Brazilian Online Physics Olympiad

rules 2025 - César Lattes category

Chapter I
Preliminary Provisions

i) The Brazilian Online Olympiads are organized by the Nucleo Olímpico de Incentivo ao Conhecimento (NOIC), through its group of collaborators. NOIC is a non-profit initiative created in 2013 by students experienced in scientific olympiads, aiming to help students prepare for these competitions. With 12 years of history, it offers a platform with study guides, theoretical courses, mock exams, among others, already reaching over 7 million views.

ii) In 2023, NOIC launched the Brazilian Online Olympiads (OBOs) project and is currently the coordinating body for OBOA, OBOArt, OBOB, OBOC, OBOCH, OBOE, OBOF, OBOFE, OBOFOG, OBOI, OBOL, OBOM, OBOQ, and OBOR.

iii) NOIC is responsible for the preparation and administration of exams, as well as their grading and prize distribution. The NOIC departments are responsible for preparing and grading the exams, while the OBOs' management handles competition administration and partner communication.

iv) The first phase will be conducted through an open Google Forms form, without supervision. The second phase will also be applied through Google Forms, but monitored via Google Meet.

Chapter II
Competition Format

i) In the César Lattes category, the OBOF will be held in two phases:

(a) First Phase: multiple-choice exam with 15 questions, each with 5 alternatives, lasting 4 hours;

(b) Second Phase: written exam with 5 questions, lasting 4 hours;

ii) It is forbidden to transmit/publish comments about the exam content by any means of communication during the exam days. Furthermore, no solution methods for any questions may be leaked by any means of communication in the same period. Violation of this item will result in the **disqualification of the student**.

iii) The topics covered in the OBOF exams are listed in the Syllabus found in **Annex II** of this notice. If there are topics not explicitly listed in this annex, the text of such problems will contain the missing elements necessary for their solutions.

iv) First phase exam:

(a) The exam will be conducted via Google Forms, available for 2 days, lasting 4 hours;

(b) Information will be sent to the email registered at the time of registration, on the first day of the exam. If the student has any problems with receiving or taking the exam, they must contact the organization by email at obonline@noic.com.br. The committee will do its best to resolve the issue but is not responsible for incorrect emails, issues with institutional emails, or the failure to receive messages if candidates do not reach out in a timely manner. Under no circumstances will the exam deadline be extended.

(c) The exam is designed to be taken without the aid of research in books or websites. Any form of consultation or help from third parties is prohibited. The exam must be taken individually, without books and without internet access beyond the application platform.

(d) Students caught taking the exam using any form of consultation, in groups, or with help from third parties will be disqualified from the edition and barred from participating in all other OBOs in the current year.

(e) At the end of the exam, the candidate must simply submit it to compete for the 2nd phase.

(f) The list of students qualified for the 2nd Phase will be published on the OBOF website on the date provided in the Official Calendar. The cutoff score will be decided after grading the first phase.

v) Second phase exam:

(a) 30% of the total candidates in each category who took the 1st phase will be approved for the 2nd phase if there are fewer than 1500 participants who submitted the exam in that category. If there are more than 1500 participants in the category, 450 will advance to the second phase. For example, if there are 5000 registered in a category but only 2000 actually submit the exam, 450 will advance. If 5000 are registered but only 600 submit, 180 will advance.

(b) The exams will be taken via Google Forms and monitored via Google Meet, in 4 possible time slots on October 25 and 26. The student may choose which time slot to take the exam.

(c) Students caught using any type of consultation, in groups, or with third-party help will be disqualified from the edition and barred from participating in all other OBOs in the current year.

(d) Candidates may only use the following materials during the exam: pencil or mechanical pencil, graphite, eraser, sharpener, transparent ruler, non-programmable scientific calculator, and black and/or blue ballpoint pens. The exam must be written on white or ruled paper, single-sided, with only one question per sheet for better scanning readability.

(e) On all sheets, the candidate must identify themselves with their ID, sent previously by email. It is forbidden to write their name on any exam sheets sent for grading.

(f) After finishing the exam or at the end of the 4-hour time limit, an additional 15 minutes will be available in the form for scanning and sending the exam (apps such as CamScanner are recommended). Exams sent after the time limit, whether by email or any other means, will not be accepted.

(g) The 2nd phase exams will be graded by a committee appointed by NOIC, under the same grading criteria. Therefore, requests for review of written exams will not be accepted.

(h) The medal thresholds scores will be determined so that 8% of the students in the second round receive a gold medal, 25% a silver medal, 50% a bronze medal, and 67% an honorable mention, following the standard used in international olympiads.

(i) The list of award-winning students will be published on the OBOF website on the date provided in the Official Calendar.

(j) Certificates will be issued to all medalists and honorable mention recipients within the timeframe established by the rules. The certificate will be posted on the NOIC website, in the OBOs section.

Chapter III
Final Responsibilities

i) The Brazilian Online Physics Olympiad will have two phases, both conducted remotely:

(a) The NOIC Team is always attentive to its communication channels to resolve, as promptly as possible, any questions that may arise and ensure that all candidates can participate in the OBOs. Unfortunately, some factors are beyond our control, but candidates will be informed if a problem arises for which we have no current solution. Our volunteer team is always striving to bring more professionalism to the OBOs.

