

1100-FWD-OG Physics in Experiments

Program

We are going to present a selection of simple physical experiments and explain them in terms of laws of physics. Most of the experiments are designed in a way allowing the student to repeat them at home. Calculations will be reduced to a strict minimum. However, we describe also phenomena that have much large scale (light years) or much smaller scale (nanometers).

1. Force and movement

- 1.1 The basic concepts of mechanics:** force, vectors, pressure, floating, equilibrium, torque.
- 1.2 Description and prediction of movement:** velocity, laws of dynamics, linear and parabolic functions, rotational motion, moment of inertia.
- 1.3 Matter and conservation rules:** conservation of momentum and energy, work, Bernoulli's law, angular momentum conservation principle.

2. Heat and molecules

- 2.1 Temperature and molecules:** temperature, Brownian motion, heat, 1st law of thermodynamics, statistical physics, isobaric process, ideal gas law.
- 2.2 Engines:** atmospheric pressure, adiabatic process, 2nd law of thermodynamics, engines and heat pumps, entropy.
- 2.3 Organisation of matter:** phase transitions, saturated vapour, crystals, surface tension, capillary effect.

3. Fields and currents

- 3.1 Electricity:** electrostatics, electric charge and current, field concept, force field, electrostatic field, Kirchhoff's laws.
- 3.2 Magnetism:** electricity and magnetism, magnetism, central and magnetic fields, induction, EM waves, motors and generators.
- 3.3 Electrons inside matter:** electrochemistry, quantum states, semiconductors, diodes, solar cells.

4. Vibrations and waves

- 4.1 Periodic movement:** rotational motion, vibration, elastic force and oscillating motion: oscillator equation, beat, superposition of oscillations, resonance.
- 4.2 Resonators and waves:** normal modes, acoustic resonators: types of resonators, modes, Young's law, spectrum of vibrations, standing and travelling waves.

5. Visible and invisible light

- 5.1 Properties of light:** EM waves, light spectrum, interference, comparison with electrons, photons, polarisation of light.
- 5.2 Emission and perception of light:** UV, luminescence, infrared, lasers, color vision, color coding.