P1

ANSWER TO QUESTION NO 1:

PRAT A: TOTAL ENERGY HEAD:

From Bernoulli principle, the total energy at a given point in a fluid is the energy associated with movement of Fluid, plus energy from Static pressure in the fluid energy from height of fluid relative to an arbitrary dadum height.

OR

The Sum of pressure head (P/g), velocity head ($v^2/2g$) and elevation head h is constant along a stream line. This constant is called Total head. H -

FROM OF ENERGY HEAD:

There are three types of energy head which are given below.

POTENTIAL HEAD: It is potential energy per unit weight. It is due to position above some detum line. Pressure Head + Velocity Head + Potential Head = Total Head. (P2)

Potential Head = Total Head - velocity Head - pressure Head.

→ KINETIC HEAD :-
It represent kinetic energy of Fluid. It is height in feet that a flowing fluid will rise in column.

Kineatic Head = Total Head - Potential head - Pressure Head.

→ PRESSURE HEAD :- It is height of liquid column that corresponds to a particular pressure ~~ex~~ exerted by liquid column that corresponds a particular pressure exerted by liquid column on the base of container.

Pressure Head = Total Head - kinetic Head - Head potential head.

PART B :- HYDRAULIC GRADE LINE :-

Hydralic grade line refers to the profile of water streaming in an open channel or a pipe Straming in a part full. when pipe is under pressure, the pressure driven reveiw line is the level to which the water would ascend to in a little vertical tube associated with a pipe.

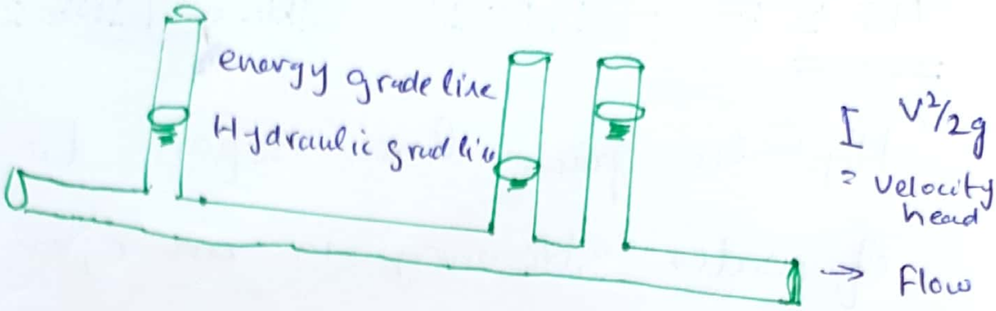
It is denoted as (HGL).

→ The hydraulic grade line is line representing the total head available to the fluid- minus velocity head and Can be ~~ref~~ expressed as

$$HGL = P/\gamma + h$$

where HGL = Hydraulic Grade line.

⇒ The hydraulic Grade line lies on velocity head below the energy line.



ENERGY LINE :- EGL

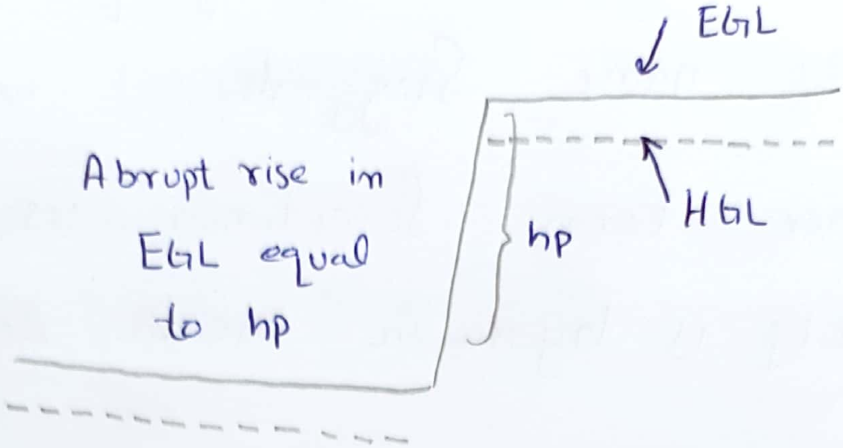
Energy Grade line refer to a line that represent to the height of energy head of water, Streaming in a pipe, course, or channal - The line is drawn over the pressure Hydraulic grade line (inclination)

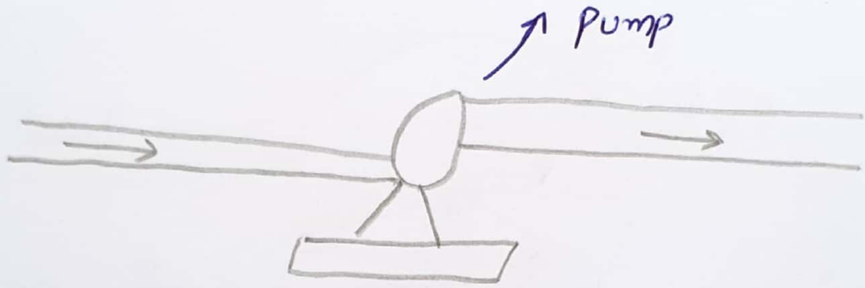
The Separation equalent to Speed head $\left(\frac{v^2}{2g}\right)$ of the water Streaming at every area or a point along the pipe or channal.

→ The energy line is a line that represent the total head available the fluid can be expressed as.

$$EL = H = P/\gamma + \frac{V^2}{2g} + h = \text{constant}.$$

along a streamline.





