

**Organic Electronic Materials 2025 Exercise 1 (submit on 14.03.25)**

1. What is the difference between a metal, a semiconductor, and an insulator? Illustrate your answer. Explain the consequence of this difference on their conductivity, and clarify the distinction between conductivity and mobility.
2. Give the time-independent Schrödinger equation in its most general form, briefly name/define all parameters/variables that appear in it, and paraphrase the meaning of the Schrödinger equation. Why is it actually a differential equation?
3. What is an atomic orbital? Explain how it is graphically represented.
4. What is the valence shell? Why are noble gases particularly stable?
5. Explain the VSEPR model. Draw and explain the structure of  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{PF}_5$ ,  $\text{BF}_3$ ,  $\text{SO}_2$ , and  $\text{CO}_2$ .
6. Explain the concept of “hybridization” of atomic orbitals and what it is useful for. Detail the case of carbon atoms in its three different states of hybridization, including AO energy level diagrams and pictorial representations of the derived hybrid AO.
7. The construction of hybrid orbitals and molecular orbitals both use linear combinations of atomic orbitals. Give a simple answer, what is the difference between the two?
8. **Homework** – After reading the two articles “Progress and Challenges in Commercialization of Organic electronics” and “The Dawn of Organic Electronics”, write a few sentences on each of the following questions:
  - What are the shortcomings in organic electronic devices?
  - What reasonable applications can you envision for organic electronic devices?
  - With some light research online (Google Scholar...) find a recent application of organic electronics that you find interesting.

**Further reading:**

*Organic Chemistry*, Clayden, Greeves & Warren 2012 – Chapter 4 – Structure of molecules (or the corresponding chapter in any other organic chemistry book)

*Physical Chemistry*, Atkins & de Paula -Chapter 8– Quantum Theory: Introduction & Principles