(b) The Olympic Code of Honor (Annex III) states that, before awards, the most important aspect is the learning and maturity that the olympiads bring, as well as the olympic spirit. Actions such as cheating or obtaining privileged information about the exams demonstrate that the candidate still

holds a superficial understanding of the learning and purpose of the olympiads. If fraud is found in the student's participation process, the committee is authorized to take more severe measures.

(c) Omitted cases will be evaluated by NOIC's coordination.

(d) By registering for the OBOF, the student agrees to comply with all items in these rules.

(e) Appeals for each phase, as well as any questions, must be sent to obonline@noic.com.br

Annex I
OBOF Calendar

1) **Registrations:** 07/07 - 11/09
2) **1st Phase Application (online):** 12 to 14/09
3) **Release of Preliminary Answer Key for 1st Phase:** 15/09
4) **Period for Appeals Regarding 1st Phase:** 16 and 17/09
5) **Release of 1st Phase Results:** 28/09
6) **2nd Phase Application (online and monitored):** 25 and 26/10
7) **Release of Expected Answers:** 27/10
8) **Period for Appeals Regarding 2nd Phase:** 28 and 29/10
9) **Release of 2nd Phase Awardees:** 29/11

Annex II
Syllabus

i) **César Lattes Level – 1st Phase (Based on ITA)**

(a) **Physical Measurements:** Significant figures; dimensional analysis; graphs; functions;

(b) **Mechanics:** Vector kinematics; projectiles; torque; stable and unstable equilibrium; circular dynamics; accelerated systems; center of mass;

(c) **Gravitation and Periodic Motion:** Kepler's laws; SHM; oscillation composition; pendulum;

(d) **Fluids:** Archimedes; Pascal; Bernoulli; Torricelli;

(e) **Thermal Physics:** Zeroth law; gas laws; kinetic theory; heat capacity; heat transfer;

(f) **Waves:** Nature of sound; musical instruments; Doppler effect;

(g) **Optics:** Slabs; prisms; optical systems; polarization; models of light;

(h) **Electrostatics and Circuits:** Electrification; field and potential; capacitors; generators; associations; Joule effect; resistivity;

(i) **Magnetism:** Currents and B field; coils; forces on charges and currents;

(j) **Induction:** Faraday; Lenz; self-induction; electromagnetic waves;

(k) **Modern Physics:** Photoelectric effect; Bohr; uncertainty; relativity (Lorentz transformations, time dilation, mass-energy);

ii) **César Lattes Level – 2nd Phase (Based on international physics olympiads; includes topics from 1st Phase)**

(a) **Advanced Mechanics**

- Displacement, velocity, and acceleration vectors with derivatives.
- Circular motion: centripetal and tangential acceleration.
- Addition of velocities and accelerations (without Coriolis).
- Rigid body rotation: instantaneous center of rotation.
- Moment of inertia via integration and parallel axis theorem.
- Work and energy with non-conservative fields.
- Inertial forces and potential energy in non-inertial frames.

(b) **Advanced Hydrodynamics**

- Surface tension and associated energy.
- Capillary pressure.

(c) **Advanced Electromagnetism**

- Biot-Savart law, field in straight wire, circular loop, and solenoid.
- Integral forms of Maxwell's equations.
- Method of image charges.
- Energy density of electric and magnetic fields.
- Eddy currents, hysteresis, and magnetic dissipation.
- Magnetic dipole and potential energy.

(d) **Advanced Electric Circuits**

- Mutual inductance.

- Complex impedance, phasor diagrams, resonance.
- Active power in AC circuits.

(e) **Advanced Oscillations and Waves**

- Forced harmonic oscillator: phase, amplitude, and resonance.
- Generation of sinusoidal waves by positive feedback.
- Group and phase concepts in harmonic waves.
- Classical Doppler effect and Mach cone.

(f) **Interference and Diffraction**

- Huygens' principle.
- Diffraction by one and two slits, diffraction grating, Bragg reflection.

(g) **Advanced Optics**

- Polarization: Malus' law, Brewster's angle.
- Dispersion and dissipation in optical media.
- Optical instruments: interferometers, resolution power of lenses and gratings.

(h) **Special Relativity**

- Lorentz transformations (time, space, energy, momentum).
- Time dilation, length contraction.
- Conservation in relativistic interactions.

(i) **Quantum Physics**

- Uncertainty principle.
- Quantization of energy and angular momentum.
- Energy levels (hydrogen atom and parabolic potentials).
- Concept of wavefunction/probability.

(j) **Atomic and Nuclear Physics**

- Emission and absorption spectra.
- Pauli exclusion principle.
- Decays: alpha, beta, and gamma.
- Fission, fusion, neutron capture, half-life.
- Compton scattering.

(k) **Advanced Thermodynamics and Statistical Physics**

- Statistical definition of temperature.
- Equipartition theorem.
- Efficiency of reversible and non-ideal Carnot cycles.
- Phase transitions and latent heat.
- Saturated vapor pressure, relative humidity.
- Wien's, Stefan–Boltzmann's, and Planck's laws (qualitatively).