Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. 1 a) Attempt any six of the following.

i) Unit of Dynamic Viscosity – $\frac{N-S}{M^2}$ 01

Surface tension - N/M

ii) Specific Volume 01

It is a ratio of volume of fluid per unit mass of fluid

V = $\frac{volume}{mass}$ = M^3/kg

Weight Density – It is ratio of weight per unit volume of fluid 01

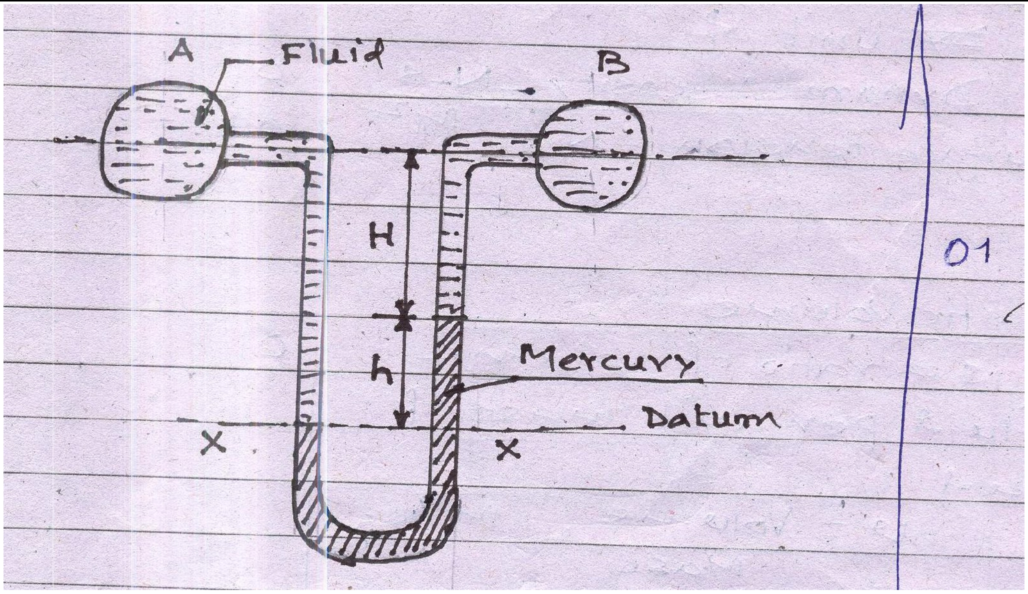
W=$\frac{weight}{volume}$ = N/M^3

iii) Compressibility – It is defined as the ratio of volumetric stain to compressive stress 01

Bulk modulus – It is the ratio of compressive stress to volumetric strain 01

K =$\frac{-lp}{dV/V}$

iv) Sketch of U- tube differential manometer---------------------------01



H- height of fluid 01

h- height of mercury

A and B are two pipes connected by U- tube differential manometer

v) Application of Bernoulli's Theorem (any four ½ mark each)

Q.1 a)

i) Venturimeter

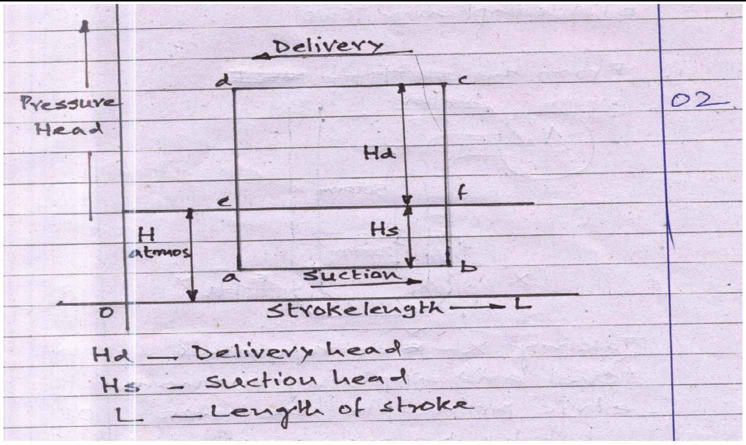
ii) Orificemeter

iii) Pitot tube

iv) Nozzle

v) Pump

vi)



Hd- Delivery head

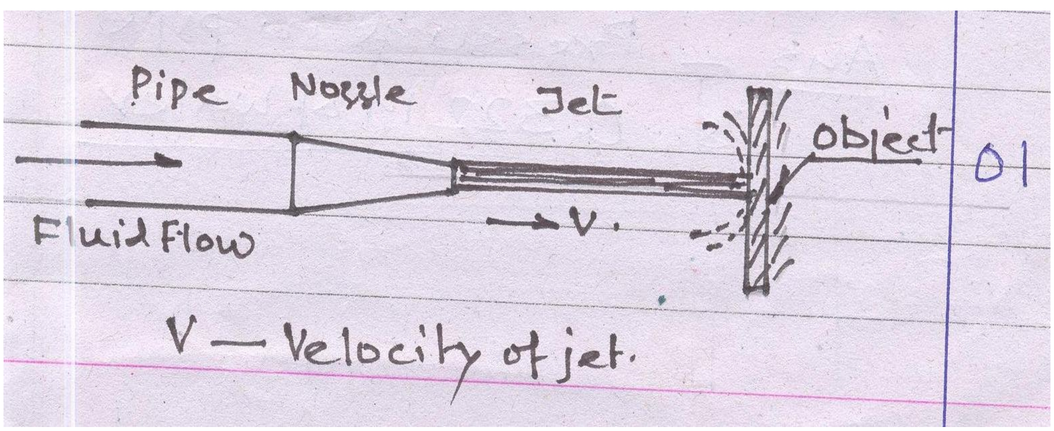
Hs- suction head

L- length of stroke

vii) Newtonion Fluid – The fluid which obeys Newton's law of viscosity is known as Newtonion fluid. 01

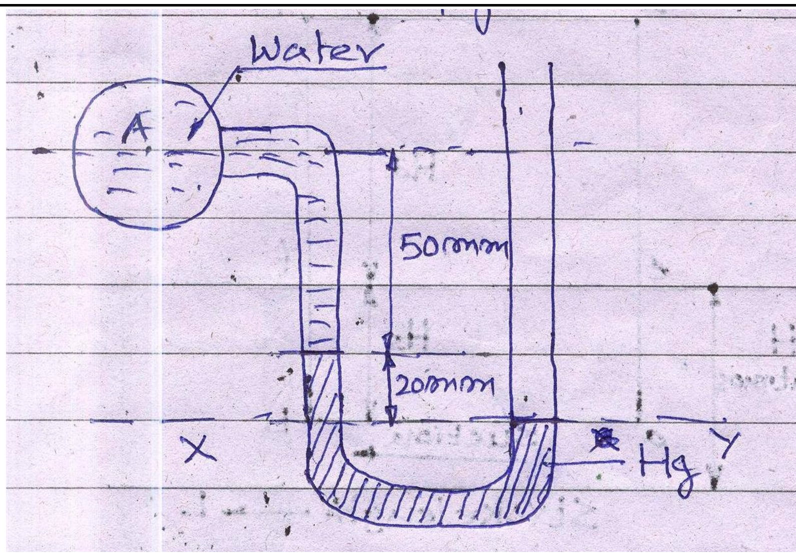
Non Newtonion fluid – the fluid which does not obeys Newton's law of viscosity is known as Non Newtonion fluid 01

viii) Impact of jet – It is defined as the force exerted by the jet on a plate which may be stationary or moving. 01



Q. 01 b) Attempt any two

i) From the fig.



