

18/ENG03/028

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1)  $V_1 = 5 \text{ m/s}$   $V_2 = 2 \text{ m/s}$   
 High 5m water = 2.5m  
 $h = (0.55(w_1 - v_1)^2) / 2g$   
 $L = 20m$

Pressure at 2m and  
 $L = z_1 = z_2$   
 $P_1 + \rho V_1^2 + \rho z_1 = P_2 + \rho V_2^2 + \rho z_2 + \rho h$   
 $P_1 = P_2 + \rho L (V_1^2 - V_2^2) + \rho (z_1 - z_2) h$   
 $= 2.5 + 5^2 - 2^2 + 2 - (0.55(5-2)^2) / (2 \times 9.81) \times 2 \times 9.81$   
 $= 2.5 + 10 + 2 - 0.1655$   
 $P_1 = 5.40 \text{ bar}$

Pressure lower end is 5.40 bar  
 2) Inlet diameter = 20cm  
 Throat diameter = 10cm  
 $P_1 = 17.659$   
 $g = 300m$   
 $Q = 0.78$

$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (0.2)^2}{4} = 0.0314 \text{ m}^2$   
 $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi (0.1)^2}{4} = 0.00785 \text{ m}^2$   
 $g = 300m$   
 $P_1 = 17.659$   
 $= 17.659 = 1.7659 \times 10^5 \text{ Pa}$   
 $\frac{P_1}{\rho} = \frac{1.7659 \times 10^5}{1.21} = 1.46 \times 10^5 \text{ m}^2/\text{s}^2$

$\frac{P_2}{\rho} = 0.3 \times 136 = 40.8 \text{ of } H_2O$   
 $h = \frac{P_1}{\rho} - \frac{P_2}{\rho} = 1.2 \times 10^5 - (4 \times 10^4)$   
 $h = 4 \times 10^4 \text{ Pa}$   
 $Q = C_d A_1 A_2 \sqrt{2gh}$   
 $Q = 0.98 \times 0.0314 \times 0.00785 \sqrt{2 \times 9.81 \times 4 \times 10^4}$   
 $Q = 0.000241 \times 8.947$   
 $Q = 0.00215 \text{ m}^3/\text{s}$   
 $A = 0.0201 \text{ m}^2/\text{s}$

3)  $D_1 = 15cm$   $D_2 = 30cm$   
 Suction of mercury = 0.5m  
 $S.G. = 13.6$   $C_d = 0.98$   
 $A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (0.15)^2}{4} = 0.0177 \text{ m}^2$   
 $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi (0.3)^2}{4} = 0.0707 \text{ m}^2$   
 $h = y \left[ \frac{P_2}{\rho} - 1 \right]$   
 $h = 0.5 \left[ \frac{P_2}{\rho} - 1 \right]$   
 $Q = C_d A_1 A_2 \sqrt{2gh}$   
 $= 0.98 \times 0.0177 \times 0.0707 \times \sqrt{2 \times 9.81 \times 0.5 \left[ \frac{P_2}{\rho} - 1 \right]}$   
 $= 2.994 \times 10^{-3} \times 11.765$   
 $= 0.0351 \text{ m}^3/\text{s}$

4)  $y = 170 \text{ mmHg} = 0.17 \text{ mHg}$   
 $S.G. = 13.6$   $S.G. = 1026$   
 $DH = y \left[ \frac{P_2}{\rho} - 1 \right]$   
 $Dh = 0.17 \left[ \frac{P_2}{\rho} - 1 \right]$   
 $Dh = 2.08 \text{ m}$   
 $v = \sqrt{2gh}$   
 $v = \sqrt{2 \times 9.81 \times 2.08}$   
 $v = 6.38 \text{ m/s}$

5)  $Q = 0.05 \text{ m}^3/\text{min} = 8.33 \times 10^{-5} \text{ m}^3/\text{sec}$   
 Speed of rotation = 1700 rev/min = 28 rev/sec  
 Torque input = 15Nm  
 Pressure Change = 15 bar = 15 x 10<sup>5</sup> Pa  
 Head  $A_1 - A_2 = \text{Nozzle diameter} \times \text{Speed Rotation}$   
 $= 10^{-3} \times 28.3 = 2.83 \times 10^{-2} \text{ m}^2/\text{sec}$

