

THE FOURTY-FIRST UBC PHYSICS OLYMPICS RULE BOOK

March, 2022

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UBC PHYSICS & ASTRONOMY



2022 UBC Physics Olympics Code of Conduct

By participating in the 2022 UBC Physics Olympics, participants agree to the Physics Olympics Code of Conduct. Any participant unable to adhere to the code of conduct will be dismissed from the event immediately; we reserve the right to limit that individual's participation in future events.

Our goal is to maintain a safe, positive, fun and challenging environment within an academic department where Physics Olympics participants can feel respected and capable. If we are to achieve this goal, it is necessary that all participants behave appropriately and respectfully towards event judges, volunteers, and other student participants.

We ask all participants to:

- Follow activity rules and instructions from the UBC Physics Olympics team.
- Treat each other with respect – be respectful of the rights and opinions of others, even if you don't agree with each other.
- Stay on topic – remember the objectives of the UBC Physics Olympics.
- Remember everything you share in the online platform is public – avoid sharing private and personal information (e.g. email address, home address or phone number for yourself or others).
- Review all rules and guidelines, and acknowledge that there are some risks involved in your participation in the program.
- Take steps to protect your own safety during the participation of any UBC Physics Olympics activities.

We will not tolerate any of the following:

- Cheating or other forms of academic misconduct.
- Speech that promotes discrimination based on race, sex, religion, nationality, disability, sexual orientation or age.
- Defamatory, indecent, hateful, deceitful, threatening, abusive, obscene, inflammatory, or inappropriate comments.
- Messages that encourage or suggest illegal activity, contain sexually explicit material, contain advertising or promote any services, or are off-topic, unintelligible or irrelevant.

If you have any questions regarding the community guidelines or are experiencing harmful behaviours, please contact

- Theresa Liao communications@phas.ubc.ca
- Marina Milner-Bolotin marina.milner-bolotin@ubc.ca

2022 General Rules

This year (2022), all activities during the UBC Physics Olympics will be conducted virtually on this Canvas platform.

Due to the virtual nature of this year's UBC Physics Olympics, there is no size limit for participating school teams. Teams can choose to have all team members participating in all activities, or have selected members participating in specific activities. Events are designed so that team members will need to work together to accomplish the event objectives. There is only one heat for each event, lasting about one hour each. There are 15 minute breaks between activities, as well as a one-hour lunch time.

Digital award certificates (pdf) will be issued to participating members of the top three teams in each event, as well as to schools with the top 6 combined scores.

The combined score of a team is the sum of their decibel scores in the 6 events. For each event, schools are ranked by their event score, and the corresponding decibel score for that event is given by $\text{dB} = 10 \log_{10}(\text{rank})$. Thus a first place ranking in an event is 0 dB, second is 3.01 dB, fifth is 6.99 dB, tenth is 10 dB, and twentieth is 13.01 dB. The overall Physics Olympics winner is the school with the lowest total decibel score.

Interpretation of Rules

Normal physics interpretations will be applied to all the terminology used in defining the challenges. Those solutions that, in the opinion of the event judges, do not comply with the spirit and intent of the rules will be disqualified from the event (and thus ranked last for the event). **The ruling of the event judges is final.**

Use of third-party applications

The following applications will be used to support the Physics Olympics activities. This list will be updated regularly. If you have any concerns or questions about the collection of your information and the applications used during UBC Physics Olympics, please contact Theresa Liao, Communications Coordinator, UBC Physics & Astronomy at communications@phas.ubc.ca.

Last updated: January 29, 2022

The following application might not be hosted in Canada:

- [Kahoot! \(Links to an external site.\)](#): learning platform for displaying and answering questions (Final Quizzics!)
- [PhyPhox \(Links to an external site.\)](#): physical phone experiment application (Prebuild)
- [YouTube \(Links to an external site.\)](#) (used within Canvas): video sharing and streaming platform (Final Quizzics!)

Some applications might ask participants to create an account in the tool; by doing so, you will be required to provide personally identifying information including but not limited to your name and email address. Because these tools might be hosted on servers outside of Canada, by creating an account you will also be consenting to the storage of your information outside of Canada. Please know you are not required to consent to sharing this personal information with the tool, if you are uncomfortable doing so. If you choose not to provide consent, you may create an account using a nickname and a non-identifying email address, or use tools that will provide disposable email addresses. You may also choose not to participate in activities that require the use of these applications.

The following applications are hosted in Canada:

- [Canvas \(Links to an external site.\)](#): online teaching and learning platform
- [Kaltura \(Links to an external site.\)](#): online video hosting platform
- [Qualtrics \(Links to an external site.\)](#): online survey application
- [Zoom \(Links to an external site.\)](#): video conferencing platform

When using these applications, your personal information is collected under the authority of section 26(c) of the [Freedom of Information and Protection of Privacy Act \(FIPPA\) \(Links to an external site.\)](#). The collected information will be used for the purpose of sending you information regarding the 2021 UBC Physics Olympics, and evaluating your participation in the UBC Physics Olympics competition.

