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Section :- A

Paper :- fluid Machanics I

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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 on arbitrary datum height.

OR

The Sum of pressure head (p/γ) velocity head $(v^2/2g)$ and elevation head to is constant along a stream line. this constant 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 repent Kinetic energy of fluid it is height in feet that a flowing fluid will rise in column.

PRESSURE HEAD :- it is height of liquid column that corresponds to a particular pressure excerted by liquid column that corresponds by liquid column that corresponds a particular pressure excerted by liquid column on the base of contains.

pressure Head = Total Head - Kinetic head - potential head.

KINETIC HEAD:-

*** MATHAMATICAL 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 it is unit is meter(m)

Potential head. Mathamatical form:-

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

Pressure Head:-

MATHAMATICAL Form:-

$$\frac{PrE}{weight} = \frac{P}{\gamma}$$

OR

$$= \frac{F \cdot ds}{W}$$

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

$$= \frac{P \cdot V}{W} = \frac{P}{\gamma}$$ is pressure

Q No #1 (Part B) 4(4)

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

↳ it is denoted

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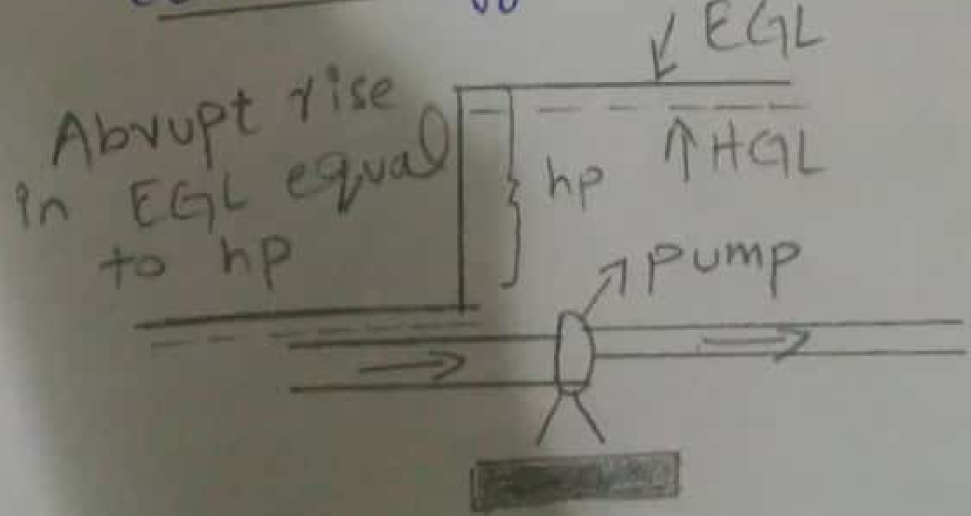
Head of water streaming in a pipe course, or channel. the line is drawn over the pressure Hydraulic grade line (inclination) The separation equalant to speed head ($v^2/2g$) of the water streaming at every area or a point along the pipe or channel

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

$$EL = H = P/\gamma + \frac{v^2}{2g} + h = \text{Constant}$$

along a stream line

EL = Energy line



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Q No#2 (part a)

⇒ Given Data:-

velocity, $V = 2 m/s$

Pressure, $p = 300 kpa = 300 \times 10$ N/m^2

datum, $Z = 5m$, $\gamma = 9810$

Required = ?

Total energy, $H = ?$

Solution:- As we known that

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

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

putting values in above equation

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

$$H = 30.58 + 0.201 + 5$$

$$\boxed{H = 35.785 \ Nm/N}$$

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Q No 02 (Part b)

Given Data

Diameter $d_1 = 300mm = 0.3m$

Diameter $d_2 = 200mm = 0.2m$

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

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

Flow Rate, $Q = \frac{40}{1000} m^2/sec = 0.04 m^2/sec$

Required:-

Datum $= Z = ?$

Solution

As we known that

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

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

$$A_1 = 0.07065 m^2$$

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

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

$$A_2 = 0.0314 m^2$$

Now As We know that

$$Q = V_1 A_1$$

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

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

$$V_1 = 0.5661 \ m/s$$

And

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

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

$$V_2 = 1.2738 \ m/s$$

Now

$$\Rightarrow \frac{P_1}{\gamma} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_n$$

Where

$Z_1 = 0$

$\gamma = 9810$

putting values

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

$$\Rightarrow 30.597 = 12.314 + Z_2$$

$$\Rightarrow Z_2 = 30.597 - 12.314$$

$$\Rightarrow Z_2 = 18.282\ m$$

$$= Z_2 = 18.282\ m$$

Result

$$\boxed{\text{Hence } Z_2 = 18.282\ m}$$

Q N!03

A 500m lng 0.2 diameter transport on oil of specific gravity .... reynold's number?

Given data

Length of pipe, $L = 500m$
Diameter, $d = 0.2m$
Specific gravity of oil $= 0.9$
flow rate, $Q = 006\ m^3/s$
viscosity, $\mu = 6 \times 10^{-5}\ N s/m^2$
Density, $\rho = 0.9 \times 1000 = 900\ kg/m^3$

Solution:- **Requied** pressure loss

As we know that

$$V = \frac{\mu}{\rho}$$

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

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

Now we have to find "v"

$v = \frac{Q}{A}$ — ①

Now for circular pipe

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

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

$A = 0.0314\ m^2$

putting values in eq①

$\Rightarrow v \ \frac{0.06}{0.0314}$

$\Rightarrow v = 1.91\ m/s$

Now we known that

$R = \frac{v \times d}{\nu}$

$R = \frac{1.91 \times 0.2}{6.67 \times 10^{-8}}$

$$\boxed{R = 572 \times 10^6}$$

Now,

$$f = 0.0032 + \frac{0.221}{(5.72 \times 10^6)^{0.237}}$$

$$f = 0.0032 + (55320 \times 10^{-8})$$

$$\boxed{f = 8.73209 \times 10^{-3}}$$

Now from Bernali's equation

Head loss, $H_F = \frac{fLV^2}{2gD}$

putting values

$$H_F = \frac{FLV^2}{2gD}$$

$$= \frac{(8.73209 \times 10^{-3})(500)(1.91)^2}{2 \times (9.81)(0.2)}$$

$$H_F = 4.0590$$

Now we know by pressure loss and head loss relation,

$\Rightarrow h_L = \frac{\Delta P}{\rho g}$

$\Rightarrow \Delta P = h_f \times \rho g$

$\Rightarrow \Delta P = 4.0590 \times 900 \times 9.81$

$\Rightarrow \boxed{\Delta P = 35837 \text{ Kpa}}$

Result:-

Hence pressure loss,

$$\boxed{\Delta P = 35.837 \text{ Kpa}}$$