WINTER – 2015 EXAMINATION

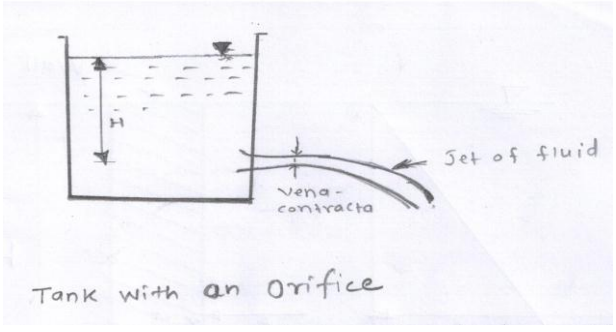
Subject: Hydraulics **Subject Code**: **17421**

Important Instructions to examiners:

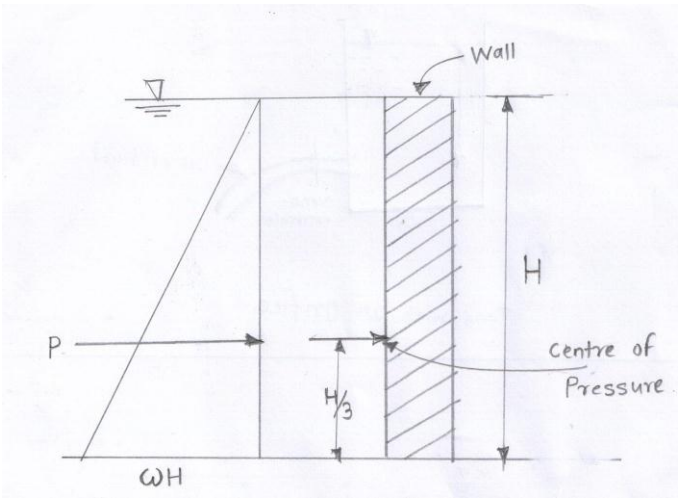
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 the candidate and those in the 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 the model answer.
6) In case of some questions credit may be given by judgment 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.

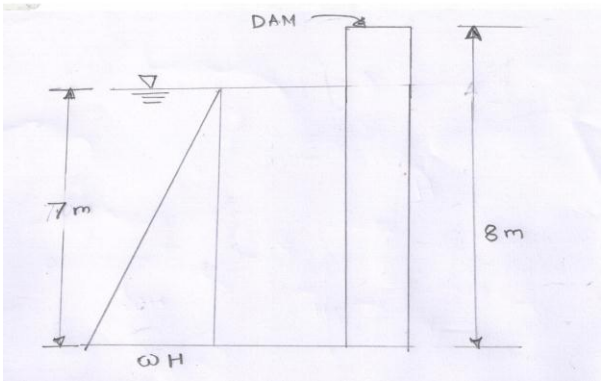
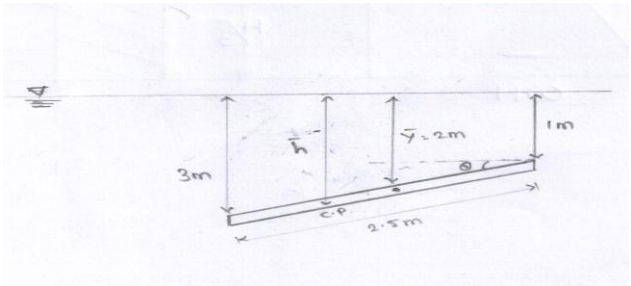
Model Answer

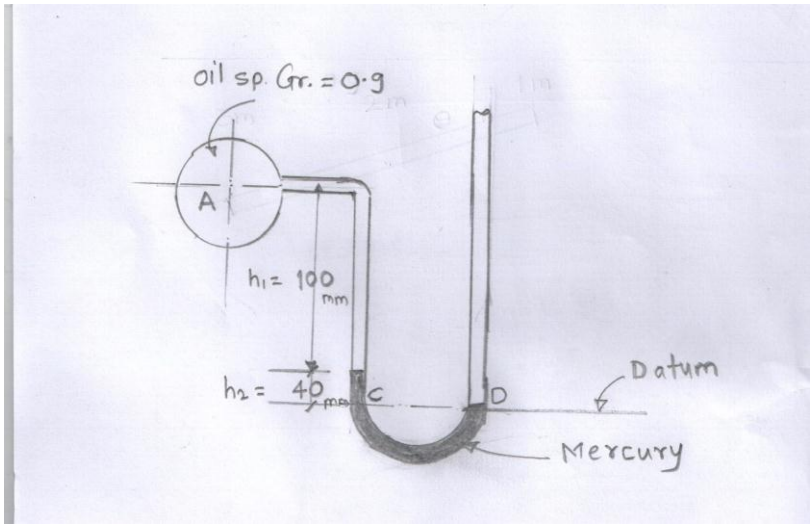
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1)	**a)**	**Attempt any SIX of the following:**		**12**
	i)	**Define ideal fluid and real fluid.**		
	Ans.	**Ideal fluid-** A fluid which is incompressible and having no viscosity is known as ideal fluid	**1**	
		Real fluid- a fluid which possess viscosity is known as real fluid	**1**	**2**
	ii)	**State Newton's law of viscosity and state unit of dynamic viscosity.**		
	Ans:	**Newton's law of viscosity-** it states that, shear stress on a fluid layer is directly proportional to the rate of shear strain.	**1**	
		$\rho = \mu \frac{du}{dy}$		
		Unit of dynamic viscosity(μ) = Ns/m^2	**1**	**2**
	iii)	**State two limitations of piezometer**		
	Ans.	1. Piezometer cannot be measure high pressure. 2. It cannot measure negative pressure.	**1** **1**	**2**

