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Section = B

Dept = BE(C)

Paper = Fluid M.

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Question = 1:-

Part = A:-

Energy head:-

It is the Sum of all energy head at a point in a fluid

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:-

$$\frac{K.E}{w} = \frac{\frac{1}{2}mv^2}{mg}$$

$$\frac{K.E}{W} = \frac{1}{2}\frac{v^2}{g}$$

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.

Mathematical 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

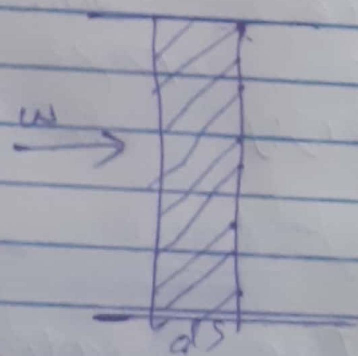
Level of fluid due to pressure exerted by fluid.

Mathematical form:-

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

OR

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



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

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

Energy grade line:-

A line that represents the elevation of energy head (in feet or meters) of water flowing in a pipe, conduit, or channel. The line is drawn above the hydraulic grade line a distance equal to the velocity head $(v^2/2g)$ of the water flowing at each section or point along the pipe or channel-

Question = 2:-

Part = A:-

Given data:-

Velocity = v = 2 m/s

Pressure = P = 300 kpa

datum = z = 5 m.

Sol:-

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

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

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

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

Part = B :-

Given data:-

Diameter = d_1 = 300mm

Diameter = d_2 = 200mm

pressure = P_1 = 300kpa = $300 \times 10^3 N/m^2$

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

Datum = z = ?

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

d_1 = 300mm = 0.8m

d_2 = 200mm = 0.2m

Required:

z = ?

Sol:

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

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

$$A_1 = 0.0706 m^2$$

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

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

$$A_2 = 0.0314 m^2$$

As we know that

$$Q_1 = V_1 A_1$$

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

$$Q = \frac{40}{1000} = 0.04$$

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

$$V_1 = 0.566 m^3$$

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

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

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

Now

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

$$Z_1 = 0$$

$$\gamma = 9810$$

$$\frac{300 \times 10^3}{9810} + \frac{0.566}{2(9.81)} + 0 = \frac{120 \times 10^3}{9810} + \frac{1.27}{2(9.81)} + Z_1$$

$$30.60 + 0 = 12.314 + Z_2$$

$$\boxed{\Rightarrow Z_2 = +18.286 m.}$$

Question = 3 :-

Given data:-

Length of pipe = l = 500m
dia = d = 0.2m
Specific gravity of oil - 0.9m
flow rate = Q = 0.06 m^3/s
Viscosity = $\mu = 6\times10^{-5}$ $N.S/m^2$

Requried:-

Pressure loss = ΔP = ?

As we know that.

$$f = \left(0.0032 + \left(\frac{0.221}{R^{0.8}}\right)\right)$$

where R = Reynold's No

and is given data

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

$$\& \; \nu = \nu = \frac{\mu}{\rho} = \frac{6\times10^{-5}}{900}$$

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

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

for circular pipe

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

$= \frac{\pi}{4} (0.02)^2$

$A = 0.031\ m^2$

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

$\Rightarrow v = 1.95\ m/s$

Now eq (1)

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

Now

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

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

or

$f = 0.00879$

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Now from Bernoulli's equation.

Head loss in eq (ii)

$$h_2 = \frac{(0.00878)(500)(1.95)^2}{2(9.81)(0.2)}$$

$\Rightarrow$ $h_2 = 4.259m$

Now to find pressure loss due to friction.
Head friction formula used.

$$h_2 = \frac{DP}{\rho g}$$

$\Rightarrow DP = h_2 = \rho g$

Put value.

$DP = 4.25 \times 900 \times 9.81$

$\Rightarrow DP = 37602.7\ Pa$

$DP = 37.602\ kPa$

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