classmate

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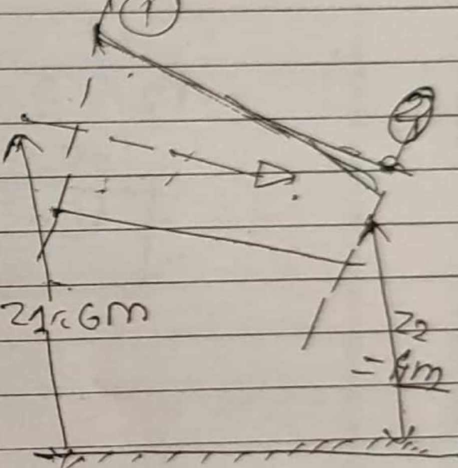
(2) The water is flowing through a pipe having diametres 20cm and 10cm at at section (1) and (2) respectivelly. The rate of flow through pipe 35 Litres/sec. The section (1) is 6m above datum and section (2) is 4m above datum. If the pressure at section (1) is 39.24 N/sec^2. find the intensity of pressure at section (2).



$\boxed{1 \text{ litre} = 10^{-3} m^3}$

Given

$D_1 = 20cm = 0.2m, \quad D_2 = 10cm = 0.1m$

$Z_1 = 6m, \quad Z_2 = 4m$

$P_1 = 39.24 N/cm^2, \quad P_2 = ?$

$= 39.24 \times 10^4$

$Q = A_1V_1 = A_2V_2$

$35 \text{ litre} = \frac{\pi}{4} \times (0.2)^2 \times V_1 = \frac{\pi}{4} \times (0.1)^2 \times V_2$

$= 35 \times 10^{-3} = \frac{\pi}{4} \times (0.2)^2 \times V_1 = \frac{\pi}{4} \times (0.1)^2 \times V_2$

$V_1 = 1.114 m/s$

$V_2 = 4.456 m/s$

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from Bernoulli's eqⁿ,

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

$$= \frac{39.24 \times 10^4}{1000 \times 9.81} + \frac{(1.114)^2}{2 \times 9.81} + 6 = 0$$

$$= \frac{P_2}{1000 \times 9.81} + \frac{(4.456)^2}{2 \times 9.81} + 4$$

$P_2 = 402712.272 \ N/m^2$

$$\boxed{P_2 = 40.27 \ N/cm^2}$$

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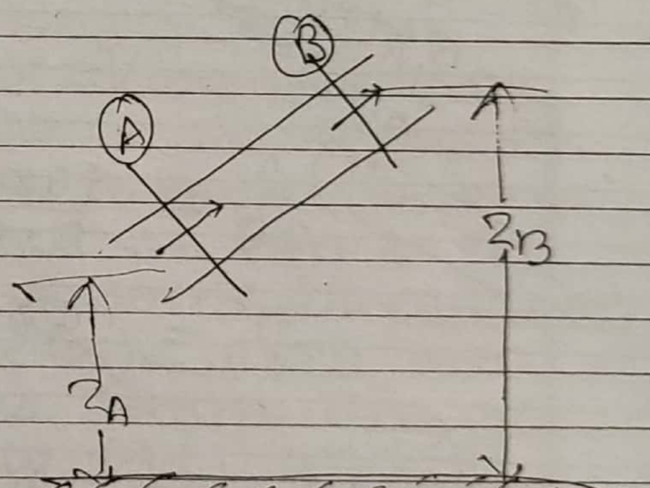
A pipe of diametre 400 millimetre carries water at a velocity of 25 m/sec. The pressures at the point A and B are given as 29.43 N/cm² and 22.563 N/cm² respectively. Where the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B.

$$E_A = \frac{P_A}{\rho g} + \frac{V_A^2}{2g} + Z_A$$

$$E_B = \frac{P_B}{\rho g} + \frac{V_B^2}{2g} + Z_{B_A}$$



$D_A = D_B = 400mm = 0.4m$

$V_A = V_B = 25 m/s$

$P_A = 29.43 N/cm^2$

$P_B = 22.563 N/cm^2$

$Z_A = 28m$

$Z_B = 30m$

$h_L = ?$

$$E_A = \frac{P_A}{\rho g} + \frac{V_A^2}{2g} + Z_A$$

$$= \frac{29.43 \times 10^4}{1000 \times 9.81} + \frac{(25)^2}{2 \times 9.81} + 28\,m$$

$$= \cancel{59.85}\ 89.85 \text{ (in terms of head)}$$

$$E_B = \frac{P_B}{\rho g} + \frac{V_B^2}{2g} + Z_B$$

$$= \frac{22.563 \times 10^4}{1000 \times 9.81} + \frac{25^2}{2 \times 9.81} + 30$$

$$= 84.85\,m \text{ (in terms of head)}$$

Hence energy loss = 89.85 − 84.85

= 5m (~~in terms of~~ of water column

Q. considered two sections ① and ② in an ideal, horizontal, nozzle flow. The cross sectional area ratio is $\frac{a_1}{a_2} = 2$ then find the pressure coefficients $\frac{P_1 - P_2}{\frac{1}{2}\rho V_1^2}$

Sol:- $A_1V_1 = A_2V_2$

from Bernoullis equation.

