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Q No # 1

Part (a)

Answer:

Total Energy Head: from Bernoulli principal, the total energy at a given point in a fluid in the energy associated with movement of fluid, plus energy from static pressure in the fluid energy from height of fluid relative to an arbitary datum height.

OR

The sum of pressure head (P/γ) velocity head ($v^2/2g$) and elevation head h is constant along a stream line. this constent is called Total height H.

Forms Of Energy Head:- There are three types of energy head which are given below.

Potential Head:- It is the potential energy per unit weight. It is due to position above some datum line. pressure Head + velocity head + Potential head = Total Head.

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.

$V^2/(2g)$

Pressure head:- It is height of liquid column that corresponds to a particular pressure exerted by liquid column that corresponds a particular pressure exerted by liquid column on the base of contains.

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

(P.T.O)

Q No # 1

part (B)

Hydraulic Grade line :- (HGL)

Hydraulic grade line refers to the profile of water streaming in an open channel or a pipe streaming in a part full.

when a piper is under pressure, the pressure driven review line is the level to which the water would ascend to in a little vertical tube associated with a piper

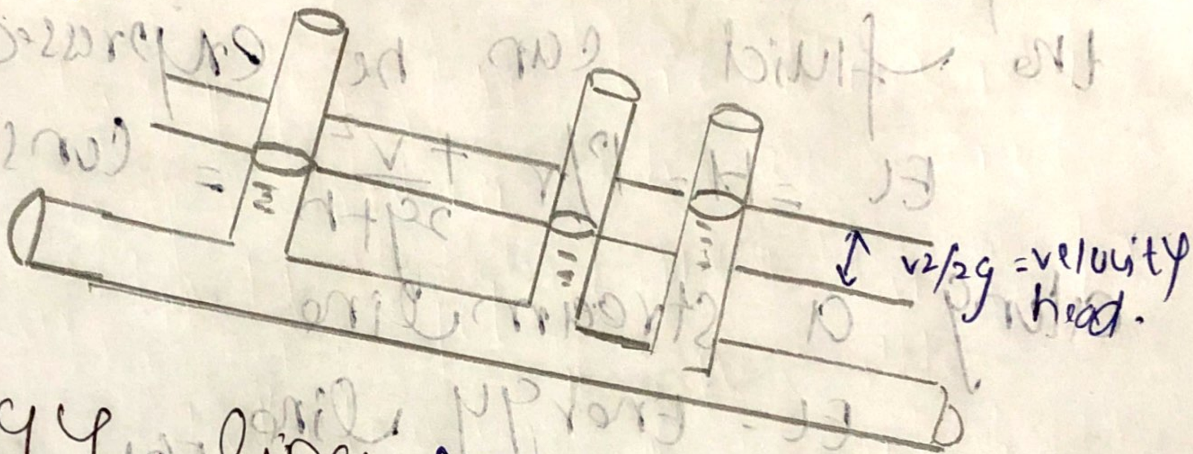
↳ It is denoted as (HGL)

↳ The hydraulic grade line is a line representing the total head avaliable to the fluid minus velocity head and can be 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 represents to the height of energy head of water streaming in a pipe course, or channel, The line is drawn over the Pressure Hydraulic grade line (inclination) (P.G.C)

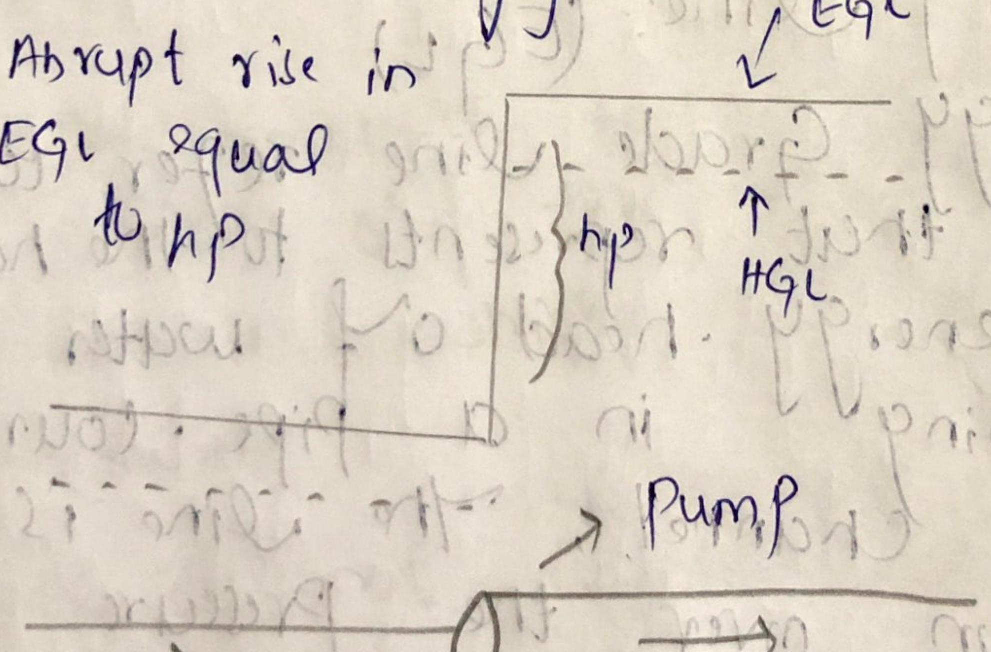
The separation equalent to speed head ($v^2/2g$) of the water streaming at every area or a point along the pipe or channel

