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How can one learn any part of physics with minimum unexpected problems?

First of all, the essential thing to understand is that results always come with time. The key to mastering any part of physics is to keep practicing, solving problems, and reflecting. It is pointless to speak about anything else unless a person has been engaging in these activities. Often one just needs more time and the results will come.

I reflected on the practices of great physicists and converted their approach into a modern digital format, which I do find helpful for learning physics. Let us look at the metaphor inspired by Laozi's Tao Te Ching book, which illustrates the main idea of this approach.

Imagine our potential as a bowl and gaining mastery as the process of filling the bowl with water. There are various water sources around us, different abilities of bowls to retain water, and some obstacles that prevent water from getting into the bowl. The key idea is that we should not be running around in search of water. Instead, we should create a reliable bowl, which would preserve the water well, and place the bowl in a rainy location. With time, "the bowl" will be filled with "water".

This "passive learning", when "water" keeps filling the "bowl", is a metaphor for optimizing the process of learning. It implies that we are gathering information and wisdom in the process of living, as all our life and work are well-organized. There are many examples of how one can use this abstract advice, but let us focus on a key part - the organization of information that we need to work with. We can structure it in the form of digital notes, which will provide a compact and easy-to-use setup for practice due to their thoughtful structure. With such a learning environment, one will hone skills faster.

This three-page file only scratches the surface of the methodology of the suggested approach and its potential. I could provide numerous examples of how this approach can enhance one's progress in terms of increased motivation, improved prioritizing and structuring information, but it would make this file too long. If you are interested, write to me to request more information.

Part of the general algorithm for how to master any science

As the general algorithm is too big to fit into this file, I will focus on its key part: taking notes, which will allow us to "fill the bowl" (i.e. practicing and learning) most efficiently. I will skip a very important psychological aspect of this approach, focusing only on its application, so as to answer the question "What to do?".

I propose creating digital notes that will represent the "bowl" as described in the metaphor above. This is not difficult but requires being comfortable in using LaTeX and having information structuring skills. Thus, I would recommend following the note-making algorithm presented below:

1) Create a LaTeX file, with the most important parts structured as follows:
Part 1. The Summary;
Part 2. The Main Theory;
Part 3. Problems And Solutions;
Part 4. Additional Theories;

Part 5. Organizational Considerations.

The structure can slightly differ depending on the complexity and purpose but try to keep it consistent. I also often create a part with a summary of special topics, because otherwise, the first part with the summary of important topics would become too long.

2) Follow the structure of a reputable book to organize the parts of the summary, main theory, and problems. Basically, simply use the table of contents of the book to create `\sections`, `\subsections` and `\subsubsections`. Do not modify the initial structure until you develop a sufficient understanding of the field. A good structure is the key to making this approach work (i.e. "the bowl" shouldn't be damaged or uncomfortable to hold).

3) Add some solved and unsolved problems for practice to the part about problems and add some key formulas and ideas to the first part. The program "Mathpix" can be helpful in this. Adding a lot of text and explanations to the summary part will not help in problem-solving, so avoid doing it.

If a person is used to LaTeX, it will take them about 30 minutes to complete these first steps. If they are not used to it, the best advice is to limit time on figuring LaTeX issues, and not to think about them much until the physics is thought out (this is obvious from the general understanding of prioritizing of activities).

4) Now that you have selected the main formulas in the summary, start thinking about solved problems, and, in the meantime, make adjustments to the notes by clarifying the guidelines, writing solutions to the unsolved problems, and optimizing solutions to the solved problems. This work is "adjusting the bowl", enabling it to gather "water" better. It is important to focus more on understanding the subject matter than on writing; however, making a good note and improving understanding are correlated.

5) For all theory questions, we have theoretical parts: create a `\paragraph` with the question that arose (if it is important) in the relevant section in the structure and fill it with the current view of it to think about it at an appropriate time. After some practice, you will feel that you have understood the subject. That's the time to write the theoretical parts. One could start doing it from the beginning, but in many cases, it is possible to solve problems without writing theoretical parts, so I don't recommend doing it as a part of the general algorithm. To create them, Snip.Mathpix pdf to LaTeX extractor can be helpful to add theory from well-established books or to download lecture notes from arxiv.org as `.tex` file (if they are available here.). If needed, change this theory by adding examples, additional explanations, and rewriting statements. With time, it is likely to become completely restructured and rewritten.

6) A typical learning is a process of making the structure of the notes more adaptive to solving problems faster and understanding the theory deeper. The most time-consuming and complicated part of this process is not writing, but achieving an understanding. Having created notes, we are able to focus on the subject-matter, which will make our understanding more profound. This will lead to making adjustments to the structure and/or content. The typical cycle of learning is adjusting the structure and changing the theory inside the structure.

I want to emphasize again and paraphrase the metaphor in the beginning: the structure of the notes determines how the whole process of learning goes. In a good bowl the water keeps gathering well, unlike in a bad bowl, where water has a little chance to gather). With a good structure, there will be very few unexpected problems.

In terms of programs and web pages, here is a list of tools that I use to create notes (in the order of importance): TeXstudio, Windows shortcuts for text editing, Notepad++, MathPix, Arxiv-s .tex sources, Sci-hub, git, and Python script for modifying all files at ones.

The last thing to mention is that the first several months of creating digital notes can be quite challenging as one will need to develop the skills of using LaTeX, structuring information, and prioritizing all activities to avoid wasting time. It is crucial to have the skill of focusing on important topics, otherwise, this approach would give not so much understanding. Adopting this approach may seem complicated, but it is not so hard. One needs just to practice to work with, and without practice, it will not work. The hardest part in the algorithm is the process of understanding. not writing, and it can be much easier if you regularly speak with someone knowledgeable in physics. This is the best way to progress fast with this method.

To conclude, structured digital notes are a powerful tool that in the long run will give one a deep understanding of the subject, a well-organized database of information, and a high level of motivation.

Are your notes completed?

No, they are not. Generally, working on these notes is a life-long project, and it requires 5 years of work to create notes on all basic parts of physics and mathematics if one is not focused a lot on research. The improvement of notes manifests a path to mastery, and this path isn't a short one. However, studying a subject at the basic level should take about one semester, since there will be practically no work on the theoretical parts, but only on the parts of summary and problems. Additionally, there is no need to finish notes, because one can make just a good structure, a good first part with a summary, some good sections with specific theory, and it will be enough to do good research, write articles, create educational or popular science videos, or pass all exams in any University. This is how the notes are intended to be used.

In fact, there is no sense in making them available to the public during the first years of working on them. I have posted them on my page for a limited circle of friends and colleagues, who might be interested in collaboration and discussion.

Why is some text written in Russian?

The first reason is that I worked on many parts during my Bachelor's and Master's programs in MIPT, where education was in Russian. The second reason is that sometimes books are available for free only in Russian, so I put theory from them into my theoretical parts and don't think about translation when I think about physics. Translation requires time and I don't have much it.

Is this approach useful in research?

Despite the obvious advantages of this approach, the results of research for one without PhD depend on a lot of factors, such as one's educational background, the supervisor, time and resources available, etc. This approach cannot change the results predetermined by these conditions. However, in the long run, this should also greatly help in research, since it is a generalization of the Fermi method, the Feynman method and others.