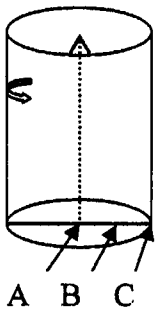
(你可以使用一般非程式電子計算機，但不可以使用電子字典; You may use a general non-programmable electronic calculator but not any electronic dictionary.)

1. (20%) A closed, fully-filled, circular water tank, of radius one meter and height 3 meters, rotates at a constant speed of 30 rpm's about the generator, as shown in the figure. Three points A, B, C, located horizontally on the bottom of tank at distances 0.0, 0.5, and 1.0 meters, respectively, from the centerline have the measured pressures as P_A, P_B and P_C. (a) Please write down the pressure-difference ratio of $r = (P_B-P_A)/(P_C-P_A)$; (b) If we move these points from the bottom surface to the top cover, what does the ratio r become? (c) What is the force increment on the tank wall due to the increasing rotation of tank by twice? (Using water density=1000 kg/m^3, gravitation constant g=10 m/s^2 in your calculation for simplicity)



2. (20%) Consider the two-dimensional fluid flow of density ρ due to a uniform flow U passing a circular cylinder of radius a. Please discuss the potential flow field around the cylinder. (You may discuss, e.g., the acceleration or deceleration of flow approaching to the cylinder, the potential lines and streamlines near the cylinder, the locations and values of maximum and minimum velocities, the stagnation points, the pressure distribution on the cylinder, etc.)

3. (20%) Hele-Shaw flow is the viscous flow between two infinite, parallel plates of small gap under low Reynolds number. In laboratory, we often use dye to observe the streamlines of the potential flows around some smooth or blunt bodies, or the potential flow disturbed by sources or sinks.
   Please describe (a) why those smoke lines can be recognized as the streamlines. (b) why the viscous flow pattern can be considered as the similarity of the two-dimensional potential flow. (c) why, however, you may still observe some particular phenomena like flow separations or wakes, which are obviously not the phenomena of potential flows.

4. (30%) Explain (but not just translation) the following terms:
   (a) material derivative, (b) Bernoulli principle, (c) hydraulic gradient line, (d) Froude number, (e) laminar and turbulent flows, (f) water hammer.

5. (10%) List all the possible factors causing the head losses in a pipe system and explain in detail their corresponding flow mechanisms related to the head loss.