Taking X-Y as reference level and applying manometric principle we have Let hA be pressure

Head in pipe in M of water column 01

Total head on X = total head on Y

$h_A + 0.05 + 0.02 \text{ x } 13.6 = 0$ 01

(0 = Atmospheric pressure = Reference pressure)

$h_A + 0.322 = 0$ 01

:. $h_A = -0.322$ M of water

-ve sign indicates, pressure in pipe is less than atmospheric pressure 01

Ans- **Pressure in pipe is 0.322 M of water .**

Q.1 (b)

ii) Data given –

Sp. Gravity of oil 0.8

Intensity of pressure – 25 k p_a

--- 25 KN/M^2

From hydrostatic equation

p= w x h

= w_o x h_o

Where w_o - sp. Weight of oil

h_o – oil column in M

1) 25 = 0.8 x 9.1 x 40

$h_o = \frac{25}{0.8 \times 9.81} = 3.185$

oil column in meter – 3.185 (02)

2) meter of Hq

we know that

$w_o \times h_o = wHq \times hHq$

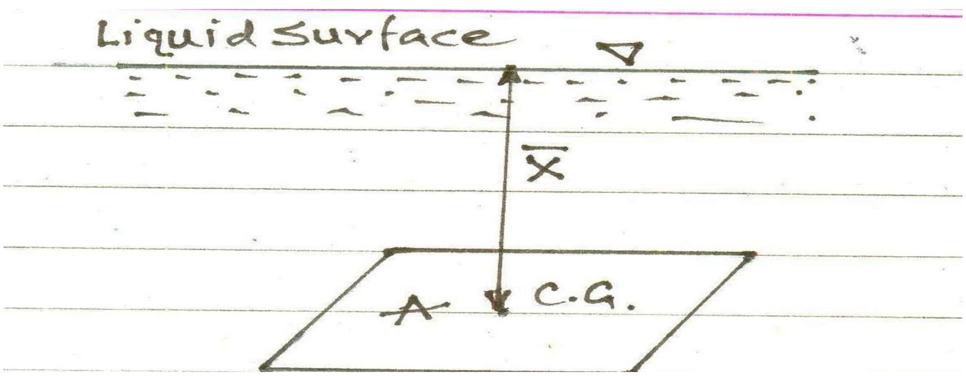
0.8 x 9.81 x 3.185 = 13.6 x 9.81 x hHq

$hHq = \frac{0.8 \times 3.185}{13.6}$

hHq = 0.187 meter (02)

iii) There are three ways of immersing surface in liquid

a) Surface immersed horizontally 1M



Total Pressure = P = $WA\bar{X}$ KN

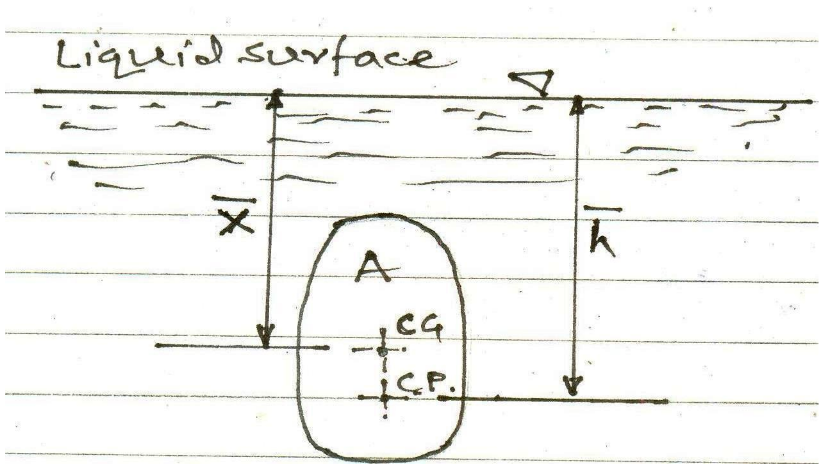
Where W - sp. Weight of liquid in KN/M^3

A – Area of surface in M^2

$\bar{X}$ -Dept of CG of surface from free liquids surface measures vertically in meters.

Dept of centre of pressure h = X It is because every point of the surface is at same depth form free surface of liquid

ii) Surface immersed vertically 1M



Total pressure – P = WA$\bar{X}$ KN

Where W - sp. Weight of liquid in KN/M^3

A – Area of surface in M^2

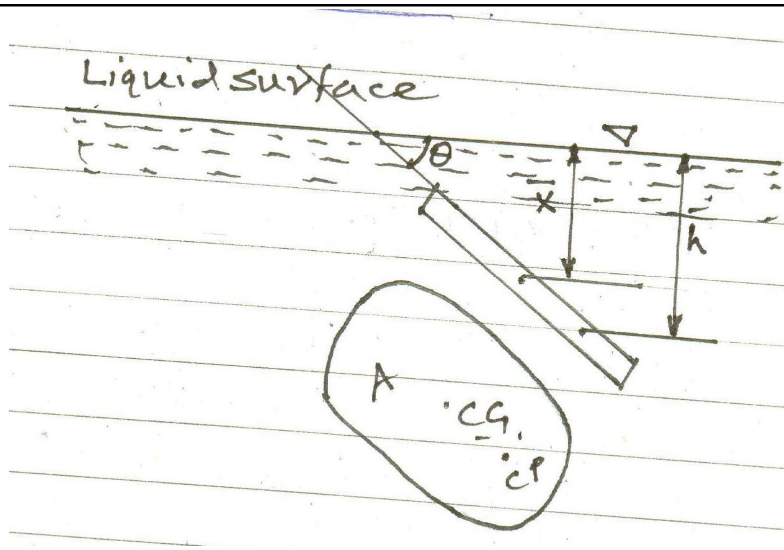
$\bar{X}$ -Dept of CG of surface from free liquids surface measures vertically in meters.

Dept of centre of pressure -$\bar{h}$

$\bar{h} = \frac{IGG}{A\bar{X}} + \bar{X}$ meter

Where IGG – Moment of inertia of the surface about an axis passing through its C.G in M^4

(iii) Surface immersed inclined with liquid surface 1M



Total Pressure $P = WA\bar{X}$ x KN

Where W- Sp. Weight of liquid in KN/M^3

A – Area of surface in M^2

$\bar{X}$ - Depth of C.G of surface form free liquid surface measured Vertically in M

Depth of centre of pressure -$\bar{h}$

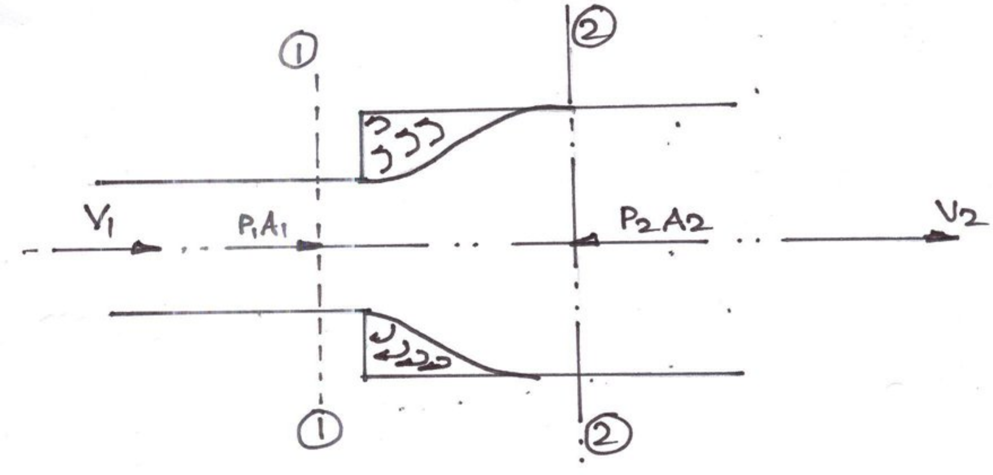
$\bar{h}$ - $\frac{IGG \sin^2\theta}{AX}$ + $\bar{X}$

