RULES AND REGULATION

Malaysia Chem-E-Car Poster Competition 2022

Updated by:

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and 2021/2022 Committee Members

for Chemical Engineering Technical Division, IEM

1. GENERAL

1.1 Objective

The Chem-E-Car Competition aims to challenge students of the institutions of higher learning to design a shoebox-sized car that is powered by a chemical energy source. This Chem-E-Car shall carry a certain load of water to a given distance, hit a ball or bowling pins and then stop autonomously. The car performance shall be judged based on the combination of completion of predefined tasks, design creativity and issues related to safety, environment and health.

1.2 Statement of Agreement

All team members must sign a Statement of Agreement (Appendix I) explicitly indicating they have understood and shall abide by this Rules and Regulation. This statement must be submitted to the Organizing Committee at least ONE (1) month before the event.

1.3. Eligibility

The competition is open to all undergraduate students who are pursuing bachelor's degree and/or diploma in any engineering discipline in Malaysia and overseas. Each institution is encouraged to send as many Chem-E-Car teams as it deems appropriate.

1.4 Team Composition

The maximum number of team members is FOUR (4). Multi-disciplinary team members from the same institution are encouraged. Each team must consist of at least TWO (2) Chemical Engineering students unless a special waiver is obtained. No Inter-Varsity team is allowed.

1.5 Complaint/Protest

An official complaint preferably with evidence such as a digital photo must be filed by the Team Advisor to the Appeal Committee with a deposit of RM 100 within ONE (1) hour of the incident. Should the complaint is rejected by the Appeal Committee, the deposit shall be forfeited. All decisions by the Appeal Committee are final and hence cannot be contested after the winners have been announced during the Closing Ceremony.

2. COMPETITION CATEGORIES

2.1 Poster Competition

Each team shall submit an electronic copy of the poster in .pdf format to the Secretariat. Failure to submit this softcopy by a certain *deadline* [1] shall cause the team to be disqualified from the competition.

2.1.1 *Sizes of Poster and Board*

Only selected teams shall display an A1-sized poster on the designated board (1 m x 1 m) that shows the team and its members' names. The poster (in *portrait* form) must be placed prior to the Opening Ceremony to be considered for the final round of the poster competition.

[1] The submission deadline is normally one month before the first day of the Chem-E-Car Competition.

2.1.2 *Judging Scheme*

The poster should be self-explanatory in describing how the car is powered and/or stopped by the chemical reaction, the unique features of the car, and economic, environmental and safety aspects of the design. No presentation is required. However, there is question-and-answer session for top 10 finalist. If necessary, an appropriate documentation (folio) on the detailed design and testing of your vehicle can be made available during the by the session. Judges who shall mark the following criteria:

1. Description of the chemical reactions, power source* (15 marks) and stopping mechanism (15 marks).

   * Description **must** incorporate a chemical engineering core knowledge. Note, cars with power sources and/or stopping mechanisms based on wet/dry cells and/or own designed batteries operated via reduction-oxidation (redox) reaction are given **zero mark** for those two sub-categories. However, the teams can still earn up to 10 marks for the description of the chemical reactions.

2. Design creativity and unique features of the vehicle, including the strategy to score a "goal" or hit the bowling pins when momentum is transferred from the car to the ball (20 marks)

3. Environmental* (5 marks) and safety features (5 marks)

   * Eco-friendly cars can get up to 10 marks if there is no CO_2 emission and/or salt generation. Non-eco-friendly cars will receive **zero mark** for the environmental sub-category. However, the teams can still earn up to 10 marks for the safety features of the cars.

4. Economic aspects (5 marks) refer to the details and overall costs of the cars that should not have exceeded RM1000.

5. Quality of the poster (15 marks) and question-and-answer (20 marks) – This criterion shall only be marked for the selected posters. In other words, the marks shall only be given to the top ten (10) finalists and hence can be one of the deciding factors in determining the winners of the poster competition.

For the poster competition, all five criteria shall be used for the selection of the winners. To summarize:

Criteria	Marks (Poster Competition)
Description of the chemical reaction / power source / stopping mechanism	30
Design creativity and unique features of the vehicle	20
Environmental and safety features	10
Economic aspects	5
Quality of the poster	15
Question-and-Answer, Q&A	20
Total Marks	**100**

2.1.3 *Prizes*
First: RM 700 + Gold Plaque + Certificate
Second: RM 500 + Silver Plaque + Certificate
Third: RM 300 + Bronze Plaque + Certificate
Fourth – Tenth: Plaque + Certificate

3. PROHIBITION AND CAUTION

3.1 Remote Control or Mechanical Starting

The car must be an autonomous vehicle and cannot be controlled remotely. Pushing to start the vehicle or installing a mechanical starting device is not allowed.

