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Paper	Fluid mechanics.

Q :1:.

Part A:

Energy head:

It is the sum of All energy head at a point in a Point.

forms of Energy head:

There are various forms of Energy head. which are in following.

i) kinetic head.
ii) Potential head.
iii) Pressure head.

Kinetic Head:

It is the kinetic energy per unit weight of the fluid

Mathematical form:

$$\frac{K.E}{\omega} = \frac{1/2\, mv^2}{mg} = \frac{1}{2}\frac{v^2}{g}$$

This is also known as velocity Head.

Unit:-

The unit is meter(m)

Potential Head:-

It is the potential energy per unit weight of the fluid.

Mathematically form:

$$\frac{P.E}{w} = \frac{mgh}{mg} = h.$$

Pressure head:-

The vertical height of the free surface above any point in a liquid at rest is Pressure Head.

OR

Level of fluid due to Pressure exerted by fluid.

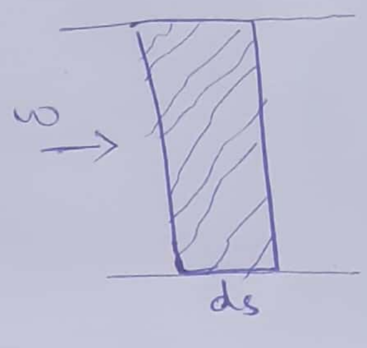
Mathematically form:-

Pressure head = $\frac{P.E}{weight} = \frac{P}{\gamma}$.

OR

$= \frac{F \cdot ds}{w}$.

$= \frac{P \cdot A \cdot ds}{w}$



$= \frac{P \cdot v}{w} = \frac{P}{\gamma}$. is pressure

Part B:-

Hydraulic grade line:-

The surface or profile of water flowing in an open channel or a pipe flowing partially it a pipe is under pressure, the hydraulic grade line is that level water would rise to in a small, verticle tube connected to the pipe also see energy grade line.

Hydraulic radius:-

The ratio of the cross-sectional area of a channel or pipe in which a fluid is flowing to the wetted perimeter of the conduct.

Energy grade line:-

A line that represented. the elevation of energy head (In feet or meters) of water Flowing in a Pipe, or Channel The line is drawn above the hydrulic grade line a distance equal to the velocity head ($v^2/2g$) of the water flowing at each seaction or point along the pipe or channel.

Q = 2:-

Part A:-

Given:

velocity = v = 2 m/s.

Pressure = P = 300 kpa.

datum = Z = 5 m.

Sol

H = pressure head + K.E + P.E

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

$$H = \frac{30 \times 10^3}{9810} + \frac{2^2}{2 \times 9.81} + 5$$

$$\boxed{H = 35.7849 \, m}$$

Q No 2:

Part B:

Given Data:

Diameter = d_1 = 300mm

Diameter = d_2 = 200mm

Pressure = P_1 = 300kpa = $300 \times 10^3 \, N/m^3$

P_2 = 120 kpa = $120 \times 10^3 \, N/m^2$.

Datum = Z = ?

$Q = \frac{40}{1000} \, m^2/sec.$

d_1 = 300mm = 0.8m

d_2 = 200mm = 0.2m

Required:

Z = ?

Sol:

$$A_1 = \frac{\pi d_1^2}{4}$$

$$A_1 = \frac{3.14 \times (0.3)^2}{4}$$

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

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$$A_2 = \frac{\pi d_2^2}{4}$$

$$A_2 = \frac{3.14 \times (0.2)^2}{4}$$

$$A_2 = 0.0314 m^2$$

As we know that

$$Q_1 = V_1 A_1$$

$$V_1 = \frac{Q}{A_1} \quad Q = \frac{40}{1000} = 0.04$$

$$V_1 = \frac{0.04}{0.0706}$$ ~~= 0.04~~

$$\boxed{V_1 = 0.566 \, m^3}$$

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

$$V_2 = \frac{0.04}{0.03144}$$

$$\boxed{V_2 = 1.27 \, m^3}$$

Now

$$\frac{P_1}{\gamma} + \frac{u_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{u_2^2}{2g} + Z_2$$

$Z_1 = 0$; $\gamma = 9810$.

$$\frac{300 \times 10^3}{9810} + \frac{0.566}{2(9.81)} + 0 = \frac{120 \times 10^3}{9810} + \frac{1.27}{2(9.81)} + Z_2.$$

$$30.60 + 0 = 12.314 + Z_2$$

$$\Rightarrow \boxed{Z_2 = 18.286\,m}$$

Q 3:

Given Data:

Length of Pipe = L = 500 m.

Diameter = d = 0.2 m.

specific gravity of oil = 0.9 m

Flow rate = Q = 0.06 m^3/s.

viscosity = μ = 6×10^{-5} N.s/m^2

Required:

Pressure loss = ΔP = ?

As we know

$$F\left(0.0032 + \left(\frac{0.221}{R^{0.237}}\right)\right]$$

where as R = Reyold's No & is give

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

& $Z = \nu = \frac{\mu}{y} = \frac{6 \times 10^{-5}}{900}$

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

and $v = \frac{Q}{A}$

For circular Pipe

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

~~$v = \frac{0.06}{0.031}$~~ $= \frac{\pi}{4}(0.02)^2$

$A = 0.031 m^2$.

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

$V = 1.95 m/s$.

no eq (1)

$R = \frac{1.95 \times 0.2}{6.67 \times 10^{-5}} = 5.53 \times 10^{6}$.

Now:

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

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

$\boxed{f = 0.00879}$.

now from Bernouli's equation

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

Putting the value in eq (11)

(11)

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

$$h_L = 4.259\,m$$

Now to find pressure loss due Friction

Pressure head formula is used

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

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

Putting the value.

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

$$\Delta p = 37602.7\,Pa$$

$$\Delta p = 37.602\,kPa$$