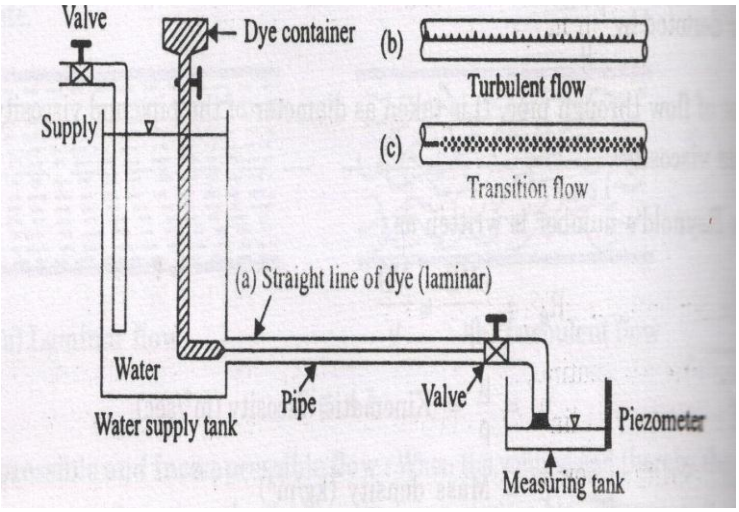
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1)	**iv)**	**Express 8.5m of mercury in N/mm^2.**		
	Ans.	$\rho = V_{hg} h$ $\rho = V_w S_{hg} h$ $\rho = 9810 \times 13.6 \times 8.5$	***1***	
		$\rho = 1134036 N/m^2$ $\rho = 1.13 N/mm^2$	***1***	**2**
	v)	**List four types of minor losses.**		
	Ans.	1. Loss of head at the entrance 2. Loss of head due to sudden expansion 3. Loss of head due to sudden contraction 4. Loss of head due to bend 5. Loss of head due to exit 6. Loss of head due to gradual contraction & expansion 7. Loss of head due to obstruction 8. Loss of head due to bends 9. Loss of head due to pipe fitting	***1/2 mark each for any four of these***	**2**
	vi)	**What is equivalent pipe. Write the equation used for it.**		
	Ans.	**Equivalent pipe-** When compound pipe consisting of several pipes of different diameters and lengths is replaced by single pipe of uniform diameter keeping loss of head and discharge equal to the loss of head and discharge of compound pipe, is known as equivalent pipe	**1**	
		Equation to find the equivalent diameter is, $\frac{l}{d^5} = \frac{l}{d_1^5} + \frac{l}{d_2^5} + \frac{l}{d_3^5}$	**1**	
		l = length of equivalent pipe = $l_1 + l_2 + l_3$ d = diameter of equivalent pipe d_1, d_2, d_3 = diameter of pipes in series l_1, l_2, l_3 = length of pipes in series		**2**
	vii)	**Draw diagram of vena – contracta.**		
	Ans.		**2**	**2**

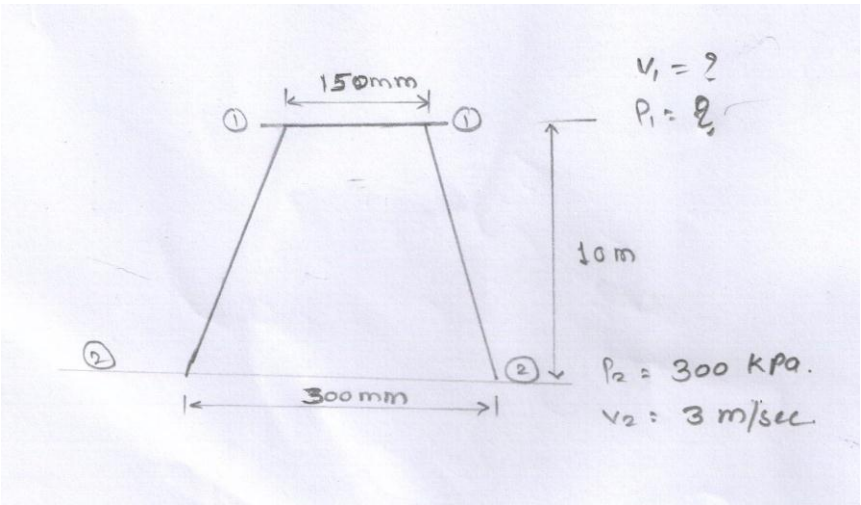
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1)				
	viii)	**Define orifice and write down the equation used for small circular orifice to determine coefficient of velocity.**		
	Ans.	Orifice is a small opening of any cross section on the side or at the bottom of a tank through which a fluid is flowing. Equation to determine coefficient of velocity(C_V)	**1**	
		$C_V = \frac{x}{\sqrt{4yH}}$ or $C_V = \frac{v}{\sqrt{2gH}}$	**1**	
		x = horizontal distance travelled by particle y = vertical distance travelled by the particle H = head over the orifice.		**2**
	b)	**Attempt any <u>TWO</u> of the following:**		**8**
	i)	**Write a note on application of hydraulics in irrigation engineering and environmental engineering.**		
	Ans.	**application of hydraulics in irrigation engineering-** 1. To determine the total pressure acting on the dam 2. To design the canal 3. To know the discharge flowing through the canal or river.	***1 mark each for any two of these***	
		application of hydraulics in environmental engineering- 1. To design the pipe line system for water supply and drainage. 2. To find the pressure acting on the side and bottom of the tank 3. To determine the discharge through the pipe 4. To determine the power of the pump required	***1 mark each for any two of these***	**4**
	ii)	**Calculate the kinetic viscosity of water whose specific weight 9810 N/m^3 and viscosity 0.0011N.s/m^2.**		
	Ans.	kinematic viscosity= $\nu = \frac{\mu}{\rho} = \frac{0.0011}{\frac{w}{g}}$	**1**	
		$\nu = \frac{0.0011g}{w}$	**1**	
		$\nu = \frac{0.0011 \times 9.81}{9810}$ $\nu = 1.1 \times 10^{-6} m^2/s$	**2**	**4**

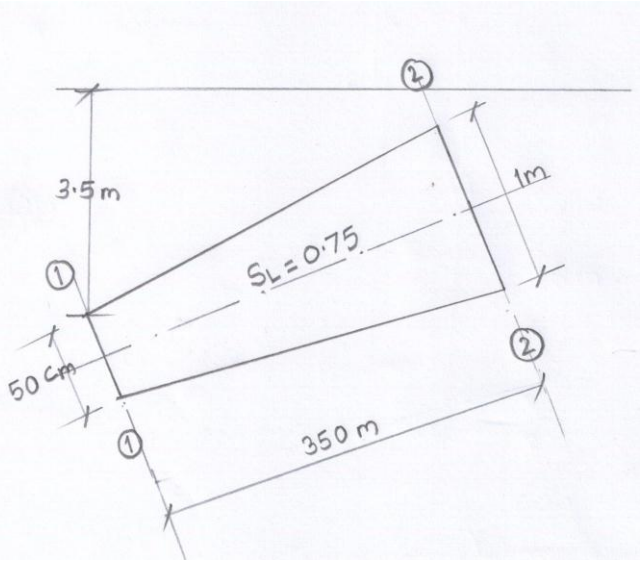
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
1)	iii)	**1.Define pressure. State its SI unit.** **2.State Pascal's law.**		
	Ans:	**1. Pressure-** The ratio of force to the cross sectional area is known as pressure.	***1***	
		P = Force / area		
		SI unit – N/m^2 or Pascal	***1***	
		2. Pascal's law- It states that, the pressure at a point in a static fluid is equal in all directions.	***2***	**4**
2)		**Attempt any <u>FOUR</u> of the following:**		**16**
	a)	**Define total hydrostatic pressure and Centre of pressure. Draw diagram to describe it.**		
	Ans:	**Total hydrostatic pressure –** It is the force exerted by a static fluid on a surface plane or curved. This force is always perpendicular to the surface.	**1**	
		Centre of pressure- It is the point at which total pressure acts on the surface.	**1**	
		Diagram-		
			**1**	
		Total pressure P = $\frac{1}{2}wH^2$	**1**	**4**
		Centre of pressure = H/3 from bottom Pressure intensity at top of wall = zero Pressure intensity at bottom of wall = wH		

