

Extramural round problems

Grand final of International Natural Sciences Tournament 2022

1. Total Recall

The sci-fi movie Total Recall (1990) shows how, thanks to alien technology, it was possible to create a breathable atmosphere on Mars very quickly.

Nowadays, there are numerous calculations and schemes of what composition the artificial atmosphere should be during terraforming, how we can theoretically generate it with appropriate resources. However, the question of atmospheric retention on planets with reduced gravity remains open. Propose a concept for retaining an artificial atmosphere on Mars without constructing an additional dome or other sheltering structures. In the solution, consider that the retained atmosphere should reflect or absorb hard radiation.

2. Watermelon

Watermelon admirers have the everlasting problem of determining whether a watermelon is ripe or not. Watermelon ripeness can be discovered in many different ways, as suggested on the Internet. The most popular advice is to test berry appearance or the sound it makes when tapped or squeezed.

However, most agree that none of these methods are 100% reliable, and the only reliable way is to cut the watermelon and try it.

Suggest a non-invasive method of determining watermelon ripeness suitable for use when buying watermelon, growing watermelons, or harvesting and sorting them en masse.

3. Stress Out

Stress has a significant impact on both emotional and physical health. Different people react differently to the same stressful situations and conditions. The same level of stress can lead to different dangerous consequences. However, measuring stress levels remains a challenge: questionnaires can be unreliable, equipment for objectively assessing specific physiological parameters is either cumbersome or inaccurate.

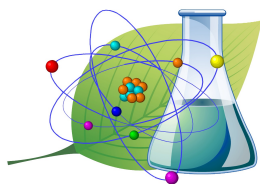
What parameters can be used to determine objectively and most accurately the stress level of a particular person and the danger of the stress for this person? How is it possible to constantly measure the level of such stress with a wearable gadget?

Important information

The Tournament consists of the Extramural round and Grand final. To participate in the Extramural round the team (3–5 students + coach) should send clear and outstanding solutions of **two out of three Extramural round problems** before the January 31st, 2022 (first wave) or before the March 1st, 2022 (second wave).

Please, remember the following notes:

- participation in the Extramural round is free of charge;
- participation fees for the Grand final participants of the first and the second waves will be announced later.



Submission of solutions

Each solution of each problem consists of **both extended solution** (*.doc, *.docx, *.pdf) – 5 pages or less) **and presentation** (*.ppt, *.pptx *.pdf). The solutions provided in the wrong formats are not accepted. Please, send separate files with presentations and extended solutions for each of the problems. Pay attention that there must be no names, logos, or any other identification marks of your team/university in the presentations or extended solutions. All the solutions must be sent before the deadline via the account on the [website](http://www.scitourn.com). All the uploaded documents must be archived. You will be able to upload only one archive via web-form.

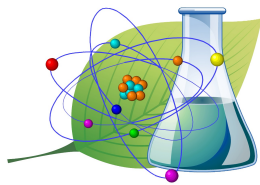
Recommendations

Extended solution

- Your team must provide the neat document in *.doc, *.docx, *.pdf formats (5 pages or less).
- All the parts of the extended solution should be linked, the course of the solution should be convincing and understandable, the information should be comprehensible and sufficient to understand the essence of the problem and the proposed solution.
- While preparing the extended solution, it is recommended to keep in mind the following questions:
 - ? What is the essence of the problem and what is required to be solved?
 - ? What is known about this problem in literature sources? Have any solutions been already proposed for the problem? What are the pros and cons of the known solution?
 - ? What is the essence of the solution you propose? How to implement it in practice? What are its pros and cons? Are there alternative solutions?
 - ? What conclusions can be drawn from the work you have done? What solution to the problem do you propose as the best and why?
- If it is necessary, provide an economic evaluation of proposed ideas, their profitability.
- When using information from literature, one should put the source is referred to at the numbered list of references at the end of the extended solution. Do not forget to refer to these sources with figures, for example [1] or ¹.
- If your team has conducted any experiment during the solving of the problem, it is highly recommended to include any information about it in the extended solution even if the result does not satisfy your team.

Presentation

- Your team should provide the neat document in *.ppt, *.pptx, *.pdf formats (the number of slides is not limited but, please make it reasonable).
- Please, keep in mind that your presentation must correlate with your extended solution.
- The presentation should not be overloaded with text. It should contain only illustrative material that supports the extended solution and makes the solution clearer and easier to understand. Text in the presentation is recommended to be used for titles, labels, formulas, brief thesis sentences, as well as conclusions and the list of references.
- All slides of the presentation, except the title slide, should be numbered.



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- All the pictures, graphs, tables, or any other graphical content should be clearly labelled. If this material is not original, then one should refer to the corresponding source of literature with figures.
- When using information from literature, it is recommended that the source is referred to at the bottom of the slide (by giving its bibliographical reference, including the title of the work). If it is inconvenient to put the full reference title on the slide, one must make a separate slide with a numbered list of references and refer to these sources with figures, for example [1] or ¹.
- If your team has conducted any experiment during the solving of the problem, it is highly recommended to include any information (especially pictures, numbers, tables, *etc.*) about it in the presentation even if the result does not satisfy your team.

If you have any questions regarding the presented information, please do not hesitate to contact Teams' coordinator Ms. Darina Barkhatova via e-mail: participants@scitourn.com.