Where θ -Angle made by plane of the surface with liquid surface 1M

Q. 2 Attempt any four

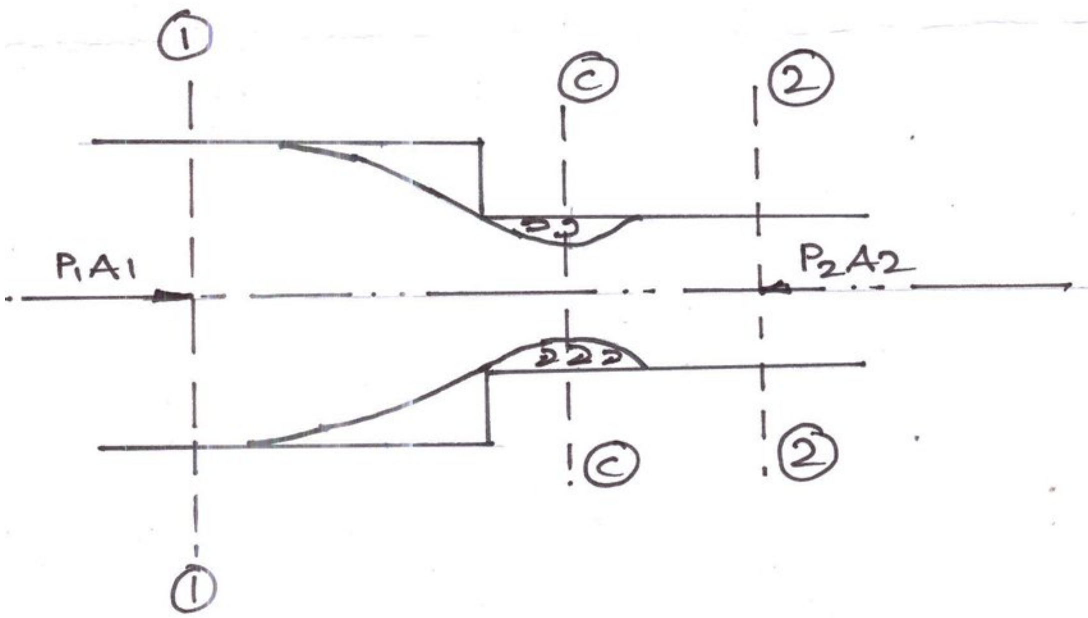
a) Sketch 02 M and Equation 02 M each

i) Loss of head due to sudden enlargement



he = $\frac{(v^1-v^2)^2}{2g}$

ii) Sudden contraction

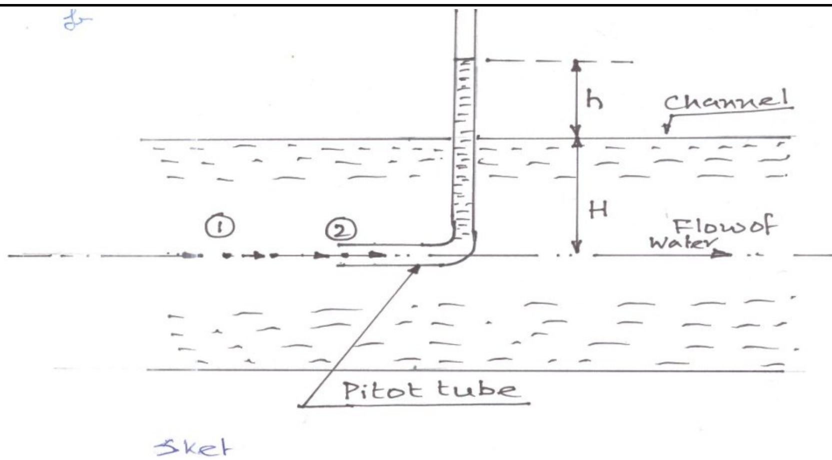


hc = $\frac{V_2^2}{2g}\left[\frac{1}{Cc} - 1x^2\right]$ M of liquid

Where C_C - coefficient of contraction

b) Pitot Tube

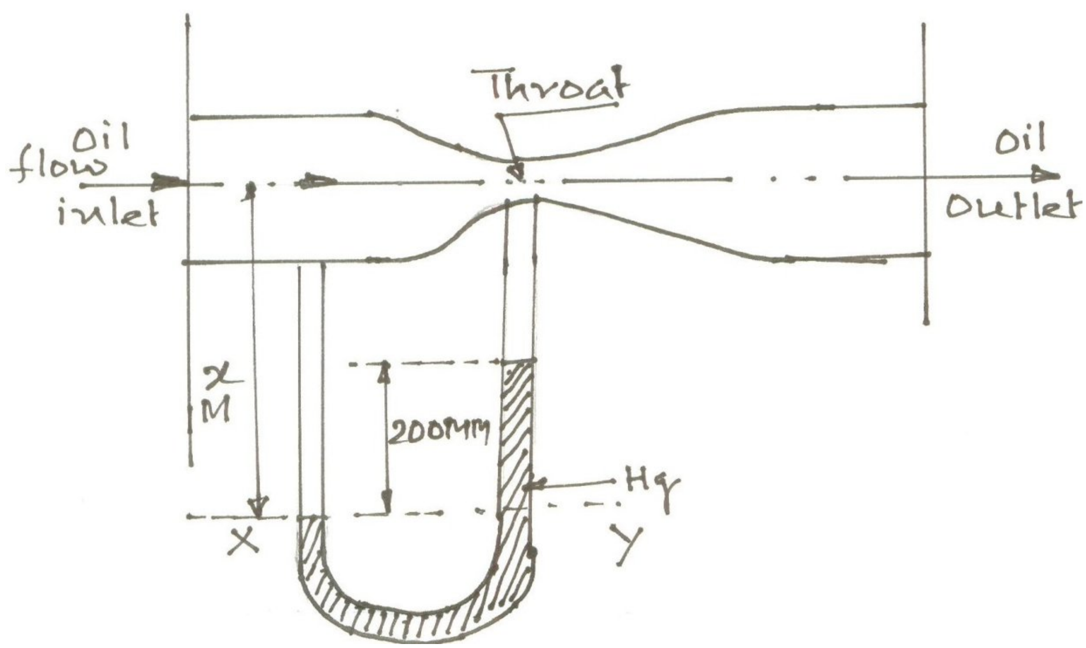
Sketch of Pitot tube 03M



Function – Its function is to measure velocity of flow at any point in a pipe or a channel velocity of flow is given by 1M

V=$\sqrt{2gh}$

Q.2 (C) Arrengment sketch 02M



The arrangement of the instrument is as shown in the fig.

Let X- Y be the reference line as shown in the fig.

X- distance between manometric of pipe and reference line on inlet side.

From monometer principle we have

Total head on X = Total head on Y Let h_1 and h_2 be the pressure head at inlet and at throat

Respectively in meter of water.

