

Subject code: 17503

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (Autonomous)

(ISO/IEC -270001 – 2005 certified)

SUMMER -2017 EXAMINATION Model Answer

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Important Instructions to examiners:

- 1) The answer should be examined by keywords 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 error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure 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 the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

Question and Model Answers	Marks
Q.1(A). Attempt ANY THREE of the following:	12M
i) State the importance of public health Engineering.	4M
 ANS:- Public Health Engineering provides knowledge regarding, a) Municipal water supply system to provide safe drinking water b) How to determine future population to workout water demand of the city c) Engineering treatment systems for water purification. d) Develop collection and treatment systems to carry domestic or industrial waste water discharges away and remove some of the pollutants before discharging it into the environment. 	1M (for each point)
ii) Define intake structure, state its types and explain any one.	4M
ANS:-	
Intake Structure:- Intakes are the structures consisting of opening grating or strainer through which the raw water from river, canal, reservoir, etc. enters and is carried to sump well by conduits. Types:-	1M

a) Canal intake: A canal intake consists of a pipe placed in a brick masonry chamber constructed partly in the canal bank. On one side of the chamber, an opening is provided with coarse screen for the entrance of water. The end of the pipe inside the chamber is provided with a bell mouth fitted with a hemisphere fine screen. The outlet pipe carries the water to the other side of the canal bank, from where it is taken to treatment plants. 2M for OR explanati b) **Reservoir intake:** Reservoir intake which is mostly used to draw water from on of any earthen dam reservoir. It consist of a intake tower constructed on the slope of the dam, one screens are provided to intake pipes and are controlled by sluice valve is provided to intake control water flow. Water level in reservoir changes from time to time intake pipes are provided at different levels. OR c) Lake intake: For obtaining water from lakes, mostly submersible intakes are used. These intakes are constructed in the bed of lake, which consists of a pipe and bell opening, protected by timber or concrete crib. Water flows from the opening and is collected in sump well and then pumped to the treatment plant. OR d) River intake: It is circular masonry tower well of 4 to 7 m diameters. It is constructed along the river bank at place from where water can be drawn in required quantity. The various river intakes are wet intake, dry intake and movable intake. (Note-If student draw the sketch of intake structure, give 1M) Enlist the objects and methods of aeration. **4M** ANS:-**Objects of Aeration:** 2M1) To remove the dissolved (like H₂S, CO₂, NO₂) gases from raw water. 2) To increase the dissolved Oxygen content in water. 3) To remove colour, odour considerably. 4) To remove iron and manganese precipitate. **Methods of Aeration:** 2M1) Cascade aeration 2) Spray Nozzles or fountains 3) Air diffusion 4) Trickling bed or tray What is jar test? State its significance. iv) **4M** ANS:-JAR TEST:-To determine optimum chemical dose, controlled test performed in the laboratory commonly called as jar test. Procedure-Fill the 6 jars with 1000ml water sample. Add the coagulant dose in increasing order and stir the sample with 60-80 RPM 3M* for one minute.

➤ After one minute reduce the speed of stirrer to 30 RPM for 15 minutes.	
➤ Then turn off the mixer and allow to settle for 30 minutes.	
Observe and measure the turbidity of each jar sample.	
➤ Good floc formation will be the optimum dose of coagulant.	
SIGNIFICANCE:-	
To determine optimum dose of coagulants and thus to achieve economic in its use.	1M
To determine optimum dose of coagulaits and thus to achieve economic in its use.	11/1
(Note- *-The student may draw the sketch of jar test apparatus, credit of 1M can be given out of 3M)	
Q.1 (B) Attempt ANY ONE of the following:	6M
i) What is the need of analysis of water? State the various tests on	6M
water.	UIVI
ANS:-	
Need of analysis of water:-	
The examination of water is done in the water works laboratory, it is necessary to examine	
the quality of water. The main advantages are:	3M
i) To know the raw water quality.	(1M each
ii) To outline the purification process as per the impurities in raw water.	for Any
iii) To determine the efficiency of the treatment units to remove the impurities.	three)
iv) To make ensure the water safe for domestic and industrial use.	
v) To determine the efficiency of distribution system to carry treated pure water upto	
consumers.	
vi) To locate the source of pollution.	
vii)To protect the public health	
Various tests for potable water:	3M
i) Physical test : Colour, Taste and odour, Temperature, Turbidity.	(1M for
ii) Chemical test: Total solids, Hardness, Chlorides, Dissolved oxygen, PH value,	each
Fluorides, Alkalinity.	category
iii) Biological test: E-coli, MPN.)
ii) Define disinfection. Enlist its various methods and explain any	6M
one.	
ANS:-	
Disinfection:	2M
The process of killing the infective or harmful bacteria from water and making it safe for	41VI
the user is called disinfection.	
Methods of Disinfection are:-	2M
a) By boiling of water	-111
b) By Chlorination	
c) By ultra-violet rays	
d) By the use of iodine and brominee) By the use of ozone	
f) By the use of excess lime	
g) By using potassium permagnate	
h) By treatment of silver or electro katadyn process.	
Disinfection by Boiling:-	
·	2M*
When water is boiled to boiling temperature (in 100°C), the bacteria is completely	