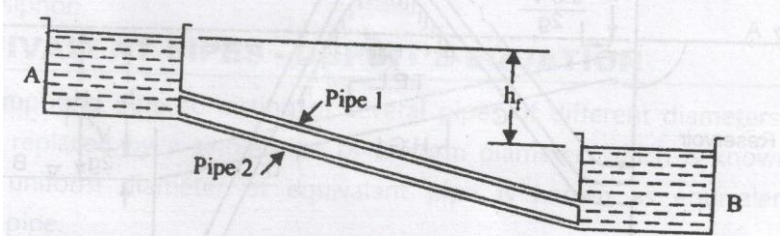
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2)	**b)**	**A masonry dam 8 m high and 3.5 m wide has water level 1 m below its top. Calculate 1) total pressure on one meter length of dam 2) Depth of Centre of pressure.**		
	Ans:			
		Given, w = 9810 N/m^2		
		Height of water = H = 7m		
		Total pressure P = $\frac{1}{2}wH^2 \times$ length	**1**	
		P = $\frac{1}{2}\times 9810 \times 7^2 \times 1$	**1**	
		P = $240345N$		
		Depth of centre of pressure from water surface= $\frac{2}{3}H$	**1**	
		= $\frac{2}{3}\times 7 = 4.66m$	**1**	**4**
	c)	**A circular plate 2.5 m diameter is immersed in oil of specific gravity 0.9 such that its greatest and least depth the below the free surface oil 3.0m and 1 m calculate- 1) total pressure on one surface of plate 2) Depth Centre of pressure**		
		Given,		
	Ans:			
		Total pressure P = $\nu_0 Ay$		
		P = $S_0\nu_w \frac{\Pi}{4}d^2 \times 2$	**1**	
		P = $0.9\times 9810 \times \frac{\Pi}{4}\times 2.5^2 \times 2$		
		P = $86634.56N$ or $86678.50N$	**1**	

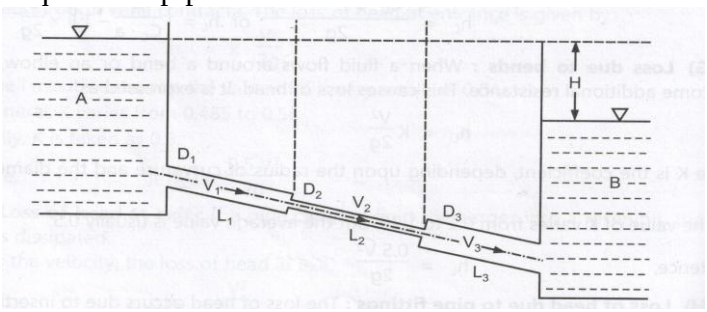
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2)	**c)**	Centre of pressure=h = $y + \frac{I_G \sin^2\theta}{\bar{A}y}$	1	
		$Here, I_G = \frac{\Pi d^4}{64} = \frac{\Pi \times 2.5^4}{64} = 1.91m^4$		
		$\sin\theta = \frac{2}{2.5} = 0.8$		
		$A = \frac{\Pi d^2}{4} = \frac{\Pi \times 2.5^2}{4} = 4.90m^2$		
		$C.P = \bar{h} = 2 + \frac{1.91 \times 0.64}{4.9 \times 2}$	**1**	**4**
		$\bar{h} = 2 + \frac{1.222}{9.8}$		
		$C.P = 2.12m$		
	d)	**A simple manometer containing mercury was used to determine the pressure in pipe containing a liquid of specific gravity 0.9 as a shown in fig.1 Calculate the pressure in N/cm^2 at A.**		
	Ans:			
		Let, P_A = pressure at point oil A Specific gravity of oil = 0.9 Specific gravity of mercury = 13.6 Density of oil = ρ_1 = 0.9 x 1000 = 900 Density of mercury = ρ_2 = 13.6 x 1000 = 13600 Equating pressure at C equal to at D		
		$P_A + \rho_1 g_1 h_1 + \rho_2 g_2 h_2 = 0$	**1**	
		$P_A = -(\rho_1 g_1 h_1 + \rho_2 g_2 h_2)$		
		$P_A = -(900 \times 9.81 \times 0.1 + 13600 \times 9.81 \times 0.04)$	**1**	
		$P_A = -(882.9 + 5336.64)$		
		$P_A = -6219.54 N/m^2$	**1**	
		$P_A = -0.6219 N/cm^2$	**1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2)	**e)**	**Define datum head, velocity head, pressure head and write down Bernoulli's equation.**		
	Ans:	**Datum head-** it is the head possessed by fluid due to having some height above the datum.	**1**	
		Velocity head- it is the head possessed by fluid due to having some velocity of the flow.	**1**	
		Pressure head- it is the head possessed by fluid due to having some pressure force by the flowing fluid**.**	**1**	
		Bernoulli's equation- $z+\frac{v^2}{2g}+\frac{p}{w}=\text{constant}$	**1**	
		Z = potential head		
		$\frac{v^2}{2g}$ = velocity head		
		$\frac{p}{w}$ = pressure head		**4**
	f)	**Write procedure for Reynolds experiment for finding out type of flow.**		
	Ans:	Reynolds apparatus consist of tank containing water and a small tank containing dye.		
		Diagram-		
			**1**	

