

Sample Exam Questions - Module 6

- 1) One of the most important successes of the kinetic theory of gases is the derivation of the ideal gas law from the assumption that a gas is made of a very large number of small particles in rapid motion. Explain the basic steps of Kroenig's (1852) and Clausius's (1857) derivations of the ideal gas law. What are the consequences for the concept of temperature?
- 2) In his celebrated *The Nature of Motion which we call Heat* Clausius (1857) argues that translation alone cannot account for the total amount of heat present in a gas, so that there needs to be other movements (e.g. rotation, vibration). Reconstruct and analyse his argument.
- 3) Soon after Clausius (1857) paper, the Dutch meteorologist Christoph Ballot presented rather simple empirical evidence to refute its results. Later known as the "dinning room rebutal", the critic can be reconstructed as follows: "If I were sitting at one end of a long dining room and a butler brought in dinner at the other end, it would be some moments before I could smell what I was about to eat. If atoms were flying at hundreds of meters per second, I should smell the dinner as soon as I saw it." What is the basis of Ballot's critique? In response, Clausius proposed the first essentially statistical concept of thermodynamics. What is this concept and how is it derived by Clausius?
- 4) In 1860 Maxwell presents the first derivation of his famous velocity distribution. Present and analyse the arguments that led him to this expression.
- 5) In 1872 Boltzmann publishes the paper *Further Studies on the Thermal Equilibrium of Gas Molecules*. What is the main goal of the paper? Was it achieved?
- 6) In response to the so-called Loschmidt's paradox, in 1877 Boltzmann writes the paper *On the Relation of a General Mechanical Theorem to the Second Law of Thermodynamics*. What is the content of this paper and is it a groundbreaking work of the history of physics?