dissolved salts. It is the mo suitable on large scale. It is as drinking water. The water drinking. In case of an epid water-borne diseases.	d at least for 10-15mins. Boiling st effective method of disinfects suitable for domestic purpose, it is should be cooled down to a commerce, the consumers should also on of any one method from about the consumers and the consumers should also on of any one method from about the consumers and the consumers are consumers.	ection. But, this method is not i.e. to boil water before its use omfortable temperature before lways boil water to check the	
Q.2. Attempt ANY FOL	•	<i>(</i>	16M
	riod and state factors affection	cting on it.	4M
ANS:-			
Design period:-The num	nber of years for which a provi as components of the water su		2M
obsolete. Design period sho ii) Ease and difficulty that future dates. iii) Amount and availabil additional provision. iv) The rate of interest on th	nt structure and the chances of uld not exceed those respective is likely to be faced in expansity of additional investment of the borrowings and the additional ulation growth including possible.	values. nsions. If under taking at likely to be incurred for l money invested.	2M (1M each for any two)
	our points between slow sa	and filter and rapid sand	4M
ANS:-			
Comparison Points	Slow Sand Filter	Rapid Sand Filter	
1. Coagulation	Not Required	Essential	
2.Compactness 3.Construction	Requires large area for its installation. Simple	Requires small area for its installation. Complicated as separate	1M (for any four
		under drainage system is required to be design.	point)
4.Cost of operation	Low	High	
5.Period of cleaning	1-3 months	2-3 days	
6.Method of clearing	Long and laborious	Due to back washing short	
7.Skilled supervision	method Not essential	and speedy method. Essential	
8.Suitability	For small towns and villages.		
9.Base material	Varies from 3-65mm in size with 300-750mm depth.	Varies from 3-40mm in size with 600-900mm depth.	
1 4 O T C1 1	1 1 5 0 7 5 0	1 2 2 50	1