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

for horizontal nozzle $Z_1 = Z_2$

so $$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g}$$

$$\Rightarrow \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$$

$$\Rightarrow \frac{P_1 - P_2}{\rho \cancel{g}} = \frac{1}{2\cancel{g}}(V_2^2 - V_1^2)$$

$$\Rightarrow \frac{2(P_1 - P_2)}{\rho} = V_2^2 - V_1^2$$

$$\Rightarrow \frac{P_1 - P_2}{\frac{1}{2}\rho} = V_2^2 - V_1^2$$

$A_1V_1 = A_2V_2$

$$\frac{P_1 - P_2}{\frac{1}{2}\rho V_1^2} = \left(\frac{A_1}{A_2}\right)^2 - 1 = \left(\frac{A_1}{A_2}\right)^2 - 1$$

$$\frac{P_1 - P_2}{\frac{1}{2}\rho V_1^2} = (2)^2 - 1 = 4 - 1 = 3 \text{ Ans}$$

from continuity equation.

$$a_1 v_1 = a_2 v_2$$

$$\frac{a_1}{a_2} = \frac{v_2}{v_1}$$

$$\Rightarrow 2 = \frac{v_2}{v_1}$$

$$v_2 = 2v_1$$

Now,
$$\frac{P_1 - P_2}{\frac{1}{2}\rho} = v_2^2 - v_1^2$$

$$\Rightarrow \frac{P_1 - P_2}{\frac{1}{2}\rho g} = (2v_1)^2 - (v_1)^2$$

$$= 3v_1^2$$

$$= \frac{P_1 - P_2}{\frac{1}{2}\rho} = 3v_1^2$$

$$\frac{P_1 - P_2}{\frac{1}{2}\rho v_1^2} = 3$$

Q

Sol:

Q. At point A in a pipe line carrying water the diametre is 1 m. the pressure is 98 KPa and the velocity is 1 m/sec. At a point B 2m higher than A, the diametre is 0.5 and the pressure is 20 KPa. find the direction of flow.

Sol^n

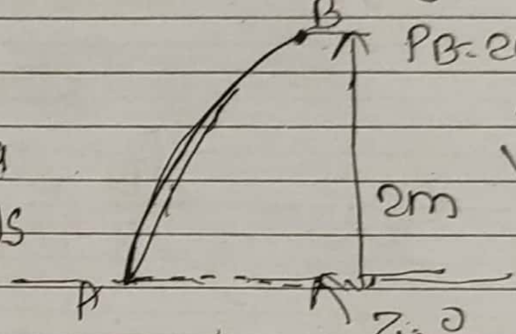
$D_A = 1m$

$P_A = 98 KPa$

$V_A = 1 m/s$

$D_B = 0.5m$

$P_B = 20 KPa$



$A_1 v_1 = A_2 v_2$

$V_B = \frac{A_1 v_1}{A_2}$

$= \frac{(1)^2}{(0.5)^2}$

$\frac{\frac{\pi}{4} \times d_1^2 \times v}{\frac{\pi}{4} d_2^2}$

$\frac{d_1}{d_2} \times 1$

$\boxed{V_B = 4m}$

$$E_A = \frac{P_A}{\rho g} + \frac{v^2}{2g} + Z_A$$

$$= \frac{98 \times 10^3}{1000 \times 9.81} + \frac{1}{2 \times 9.81} + 0 = 10.04 m$$

$$E_B = \frac{P_B}{\rho g} + \frac{v^2}{2g} + Z_B$$

$$= \frac{20 \times 10^3}{1000 \times 9.81} + \frac{4v^2}{2g} + 2$$

$$= 4.854 m$$

~~total~~ = ~~10.04~~

$E_A = E_B + h_L$

$h_l = E_A - E_B$

$= 10.04 - 4.854$

$= 5.186 m$ B

Q. At a location 1m of a horizontal pipe the pressure head is 32cm and velocity head is 4cm. The reduction in area at the location to is such that the pressure head drops down to zero then find the ratio of velocity at section (2) to section (1)

Soln: from Bernoullis equation for horizontal pipe,

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} \quad (1)$$

Given, $\frac{P_1}{\rho g} = 32cm$ | $\frac{P_2}{\rho g} = 0cm$

$\frac{V_1^2}{2g} = 4cm$ | $\frac{V_2^2}{2g} = ?$

So from (1),

$$32 + 4 = 0 + \frac{V_2^2}{2g}$$

$$V_2^2 = 36 \times 2g$$

Again

$$\frac{V_1^2}{2g} = 4$$

$$V_1^2 = 4 \times 2 \times g$$

$$\frac{V_2^2}{V_1^2} = \frac{\cancel{36}^{9} \times \cancel{2g}}{\cancel{4} \times \cancel{2g}}$$