3.2 Sensor, Electronic and Other Devices

Any type of sensor(s) and/or device(s) for car alignment is allowed before the car moves. This includes the use of laser pointer and/or laser distance meter. However, the sensor(s) and/or devices(s) must not be part of the car and must be turned off and/or removed from the track before the car starts to move. No other electronic devices such as built-in circuit, capacitor, microcontroller or voltage / ampere stabilizer is allowed.

3.3 Commercial Batteries / Power Mechanism

No commercial batteries of any kind (e.g., fuel cells, dry cells and lead-acid or any lead-based batteries such as lead oxides) are allowed as a power source (see Appendix II-a). On top of that, any own designed dry cells or lead-based batteries with similar contents used in commercial batteries is also strictly prohibited. To be clear, they are NOT even allowed to power up instrumentation (e.g., detectors, sensors) and/or devices (e.g., flash/LED lights) used in the electrical circuit such as in the iodine clock stopping mechanism. **Teams that use commercial batteries shall be disqualified from the competition. To inculcate creativity and innovativeness, non-conventional power sources such as thermoelectric generator is allowed provided a chemical reaction takes place to heat up and/or cool down the liquid (water) reservoir.** For instance, if any cold reservoir consists of a single or mixture of cold components (e.g., liquid nitrogen, dry ice, or ice with solvents), the hot reservoir must involve chemical reactions other than hydration and dissolution as described in Appendix II-b.

3.4 Stopping Mechanism

No mechanical force can be applied to the wheel or ground to slow or stop the car (e.g. no brakes). However, a stopping mechanism that is based on chemical engineering principles is allowed. There can be no mechanical or electrical timing device(s) to stop the chemical reaction or stop the car. For example, a stop switch consisting of a liquid draining out of a vessel is considered a mechanical timing switch and shall not be allowed. Similarly, microcontrollers can be used as an electrical timer and hence shall be prohibited.

3.5 Front Part of the Car

Teams are encouraged to concentrate on Momentum Transfer for this competition; hence the use of spring on the front part of the car is prohibited. Since there are two different challenges, the teams

are allowed to swap the front part of the car with an *approved*[2] one provided this and other parts of the car fit onto an A4-sized paper. For instance, the installation of rotating device is allowed but the device must be powered by own-designed chemical energy source. Once the car stops, the rotating device should also stop running before the 2-minute timer runs out, i.e., when the timer shows ZERO (0). Otherwise, the team will be disqualified for that round. Any approved modification shall be limited to a maximum of 20% change in overall design of the car.

3.6 Pressure Vessel

Any vessel that is pressurized must have evidence of proper/adequate pressure testing. **NO** plastic bottle is allowed to be used as a pressure vessel under any circumstances. Any (metal-based) pressure vessel used must be equipped with a working pressure gauge and a pressure relief valve. However, teams using a pressure regulator will be disqualified because the pressure regulator can be used to control pressure release from the vessel. This mechanism is deemed as a mechanical timer, which is explicitly explained in Item 3.4 above.

3.7 Safety Instruction for Corrosive / Hazardous Chemicals

Any entry using or producing a corrosive / hazardous chemical(s) must have the chemical(s) sealed in a close container (i.e. a container with a cover / lid). Chemicals must have external redundant containment (i.e. double container) as a component of the vehicle to prevent spillage.

3.8 Open and/or Improperly Secured Containers

All containers on the vehicle containing chemicals must be securely attached to the vehicle to prevent the container from tipping over during the competition. The lid to this container must also be securely attached to the container and must be capable to preventing spillage of the chemical during the competition.

3.9 Chemical Preparation and Handling

Chemicals must only be prepared at the Preparation Area. During the competition, it is suggested that a small holding tank with a valve or a syringe be added to the car to add the chemical at the Launching Pad or on the Starting Line. The chemicals can be added either by using a syringe or by gravity flow through the valve. All containers at the Launching Pad with chemical must be properly labeled, with a lid and must be properly managed to prevent spillage. In the event of spillage at the competition field (FIGURE 1a), the team shall be disqualified for that round.

[2] As approved by the Chairman of the Chem-E-Car Competition or his/her nominee

4. SAFETY

4.1 Personal Protection

During the competition, all participants are requested to ensure that they wear appropriate personnel protection equipment (PPE). In particular, team members handling chemicals must wear covered shoes, rubber gloves, lab coats and safety goggles.