10.Loss of head

11.Rate of Filtration

3m-3.50m

3000-6000 lit./hr/m²

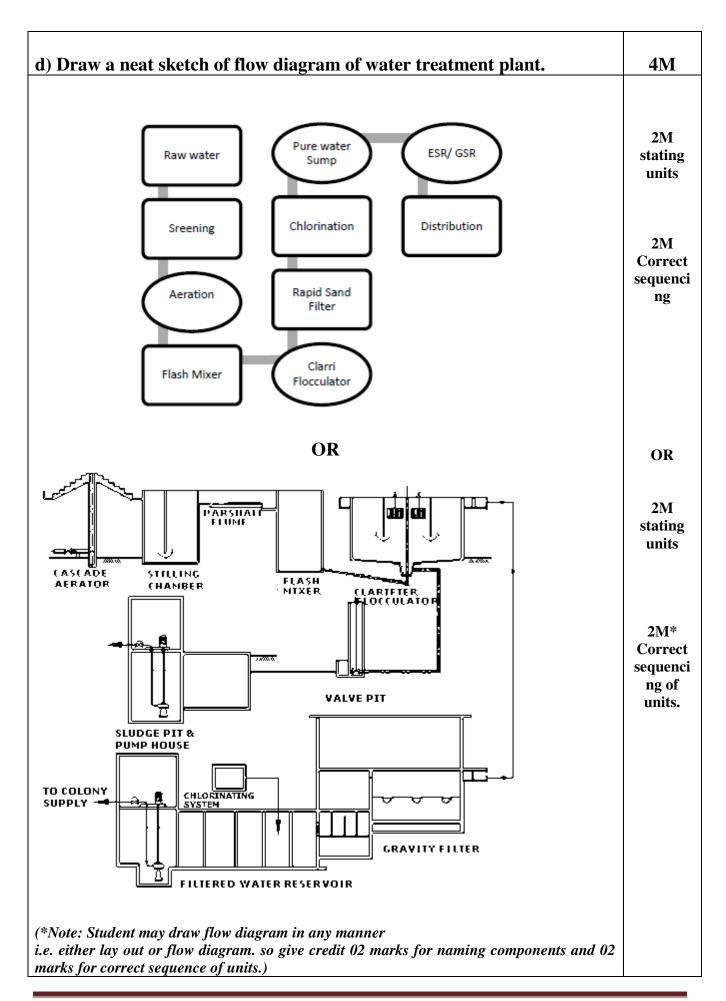
150-750mm

100-200lit/hr/m²

c) Draw a neat sketch of classiflocculator. **4M** ANS:-Mechanism Flocculation zone support - Bridge Motor Clarifier drive head Flocculator drive head **2M** (for Water Level sketch) Stationery paddles Effluent -Flocculator & weir tank Raking arm 2M(for labeling) Flocculator blade Sludge Moving pipe discharge pipe paddles Clariflocculator (Note- In question it is printed as classiflocculator, But it should be Clariflocculator) d) State the location and function of the following pipe fittings: Air valve **4M** (i) (ii) Non-return valve (iii) **Scour valve** Foot valve (iv) ANS:-Type Of Location **Function** Valve **1M** Air valve To release accumulated air that They are provided at summit points in Each the alignment of pipes. can obstruct the flow of water. A non-return valve is fitted to ensure To allows water to flow one (Of Nonwhich return that a medium flows through a pipe in direction only $\frac{1}{2}$ M for the right direction, where pressure valve location conditions may otherwise cause & reversed flow. $\frac{1}{2}$ M for They are located at the dead ends and To and Scour remove sand silt function) depression or at lowest points in valve deposited in pipeline. mains. Foot valve They are at the end of the suction To prevent siphoning and loss of prime in diaphragm line.

e) Enlist the qualities of good trap.	4M
ANS:- Qualities of good trap are:- It should provide enough water seal around 50mm with large surface area. Interior should be smooth so that water flow should not obstruct. Good trap should achieve the self-cleansing velocity. An assess door should be provided for cleaning the trap. It should be made up of non-adsorbent material.	1M (for each point)
f) With the help of line diagram show arrangement of the sanitary plumbing for residential building.	4M
R.W. C.E. Building block B.W. C.E. Building block B.W. C.E. Building block B.W. C.E. B.W. Bath waste C.E. Cleaning eye S.W. Sink waste I.T. Intercepting chamber I.T. Intercepting trap F.A.I. Fresh Air Inlet W.C. Water closet L.B.W. Lavotary basin waste M.H. Manhole	2M (for line diagram) & 2M (for labeling)

Q.3	Attempt any FOUR of	of the following	16M
8	a) Define Sewage, Sull	lage, effluent and Garbage.	4M
latrii ii) S kitch iii) H from iv) (stora	nes, urinals, stables and stoullage – The liquid waste (nen sink is called as sullage Effluent - Effluent is an our a manmade structure Garbage - The putreciable stage of meat, fruit, and veget	not foul in nature) collected from wash basin, baths and tflowing of water or gas from a natural body of water, or solid waste constituents produced during the preparation or tables is known as garbage	1M each
		ards for drinking water	4M
iii) T	 4 - 6.5 to 8.5 burbidty- 5-10 PPM (S cotal Solids - 500PPM MPN/100ml - 1 per 100mls 		1M each
(c) Difference between	one pipe and two pipe system of plumbing	4M
1 2 3 4 5	One pipe system of plumbing One pipe carrying all types of liquid waste. Single vent pipe Gully trap Not required Less costly Low maintenance	Two separate pipes one soil pipe and other waste pipe Two separate vent pipes for both soil and waste pipe. Gully trap required More costly than one pipe system High maintenance	1M each (for any four point)



