Tutorial sheet 14: Summary list of discussion topics

- Which idealizations underlie the description of a macroscopic many-body system as a continuous medium?
- How is local thermodynamic equilibrium defined?
- What are the Lagrangian and Eulerian descriptions?
- How is a fluid defined?
- What are the strain rate tensor, the rotation rate tensor, and the vorticity vector? How do they come about and what do they measure?
- What is the Reynolds transport theorem (and its utility)?
- Give the basic equations governing the dynamics of perfect fluids. Which physics principles do they embody?
- What is the Bernoulli equation? Give some examples of application.
- What is Kelvin's circulation theorem? What does it imply for the vorticity?
- What is a potential flow? What are the corresponding equations of motion?
- What is a sound wave? How do you derive the corresponding equation of motion? How is the speed of sound defined? What happens when the wave amplitude becomes large?
- What are the fundamental equations governing the dynamics of non-relativistic Newtonian fluids?
- Dynamical similarity and the Reynolds number
- What are the equations describing flows at small Reynolds number?
- Turbulence in fluids: what is it? Why does it require a Reynolds number larger than some critical value to develop? In fully developed turbulence, what are the mean flow, the fluctuating flow, the Reynolds stress tensor, the energy cascade?
- Convective heat transfer: what is the Rayleigh–Bénard convection? Describe its phenomenology. Which effects play a role?
- What are the fundamental equations of the dynamics of a relativistic fluid?
- What is the relation between the energy-momentum tensor of a perfect relativistic fluid and its internal energy, pressure, and four-velocity? How is the latter defined?