Equations to be derived, Fluid Mechanics oral exam for a mark of five
for the English course (intentionally the same as for the Hungarian course)

1. Continuity theorem and application for a streamtube.
2. The velocity distribution in a potential vortex
3. Computation of the mass flow rate in a pipe for a given v = f(r) velocity profile.
4. Movement of small fluid parcels.
5. Expression for the temporal change of a scalar flow variable (e.g. density) for a unit time, local and convective acceleration.
6. Derivation of the Euler equation (component equations, vector form).
7. Derivation of the basic equation of hydrostatics, its solution for a constant density and a potential force field, as well as for the case of an isothermal atmosphere.
8. Derivation of the tangential and normal component equations of the Euler equation in the streamline coordinate system (otherwise known as the streamwise or natural coordinate system).
9. Bernoulli equation, simplification assumptions.
10. Derivation of the Euler turbine equation for a radial impeller.
11. Derivation of the Thomson theorem.
12. Derivation of the Hemholtz 1st and 2nd theorem.
13. Derivation of the integral momentum theorem (including the $\underline{R}$ force vector).
14. Borda discharge nozzle, contraction.
15. Borda-Carnot loss.
16. Pelton turbine.
17. Derivation of the force acting on a propeller (including the velocity v passing the propeller and the propulsive efficiency)
18. Derivation of the Kutta-Joukowski theorem.
19. Pressure difference due to surface tension.
20. Derivation of the vectorial form of the momentum equation for viscous fluids (without expressing the stress tensor as a function of the velocity gradient tensor)
21. Starting with the vectorial form of the momentum equation for viscous fluids, the derivation of the most general form of the momentum equation.
22. Derivation of the Navier-Stokes equation starting from the most general form of the momentum equation, its rearrangement and the explanation of this form of the equation.
23. Similarity of flows, determining the Reynolds and Froude numbers.
24. Derivation of pressure loss in a fully developed laminar pipe flow.
25. Open surface channels, the Chézy expression.
26. The momentum equation for temporally averaged velocities, derivation of the Reynolds shear stresses from the Navier-Stokes equation.
27. Friction losses for compressible flows in a pipe.
28. Boundary layer equations and their simplifications, their application in the case of turbulent flows.
29. Prandtl's mixing length theorem, and the universal law of the wall.
30. The energy equation.
31. The shape of $v=f(p_o)$, $A=f(p_o)$ curves, its characteristic values, the Laval nozzle.
32. The propagation speed of pressure waves, the speed of sound in air.
33. The pressure wave phenomena occurring when closing the end of a pipe, the amplitude of the wave, its reflection from the open and closed end of a pipe.
34. The application of the Bernoulli equation for compressible flows.