Quantum Club

Assignment 1

INTRODUCTION TO QUANTUM PHYSICS

- Study Sec. 1.1 of the textbook (*A. I. Lvovsky, Quantum Physics: an Introduction Based on Photons*).

LINEAR SPACES. BASIS. DIMENSION.

- Study Secs. A.1–2 of the textbook and solve the exercises therein.

Problem 1.[1] Are the following sets linear spaces:

a) the set of all arithmetic progressions (i.e. each progression is treated as a single element of the set);

b) the set of all geometric progressions;

c) the set of all sequences that satisfy the condition $x_{n+1} = x_{n-1} + x_n$ (Fibonacci sequences).

Problem 2. For two bases of a linear space, one is a subset of the other. Show that these bases are identical.

Problem 3. What is the dimension of each of the linear spaces of Ex. A.1 in the textbook?

Problem 4. Problem 1 from the set
`https://users.physics.ox.ac.uk/~lvovsky/yr1maths/MT/MT%203%20V&Mps1.pdf`.

Problem 5. Problem 3 from the same set.

Problem 6. Problem 4 from the same set.

Problem 7. Problem 5 from the same set [a proof of the general formula in (c) must be given].

POLARIZATION OF LIGHT

- Study Appendix C of the textbook and solve the exercises therein.
- Download the demonstration at
`http://demonstrations.wolfram.com/PolarizationOfAnOpticalWaveThroughPolarizersAndWavePlates/`
(to run the demo, if you don't have Mathematica, you will also need the Mathematica plugin for your browser or the Wolfram CDF Player available at `http://www.wolfram.com/products/player/download.cgi`). Verify that the transformations of the waves under the action of waveplates is consistent with that described in Section C.3 of the book.
- Watch the videos `https://www.youtube.com/watch?v=_sUVXHfUVsY` and `https://www.youtube.com/watch?v=EBVNbRN805o`.

Problem 8. Complete Ex. C.2 from the textbook for

[1] Problems 1–3 originate from the Russian textbook `https://www.mccme.ru/free-books/57/davidovich.pdf`.

a) $A_H = 1, A_V = 1, \varphi_H = 0, \varphi_V = 0$;

b) $A_H = 1, A_V = 1, \varphi_H = 0, \varphi_V = \pi/4$.

Problem 9. Complete Ex. C.7 for the polarization patterns of Problem 8. For the quarter-wave plate, consider both cases $\delta\varphi = \pi/2$ and $\delta\varphi = -\pi/2$.

Problem 10. Ho would you convert the polarization pattern of Problem 8(b) to horizontal using one half- and one quarter-wave plates? What should be the angles of both plates?