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Question 1. Part A.

=> Potential Head:

It is due to the position above some suitable datum.

Potential Head = Z

=> Velocity Head:

It is due to the velocity of flowing liquid

Velocity head = $\frac{v^2}{2g}$

=> Pressure Head:

It is due to pressure of the liquid.

Pressure head: $\frac{P}{w}$ or $\frac{P}{\rho g}$

=> Total energy head:

It is the sum of potential head, velocity head & pressure head.

$$H = z + \frac{v^2}{2g} + \frac{P}{w}$$

Question 1 Part b.

=> Hydraulic Grade Line:

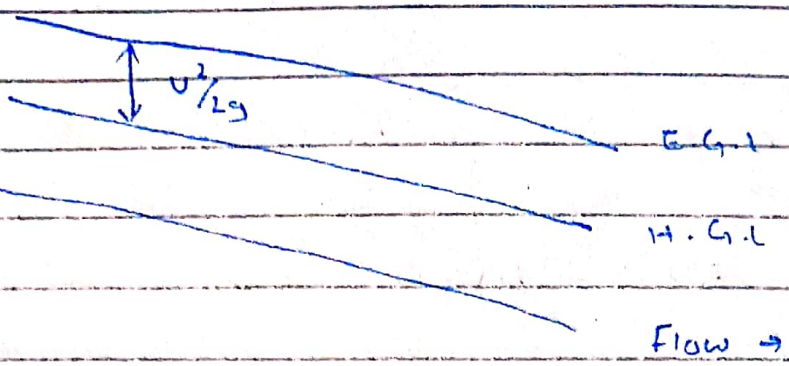
It refers to the profile of water streaming in open channel or a pipe streaming in part full.

$$\rightarrow H.G.L = \frac{P}{w} + z$$

=> Energy Grade Line:

It refers to a line that represents to the height of energy head of water streaming in a pipe, course or channel.

$$\rightarrow E.G.L = h_o = \frac{P}{w} + \frac{v^2}{2g} + z$$



H ⇒ Hydraulic radius:-

The cross-sectional area of how divided by the wetted perimeter

$$R_w = \frac{A}{P_w}$$

Question No.2 Part a

Given data: $z = 5\,m$ $v = 2\,m/s$

$\rho = 300\ \frac{KN}{m^2}$ $w = 9.81\ KN/m^2$

Sol: $H = 5 + \frac{(2)^2}{2 \times 9.81} + \frac{300}{9.81}$

$H = 35.785\ \frac{Nm}{N}$

Question No.2 Part b

Given data: $d_1 = 300\ mm$

$d_2 = 200\ mm$ $\quad P_2 = 120\ KN/m^2$

$P_1 = 300\ KN/m^2$ $\quad Q = 40\ l/s = 0.04\ m^3/s$

Calculate $Z_1 - Z_2 = ?$

$$\frac{P_1}{w} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{v_2^2}{2g} + Z_2$$

$$v_2 = \frac{Q}{A_1} \Rightarrow v_1 = \frac{0.04}{\frac{\pi d^2}{4}} = 1.27\ m/sec \qquad \therefore w = \rho g = 9.81\ \frac{KN}{m^3}$$

$$v_1 = \frac{Q}{A_2} = \frac{0.04}{\frac{\pi d^2}{4}} = 0.565\ m/sec$$

$$\frac{120}{9.81} + \frac{(1.27)^2}{2 \times 9.81} + Z_2 = \frac{300}{9.81} + \frac{(0.565)^2}{2 \cdot 9.81} + Z_1$$

$$12.31 + Z_2 = 30.61 + Z_1$$

$$Z_2 - Z_1 = 30.61 - 12.31$$

$$Z_2 - Z_1 = 18.30$$

Q3. Given data.

$L = 500m$ $\quad D = 0.2m$ $\quad S = 0.9$

$\mu = 6 \times 10^{-5} \frac{N.s}{m^2}$ $\quad Q = 0.06 m^3/sec$

Sol: $f = [0.0032 + (0.221 / R^{0.237})$

$S = \frac{\rho}{\rho_w}$ $\quad \rho = 0.9 \times 997 \ Kg/m^3$

$\rho = 897.3$

$A = \frac{\pi d^2}{4} \Rightarrow A = 0.0314 \ m^2$

$V = Q/A \Rightarrow V = 1.91 \ m/sec$

$R = \frac{\rho V d}{\mu} \Rightarrow R = \frac{897.3 \times 1.91 \times 0.2}{6 \times 10^{-5}} \Rightarrow 5712810$

$h_f = \frac{4 f l v^2}{2 g D} \Rightarrow$ ~~$[0.0032 + (0.221 / R^{0.237})]$~~

$f = 0.0032 + (0.221 / R^{0.237})$

$f = 8.73 \times 10^{-3}$

or $f = 0.00873$

Now from Bernouli Equation

Head loss $H_L = \frac{f l v^2}{2 g D}$

Putting valve's in bernoli equation

$$h_L = \frac{(0.00873)(500)(1.91)^2}{2(9.81)(0.2)}$$

h_L = [illegible] m => 16.25 m

Now to find pressure loss due to friction

Pressure head formula.

$$h_L = \frac{DP}{S_g} \qquad DP = h_L \times S_g$$

Put values.

$DP = 16.25 \times 900 \times 9.81$

$DP =$ [illegible] 143471.2 Pa

$DP =$ [illegible] 143.47 KPa Ans.