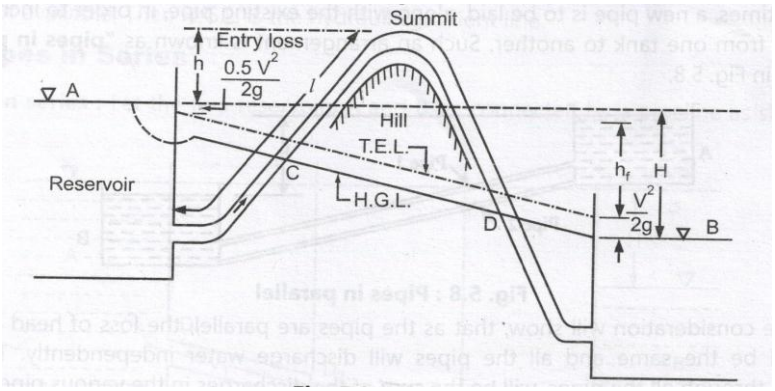
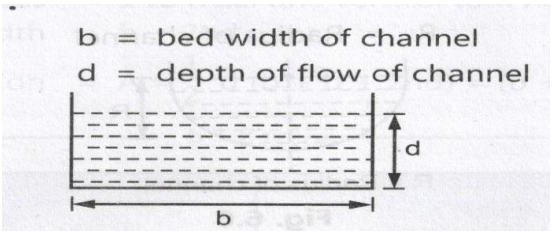
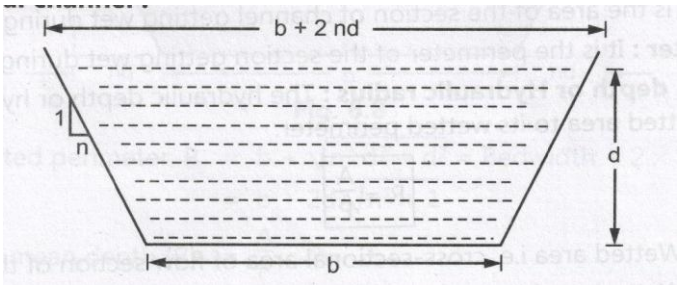
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2)	**f)**	To the tank, a horizontal glass tube is fitted through which the water can flow. The flow is regulated by adjusting valve as shown in figure. The water in the tank is allowed to become completely rest. The valve is opened slightly then a jet of dye having same specific gravity as that of water is allowed to enter in the Centre of glass tube. It will seen that a fine thread of the dye is carried by the flowing water as shown in figure. The dye thread will move steadily, such a flow as laminar flow. If we increase the velocity, the dye thread will start to become irregular and then break.	**2**	**4**
		Reynolds number = Re = $\frac{\rho v D}{\mu}$	**1**	
		ρ = mass density of water		
		V = velocity of flow = Q/A		
		D = diameter of pipe		
		μ = dynamic viscosity of water		
		if R_e < 2000 laminar flow		
		if R_e > 4000 laminar flow		
		if R_e = 4000- 2000 = transition flow		
		Actual discharge is calculated by collecting volume of water in specific time		
3)		**Attempt any <u>FOUR</u> of the following:**		**16**
	a)	**A conical cube is fixed vertically with its smaller end upward having diameter 150 mm and 300mm at bottom. Length of pipe is 10m pressure at bottom is 300KPa. And velocity at bottom is 3 m/s. Find pressure at top of pipe. If loss of head is 2 m of water**		
	Ans:			

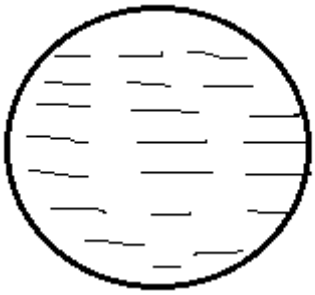
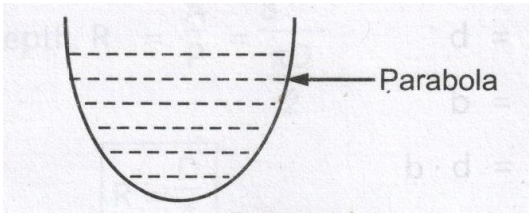
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**a)**	$Q = a_1 v_1 = a_2 v_2$ $Q = \frac{\Pi}{4} \times 0.3^2 \times 3 = \frac{\Pi}{4} \times 0.15^2 \times v_1$ $v_1 = 12 m/s$ $z_1 = 10$ or $z_2 = 0$ considering flow in upward direction $\frac{P_1}{\rho_w} + \frac{v_1^2}{2g} + z_1 + h_f = \frac{P_2}{\rho_w} + \frac{v_2^2}{2g} + z_2$ $\frac{P_1}{9810} + \frac{12^2}{2 \times 9.81} + 10 + 2 = \frac{300 \times 10^3}{9810} + \frac{3^2}{2 \times 9.81} + 0$ $\frac{P_1}{9810} + 19.339 = 31.039$ $P_1 = (31.039 - 19.339) \times 9810$ $P_1 = 114772.59 N/m^2$ $P_1 = 114.772 KPa$ **or** if flow in downward direction $\frac{P_1}{9810} + \frac{12^2}{2 \times 9.81} + 10 = \frac{300 \times 10^3}{9810} + \frac{3^2}{2 \times 9.81} + 2$ $\frac{P_1}{9810} + 17.339 = 33.039$ $P_1 = (33.039 - 17.339) \times 9810$ $P_1 = 154017 N/m^2$ $P_1 = 154 KPa$	***1*** ***1*** ***1*** ***1*** ***1*** ***1*** ***1***	**4**
	b)	**A sloping pipe line has diameter of 1 m at higher end and 50 cm at lower end . it carries liquid at specific gravity 0.75 at 4800 lpm. The length of pipe is 350m and it is laid on slope 1 in 100. The pressure at lower end is 1200KN/m^2. Determine the pressure at higher end.**		
	Ans:			