.'. $h_1 + x0.8 = h_2 + 0.8(x - 0.2) + 0.2 \times 13.6$

$h_1 + x0.8 = h_2 + 0.8x - 0.16 + 0.272$

$= h_2 + 0.8x + 2.56$

$h_1 = h_2 + 2.56$

$h_1 - h_2 = 2.56$ 02 M

Q.2 d) Any four points 04 Marks

Sr. No	Laminar Flow	Turbulent flow
1	Fluid particles move along well-defined path	Fluid particle move in a zig-zag path
2	Eddies does not form	Eddies formation lakes place
3	Energy loss is minimum	Energy loss is high
4	Flow speed is very low	Flow speed is very high
5	Reynold's number is less than 2000	Reynold's number is more than 4000
6	It is a ideal flow	It is a particle flow
7	Viscous flow	Non- viscous flow
8	Steady flow	Unsteady flow

Q.2 (e) Darcy's formula for loss of head due to friction

$h_f = \frac{4fLV^2}{2gd}$ (02)

Where

h_f = Loss of weight head due to friction M

L = Length of pipe over which h_f is to be calculated M

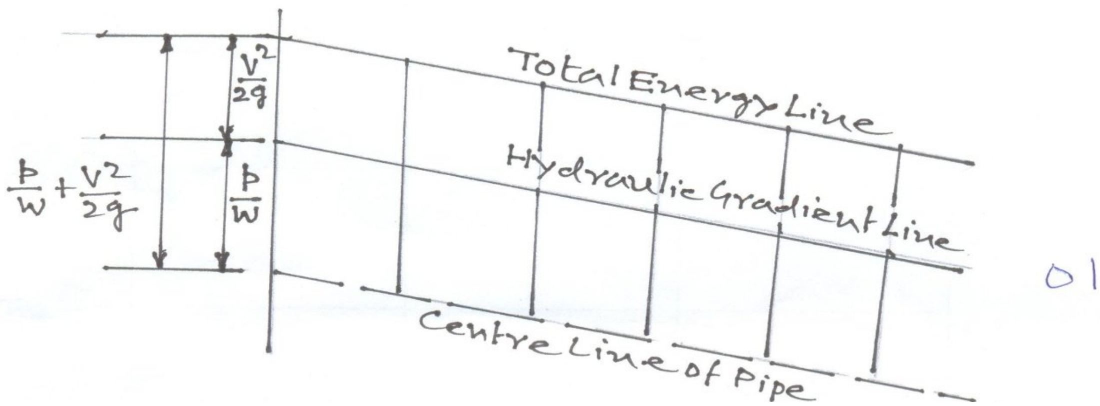
V = Velocity of flow M/s

d = diameter of pipe M

f = Darcy's co-efficient of friction 02M

(f) Hydraulic Gradient line 02M

If pressure heads, p/w of liquid flowing in a pipe be plotted ad a vertical ordinates on the centre line of the pipe , then line joining the tops of such ordinates is known as hydraulic gradient line. This is as shown in the fig.



Total Energy Line-

If sum of pressure heads and velocity heads $\left(\frac{p}{W}+\frac{V^2}{2g}\right)$ of liquid flowing in a pipe be plotted as vertical ordinates on the centre line of the pipe, then the line joining tops of such ordinates is known as total energy line 01M

Q 3 a) Given Data – Fixed vertical plate

D=diameter of jet of water =50mm =0.05 m

A= area of jet=$\pi/4\ d^2$ =0.00196 m^2 **(1 Marks)**

V =velocity of jet=25 m/s

The force exerted by the jet on a flat plate F = ρ A V^2 **(1 Marks)**

ρ=Mass density of water =1000 kg/ m^3

F= 1000 x 0.00196 x$(25)^2$ = 1227.2 N =1.2272KN **(2 Marks)**

Q. 3b) Expression for the force exerted by a jet of water on moving inclined plate

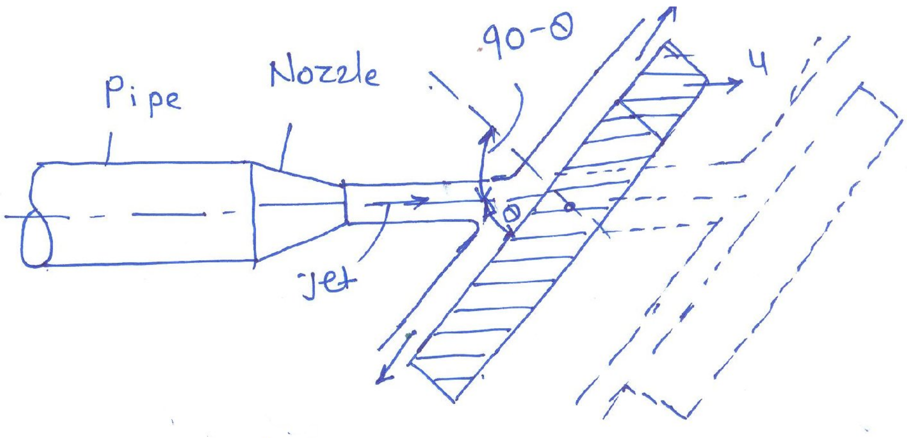


Fig. No3.b **(For sketch 1 Marks)**

V- absolute velocity of the jet A-cross sectional area of jet

u-velocity of plate in the direction of jet Ɵ- angle between jet and the plate

Relative velocity with which the jet strikes on plate= (V- u)

The force exerted by the jet on the plate in the direction normal to plate Fn

Fn =Rate of change of momentum **(1 Marks)**

=Mass/sec [Velocity of jet before striking the plate - Velocity of jet after striking the plate]

Mass of fluid striking on the plate per sec=ρ A (V –u)

$Fn= \rho A (V - u) [(V - u) \sin\Theta - 0] = \rho A (V - u)^2 \sin\Theta$ **(1 Marks)**

The component of this force in the direction of the jet

$Fx= Fn \sin\Theta = \rho A (V - u)^2 \sin^2 \Theta$ **(1 Marks)**

Q.3 c) Classify turbine

i) Head at the inlet of turbine **(2 Marks)**

1. *Impulse turbine*: - In the impulse turbine, the total head of the incoming fluid is converted in to a large velocity head at the exit of the supply nozzle. *Pelton wheel turbine.*

2. *Reaction turbine*: In this type of turbines, the rotation of runner or rotor

(rotating part of the turbine) is partly due to impulse action and partly due to change in pressure over the runner blades. *Francis turbine , Kaplan turbine*

ii) The direction of flow through runner **(2 Marks)**

1.*Tangential flow turbines*: In this type of turbines, the water strikes the runner in the direction of tangent to the wheel. *Example:* Pelton wheel turbine.

2. *Radial flow turbines*: In this type of turbines, the water strikes in the radial direction.

i) *Inward flow turbine:*

ii) *Outward flow turbine:*

3.*Axial flow turbine*: The flow of water is in the direction parallel to the axis of the shaft. *Example:* Kaplan turbine and propeller turbine.

4.*Mixed flow turbine:* The water enters the runner in the radial direction and leaves in axial direction. *Example:* Modern Francis turbine.

