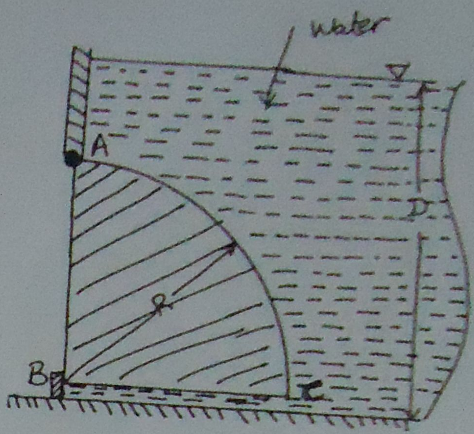
Major Examination Part B **APL105** **2-05-2015**

Answers to Part A have to written on the provided question paper. There is negative marking for MCQ type questions. Negative marks awarded for wrong answers or for marking more than 1 choices. For 1 mark questions 0.25 negative mark, For 2 mark questions 0.5 negative mark and for 3 and 4 mark questions, -1 negative mark. The marks are written in parenthesis at the end of each question.

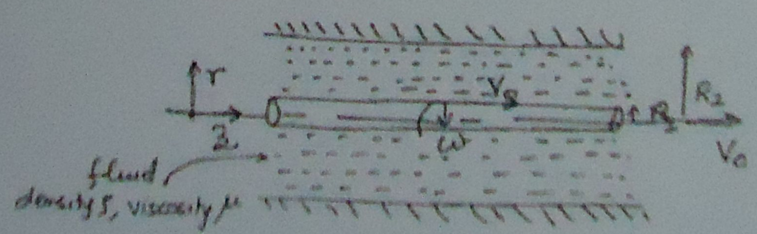
Q1. A gate (ABC), in shape of a quarter circle, hinged at A and sealed at B, is 2 m wide. In the given figure D = 3m and the radius R = 2m. Determine the force on the stop at B assuming that it acts only in the horizontal direction. Neglect the weight of the gate. (15)



Q2. In a textile manufacturing process, a wire of radius R_1 is being pulled out from a cylindrical tank of fluid of constant density ρ and viscosity μ. The radius of the tank is R_2. The wire is spinning about its axis with an angular speed ω and also has an axial velocity V_0. We wish to obtain the velocity profile of the fluid occupying the region $R_1 \le r \le R_2$. The following approximations can be made:

i. Gravity can be neglected.
ii. Since the wire is long, $\partial \mathbf{V} / \partial z = 0$.
iii. The flow is steady so **V** and p do not change with time.
iv. The flow is axisymmetric so **V** and p do not change with θ.
v. $\partial p / \partial z = 0$.

a) State the boundary conditions on **V**.
b) Simplify the continuity equation and solve for V_r.
c) Simplify the appropriate components of the Navier Stokes equations to obtain the velocity profile.
d) Estimate the power required per unit length of wire to carry out this operation. Hint: Due to Force, Power = (Force X Velocity) and due to Moment, Power = (Moment X Angular Velocity).



(20)

Reynolds Transport theorem

$$\frac{dB}{dt} = \frac{\partial}{\partial t}\iiint_{V} \beta \rho \, dV + \oiint_{CS} \beta (\rho \vec{V}\cdot\hat{n}) \, dA$$

mass balance $\beta = 1$, momentum balance $\beta = \vec{V}$