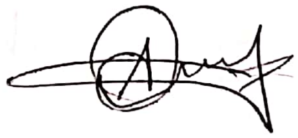
NAME	M. Afnan
ID	7895
Section	"A"
Semister	4th
Department	Civil engineering
Sign	
paper	fluid mechanics

Scanned with CamScanner

Q No 01 (Part a)

Energy Head:

It is the sum of all energy heads at a point in a fluid.

Form of Energy Head:

There are various form of energy head which are as follow.

1) Kinetic Head
2) Potential Head
3) Pressure Head

Kinetic Head:

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

Scanned with CamScanner

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: is meter (m).

Potential Head:

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

Mathematical Form:

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

Scanned with CamScanner

PRESSURE HEAD:

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

OR

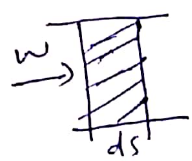
Level of fluid due to pressure exerted by fluid.

Mathematical Form:

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

OR

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



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

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

Scanned with CamScanner

Q No 01 (Part B)

Hydraulic grade line :

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

Energy grade line :

A line that represent elevation of energy Head (in feet or meters) of water

Scanned with CamScanner

flowing in a pipe, conduit or channel. The line is drawn above the hydraulic grade line (gradient) a distance equal to the velocity head ($v^2/2g$) of the water flowing at each section or point along the pipe or channel. Also see hydraulic 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 conduit.

the

Scanned with CamScanner

Q2 (Part a)

Given data:

velocity = V = 2 m/s

pressure = P = 300 KPa

datum = Z = 5 m

Sol:

H = Pressure Head + KE + PE

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

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

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

Scanned with CamScanner

Q2 (Part B)

Given data:

Diameter $= d_1 = 300mm$

Diameter $= d_2 = 200\ mm$

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

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

Datum $= Z = ?$

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

$d_1 = 300\ mm = 0.3\ m$

$d_2 = 200mm = 0.2m$

Required:

$Z_2 = ?$

Sol:

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

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

Scanned with CamScanner

$$A_1 = 0.0706\ m^2$$

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

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

$$A_2 = 0.0314\ m^2$$

we know that

$$Q_1 = V_1 A_1$$

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

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

$$V_1 = 0.566$$

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

$$\Rightarrow 0.04$$

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

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

$$V_2 = 1.27$$

Scanned with CamScanner

Now

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

$Z_1 = 0$

$\gamma = 9810$

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

$30.59 = 12.314 + Z$

$Z_2 = 18.276m$

———— X ————

Scanned with CamScanner

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 $= \mu = 6 \times 10^{-5}\ N.s/m^2$

Required:

pressure loss $= \Delta P = ?$

As we know that

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

where R = Reynoid's No and is given as:

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

Scanned with CamScanner

and

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

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

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

$\because$ for circular pipe

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

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

$$A = 0.031 \, m^2$$

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

$$V = 1.95 \, m/s.$$

Now

eq ① $\Rightarrow$ $R = \frac{1.95 \times 0.2}{6.67 \times 10^{-5}} = 5.73 \times 10^{6}$

Now

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

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

$$f = 0.00879$$

Scanned with CamScanner

Now from Bernoulis equation

Head loss $= h_2 = \frac{fLV^2}{2gD}$ → (ii)

Putting values in eq (2)

$$h_2 = \frac{(0.00879)(500)(1.95)^2}{2(9.81)(0.2)}$$

$$\boxed{h_2 = 4.259\ m}$$

Now to find pressure loss due to friction:

pressure head formula is used

$$h_2 = \frac{\Delta P}{\delta g}$$

$$\Rightarrow \Delta P = h_2 \times \delta g$$

Put values

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

$$\Delta P = 37602.7\ Pa$$

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

Scanned with CamScanner