Q.3 d)Inlet and outlet velocity triangle for pelton wheel

(Sketch 2 Marks and terms meaning 2 Marks)

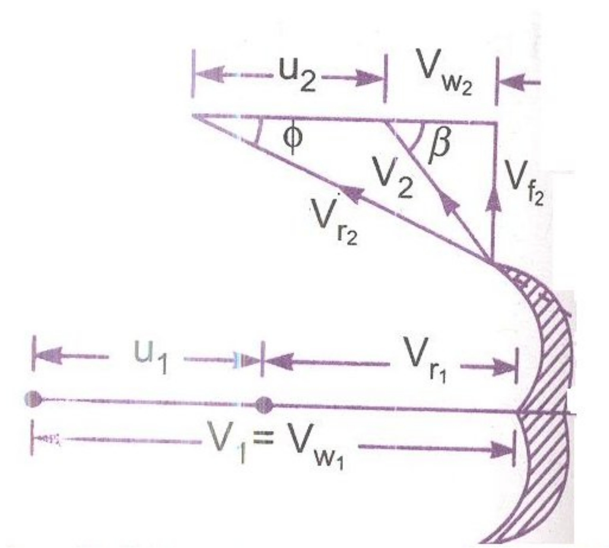


Fig No 3.d

V_1 ,V_2 = absolute Velocity of water jet at inlet and outlet respectively.

Vr_1 ,Vr_2 =Relative Velocity of vane at inlet and outlet respectively

Vf_1 ,Vf_2 = Velocity of flow at inlet and outlet respectively

Vw_1 ,Vw_2 = Velocity of whirl at inlet and outlet respectively

α=Nozzle angle at inlet /Guide angle at inlet

β=Angle made by the velocity V_2 with the direction of motion of vane at outlet.

Θ= vane angle at inlet

Φ= vane angle at outlet.

Q.3 e) Given data: Conical Pipe

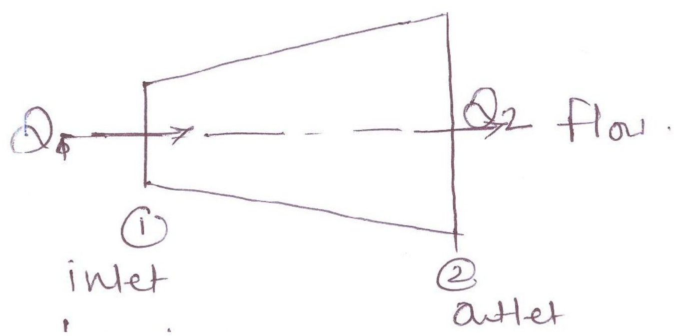


Fig. No

At inlet d_1= 0.1 m V_1 = 5 m/s

At outlet d2= 0.15 m V_2 = ?

From the equation of continuity

Rate of flow at Inlet = Rate of flow at Outlet ($Q = Q_1 = Q_2$)

$Q = A_1V_1 = A_2V_2$

i) Rate of flow $Q=A_1V_1= \pi/4\ d_1^2 \times 5$ **(2 Marks)**

$= \pi/4\ (0.1)^2 \times 5 = 0.0393\ m^3/sec$

ii) velocity of flow at larger end V_2 **(2 Marks)**

$Q = A_2V_2$

$0.0393 = \pi/4\ (0.15)^2 \times V_2$

V_2= 2.23 m/s

Q.3 f) two stage centrifugal pumps joined in parallel **(Sketch with labeled 4 marks)**

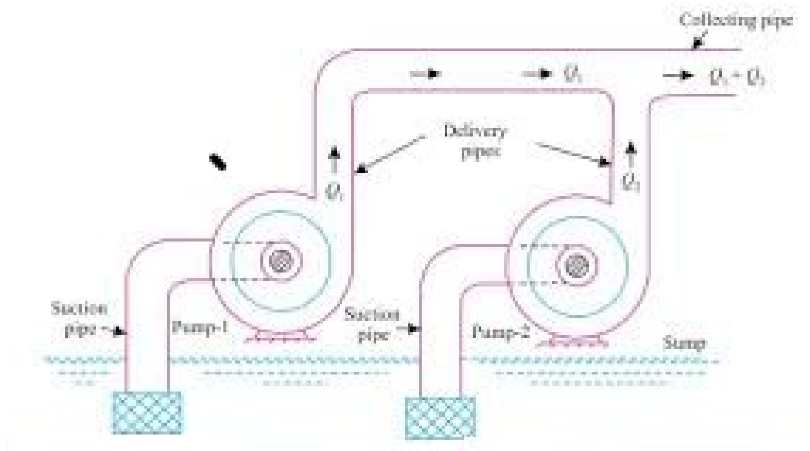
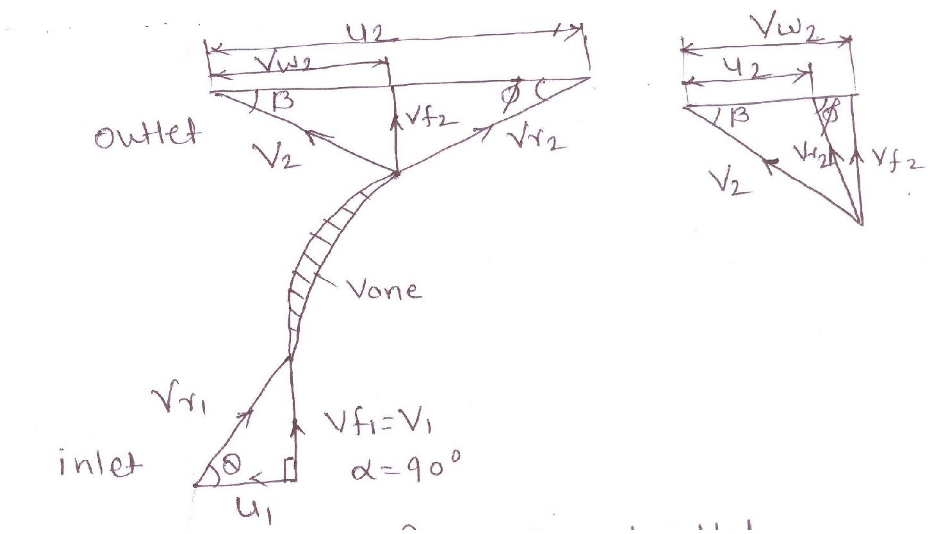


Fig. no. 3.f Pipes in Parallel

Q.4 a) Given data Centrifugal Pump

$Q = 0.130\ m^3/sec$ N= 1200 rpm H=20m ηmano= 75%

D_2=Impeller diameter at outlet =0.25m B_2= width at outlet =0.04m



For velocity triangle (3 Marks)

i) Tangential velocity of impeller at outlet $u_2 = \pi D_2 N/60 = \pi \times 0.25 \times 1200/60 = 15.71$ m/sec **(1 Marks)**