Privacy and Recording

While this event is not open to the general public and some safeguards will be in place to protect teams' privacy, teams should consider their usages of the Canvas platform, other applications, and their participation in Physics Olympics activities as being public, with the possibility of being recorded. Efforts should be made to avoid posting/sharing personal information in the forms including but not limited to text, video, and audio.

The Final Quizzics! event will be streamed within Canvas through YouTube. It might be recorded only for the purpose of ensuring final scores are correctly tabulated. The video recording made by UBC Physics & Astronomy will be kept confidential and private.

Zoom Participation

When video participation is necessary, students are not required to have their cameras on.

To facilitate Zoom breakout room assignment, when joining a Zoom call, please add your school name to your display name. Instructions for customizing your name once you are in the session:

- Click the Participants icon in the bottom bar.
- In the panel that opens, hover over your name, click More, and select Rename.
- Enter the name you'd like displayed, which can include your preferred pronouns if you like, and click Rename to save your changes.

2022 Pre-build: Smartphone Elevator

Pre-build: Smartphone Elevator

Last updated: February 7, 2021. [Download the pdf version here.](#)

Judges: Dr. Andrzej Kotlicki (kotlicki@phas.ubc.ca) and Dr. Valery Milner (vmilner@phas.ubc.ca). Any questions about this activity should be directed to the activity judges.

The deadline for submission is 11:59 pm on Tuesday, March 1st, 2022. Instructions for submitting materials online will be announced soon.

Main objective

Your team's objective is to build an apparatus that will transport a typical smartphone from the surface of a table, 1 m above the floor level, to the floor in the shortest possible time and with the smallest possible peak acceleration.

Apparatus construction

The only energy used in the whole process should be the potential gravitational energy of the phone or any other parts of the apparatus. This energy can be converted during the process to other forms of mechanical energy.

The apparatus may be built out of any non-hazardous materials. Any apparatus that represents a hazard to the operator or bystanders will be disqualified. Contact the judges should you have any concern about the material or the design principles.

The apparatus must not exceed the dimensions of 2 m x 2 m x 2 m.

The apparatus may incorporate pre-manufactured objects.

Judges have the final decision on determining whether the apparatus is compliant with these rules.

Any mechanical motion of the constructed apparatus, including the transportation of the smartphone from the table to the floor, must be started by cutting a thread.

The position of the smartphone inside the built apparatus should be not higher than 2cm from the surface level on which the apparatus resides, both at the beginning and at the end of the transportation process.

Measurement

The smartphone should be pre-loaded with the free [PhyPhox app \(Links to an external site.\)](#), and will be the only measuring device used in this pre-build activity. The app will record acceleration during the process of transporting the phone using the “Acceleration (**without g**)” function.

—At the beginning of the transportation process:

- * The smartphone should lay flat on the table or inside the built apparatus so that the whole surface of the phone is above the surface of the table (i.e. not sticking out beyond the table’s edges). The transporting apparatus, on the other hand, may extend beyond the edges of the table.
- * The smartphone must be oriented face-up with its screen reachable by the operator, who should be able to start the PhyPhox app without moving the phone from its initial position. You can also start the app remotely with your computer without touching the smartphone using the remote function of the PhyPhox.
- * The PhyPhox app must be started approximately 10 seconds prior to triggering the transportation process (which is done by cutting a piece of thread). In other words, your recorded data must start with approximately 10 seconds (plus/minus a couple of seconds) of “quiet time” when nothing moves.

—At the end of the process:

- * The smartphone should again be oriented face-up and be reachable by the operator, who will stop the PhyPhox data collection without moving the smartphone.
- * The data collection should be stopped approximately 10 seconds (again, plus/minus a couple of seconds) after the smartphone comes to rest.

Scoring

The score will be the product of two numbers: the transportation time, during which the phone was moving, and the maximum **absolute value** of the recorded acceleration to the power of three.

Score = $t * a^3$, where t is measured in seconds and a in m/s^2 .

The apparatus that produces the **smallest score** will win.

The transportation time will be determined as the time between two events: (1) the moment the absolute value of the recorded acceleration at the *end of the initial “quiet period”* (of roughly 10 seconds) increases above a threshold of either $0.1m/s^2$ or 1% of the maximum recorded acceleration, whichever is smaller; and (2) the moment the absolute value of the recorded acceleration at the *beginning of the final “quiet period”* (when the phone is resting within 2 cm

from the floor level) decreases below a threshold of either 0.1m/s^2 or 1% of the maximum recorded acceleration, whichever is smaller.

The maximum absolute value of the recorded acceleration will be extracted from the submitted PhyPhox data file. The two spikes in acceleration, one at the very beginning of the record and one at the very end – both due to the tapping on the phone’s screen for turning the app on and off, will be disregarded.

