

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: magnetic fields, induction, electricity and magnetism, magnetism, 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.

4.3 Secrets of waves: electromagnetic waves, longitudinal and transverse waves, polarization, gravitational waves, Doppler effect, X-rays.

5. Visible and invisible light

5.1 Properties of light: 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.