Conclusion

This final problem set wraps up some loose ends and points out a way forward.

1 Extra Problems

The following questions contain applied physics topics. They were not included in the main problem sets mostly because they used a variety of topics about equally, but they're great review practice.

[5] **Problem 1.** IPhO 2013, problem 2. A rather long but straightforward problem, with many numerical calculations, illustrating a real practical setup in detail. Use the data sheet of physical constants provided in the folder.

[5] **Problem 2.** IPhO 2013, problem 3. A solid question on an ice sheet, using thermo and data analysis. Use the data sheet of physical constants provided in the folder.

[5] **Problem 3.** IZhO 2022, problem 2. A practical problem on estimating the greenhouse effect.

[5] **Problem 4.** IPhO 2018, problem 3. Some models in biophysics, using fluids and thermo.

[5] **Problem 5.** IPhO 2021, problem 1. The basics of geophysics, using fluids and waves.

[4] **Problem 6.** GPhO 2022, problem 2. Some simple estimates involving renewable energy.

[5] **Problem 7.** APhO 2014, problem 1. A very hard problem on atmospheric convection.

[5] **Problem 8.** APhO 2012, problem 3. A somewhat technical problem that combines polarization and interference, to derive a neat effect called a "geometric phase".

2 Extra Theoretical Exams

If you've made it this far, you're probably training for the IPhO. I've reserved questions from a few Olympiads you can take as full-length practice exams. The NBPhO is usually 2 days long, with 5 hours per day. However, it includes experimental questions that you can't do at home, and it's slightly easier than the IPhO, APhO, or EuPhO, so I've adjusted the time limits accordingly.

[8] **Problem 9.** USAPhO 2003.

[8] **Problem 10.** USAPhO 2005.

[10] **Problem 11.** USAPhO 2001.

[10] **Problem 12.** USAPhO 2000.

[12] **Problem 13.** NBPhO 2021.

[12] **Problem 14.** NBPhO 2019.

[12] **Problem 15.** GPhO 2019.

[15] **Problem 16.** IPhO 2015.

[15] **Problem 17.** NBPhO 2022.

[20] **Problem 18.** EuPhO 2020.

[20] **Problem 19.** EuPhO 2021.

[20] **Problem 20.** APhO 2017.

[20] **Problem 21.** IPhO 2019.

Remark

A few IPhOs and APhOs have been omitted from the handouts entirely.

- IPhO 2017 has many errors, and shouldn't be used.
- APhO 2018 introduces some interesting effects in applied physics, but it has an issue common in modern APhOs. The problems are divided into many subparts (55 in total, so about 5 minutes each!), each of which is fairly straightforward undergraduate textbook physics. To do well in this kind of exam, you have to become a fast, reliable accounting machine. It's only worth doing if you care about polishing exam technique.
- APhO 2019 is also interesting, but a bit uneven in quality. Problem 1 is primarily hard because it uses a lot of jargon from more advanced physics. Problem 2 has major errors. Problem 3 is a good, but very tough 3D rotation problem.
- There was no APhO in 2020.

- APhO 2021 has the same issues as APhO 2018. Problem 1 is conceptually messy, and sensitive to modeling assumptions. Problem 2 is very tedious and well outside the Olympiad syllabus. Problem 3 is decent, though its solution is a bit confusing; it's already included in **ERev**.
- APhO 2022 is okay, but easy. The questions are like those one might see in a standard undergraduate textbook.
- APhO 2023 is decent, and illustrates some interesting ideas. It might be worth doing, though some questions are written in an unnecessarily tedious way.
- IPhO 2023 has many straightforward, standard subparts; its interesting new ideas have already been distributed throughout the handouts.
- APhO 2024 is extremely easy.
- IPhO 2024 is okay, though many of its core ideas overlap with other questions in the handouts. In particular, problem 1 is perfectly straightforward if you've done **T2**, but extremely messy and tedious.

Once you finish this and get your IPhO medal, you've outgrown Olympiad physics. The stuff covered in Olympiads *is* real physics – the rough estimates and calculations a physicist would do when exploring a new idea actually resemble what you see in IPhO and APhO problems. But the IPhO and APhO are restricted by a syllabus that assumes very little mathematical background. There is a whole lot more beautiful, fascinating stuff you can do once you pick up vector calculus and linear algebra, the two most important pieces of the physicist's toolkit. For more advice on what you can do next, see my second advice file. You have a lot of options, and you've earned it.