ii) Rate of flow $Q = \pi . D_2 . B_2 . Vf_2$

$Vf_2 = 0.130/3.14 \times 0.25 \times 0.04 = 4.14$ m/sec **(1 Marks)**

iii) $\eta mano = gHmano/Vw_2\, u_2$

$Vw_2 = 9.81 \times 20/0.75 \times 15.71 = 16.65$ m/sec **(1 Marks)**

From velocity triangle at outlet

iv) $\tan \Phi = Vf_2/(Vw_2 - u_2) = 4.14/(16.65-15.71) = 4.14/0.94$

$\Phi = \tan^{-1}(4.4) = 77^o 22''$

Vane angle at outlet $\Phi = 77^o 22''$ **(2 Marks)**

Q.4 b) Given data :Pelton Wheel

H= 50m Shaft power P= 80,000 Watt N= 230 rpm $\eta o = 78\%$ Cv=0.98

i)Velocity of jet V_1 **(2 Marks)**

$V_1 = Cv \sqrt{2g H} = 0.98 \times \sqrt{2 \times 9.81 \times 50} = 30.7$ m/sec

ii) Rate of Flow Q **(3 Marks)**

ηo =Shaft Power / Water power =P /w.Q.H

$80{,}000 = 9810 \times Q \times 50 \times 0.78$

$Q = 0.21\ m^3/sec$

iii) Diameter of jet d **(3 Marks)**

Discharge of jet = Area of jet x Velocity of jet

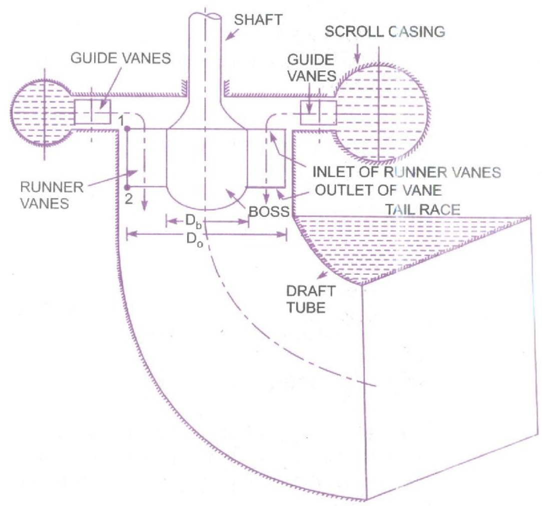
$Q = \pi/4\, d^2 \times V_1$

$0.21 = \pi/4\, d^2 \times 30.7$

$d^2 = 0.00871$

$d = 0.093m = 93.30mm$

Q.4 c) Kaplan Turbine (**sketch 4 Marks and Explanation working 4 Marks**)



Main components of Kaplan turbine.

Fig. no. 4.c **(Sketch 4 Marks and working 4 Marks)**

The main parts of kalplan turbine

1.scroll casing 2.Guide vanes mechanism 3.Hubwith vanes or runner of the turbine 4. Draft tube

Working : The water from penstock enters the scroll casing and then moves to the guide vanes. From the guide vanes ,the water turns through 90^o and flows axially through the runner .The water after imparting its energy to the turbine is discharged into the draft tube . The draft tube delivers the water to the tail race.

Q 5 a i) Any four point from the following (1X4=4 marks)

Sr no	Parameter	Fransis Turbine	Kaplan Turbine
1	Construction- Entry of Water	It is radial flow turbine	It is axial Flow turbine
2	Number of vanes	It has large number of vanes i.e. 16 to 24	It has small number of vanes i.e.3 to 8
3	Position of vanes	The runner vanes are fixed	The runner vanes are adjustable which are fixed on hub
4	Working	It is used for medium head and medium discharge	It is used for low head and high discharge
5	Frictional resistance	Frictional resistance is high due to number of large no of vanes	Reduced frictional resistance due to small number of large no of vanes

Q 5 a-ii) Air vessel is a closed chamber connected in the suction and discharge lines of a reciprocating pump.

The vessel contains liquid with air entrapped in the upper part as shown in figure.

The functions of the air vessel in the reciprocating pump are;

1) To reduce peak pressure and flow pulsation in the flow
2) To provide continuous supply of the liquid at the uniform flow rate
3) To save the power required to drive the pump
4) To run the pump at much higher speed without any danger of the separation

[3 Marks]

