National Day Holiday (China)

8.00 am

NAME :- SULEMAN HAKEEM

8.30

I.D :- 16757

9.00

9.30

SEC :- B

10.00

10.30

PAPER :- Fluid-Mech

11.00

SEM :- 4th.

11.30

Noon

QUESTION 1

12.30

Part (b) :-

1.00

1.30

Define Hydraulic .... ?

2.00

2.30

HYDRAULIC GRADE :-

3.00

Hydraulic grade

3.30 line (HGL). The Surface or

4.00 profile of water flowing in

4.30 an open channel or a pipe

5.00 flowing partially full.

6.00 pm

If a pipe is under pressure, the hydraulic grade line is that level water would rise to in a small, vertical tube Connected to the pipe.

OR

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

EQUATION:-

$$HGL = \frac{P}{\gamma} + Z$$

## ENERGY LINE :-

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

## EQUATION :-

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

Constant along a streamline.

## HYDRAULIC RADIUS :-

It is the area of the 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 $d/4$.

## MEASURE :-

Hydraulic radius measure the flow efficiency of a pipe.

## EQUATION :-

$$R = \frac{A}{PW} \quad \text{or} \quad R = \left(\frac{\pi D^2}{4}\right) / \pi D$$

$$= \frac{D}{4}.$$

## OR

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

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8.00 am

Question (1)

8.30

9.00

PART (A).

9.30

Define total energy head ....?

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## TOTAL ENERGY HEAD :-

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From Bernouilli's princi-

11.30

ple, the total energy at a

Noon

given point in a fluid is the

12.30

energy associated with the

1.00

movement of the fluid, plus

1.30

energy from the height of

2.00

the fluid relative ta an

2.30

arbitrary datum. Head is

3.00

expressed in Units of height

3.30

such as meter or feet.

4.00

## FORMS OF ENERGY

4.30

## HEAD :-

5.00

6.00 pm

(6)

The following are the forms of energy head.

Forms of energy

- → Potential energy / Potential head
- → Kinetic head or energy
- → Pressure head or energy

⇒ **Potential Energy or Potential Head :-**

It is due to the position above some suitable datum line. It is denoted by Z.

**Mathematically :-**

$$Z = P_w g h$$

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6.00 pm

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=> Kinetic Energy or Kinetic Head :-

It is due to the velocity of flowing liquid. Its value is given by $V^2/2g$, where V is the velocity of flow and g is the acceleration due to gravity.

Mathematically :-

$$= \frac{1}{2} P_w V^2 .$$

=> Pressure energy or Pressure Head :-

It is due to the pressure of liquid. Its value is given by $P/w$, where P is the pressure in $N/m^2$ and w is the weight density of the liquid in

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$N/m^3$.

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Mathematically :-

9.00

$= P$

9.30

So

10.00

Total energy, $E$ = Potential energy

10.30

+ Kinetic energy + Pressure.

11.00

$= P_w g h + \frac{1}{2} P_w v^2 + P$

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Now

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Total Head =

1.00

1.30

Expressing the total energy as

2.00

head (unit of length).

2.30

Total Head = Elevation head + velocity + Pressure

3.00

$$h = Z + \frac{u}{\gamma_w} + \frac{v^2}{2g}$$

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For flow through soils velocity is very small that why zero.

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QUESTION (02)

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a) Calculate the total .....?

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GIVEN DATA :-

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v = velocity = 2m/s

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Pressure = P = 300 KPa

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Datum = Z = 5m.

TO FIND :-

Noon

Datum = Z

12.30

Total Energy = ?

1.00

1.30

SOLUTION :-

2.00

As we know that.

2.30

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

3.00

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

3.30

putting values.

4.00

4.30

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

5.00

6.00 pm

(10)

As $300\ KPa = 300 \times 10^3\ N/m^2$.

So

$$H = 30.58 + 0.101 + 5$$

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

So $\boxed{35.785\ m\ \text{Ans}}$

## QUESTION (2)

## Part (B).

### GIVEN DATA:-

Diameter $= d_1 = 300\ mm$

Diameter $= d_2 = 200\ mm$

Pressure $= P_1 = 300\ KPa = 300 \times 10^3\ N/m^2$

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

### TO FIND:-

Datum, $Z_2 = ?$

### SOLUTION :-

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

$d_1 = 300 \ mm = 0.3m$
$d_2 = 200 \ mm = 0.2m.$

So

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

putting values

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

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

Now finding

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

putting values.

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

$$\boxed{A_2 = 0.0314 \ m^2}$$

(12)



As we know that

$$Q_1 = V_1 A_1$$

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

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

$$V_1 = \frac{0.04}{0.706}$$

$$\Rightarrow 0.04$$

$$V_1 = 0.566.$$

Now.

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

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

$$V_2 = 1.27.$$

Now

As we know

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

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6.00 pm

Putting Values.

$Z_1 = 0$

$Y = 9810.$

putting values.

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

$$30.59 = 12.314 + Z_2$$

So

$$\boxed{Z_2 = 18.276}$$

## QUESTION (3)

## GIVEN DATA :-

Length of pipe = $l$ = 500 m

dia = $d$ = 0.2 m

Specific gravity of oil = 0.9

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

viscosity = $\mu = 6 \times 10^{-15}\ N.s/m^2$

## TO FIND :-

Pressure loss = ?

## SOLUTION :-

As we know that

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

where R = Reynold's No and is given as.

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

and

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

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

and

$$V = \frac{Q}{A} \rightarrow (2)$$

for circular pipe

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

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

$$\boxed{A = 0.031\ m^2.}$$

Putting values in (2)

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

$$\boxed{V = 1.935\ m/s.}$$

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6.00 pm

Now

eq (1) $\Rightarrow$

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

$$\boxed{= 5.73 \times 10^{6}}$$

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 Bernoul's eq

Head loss $= h_L = f \frac{L}{2} \frac{v^2}{gD} \rightarrow$ (iii)

putting values in (iii)

$$h_L = \frac{(0.00879)(500)(1.95)^2}{2(9.8)(0.2)}.$$

(17)

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$$\boxed{h_L = 4.259\ m.}$$

8.30

9.00 Now finding pressure loss due

9.30 to friction.

10.00

10.30 Pressure head formula is used

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11.30 $h_L = \frac{\Delta P}{\delta g}$

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12.30 $\Delta P = h_L \times \delta g$

1.00

put values

1.30

2.00 $\Delta P = 4.259 \times 9000 \times 9.81$

2.30 $\Delta P = 37602.7\ Pa$

3.00

$$\boxed{\Delta P = 37.602\ KPa.}$$

3.30 Ans.

4.00

4.30

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6.00 pm