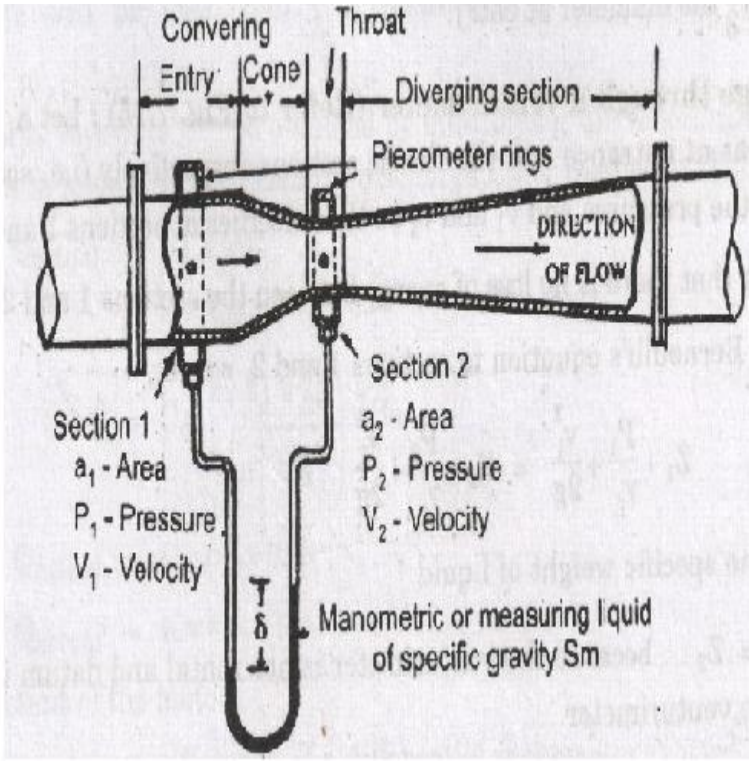
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**b)**	Q = discharge=48000lpm $=48\text{m}^3/\text{min}$ $=\frac{48}{60}\text{m}^3/\text{sec}$ $=0.8\text{m}^3/\text{sec}$ $P_1 = 1200\text{kN/m}^2 = 1200\times10^3\text{N/m}^2$ $P_2 = ?$ finding velocities at 1-1 and 2-2 $Q=a_1v_1$ $0.8=\frac{\Pi}{4}\times0.5^2\times v_1$ $v_1=\frac{0.8}{0.196}=4.07\text{m/sec}$ $Q=a_2v_2$ $0.8=\frac{\Pi}{4}\times1^2\times v_2$ $v_2=\frac{0.8}{0.785}=1.01\text{m/sec}$ $z_1=0, v_1=4.07m/\text{sec}, P_1=1200\times10^3N/m^2$ $z_2=3.5, v_1=1.01m/\text{sec}, P_2=?$ using Bernoulli's theorem $z_1+\frac{v_1^2}{2g}+\frac{P_1}{w}=z_2+\frac{v_2^2}{2g}+\frac{P_2}{w}$ $0+\frac{4.07^2}{2\times9.81}+\frac{1200\times10^3}{0.75\times9810}=3.5+\frac{1.01^2}{2\times9.81}+\frac{P_2}{w}$ $0.844+163.09=3.5+0.051+\frac{P_2}{w}$ $\frac{P_2}{w}=160.38$ $P_2=1180.017KN/m^2$	***1*** ***1*** ***1*** ***1***	**4**
	c) **Ans:**	**Explain the terms – i. pipes in parallel ii. Equivalent pipe.** **i. pipes in parallel -** Consider two tanks connected by parallel pipes of same lengths.  	***1***	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**c)**	l = length of both pipes d_1, d_2 = Diameter of the pipes In above arrangement loss of head in both the pipes is same Loss of head in pipe 1 = loss of head in pipes $\frac{f_1 l v_1^2}{2gd_1} = \frac{f_2 l v_2^2}{2gd_2}$ $\frac{f_1 v_1^2}{d_1} = \frac{f_2 v_2^2}{d_2}$	***1***	
		ii. Equivalent pipe- if the two tanks are connected by pipes of different lengths and diameters. It is called as compound pipe. If this compound pipe is replaced by a single pipe of same diameter it is called as equivalent pipe.  	***1***	
		It's diameter is calculated by equation, $\frac{l}{d^5} = \frac{l_1}{d_1^5} + \frac{l_2}{d_2^5} + \frac{l_3}{d_3^5}$	***1***	**4**
	d)	**Three pipes having same length and same friction factor having different diameter 250mm, 100mm 75 mm respectively. When three pipes are connected in parallel gives total discharge 0.75m^3/s. Find out discharge in each pipe.**		
	Ans:	given, $f_1 = f_2 = f_3$ and $l_1 = l_2 = l_3$ $d_1 = 250mm, d_2 = 100mm, d_3 = 75mm$ $d_1 = 0.25m, d_2 = 0.100m, d_3 = 0.075m$ $Total\ Q = 0.75m^3/s, Q_1 = ?, Q_2 = ?, Q_3 = ?$ for pipes connected parallel, head loss is equal		

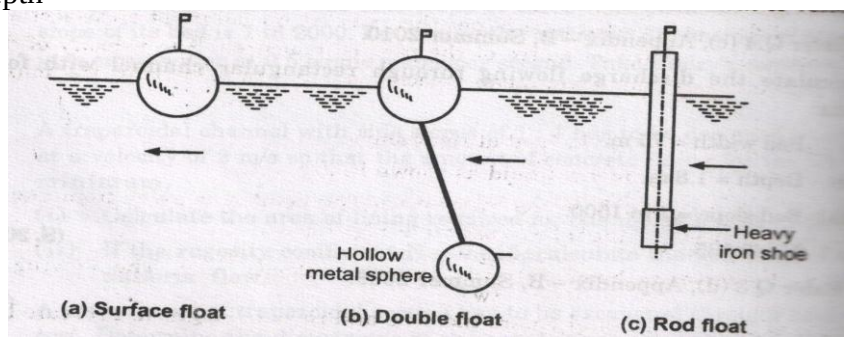
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**d)**	$\frac{f_1 l_1 v_1^2}{2gD_1} = \frac{f_2 l_2 v_2^2}{2gD_2} = \frac{f_3 l_3 v_3^2}{2gD_3}$ But $f_1 = f_2 = f_3$ and $L_1 = L_2 = L_3$ V_1, V_2 & V_3 are the velocities through pipe 1,2,3. $\frac{v_1^2}{d_1} = \frac{v_2^2}{d_2} = \frac{v_3^2}{d_3}$ $v_1^2 = \frac{d_1}{d_2} \times v_2^2$ $v_1^2 = \frac{0.25}{0.1} \times v_2^2$ $v_1 = 1.58 v_2$ $v_2 = 0.63 v_1$ also, $\frac{v_1^2}{d_1} = \frac{v_3^2}{d_3}$ $v_3^2 = \frac{d_3}{d_1} \times v_1^2$ $v_3^2 = \frac{0.075}{0.25} \times v_1^2$ $v_3 = 0.54 v_1$ $Q_1 = a_1 v_1 = \frac{\Pi}{4} \times 0.25^2 \times v_1 = 0.049 v_1$ $Q_2 = a_2 v_2 = \frac{\Pi}{4} \times 0.1^2 \times 0.63 v_1 = 0.0049 v_1$ $Q_3 = a_3 v_3 = \frac{\Pi}{4} \times 0.075^2 \times 0.54 v_1 = 0.0023 v_1$ $Q = Q_1 + Q_2 + Q_3$ $0.75 = 0.049 v_1 + 0.0049 v_1 + 0.0023 v_1$ $0.75 = 0.0562 v_1$ $v_1 = 13.34 m/\sec$ $v_2 = 8.40 m/\sec$ $v_3 = 7.2 m/\sec$ $Q_1 = 0.65 m^3/\sec, Q_2 = 0.065 m^3/\sec, Q_3 = 0.0318 m^3/\sec$	***1*** ***1*** ***1*** ***1***	**4**
	e) **Ans:**	**Explain Syphon pipe with sketch.** Syphon is long bent pipe which is used to transfer the liquid from reservoir at a higher level to another reservoir at a lower level to another reservoir at a lower level. When two reservoirs are separated by a hill or high level ground as shown in figure.	***1***	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**e)**		**2**	**4**
		The point C which is at the highest of the syphon is called as summit. The point C is above the free water surface point A, the pressure at point C is less than atmospheric pressure. Maximum up to 2.7m water absolute. Syphon is used to carry water from one reservoir to another reservoir.	**1**	
	f)	**Explain with neat sketch different types of open channel.**		
	Ans:	**1. Rectangular channel-** This is used in case of hard rock strata.		
			**1**	
		b= width of the channel d= depth of the flow m= hydraulic mean depth Area= b x d Perimeter = b + 2d The condition of most economical section is that for a given area the perimeter should be minimum b = 2d m = d/2		
		2. Trapezoidal channel- this is most commonly used shape because of stability.	**1**	
				
