

Required knowledge in Physics

NB: General concepts as energy conservation and momentum conservation laws are a must for the test.

1 Newtonian mechanics

The laws of movement of a point with mass m submitted to external forces must be known, in one, two and three dimensions. The core Newton laws must be mastered by the candidates : the principle of inertia, the principle of action and reaction, the fundamental equation of dynamics, as well as the angular momentum theorem, the kinetic energy theorem. Notions of non-inertial frames and forces referred to as *inertia* forces are pre-supposed (in particular, in the case of linear acceleration and uniform rotation frames). The questions of this part will cover the three levels (+),(++) and (+++). Basics knowledge of newtonian mechanics applied to ideal fluid as well as hydrostatic laws must be known by the candidates, and these questions will be of level (++).

2 Solid mechanics

Within this syllabus, the mechanics of solids deals with both rigid and deformable bodies. Additionally, only solids rotating about a fixed axis are a possible examination topic. The knowledge of tensors is required. The expression of the kinetic energy of a rotating solid should be known. Some question might also cover the chock between solids, therefore the knowledge of conservation laws are required. All these questions will be of level (++) and (+++).

3 Thermodynamics: ideal gas, reversible thermodynamical cycle

The usual thermodynamics functions as internal energy, entropy, enthalpy, free energy, free enthalpy, as well as their differentials must be known. The candidates are also expected to master the concepts and equations related to the thermal flux. The heat capacities at constant volume and at constant pressure equal the partial derivatives of internal energy and of enthalpy with respect to the temperature must also be known by the candidates. The definitions of extensive and intensive variables, as well as of thermodynamic equilibrium must be known. The gas will be considered as perfect, and the equation $PV = nRT$ must be mastered. The entropy for ideal gas as function of volume, pressure and temperature must also be known. The three principles of thermodynamics must be known. The reversible thermodynamical cycles must also be known. The isobaric and adiabatic process must be known by the candidates. The questions will cover the three levels (+),(++) and (+++).

4 Geometrical optics

The concept of light rays, reflection and refraction by a plane mirror and the Snell – Descartes’ laws, as well as the focalisation by lenses, must be known. The questions will not concerns wave optics, and will cover the three levels (+),(++) and (+++).

5 Electromagnetism

Coulomb’s law, the concept of electric field, electrostatic field E , current circulation and flow under static electric field must be known. The magnetic field B , the symmetry properties of B and the interaction of magnetic field with a charged particle must be mastered by the candidates. The candidates must also know the Maxwell equations. These questions will cover the three levels (+),(++) and (+++).

6 Electronics

Electric voltage, Kirchoff’s laws of knots and meshes, electrical current, Ohm’s law and the superposition theorem must be known. The physical bases of operation of the basic circuit components: resistor, capacitor, induction coil, are required. Circuits with flip-flops and MOS, as well as filter gain must also be known by the candidates. Their impedances in a sinusoidal regime must be known, as well as the transient regime of

charging and discharging a capacitor. The candidates must also know the basic examples of RC, RL, LC and RLC circuits, as well as circuits with operational amplifiers and transistors. Candidate must also know the boolean logic. The questions will cover the three levels (+),(++) and (+++).

7 Quantum mechanics

Candidates must master the concept of hamiltonian, and must know the Schrödinger equation, as well as how to solve it in the majority of simple cases, when the potential energy is constant and in the case of the harmonic oscillator. The eigen energies and eigen vectors of the hamiltonian in the case of standard potential energy like quantum well, harmonic oscillator and Coulomb potential must be known. The candidates must also master the concept of wave function, together with its meaning and its physical properties. The questions will cover the three levels (+),(++) and (+++).