2022 OPhO Invitational Theory Clarifications

MAJOR NOTES

- **Last updated: July 30, 12:01 am UTC**
- We will only be adding clarifications that cannot already be found in the exam. If you are not seeing your clarification answered, try looking through the exam again to see if you did not miss anything.

Experimental Notes

- See: https://docs.google.com/document/d/1bHIC5R_OLfEVP8yAwU-YQQgCfLPJ9WwqdZALvZdbKiA/edit?usp=sharing

Problem Notes

- **T1**
- **T2**
  - The disk “wobbles”, acquiring an angular velocity Omega_0 with respect to the z-axis - think of what that means in the given set up
  - The disk rolls over a bump, rolls delta (by distance, not angle) and meets another bump
- **T3**
  - There is a typo in the problem. It should say “After time t=NL/v, there will be N particles on either side of the box” instead of t =L/v.
  - Assume the box is a 2-dimensional rectangle with horizontal length L. There are 2N particles in total, N of which start on the left side of the box and N of which start on the right side. The particles are launched in the horizontal direction.

- **T4**
    - “Level off” in part (d) refers to the phenomenon in part (c) but for a box with the conductive wall at temperature T_b/3
- **T5**
    - There is a typo in *5c).* The output state should be **i/sqrt(2) (|00>-|11>)** instead of i/sqrt(2) (|0>-|1>)
    - The written Hadamard gate should have a factor of 1/sqrt(2) in front of the matrix, in order to preserve magnitude.
    - 5i) By “implement,” please think about how you would create the gates (or create the same effects as the gates) as a physical system. It’s the real world you’re dealing with here, not just some math!
    - *Overall Hint:* Don’t overthink too much! All that is required for these questions is basic linear algebra (matrices and understanding of basis vectors) and calculus with ordinary differential equations.

Other Notes

- You are allowed to refer to Wikipedia (but not any other sources). You should typically rederive proofs instead of citing them.
- Uploading images: View this link to find how to upload images on overleaf.
- You are allowed to mix LaTeX and handwritten PDFs for your answer sheet. Note that you need to write your solution to the problem alongside your final answers. If you desire a LaTeX template, we have made one for you here. Make a copy of the project to edit the document.
- You can use basic formulae related to topics on the IPhO syllabus without derivation but all other formulae which go beyond that must be derived.
- If you find that space is running out on your LaTeX file, try to use `\newpage` and see if that fixes it.