4.2 Safety Data Sheet (SDS)

SDS of all chemicals used must be made available upon request.

4.3 Transportation and Disposal of Chemicals

Participants are responsible for transportation of the chemicals to the competition sites. Safe transportation protocols must be followed. Students are also responsible for arranging for the disposal of their chemicals and wastes. Hazardous chemical protocols must be followed and reported on the poster. If obvious safety violations occur, the judges have the discretion to disqualify the entry.

4.4 Safe Operation

All cars must be safely operated. If a car is deemed unsafe, the judges have the rights to disqualify it.

Clarification on Rules and Regulation

In case of any uncertainties, please contact the Chem-E-Car Secretariat at amira@iem.org.my (Amira).

Appendix I: Statement of Agreement

The Institution of Engineers Malaysia (IEM, "Organizer") and Universiti Teknologi PETRONAS (UTP, "Host") do not provide liability insurance for the protection of individuals, groups, organizations, businesses, spectators or others who may participate in the Malaysia Chem-E Car Competition 2020 ("Activity").

I testify that I have read and understood the Rules and Regulation (Revision: **16 April 2022 Version 1.0**) of the Activity. In consideration for my participation in said Activity, the individual, group, organization, business, spectator or other (collectively "Participant"), does hereby release and forever discharge the Organizer, Host and its affiliates and their respective officers, members, volunteers, agents, contractors, representatives and partners (collectively "Releasees"), jointly and severally from any and all actions, causes of actions, claims and demands for, upon or by reason of any damage, loss, death or injury, which hereafter may be sustained related to (i) my participation in the Activity, (ii) the negligence or other acts, whether directly connected to these activities or not, caused by any Releasee, or (iii) the condition of the premises where the Activity occurs, whether or not I am then participating in the Activity. I also agree that I, my assignees, executors, administrators, distributees, guardians, next of kin or legal representatives will not make a claim against, sue or attached the property of any Releasee in connection with any of the matters covered by the foregoing release.

Signatures and Names of Participants*:

Institution's Stamp:

Date: _____

Team Supervisor's Name(s) and Signature: _____

Team Supervisor's Phone Number(s): _____

Please fill in, if different from the above.

Name of Emergency Contact Person: _____

Emergency Contact Number: _____

**** All members of the participating team must fill in this Statement of Agreement Form and submit it to the Organizer at least ONE (1) month before the Activity starts.***

Appendix II-a: Commercial Type of Batteries

Item	Wet Cells	Dry Cells	Fuel Cells
Description	An electrochemical cell with a liquid electrolyte.	An electrochemical cell with a paste as the electrolyte.	An electrochemical cell uses chemical energy of hydrogen or another fuel (eg. methanol, natural gas, coal) to cleanly and efficiently produce electricity.
Example	• Lead-Acid Battery • Ni-Fe Battery • Wet Ni-Cd Battery • Absolyte (PbAcid-Cd)	• Zn-MnO_2 Battery (Electrolyte mixture: $ZnCl_2$, NH_4Cl Filler, Carbon black) • Zn-Ag_2O Battery (Electrolyte mixture: KOH) • Zn-MnO_2 Battery (Electrolyte mixture: KOH) • Zn-HgO Battery (Electrolyte mixture: KOH) • Cd-NiO Battery (Electrolyte mixture: KOH) • Li-Iodine Complex Battery (Electrolyte mixture: LiI)	• Hydrogen Fuel Cells • Direct Methanol Fuel Cells • Polymer Electrolyte Membrane Fuel Cells • Alkaline Fuel Cells • Phosphoric Acid Fuel Cells • Molten Carbonate Fuel Cells • Solid Oxide Fuel Cells

Appendix II-b: Hydration/Dissociation and Dissolution Reactions

Chemical Reaction	Description	Example
Hydration/Dissociation	A chemical reaction in which a substance combines with water.	$H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^- +$ heat
Dissolution	A nonelectrolyte dissolves into solute it changes from its original state (the solid/liquid/ gas) and goes into aqueous solution.	NaOH(s) + H2O(l) → Na+ + OH^- + H_20 + heat
Cooling bath only, i.e., no chemical reaction involved	A liquid mixture (no chemical reaction or bonding occur) which is used to maintain low temperatures.	Dry Ice-Acetone (Solvent) Dry Ice-Water (Solvent) Dry Ice-Ethanol (Solvent) Liquid N_2 - Methanol etc. Ice-Methanol etc.