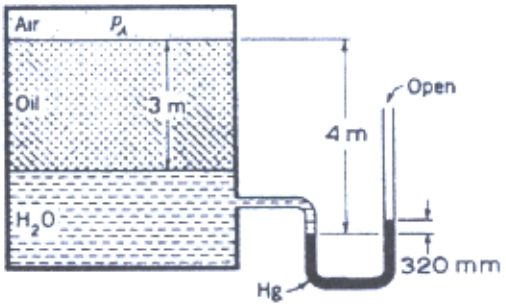
93學年度國立成功大學系統及船舶機電工程學系 甲組 流體力學 研究所招生考試 試題

1. Please explain the following terms in Chinese: (15%)
   A. Kinematic viscosity. (3%)
   B. Incompressible fluid. (3%)
   C. Boundary layer. (3%)
   D. Kutta-Joukowski Law (3%)
   E. d'Alembert's paradox (3%)

2. A military submarine is required to sail at a speed of 20m/s at a depth of 500m. What is the minimum pressure its hull must be able to resist at its bow (the stagnation point)? The density of sea water is 1030 kg/m^3. (15%)

3. For the set up in Fig.1, what is the pressure Pa if the specific gravities of oil and mercury are 0.75 and 13.6, respectively? (10%)



4. Water (density=1000kg/m^3, kinematic viscosity=1.12x10^{-6} m^2/s) flows in a smooth round pipe (diameter=150mm) at an average velocity of 12m/s.
   A. Calculate its Reynolds number. (3%)
   B. Is this pipe flow laminar? Why? (3%)
   C. Calculate its mass flow rate. (4%)

5. The potential flow around a circular cylinder can be expressed as $\phi = Ur(1+a^2/r^2)\cos\theta$ where a is its radius and U is mean flow velocity. Derive the tangential velocity and pressure distribution on its surface. (15%)

6. Prove that a ship model test which needs to consider dynamic similarity can not be done on the earth using the same fluid, if both Reynolds number and Froude number are required to be the same for the model and the real ship. (20%)

7. A rectangular hydrofoil is moving at a speed of V and encountering a drag force D and a lift force L. Its area is S. The fluid's density is ρ. Use dimensional analysis to analyze this problem and let lift and drag forces be non-repeating variables to derive lift coefficient and drag coefficient. (12%) How can a hydrofoil's efficiency be expressed by these two coefficients? (3%)