Data submission format

Each team must submit one Excel file named according to the following template ‘SCHOOL_NAME.xls’ (e.g., ‘University_Hill.xls’ or ‘Lord_Byng.xls’).

The file should be generated within the PhyPhox app by pressing on the menu sign and choosing “Export Data” and then “Excel” format. The data file must not be modified in any way other than changing its name according to the template described above. Any suspicion that the contents of the file were modified will result in disqualifying the team!

Each team must also submit a video of the transport process during which the data in the submitted Excel file was generated. Instructions for submitting videos will be announced soon.

Demonstration

Selected teams will be requested by judges to explain and demonstrate how their apparatus works, and generate new data from the particular demonstration, on the day of the Physics Olympics event (March 5, 2022). The team will have to immediately transmit new data to the judges after the demonstration. Teams should monitor their emails and Canvas on or before March 5 in case judges contact them.

2022 Planetary Astronomy Lab

Please direct any questions about this event to the event judge, Dr. Joss Ives (joss@phas.ubc.ca).

This year’s live lab event is a planetary astronomy lab. This event will run on the day of Physics Olympics, from 10:30-11:30am, with the link to the activity being made available here in advance of the activity.

Overview of the event

A virtual laboratory-based event involving exoplanet detection and characterization. Understanding of one or more of the following will be necessary to complete the lab: transits, radial velocity measurements, Kepler’s laws, and flux laws. Practice questions and additional

details about the event will be available at least one week prior to the day of Physics Olympics (March 5, 2022).

2022 Quizzics!

Team members will work together to answer questions about physics and astronomy. Questions may involve mechanics, waves, electricity and magnetism, optics, fluids, modern physics, famous scientists, or the history of science. Some questions may involve short calculations.

All teams will participate in the preliminary Quizzics! Questions are in multiple-choice format and each team will answer online through the Qualtrics survey. Consultation between team members is allowed. We encourage teams to set up a group video call that includes all team members, so that you can discuss your answers. One team member should be designated to submit your team's responses in the survey.

The questions will each have a 2 minute time limit (and one minute to see the explanation); a timer will be displayed on each page. Pages will proceed at the end of the time period, and your answers will then be recorded. You will only be able to proceed to the next page when the time is up, with the exception of the last two questions, for which the shortest submission time will be used as a tie-breaker. In all cases, teams should make sure to submit their answers before the time expires. The first 8 questions are worth one point each, and the last 7 questions are worth two points each.

The teams with the highest scores in the preliminary heats will meet in the round of Final Quizzics!.

The final round will be held in Zoom. Each team will be in their own breakout room with their team members.

Final Quizzics!

- The Final Quizzics will be hosted using the [Kahoot! \(Links to an external site.\)](#) application.
- The Final Quizzics! will include 10 questions. Teams will be awarded points based on whether they answer the question correctly, and how fast they are able to select the correct answer.

Video Recording & Privacy

Please note that the Final Quizzics! will be live streamed via YouTube on Canvas and could be recorded by UBC Physics Olympics only for the purpose for score validation. The video will not be made public, and showing personal video/audio is not mandatory.

Sample Questions

Students interested in accessing sample questions for Quizzics can now go through the 2021 preliminary Quizzics to get a sense of the style of questions we might ask. Do note that topics

covered in Quizzics differ from one year to another, and judges reserve the right to make any changes. This is purely for practice and demonstration purposes.

[Go to the 2021 Preliminary Quizzics](#)

2022 Fermi Questions

The great twentieth century physicist Enrico Fermi was famous for being able to estimate anything to within a factor of ten. Examples of “Fermi Questions” are:

- What is the total mass of the students competing in the Physics Olympics today?
- How many litres of gasoline are consumed in Greater Vancouver each year?
- How many molecules of air are there in this room?

For more examples, look on the web. Examples can be found at: https://scioly.org/wiki/index.php/Fermi_Questions

Answering a Fermi question in physics requires common sense understanding, knowing the order of magnitude of key constants of nature and physical parameters, and the ability to do approximate calculations quickly.

Your team will be given a number of Fermi Questions to answer using only pencil and paper and your own knowledge. **No notes, tables, books, or calculators are allowed. Cellphones, tablets or computers are only allowed to communicate with your teammates and to access the Canvas site.** Since there will be a substantial number of questions to answer and only a limited time to answer them, speed and teamwork will be important. Your written answers will be graded for accuracy appropriate to the questions. Your answers must include appropriate units, in the SI (MKS) system.

Many physicists pride themselves on knowing various constants of nature and physical parameters to at least one decimal place. Parameters that may be needed, to this accuracy, include but are not limited to:

- the speed of light
- Planck’s constant
- Boltzmann’s constant
- Avogadro’s number
- the mass of the electron
- the mass of the proton
- the charge of the electron
- the constant in Coulomb’s Law
- the constant in Newton’s Law of Universal Gravitation
- the acceleration of gravity on Earth
- the radius of the Earth, and
- the distance from Earth to the Sun