		b = width of the channel at bottom d= depth of the flow the side slope is given as 1 vertical to n horizontal most economical conditions are- half of top width= sloping side m = d/2		

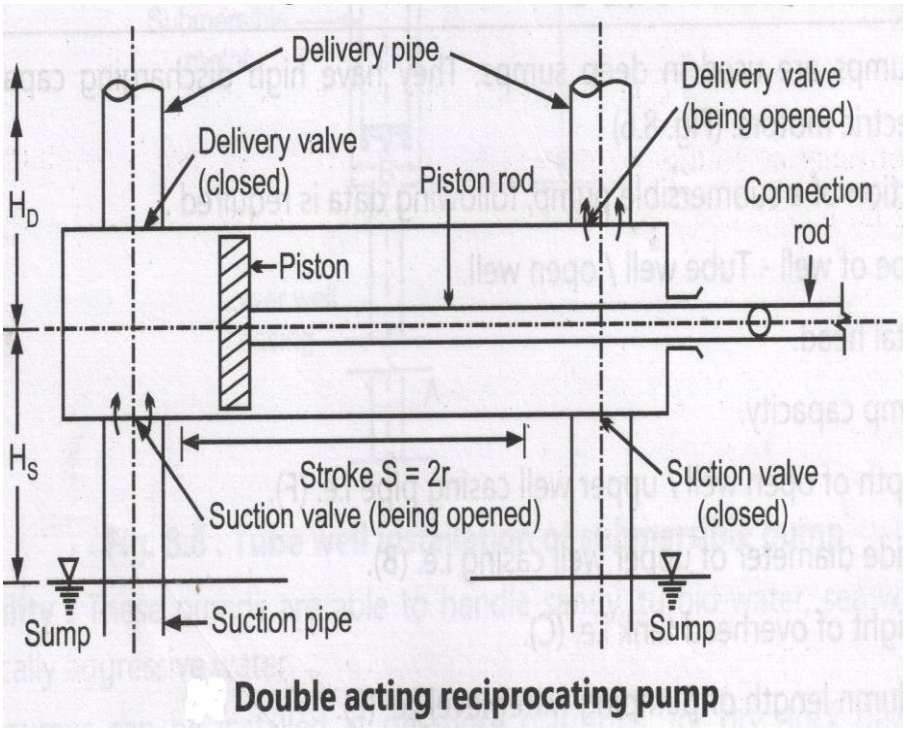
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
3)	**f)**	**3. Circular section-**  d= depth of the flow R= radius of channel Though it is closed the pressure on water surface is atmospheric	**1**	
		4. V shaped channel-  d= depth of the flow θ = angle The pressure on water surface is atmospheric.	**1**	**4**
4)		**Attempt any <u>FOUR</u> of the following:**		**16**
	a)	**Define wetted area and wetted perimeter and write the formulas for the trapezoidal section.**		
	Ans:	**wetted area-** it is cross sectional area which is covered by water.	**1**	
		wetted perimeter- It is length of channel boundary which is wetted.	**1**	
		For trapezoidal section,		
		Wetted perimeter = P = $b + 2d\sqrt{1+n^2}$	**1**	
		Wetted area = (b + nd) d	**1**	
		Where, b = bottom width of channel		
		d = depth of flow		**4**
		1: n = side slope		
	b)	**State the conditions for most economical regular section and trapezoidal section.**		
	Ans:	For rectangular section- b = 2d and m = d/2	**2**	
		For trapezoidal section- Half of top width = sloping side		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
4)	**b)**	$\frac{b+2nd}{2} = d\sqrt{1+n^2}$ And m or R = d/2 b = width at bottom of channel d = depth of flow 1: n = side slope m= hydraulic mean depth	***2***	**4**
	c) **Ans:**	**Define hydraulic jump and state its two applications.** **Hydraulic jump-** It is the phenomenon in which supercritical flow is converted to subcritical flow. It's applications are- 1. To minimize the energy of flowing water 2. To mix the chemicals in the flow of water 3. To increase the depth of water	***2*** ***1 mark each for any two of these***	**4**
	d) **Ans:**	**Explain venturimeter with neat sketch** Venturimeter is a device used to measure the discharge of a fluid flowing through pipe. It consists of three parts- 1. A short converging part 2. Throat 3. Diverging part  	***1*** ***1***	