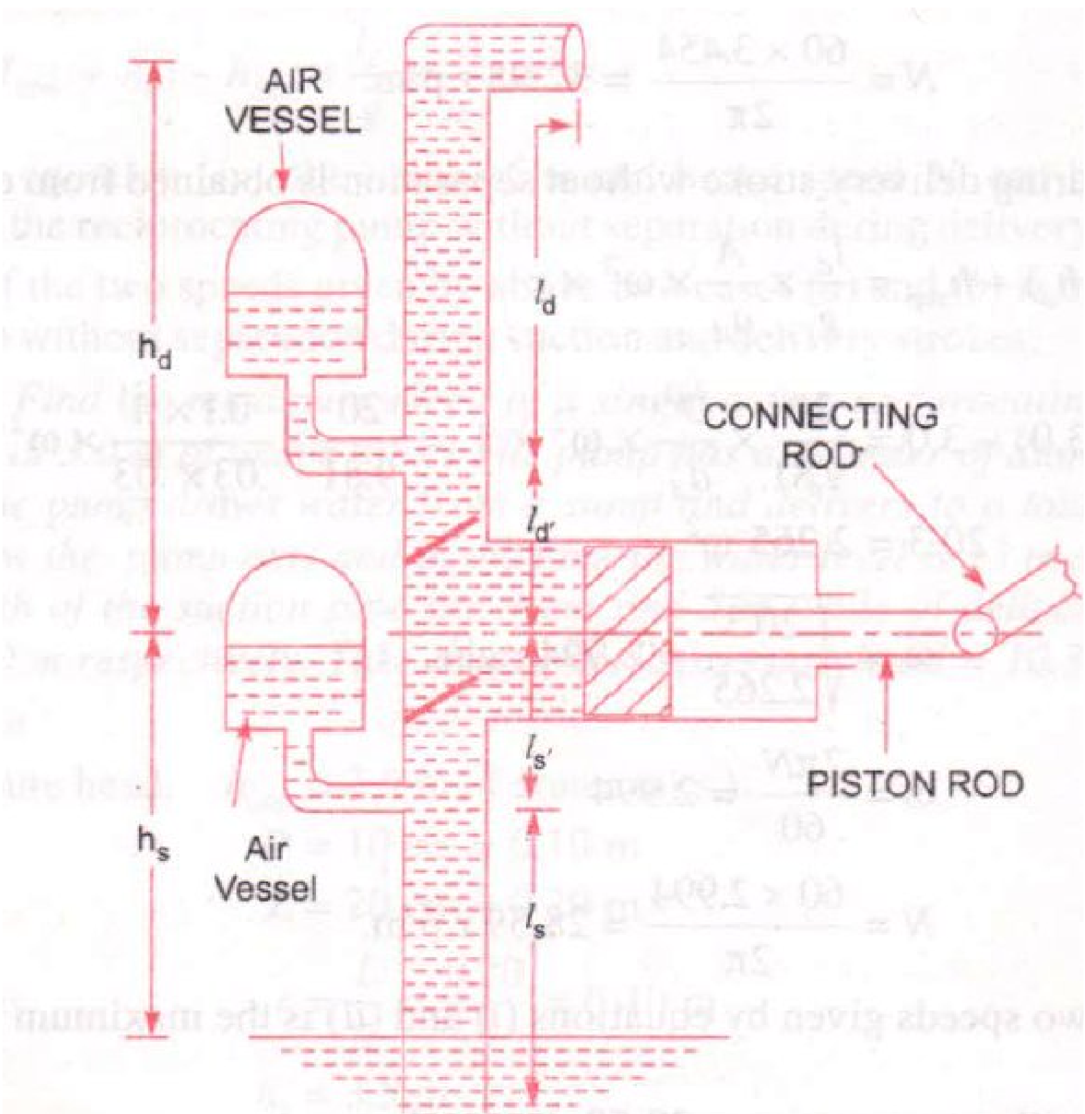


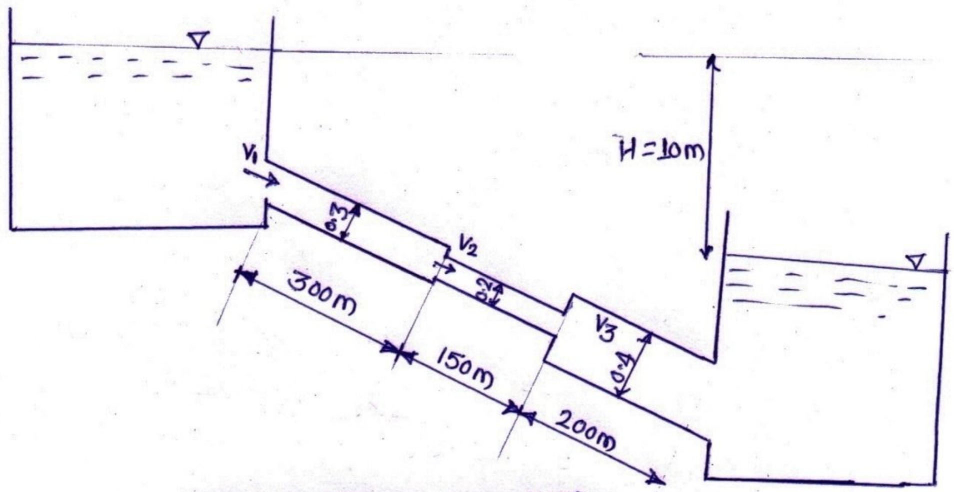
Fig-Air Vessel in the Reciprocating Pump [1 Marks]

Q 5b-Comparision between Centrifugal Pump and Reciprocating Pump

(ANY EIGHT FROM FOLLOWING 1 Marks each; 1X8=8 Marks)

Sr No	Centrifugal Pump	Reciprocating Pump
1	The discharge is continuous and high.	The discharge is fluctuating and pulsating.
2	It can handle large quantity of liquid	It can handle small quantity of liquid only.
3	Priming is necessary	Priming is not necessary
4	It doesn't require air vessel.	Air vessel is required for continuous flow.
5	Centrifugal pump runs at higher speed, they can be coupled to electric motor	Reciprocating pump runs at slow speed. Speed is limited due to consideration of separation and cavitations.
6	Efficiency is high	Efficiency is low.
7	Operation of centrifugal pump is smooth and without much noise	Operation of reciprocating pump is complicated and with much noise.
8	Centrifugal pump requires smaller floor area and its installation cost is low.	Reciprocating pump requires large floor area and its installation cost is high.
9	It is used for larger discharge through smaller heads.	It is meant for small discharge and high heads.
10	It can be used for lifting highly viscous liquids.	It is used only for lifting pure water or less viscous liquids.
11	Action on fluid is dynamic.	Action on fluid is due to positive displacement.

Q-5-C :- Numerical for 08 Marks)



Given:- H = distance between two tank
= total head lost
= 10m.

$L_1 = 300m, \quad d_1 = 0.3m, \quad f_1 = 0.0005$

$L_2 = 150m, \quad d_2 = 0.2m, \quad f_2 = 0.0052$

$L_3 = 200m, \quad d_3 = 0.4m, \quad f_3 = 0.0048$

To find:- Rate of flow i.e. discharge

Solution:- H = (Total Major loss) + (Total minor loss)

$$\text{Total Major loss} = \frac{4f_1 l_1 V_1^2}{2gd_1} + \frac{4f_2 l_2 V_2^2}{2gd_2} + \frac{4f_3 l_3 V_3^2}{2gd_3}$$

But velocities are unknown, so, using

$A_1V_1 = A_2V_2 = A_3V_3$

$A_1V_1 = A_2V_2$

$\frac{\pi}{4} \times d_1^2 \times V_1 = \frac{\pi}{4} \times d_2^2 \times V_2$

$\cancel{\frac{\pi}{4}} \times d_1^2 \times V_1 = \cancel{\frac{\pi}{4}} \times d_2^2 \times V_2 \longrightarrow \pi/4$ gets cancelled from both sides

$$d_1^2 \times V_1 = d_2^2 V_2$$

$$\left(\frac{d_1}{d_2}\right)^2 \times V_1 = V_2$$

$$\left(\frac{0.3}{0.2}\right)^2 \times V_1 = V_2$$

$$2.25 V_1 = V_2$$

$$\boxed{V_2 = 2.25 V_1}$$

Also

$$A_1 V_1 = A_3 V_3$$

$$\frac{\pi}{4} \times d_1^2 \times V_1 = \frac{\pi}{4} \times d_3^2 \times V_3$$

$$\cancel{\frac{\pi}{4}} \times d_1^2 \times V_1 = \cancel{\frac{\pi}{4}} \times d_3^2 \times V_3 \rightarrow \pi/4 \text{ gets cancelled.}$$

$$\left(\frac{d_1}{d_3}\right)^2 V_1 = V_3$$

$$\left(\frac{0.3}{0.4}\right)^2 V_1 = V_3$$

$$0.5625 V_1 = V_3$$

$$\boxed{V_3 = 0.5625 V_1}$$

$$\boxed{V_3 = 0.56 V_1}$$

(2 Marks)

$$\text{Total Major loss} = \frac{4 f_1 l_1 V_1^2}{2 g d_1} + \frac{4 f_2 l_2 V_2^2}{2 g d_2} + \frac{4 f_3 l_3 V_3^2}{2 g d_3}$$

$$(H_{f\,major})_{Total} = \frac{4 f_1 l_1 \times V_1^2}{2 g d_1} + \frac{4 f_2 l_2 \times (2.25 V_1)^2}{2 g d_2} + \frac{4 f_3 l_3 V_3^2}{2 g d_3}$$

$$= \frac{4 \times 0.0005 \times 300 \times V_1^2}{2 \times 9.81 \times 0.3} + \frac{4 \times 0.0052 \times 150 \times 5.06 V_1^2}{2 \times 9.81 \times 0.2} + \frac{4 \times 0.0048 \times 200 \times 0.31 V_1^2}{2 \times 9.81 \times 0.4}$$

$$= 0.1019 V_1^2 + 4.023 V_1^2 + 0.1516 V_1^2$$

Total Major loss $= 0.10V_1^2 + 4.02V_1^2 + 0.15V_1^2$

$$\boxed{\text{Total Major loss} = 4.27V_1^2}$$

(2 Marks)

Total Minor loss = loss at entry + loss due to sudden contraction + loss due to sudden expansion + loss at exit

$$= \frac{0.5V_1^2}{2g} + \frac{0.5V_2^2}{2g} + \frac{(V_2-V_3)^2}{2g} + \frac{V_3^2}{2g}$$

$$= \frac{1}{2g}\left[0.5V_1^2 + 0.5\times(2.25V_1)^2 + (2.25V_1 - 0.56V_1)^2 + (0.56V_1)^2\right]$$

$$= \frac{1}{2g}\left[0.5V_1^2 + 2.53V_1^2 + 2.8561V_1^2 + 0.31V_1^2\right]$$

$$= \frac{1}{2g}\left[6.1961V_1^2\right]$$

$$= \frac{6.1961}{2\times 9.81}V_1^2$$

$$= 0.3158V_1^2$$

(2M)

Total loss(H) $= 4.27V_1^2 + 0.3158V_1^2$

$$= 4.5858V_1^2$$

$$10 = 4.59V_1^2$$

$$\boxed{V_1 = 1.4760 \text{ m/s}}$$

(1 Marks)