↳ The Energy line is a line that represent the total head avaliable the fluid can be expressed as.

$$EL = H = P/r + \frac{v^2}{2g} + r = \text{constant}$$

along a stream line

EL = Energy line



* Hydraulic Radius:- Hydraulic radius is the area of water Prism in a pipe or channel divided by the wetted perimeter Thus, for a sound conduit flowing full or half full, the hydraulic radius is d/4

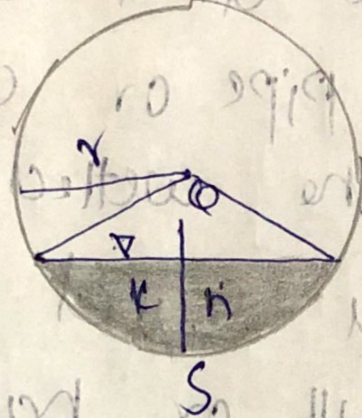
- Hydraulic radius measures the flow efficiency of a pipe.

- In trenchless technology it is a function of the shape of the pipe in which the liquid is flowing.

- It does not indicate half of the diameter as the name suggests.

- Another term sometimes used for

this quantity is hydraulic mean depth.



Question # 2
part (a)

Given data:

$V = 2 m/sec$

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

$Z = 5 m$

$\gamma = 9810$

Required:-

H = Total energy per unit weight = ?

Solution:-

As we know that

H = pressure head + kinetic energy (Head) + potential energy (Head)

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

putting the values in the above equation

p.t.o

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

$$H = 30.581 + 0.20 + 5$$

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

Question NO # 2

(part b)

Answer:-

Given Data:

Diameter = d_1 = 300mm

Diameter = d_2 = 200mm

pressure = P_1 = 300 kpa = 300×10^3 N/m^2

P_2 = 120 kpa = 120×10^3 N/m^2

Required data:

Datum = Z = ?

Solution:-

$Q = \frac{40}{1000}$ m^3/sec = [0.04]

d_1 = 300mm = 0.3m

d_2 = 200mm = 0.2m

(P.T.O)

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

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

$$\boxed{A1 = 0.0706 m^2}$$

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

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

$$\boxed{A_2 = 0.034}$$

we know that

$$Q = V_1 A_1$$

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

$$\boxed{V1 = 0.566}$$

$$V_2 = \frac{Q}{A_2} \Rightarrow \frac{0.04}{0.0314} \Rightarrow \boxed{V_2 = 1.27 m^3}$$

Now

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$$

Put $z_1 = 0$

$\gamma = 9810$

$$\frac{300 \times 10^3}{9810} + \frac{(0.566)^2}{2(9.81)} + 0 = \frac{120 \times 10^3}{9810} + \frac{(1.27)^2}{2(9.81)} + z_2$$

$$30.597 = 12.314 + z_2$$

$$z_2 = 18.283$$

Now Datum

$$= z_2 = 18.283\,m$$

Question No #3

Given data:

length of pipe = $l = 500m$

dia = $d = 0.2m$

Specific gravity of oil = 0.9

flow rate = Q = $0.06 \, m^3/s$

viscosity = $\mu = 6\times10^{-3} \, N.s/m^2$

Required:

pressure loss = Δp = ?

As we know

$$f = \left(0.0032 + \frac{0.221}{R^{0.2}}\right)$$

where R = Reynolds No and is given as,

$$R = \frac{v \times d}{\nu} \rightarrow (1)$$

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

$\nu = 6.67 \times 10^{-8}\ m^2/s$

and $v = \frac{Q}{A}$ ∴ for circular pipe $A = \frac{\pi}{4} d^2$

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

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

$\Rightarrow v = 1.95\ m/s$

$A = 0.031\ m^2$

Now eq (1) $\Rightarrow$ $R = \frac{1.95 \times 0.2}{6.67 \times 10^{-8}} = 5.73 \times 10^{6}$

Now;

$f = 0.0032 + \frac{0.221}{(5.73 \times 10^{6})^{0.237}}$

$\Rightarrow f = 8.79 \times 10^{-3}$

or $f = 0.00879$.

Now from Bernoulli's equation

Head loss $h_L = \frac{fLv^2}{2gD} \rightarrow$ (ii)

putting values in eq (ii)

$$h_L = \frac{(0.00879)(500)(1.95)^2}{2(9.81)(0.2)}$$

$\Rightarrow h_L = 4.259\,m$

Now, to find pressure loss due to friction; pressure Head formula is used

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

$\Rightarrow \Delta p = h_L \times \rho g$

$\Delta p = 4.259 \times 900 \times 9.81$

$= 37602.7\ Pa$

$\Rightarrow \Delta p = 37602.7\ Pa$

$\boxed{\Rightarrow \Delta p = 37.602\ kPa}$