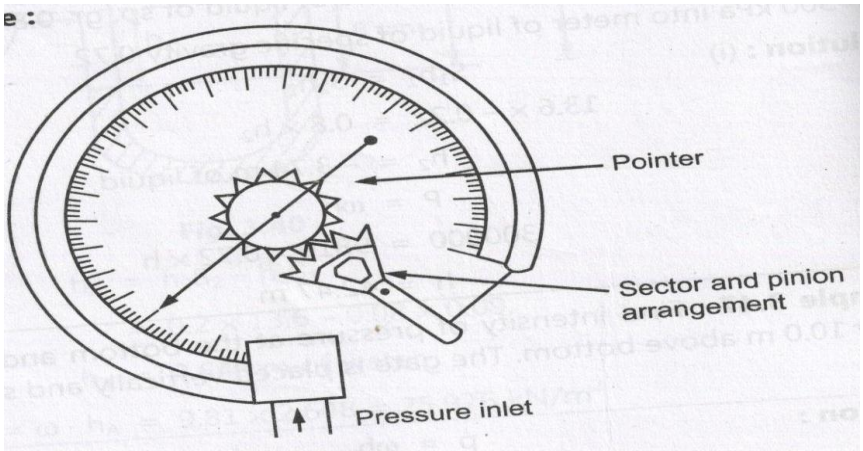
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
4)	**d)**	Venturimeter works on the principle of Bernoulli's theorem. Generally the diameter at throat is half of pipe diameter. The pressure at the inlet of convergent cone and throat is measured. It is used to find the discharge through pipe. Discharge is calculated by formula. $Q = \frac{C_d a_1 a_2 \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$ a_1= area of inlet of convergent cone a_2= area at throat section h = difference of pressure	***1*** ***1***	**4**
	e) **Ans:**	**Explain critical flow and sub critical flow** **Critical Flow-** The flow at which specific energy is minimum is called as critical flow. At critical flow Froude's number is 1. $F_r = \frac{v}{\sqrt{gh}} = 1$ **Subcritical flow-** when the depth of flow in a channel is greater than the critical depth, the flow is said to be sub critical. For this flow, Froude's number is less than 1.	***1*** ***1*** ***1*** ***1***	**4**
	f) **Ans:**	**A 100mm diameter orifice discharge 40 lit/ sec liquid under constant head of 2. the diameter of jet at vena- contracta is 90mm. Calculate C_d, C_v, C_e** **Given, Discharge= 40 lit/sec** Discharge= $\frac{40}{1000}$ m^3/sec Discharge= 0.040 m^3/sec $Head = H = 2m$ $Diameter = D = 100mm = 0.1m$ diameter of vena- contracta $= 90mm = 0.09m$ therotical velocity= $V_{th} = \sqrt{2gH}$ $V_{th} = \sqrt{2 \times 9.81 \times 2}$ $V_{th} = 6.26 m/\sec$ therotical discharge= $Q_{th} = V_{th} \times$ Area of orifice $Q_{th} = 6.26 \times \frac{\Pi}{4} \times 0.1^2$ $Q_{th} = 0.049\ m^3/\sec$	***1***	

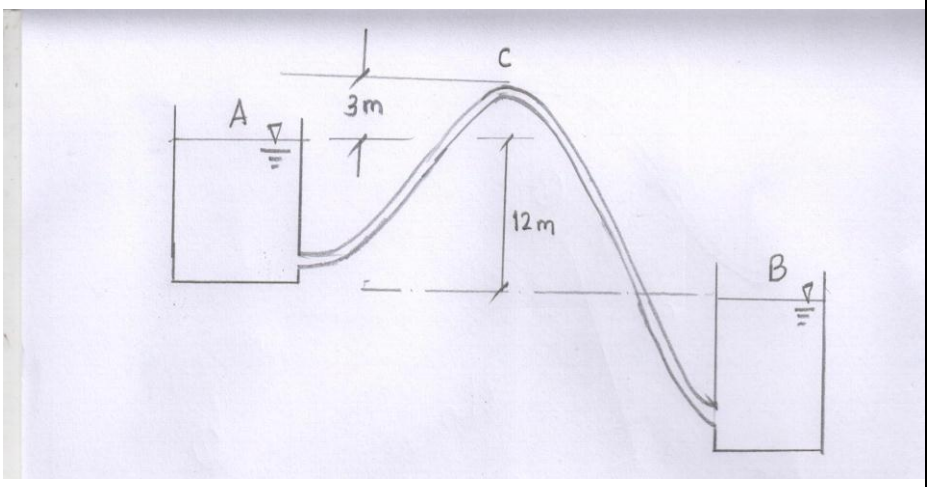
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
4	**f)**	$C_d = \frac{\text{actual discharge}}{\text{theoretical discharge}}$ $C_d = \frac{0.04}{0.04914}$ $C_d = 0.81$ $C_c = \frac{\text{area at vena-c ontracta}}{\text{area of orifice}}$ $C_c = \frac{\frac{\Pi}{4} \times 0.09^2}{\frac{\Pi}{4} \times 0.1^2}$ $C_c = 0.81$ $C_d = C_c \times C_v$ $C_v = \frac{C_d}{C_c}$ $C_v = \frac{0.81}{0.81} = 1$	*1* *1* *1*	**4**
5	**a)**	**Attempt any <u>FOUR</u> of the following:** **Write a short note on floats.**		**16**
	Ans:	A float is small object made of wood or other suitable material which is lighter than water and thus capable of floating on the water surface. It provides a simple way of measuring the velocity of the flow of water in river and channels. Different types of float are- a) Single float or surface float b) Subsurface float or double float **c)** Rod floats or velocity rods	*1*	
		a)Single float or surface float – It may be a piece of wood or an empty bottle. This is put on the surface of flowing water and time is noted. This float will flow with the flowing water and time is noted after travelling some distance Velocity= distance travelled / time This gives surface velocity	*1*	
		b)Subsurface float or double float- it is used to determine the mean velocity. It consist of two floats connected by chain or rope. One float moves on the surface and other which is heavier located at 0.6 of total depth  	*1*	**4**
		c)Rod floats or velocity rods - it consist of vertical wooden rod heavier at the bottom. The depth of rod is 0.9 to 0.97 times total depth. It gives mean velocity.	*1*	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5)	**b)**	**Determine the discharge through 60^0 triangular notch in lit/sec under head of 0.15m. take C_d= 0.6**		
	Ans:	Given, $\Theta=60^0$, Q=? Head= H= 0.15m, C_d=0.6		
		$Q = C_d \times \frac{8}{15} \times \sqrt{2g} \times \tan\frac{\theta}{2} \times H^{\frac{3}{2}}$	*1*	
		$Q = 0.6 \times \frac{8}{15} \times \sqrt{2 \times 9.81} \times \tan 30^0 \times 0.15^{\frac{3}{2}}$	*1*	
		$Q = 0.6 \times \frac{8}{15} \times 4.42 \times 0.577 \times 8.7 \times 10^{-3}$		
		$Q = 7.11 \times 10^{-3} m^3/\sec$	*2*	**4**
		$Q = 7.11 lit/\sec$		
	c)	**Water is flowing over 4 m long weir under a head of 1.2m. calculate the discharge over weir if C_d= 0.6.**		
	Ans:	Given, L=Length of weir=4 m Head = H = 1.2m $C_d = 0.6$ Discharge over weir is given by		
		$Q = \frac{2}{3} \times C_d \times L \times \sqrt{2g} \times H^{\frac{3}{2}}$	*1*	
		$Q = \frac{2}{3} \times 0.6 \times 4 \times \sqrt{2 \times 9.81} \times (1.2)^{\frac{3}{2}}$	*1*	
		$Q = 9.20 m^3/\sec$	*2*	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5)	d)	**Draw neat sketch of reciprocating pump (Double acting).**		
	Ans:		***2 marks for labeling and 2 marks for diagram***	**4**
	e)	**Compare reciprocating pump and centrifugal pump on any four points.**		
	Ans:		***1 mark for each Any four***	***4***

