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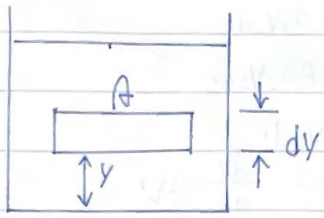
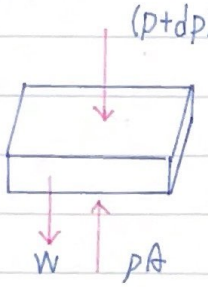
Fluid Mechanics

Pressure in a Fluid



$dV = A\,dy$, $dm = \rho dV = \rho A\,dy$, $dW = dm\,g = \rho g A\,dy$

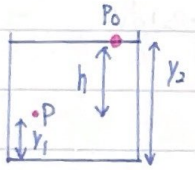


$\sum_i y = 0 \quad pA - (p+dp)A - \rho g A\,dy = 0$

$pA - pA - dp - \rho g\,dy = 0$

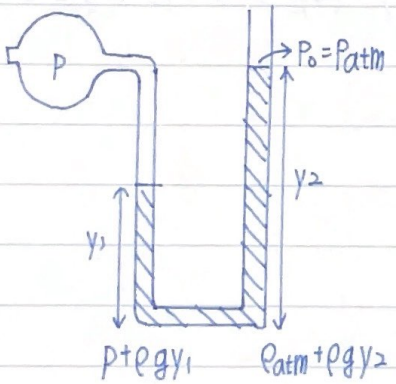
$$\frac{dp}{dy} = -\rho g$$

$$p_2 - p_1 = -\rho g (y_1 - y_2)$$



$P_0 - p = -\rho g (y_2 - y_1) = -\rho g h$

$\Rightarrow \quad p = p_0 + \rho g h$



$p + \rho g y_1 = p_{atm} + \rho g y_2$

$p - p_{atm} = \rho g (y_2 - y_1) = \rho g h$

p: absolute pressure

$p - p_{atm}$: gauge pressure

Q&C

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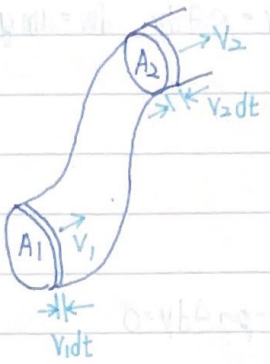
Fluid Flow

continuity equation



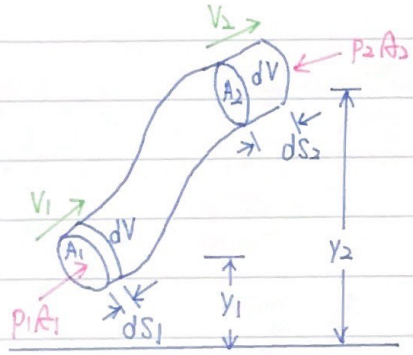
$dV_1 = A_1V_1dt \quad dV_2 = A_2V_2dt$

$dm_1 = \rho A_1V_1dt \quad dm_2 = \rho A_2V_2dt$

$\rho A_1V_1dt = \rho A_2V_2dt$

$\Rightarrow A_1V_1 = A_2V_2 \qquad \frac{dV}{dt} = AV$

Bernoulli's Equation



if the fluid is incompressible

$dV = A_1ds_1 = A_2ds_2$

$dW = p_1A_1ds_1 - p_2A_2ds_2 = (p_1 - p_2)dV$

$dK = \frac{1}{2}\rho dV(v_2^2 - v_1^2)$

$dU = \rho dV(y_2 - y_1)$

$dW = dK + dU \Rightarrow p_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = p_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$

Q&C