

Physics 2

List of possible questions (10 will be selected – max. one from each group):

- 1a: Describe magnetic dipole and the character of its field. Define the magnetic flux.
- 1b: Define magnetic intensity and induction, give the basic relation between them.
- 1c: Explain basic magnetic property of the material (permeability) and explain basic types of material – diamagnetic, paramagnetic and ferromagnetic.
- 2a: Explain magnetic hysteresis.
- 2b: Explain concept of magnetic domains.
- 2c: Explain Curie's temperature.
- 3a: Write the Lorentz force (law) for a particle with charge q and velocity \mathbf{v} .
- 3b: Explain the right-hand rule for Lorentz force (law).
- 3c: Describe the Biot-Savart law.
- 4a: Faraday's law of induction – define the electromotive force (and its unit).
- 4b: Faraday's law of induction – define the inductance).
- 4c: Describe the difference between a DC dynamo and AC alternator.
- 5: Give Maxwell's equations in integral or differential form.
- 6a: Explain the character of EM waves (with the right hand rule for wave description).
- 6b: Explain the role of Poynting vector in EM waves description.
- 6c: Explain the known EM spectrum, define the limits of visible light wavelengths.
- 7a: Explain basic properties of light reflection and refraction (and diffraction).
- 7b: Explain properties of different types of lenses and mirrors (explain optical microscope).
- 7c: Explain the black body radiation.

8a: Write the law of reflection.

8b: Write the law of refraction.

8c: Write the thin lens formula.

9a: Briefly explain the principle of optical microscope.

9b: Briefly explain the principle of light emitting diode.

9c: Briefly explain the principle of laser.

10a: Give Einstein's two postulates of Special theory of relativity.

10b: Explain the Lorentz transformations equations (time dilation and length contraction).

10c: Give the known relation between mass and energy.

11a: Explain the spacetime diagram and light cone.

11b: Explain tenets of general theory of relativity and principle of equivalence.

11c: Explain properties of spacetime (curvature, gravitational lensing, etc.).

12a: Explain Thomson's, Rutherford's, Bohr's and cloud models of atom.

12b: Describe properties of nucleons and first experiments of their detection.

12c: Explain photoelectric effect and Plank's (Einstein's) interpretation.

13a: Explain the binding energy of nucleus.

13b: Explain alpha, beta, gamma and neutron radiation.

13c: List four radioactive series and 3 basic types of radiation.

14a: Give the four basic classes of phenomena in quantum mechanics.

14b: Explain the Heisenberg's uncertainty principle and write the Schrödinger's equation.

14c: Give the basic elements of The Standard Model (elementary particles categories and force carriers).

List of possible exercises (2 will be selected):

(list of basic physical constants can be used, and also a calculator - but NOT a mobile-phone!)

1. Calculate the magnetic induction in vacuum in a small distance from very long straight wire, when the current is given?
2. What refraction angle has a light ray, entering from air into water under given incident angle? The value of the refraction index for pure water is 1.33.
3. Vertical line object with given height is located in a given distance in the front of a camera lens. Find the distance of the image from the lens, when the focal length of the lens is given.
4. Certain physical process requires very short time to occur in an atom at rest in a laboratory. How much time will an observer measure, when the atom is moving with a very speed (close to the speed of light)?
5. Consider a parallel plate capacitor, which is maintained at electrical potential U . Calculate the displacement current for a very short time interval, when is given the distance between the plates and the area of the plates.
6. The half-life of selected radioactive isotope is given. Find the time in which the total amount of not decayed atoms equals to some percentual part of the original amount.