between 4 - 6 mm in diameter (<4 mm not raceable)	-/+ 0.1 mm tolerance			0.2
	11e	The bottom of the hole must be a maximum of 8 mm off the ground when fully assembled including wheels	-/+ 0.1 mm tolerance			2
	11f	Have a depth/length of the hole/opening along the direction of the hole of 5 - 7 mm (< 3 mm not raceable)	-/+ 0.1 mm tolerance			0.2
	11g	Have a minimum wall thickness around the hole of 3 mm (< 1.5 mm not raceable)	-/+ 0.1 mm tolerance			0.1
	11h	Have a clear path between eyelet holes as well as to the front and back of the car; axles must not impede guide wire	line of sight			
SAFETY	12	No part of the car including the eyelet (except the wheels) can be closer than 2mm from the surface of the track when car is fully assembled.	-/+ 0.1 mm tolerance			
	13	Must not cause or potentially cause damage or breakage to any part of the track including the guide wire or any person or object as judged by QV staff.			QV Staff use only	