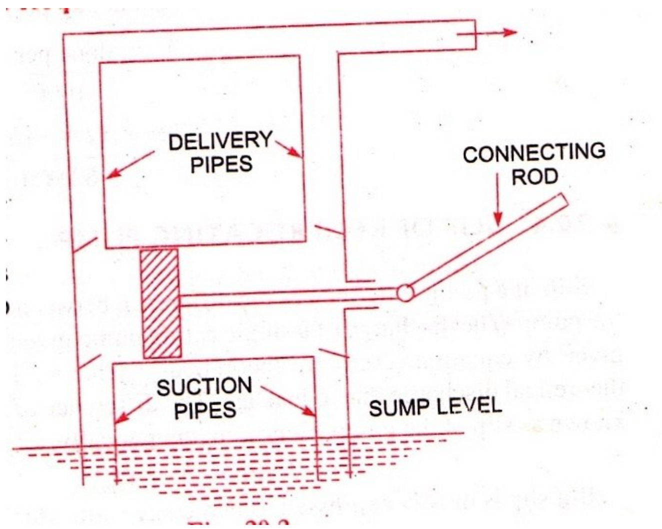
$$Q = \frac{\pi}{4}\times(0.3)^2\times 1.4760$$

$$= 0.1043 \text{ m}^3/\text{s}$$

$\boxed{Q = 0.104 \text{ m}^3/\text{s} \text{ i.e. } 104.3 \text{ lit/sec}}$ → Ans. (1 Mark)

Q 6: Attempt Any Four (4X4=16 Marks)

Q 6 -a) Working of Double acting Reciprocating pump.



Double Acting Reciprocating pump 1 Marks

(1Marks Sketch+3 marks explanation=04 Marks)

1) In case of double acting pump the water is acting on the both sides of the piston as shown.
2) Thus we require two suction pipes and two delivery pipes for double acting pump.
3) When there is suction stroke on the one side of the piston there is at a same time delivery stroke on the side of the piston.
4) Thus for one complete revolution of the crank there are two delivery strokes and water is delivered to the pipes by the pump during these two delivery strokes.
5) Discharge is given by $Q = \frac{2ALN}{60}$ 3Marks

Q 6-b) Coefficient of Discharge-It is defined as the ratio of actual discharge to the theoretical discharge. It is denoted by C_d 1Mark

$$\text{Coefficient of Discharge} = \frac{\text{Actual Discharge}}{\text{Theoretical Discharge}}$$

$$\text{Coefficient of Discharge} = \frac{\text{Actual Velocity} \times \text{Actual Area}}{\text{Theoretical Discharge} \times \text{Theoretical Area}}$$

$C_d = C_v \times C_c$ 2 Mark

Actual discharge (A_{actual})= ($C_d \times A_1 \times A_2 \times \sqrt[2]{2gH}$)/($\sqrt{A1^2 - A2^2}$ 1 Mark

Q-6.c Numerical for 04 marks

Given:- Vacuum pressure = 200mm of Hg

= 20cm of Hg.

= 0.2m of Hg.

To find:- Absolute pressure in N/mm^2

Solution:- We know that

$P_{abs} = P_{atm} - P_{vacuum}$ (1 marks)

$= (760 - 200)$ mm of Hg

$\boxed{P_{abs} = 560 \text{ mm of Hg.}}$ (1 Marks).

Now,

$P_{abs} = (13.6 \times 9.81 \times 0.56)$ (1 Marks)

$P_{abs} = 74.71\ kN/m^2$

$= \frac{74.71 \times 10^3}{(10^3)^2}$

$= \frac{74.71 \times 10^3}{10^6}$

$= 74.71 \times 10^3 \times 10^{-6}$

$\boxed{P_{abs} = 0.07471\ N/mm^2}$ ⟶ 1 Mark.

Q 6 d)

Manometric Head-It is defined as the head against which the pump has to work. It is denoted by H_m.
1 Mark

Manometric Head=Head imparted by the impeller to water-Loss of head in pump

= $(V_{w2} U_2)/g$ - Loss of head in impeller and casing pump.

= $V_{w2} U_2)/g$ Neglecting the losses.

$H_m=H_s+H_d+H_{fs}+H_{fd}+(V_d^2)/(2g)$ 1Mark

Manometric Efficiency=It is defined as the ratio of manometric head to the head imparted by impeller to the water. It is denoted by $\eta_{mano.}$ 1 Mark

$$\eta mano = \frac{\text{Manometeric Head}}{\text{Head imparted by impeller to water}}$$

$\eta_{mano} =(g H_m)/(V_{w2} U_2)$ 1 Mark

Q 6 e)

Compressible Flow-Compressible flow is that type of flow in which the density of the fluid changes from point to point.

$\rho \neq \text{Constant}$ 2 Mark

Incompressible Flow-Incompressible flow is that type of flow in which the density for the fluid flow is constant. Liquids are generally incompressible while gases are compressible

$\rho = \text{Constant}$ 2 Mark

Q 6 f)

Impeller- An impeller is a rotating part of a centrifugal pump with the series of backward vanes. There are three types which are commonly used (ANY TWO-2X2=4)

(1 Mark for each diagram and 1 Mark for explanation)

1) Closed impeller

2) Semi open impeller

3) Open impeller

1) Closed impeller

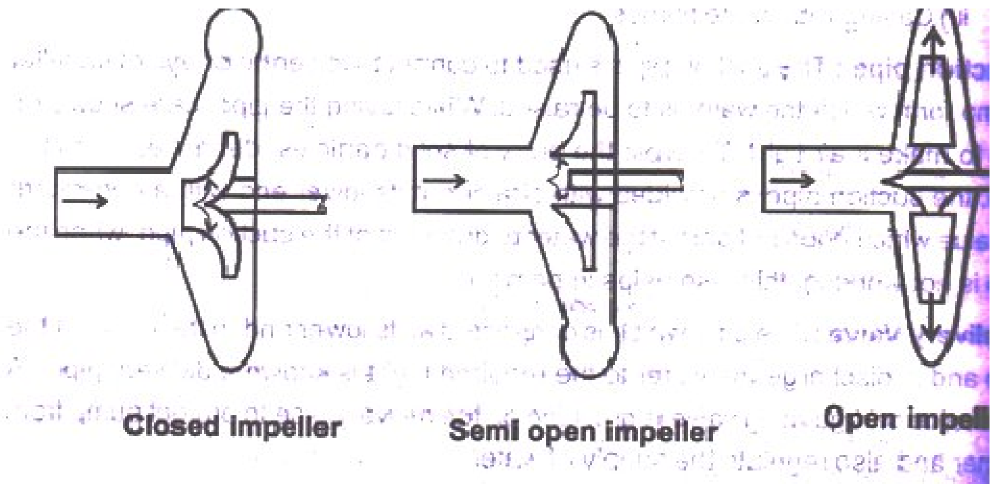
Closed Impeller-This type of impeller is provided with circular plates on each side which encloses the vanes. It provides better guidance to water and is used for water is pure and free from debris.

2) Semi open impeller

In this type of impeller only one side is provided with circular cover plate. This impeller can be used even if the water contains some debris.

3) Open Impeller.

In this type of impeller there is no circular plate on any side of the vanes so the vanes are open. Such impeller are used for pumping the water containing the suspended solid matter such as sewage, paper pulp etc



1Marks each for Neat Sketch.