Reciprocating Pump	**Centrifugal pump**
1.Complicated because more no. of parts	1.Simple in construction Less no. of parts
2.Total weight of pump is more	2.Total weight of pump is less
3.Suitable for less discharge and more head	3.Suitable for large discharge and small head
4.Require more area and Heavy foundation	4.Require less area and simple foundation
5.More wear and tear	5.Less wear and tear
6.Maintenance cost is more	6.Maintenance cost is less
7.Cannot handle dirty water	7.Can lift dirty water

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
5)	**f)**	**A centrifugal pump is required to pump 15 lit/ sec against head of 35 m. Find the power required by the pump taking overall efficiency 80%.**		
	Ans:	*Given*, discharge=15lit/sec $=0.015 m^3/sec$ Head= H= 35m overall efficiency= 80% = 0.8 Power = ? Power = $\frac{wQH}{75\eta}$ assuming liquid is water, $w= 1000 kg/m^3$ Power = $\frac{1000 \times 0.015 \times 35}{75 \times 0.8}$ Power = 8.75HP	*1* *1* *2*	**4**
6)		**Attempt any <u>TWO</u> of the following:**		**16**
	a)	**Explain construction and working of Bourdon's pressure gauge with neat sketch. Write advantages of it.**		
	Ans:	The pressure above or below the atmospheric pressure may be easily measured by Bourdon's pressure gauge. It consists of an elliptical tube ABC bent into an arc of circle as shown in figure. When gauge tube is connected to the fluid whose pressure is to be measured at C. The fluid under pressure flows into the tube. The Bourdon's tube as a result of increased pressure tends to strengthen itself. Since the tube is encased in circular cover. Therefore it tends to become circular instead of straight with the help of simple pinion and sector arrangement, the elastic deformation of Bourdon's tube rotates the pointer. This pointer moves over a calibrated scale, which directly gives the pressure. **Diagram-**  	*1* *3* *4*	**8**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6)	**b)**	**Two reservoirs having difference in elevation of 12 m are connected by 200mm diameter syphon is 400 m and summit is 3 m above water level in upper reservoir. The length of pipe from the reservoir (upper) to summit is 120m. determine discharge through syphon and pressure of summit(neglect minor losses)**		
	Ans:	**Given,** Diameter of syphon= d = 200mm = 0.2m Difference of level in reservoir = H= 12m Length of syphon = 400m Height of summit from upper reservoir = 3 m Length of syphon up to summit = 120 m Head loss due to friction = h_f		
				
		applying Bernoulli's equation to point A & B $\frac{P_A}{w}+\frac{v_A^2}{2g}+z_A=\frac{P_B}{w}+\frac{v_B^2}{2g}+z_B+h_f$ $P_A = P_B$(atmospheric pressure) $v_A = v_B$(same diameter) $0+0+z_A=0+0+z_B+h_f$ $z_A - z_B = h_f$ $20 = h_f\,(z_A - z_B = 20m)$	***1***	
		$-12=\frac{flv^2}{2gd}$ $12=\frac{0.02\times 400\times v^2}{2\times 9.81\times 0.20}$ $v = 2.42m/\sec$	***1***	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6)	**b)**	Discharge= Area $\times$ velocity Discharge= $\frac{\Pi}{4}\times 0.2^2\times 2.42$ Discharge=$0.0759 m^3/sec$ pressure at summit- applying bernoulli's equation to point A and C $\frac{P_A}{w}+\frac{v_A^{\ 2}}{2g}+z_A=\frac{P_C}{w}+\frac{v_C^{\ 2}}{2g}+z_B+h_f$ Assuming datum passing through A $0+0+0=\frac{P_C}{w}+\frac{2.8^2}{2\times 9.81}+3+h_f$ $0=\frac{P_C}{w}+0.39+3+\frac{flv^2}{2gd}$ $0=\frac{P_C}{w}+3.39+\frac{0.02\times 120\times 2.8^2}{2\times 9.81\times 0.2}$ $0=\frac{P_C}{w}+3.39+4.79$ $0=8.18+\frac{P_C}{w}$ $\frac{P_C}{w}=-8.18$ of water	***2*** ***1*** ***1*** ***1*** ***1***	**8**
	c)	**Design most economical trapezoidal section having side slopes 1.5:1 (H:V). for discharge 10 m^3/s and bed slope 0.6m in 3 km. take N= 0.015 (manning's formula).**		
	Ans:	Given, side slope = n =horizontal/vertical= 1.5/1= 1.5 Slope of bed= S = 0.6/3.0 =0.5 Discharge= Q= $10 m^3/sec$ Manning's constant= N= 0.015		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6)	**c)**	$\frac{b+2nd}{2} = d\sqrt{n^2+1}$	***1***	
		$\frac{b+2\times1.5\times d}{2} = d\sqrt{1.5^2+1}$		
		$\frac{b+3d}{2} = 1.8d$		
		$b+3d = 3.6d$	***2***	
		$b = 0.6d$		
		$A = (b+nd)d$		
		$A = (b+1.5d)d$		
		$A = (bd+1.5d^2)$		
		$A = 0.6d^2+1.5d^2$		
		$A = 2.1d^2$		
		$v = \frac{1}{N}\times R^{\frac{2}{3}}\times s^{\frac{1}{2}}$	***1***	
		$v = \frac{1}{0.015}\times(\frac{d}{2})^{\frac{2}{3}}\times(\frac{1}{5000})^{\frac{1}{2}}$		
		$v = 0.593d^{\frac{2}{3}}$	***1***	
		$Q = 2.1d^2\times0.593d^{\frac{2}{3}}$	***1***	
		$Q = 1.24d^{\frac{8}{3}}$		
		$8.01 = d^{\frac{8}{3}}$		
		$d = 2.18$	***1***	
		$b = 1.308$	***1***	**8**