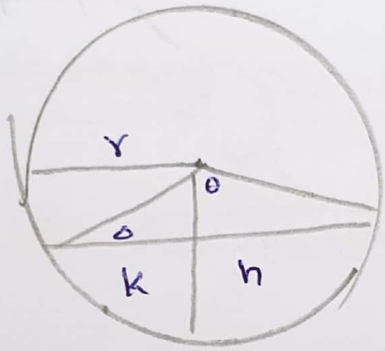
→ HYDRAULIC RADIUS :- Hydraulic Radius is the area of water prism in a pipe or channel divided by the wetted perimeter. Thus for a Round Conduit flowing full or half full. The hydraulic radius is d/4.

→ Hydraulic radius measure the flow efficiency of a pipe.

→ In trenchless technology, it is a function of the shape of the pipe in which liquid

→ It doesnot indicate half of the diameter as the name suggests.

→ Another term sometimes used for this quantity is hydraulic mean depth.



(2) ANSWER TO QUESTION No 2 :

PART A : GIVEN DATA

$V = 2 m/sec$

$P = 300 KPS = 300 \times 10^3 N/m^2$

$Z = 5m$

$\gamma = 9810$

REQUIRD :

H = total energy per unit weight = ?

SOLUTION : As we know that

H = Pressure Head + Kinedic energy (Head) + potential Energy (Head).

$$H = \frac{P}{\gamma} + \frac{V^2}{2g} + Z$$

putting the values in the above equation

$$H = \frac{300 \times 10^3}{9810} + \frac{(2)^2}{2(9.81)} + 5m$$

$$H = 30.581 + 0.20 + 5$$

$$\boxed{H = 35.784 m}$$ Ans.

PART B :

GIVEN DATA :

Diameter = d_1 = 300mm

Diameter = d_2 = 200 mm

Pressure = P_1 = 300kpa = 300×10^3 N/m²

P_2 = 120kpa = 120×10^3 N/m²

Datum = Z = ?

SOLUTION

$Q = \frac{40}{1000}$ m²/sec = $\boxed{0.04}$

d_1 = 300mm = 0.3m

d_2 = 200mm = 0.2m.

REQUIRED :

Z = ?

SOLUTION :

$A_1 = \frac{\pi d^2}{4}$

$= \frac{(3.14)(0.3)^2}{4}$

$\boxed{A_1 = 0.0706 m^2}$

$A_2 = \frac{\pi d^2}{4}$

$= \frac{(3.14)(0.2)^2}{4}$

$A_2 = 0.0314 m^2$

we know that

$Q = V_1 A_1$

$V_1 = \frac{Q}{A_1} = \frac{0.04}{0.0706}$

$V_1 = 0.566$

$\Rightarrow V_2 = \frac{Q}{A_2}$

$V_2 = \frac{0.04}{0.0314}$

$V_2 = 1.27$

Now

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

Put $Z_1 = 0$

$\gamma = 9810$

$$\frac{300 \times 10^3}{9810} + \frac{(0.566)^2}{2(9.81)} + 0$$

$$= \frac{120 \times 10^3}{9810} + \frac{(1.27)^2}{2(9.81)} + z_2$$

$$30.597 = 12.314 + z_2$$

$$z_2 = ⊖ 30.597 - 12.314$$

$$z_2 = +18.283$$

Now Datum $= \boxed{z = 18.283}$

ANSWER TO QUESTION 3

⇒ **GIVEN DATA :**

Length of pipe = 500m

Diameter = $d = 0.2m$

Specific gravity of oil = 0.9

Flow rate = $Q = 0.06 m^3/sec$

Viscosity = $\mu = 6 \times 10^{-5} N.S/m^2$

REQUIRED:

Pressure loss = $\Delta P = ?$

$$f = \left(0.0032 + \left(\frac{0.221}{R^{0.237}}\right)\right)$$

where

R = Reynold's Number Eq is given by

$$R = \frac{V \times d}{\upsilon} \rightarrow (a)$$

$$\upsilon = \frac{\mu}{\rho} = \frac{6 \times 10^{-5}}{900}$$

$\upsilon = 6.07 \times 10^{-8}\ m^2/sec$

and

$V = \frac{Q}{A}$

For Area of circular pipe

$A = \pi/_4\, d^2$

$= \frac{\pi}{4}(0.2)^2$

$A = 0.0314\ m^2$

$V = \frac{0.06}{0.031}$

$V = 1.935\ m/sec$

putting the values in eq ⓐ

eq ⓐ ⇒ $R = \frac{1.935 \times 0.2}{6.67 \times 10^{-5}}$

$= \frac{0.387}{6.67 \times 10^{-5}}$

$R = 5.802 \times 10^{3}$

Now $f = 0.0032 + \frac{0.221}{(5.802 \times 10^3)^{0.237}}$

$f = 0.3154$

From Bernouli's Equation

Head Loss $= h_L = \frac{fLU^2}{2gD} \rightarrow$ (b)

putting the values in eq (b)

eq (b)

$\Rightarrow \quad h_L = \frac{(0.3154)(500)\times(1.935)^2}{2(9.8)(0.2)}$

$h_L = \frac{590.464}{3.924}$

$h_L = 150.475 \text{ m}$

Now pressure loss due to friction

$h_L = \frac{\Delta p}{\delta g}$

$\Delta P = h_L \times \delta g$

putting the values

$\Delta P = 150.475 \times 900 \times 9.81$

$\Delta P = 1328543.775$

$\Delta P = 1.328 MPa$. Ans

Pressure loss.

P ———————— X ———————— X.