Q NO 1:-

Part a:-

Total Energy Head:-

From the Bernoulli's principle the total energy at a given point in a fluid, Plus energy associated with the movement of the fluid, plus energy from the height of the fluid, plus energy from the height of the fluid relative to an arbitrary datum. Head is expressed in units of height such as feets or meters.

UNITS:-

It is expressed in unit of height, such as meters or feet. The static head of a pump is the maximum height (pressure) it can deliver. Head is equal to the fluid's per unit weight.

Kinds of Energy Head:-

Following are the three types of energies or head of flowing liquids.

- potential Head
- kinetic Head
- Pressure Head.

- Potential Head:- ③

It is the potential head energy per unit weight. It is due to the position above same datum line pressure Head + velocity head + Potential Head = total Head.

potential Head = total Head

-velocity head - Pressure head.

Potential Head = Z

Kinetic Head:-

It represent kinetic energy of fluid kinetic energy per unit weight of the fluid is known as kinetic head mathematically

$$K.E = \frac{V^2}{2g}$$

Pressure Head:

In fluid mechanics it is the height of fluid due to the pressure exerted on it's container. It may also called static pressure.

Mathematical Form:

Pressure head = Total head - kinetic head - potential Head.

$$\psi = \frac{P}{\gamma} = \frac{P}{\rho g}$$

ψ is pressure head (actually length)

P is fluid pressure

γ = is specific weight

ρ = Density of fluid

g = Acceleration due to gravity.

Question NO 1:- ①

part (B)

Hydraulic Grad line:-

It is a line representing the total head available to the fluid - velocity head.

Mathematical Form

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

OR

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

Energy Grade Line:-

A line that represents the elevation of energy head of water 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.

OR

Energy grade line refer to a line that represent to the height of energy head of water streaming in pipe, course or channel. The line is drawn over the pressure hydraulic grade line (inclination).

Hydraulic Radius:-

Hydraulic radius is defined as the cross section area of flow divided by the wetted perimeter. So the calculation of rectangle and trapezoid area and rectangle area will be included along with the perimeter for each.

Mathematical form:-

$$R_h = \frac{A}{P}.$$

where A = cross-sectional area of flow

P = wetted perimeter

Question NO 2

Part * (a)

Given Data:-

velocity = V = 2 m/s

Pressure = P = 300 KPa

datum = Z = 5m.

Sol:-

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

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

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

$$H = 35.7849 \, m$$

②

Question NO #2.

Part (b)

Given Data:

Diameter = d_1 = 300 mm

Diameter = d_2 = 200 mm

Pressure = P_1 = 300 kPa = 300×10^3 N/m²

Pressure = P_2 = 120 kPa = 120×10^3 N/m²

Datum = Z = ?

Sol:-

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

$$d_1 = 300 \text{ m} = 0.3 \text{ m}$$

$$d_2 = 200 \text{ m} = 0.2 \text{ m}$$

Required:-

$$Z = 8$$

Sol:-

$$A_1 = \pi d_1^2$$

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

$$A_1 = 0.0706\ m^2$$

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

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

$$A_2 = 0.0314\ m^2$$

As we know

$$Q_1 = V_1 A_1$$

$$V_1 = Q/A_1$$

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

$$\boxed{V_1 = 0.566}$$

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

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

$$V_2 = 1.27$$

NOW

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

$$Z_2 = 0$$

$$\gamma = 9810$$

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

$$30.60 + Z_1 = 12.314$$

$$\boxed{Z_1 = -18.286}$$

Question No 3:-
Answer:-

Given:-

Length of pipe = 500m

diameter = d = 0.2m

specific gravity oil = 0.9

Flow rate = Q = 0.06 m^3/sec

viscosity = μ = 6×10^5 N.s/m

Required:-

Pressure loss = ?

sol:-

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

where

R = Reynold's number and is given by

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

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

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

Bernoulli Equation:-

Head loss $= h_l = \frac{fLV^2}{2gD} \rightarrow (B)$

By putting values in (B)

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

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

Now we will find pressure loss due to friction.

As we know that

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

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

put values

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

$$\Delta P = 37602.7 \text{ Pa}$$

$$\boxed{\Delta P = 37.6021 \text{ KPa}}$$