e) Define self-cleaning and non-scouring velocity.	4M
i) Self-Cleaning velocity: - The minimum velocity which will prevent the silting or deposition of particles of solid matter in sewers is known as self-cleaning velocity.	2M
ii) Non-Scouring velocity: - The maximum permissible velocity at which no scouring action by the solid particles of sewage on inside smooth surface of sewers will occur is known as non-scouring velocity.	2M
Q 4 (A)Attempt Any three of the following	12 M
(i) Define the terms water pipe, soil pipe, sullage pipe, vent pipe	4M
a) Water pipe – Pipe which is used to carry the water under pressure is known as water pipe	
b) Soil pipe – The pipe carrying waste water from water closet is known as soil pipe.	1M each
c) Sullage pipe – The pipe carrying waste water from sink and bathroom is known as	
sullage pipe. d) Vent pipe – The pipe used for the purpose of ventilation is known as vent pipe.	
ii) Draw a neat sketch of inspection chamber and label it.	4M
C.I. Cover Brick work in C.M. (1:6) Plaster Chain From house drain Half round channel Concrete bed	2M for sketch & 2M for labelling
iii) State the Advantages and disadvantages of dead end system of distribution of water	4M
Advantages of dead end system a) Cheap in initial cost b) Easy determination of pipe sizes c) Laying of pipes simple d) Less no of Valves are required	01 M (each for any two)
Disadvantages of dead end system a) Due to stagnation, water gets polluted b) In case of repairs, the whole locality beyond that point gets affected c) This system cannot meet fire demand	01 M (each for any two)

(iv) Enlist the	e different meth	ods (of testing	of sewers	and ex	xplain any one	4M
Testing of Sewe	ers						
a) Water test							
b) Air test							01 M
c) Smoke test							
d) Test for straig	d) Test for straightness and obstruction						
a) Water Test							
· /	rried out for sewer			o manholes.	•		
, , ,	one by rubber plug						3M for
,	is connected with a				1		correct
	d of sewer is plugg					1 1: 4	sequenci
*	filled with water ar		naintain the	required he	ad, wate	er level in the	al
_	m above the upper						procedur
· /	ries with the materi						e
· ·	t iron sewer, the he				of land	th of the cover	(any one)
	le loss or head loss his test sufficient ar				_	un of the sewer.	
9) 10 periorii u	ns test sufficient ai	Hount	OR Water sin	bulu be ava	nabie.		
b) Air Test			<u>OK</u>				
,	ent amount of wate	r is no	t available.	then air test	is to be	carried out	
	d into the pipeline,						
	nanometer is aroun		-	Pullip Will	i a com	or varye, and the	
_	then left for 5-10 n			or temperati	ire stabi	lization within the	
	oressure is reduced			-			
	ter is then monitore		-				
· ·	ıld not fall below th		-				
	ed to be a 'pass' and			-		and can be	
backfilled.	1	1	1		J		
6) However, if t	he level in the man	omete	r does fall b	elow the 75	5mm ma	rk, then the	
equipment shou	ld be checked and	cleane	d and the pi	peline exan	nined for	r leaks or defects.	
7) If any problem	ms are identified, th	ney sho	ould be rect	ified before	re-testi	ng.	
	r relevant method			dered)			
Q 4 (B)Atten	npt any ONE of	the f	ollowing				06M
<u>` ′</u>	e population at th				nental i		
Year	1971	198		1991		2011	
Population	79560	120	0320	160530		190670	
Ans.							
Year	Population		Increment	(I)	Incren	nental increase(r)	
1971	79560						
1981	120320		40760				01M
1991	160530		40210		-550		(Avg.I)
2001	190670		30140		-10070)	('B'')
	Total			110		-10620	
	Average		1111	10/3		-10620/2	01M
	-		I =3	7037		r = -5310	(Avg .r)
					1		

Formula for Incremental Increase method as follows- $P_n = P + nI + \left(\frac{\mathbf{n}(n+1) \mathbf{r}}{2}\right)$	01 M
Where, $P = Population in 2001 = 1,90,670$ $n = number of decades = (2021-2001)/10 = 02$ $I = Average increase per decade = 1,11,110 / 3 = 37036.66 \approx 37037$ $r = Average incremental increase = -10620/02 = -5310$ $\therefore P_{2021} = 190670 + \left(2 \times 37037\right) + \left(\frac{2(2+1) \times (-5310)}{2}\right)$ $\therefore P_{2021} = 2,48,813$ Souls Note:- (In the census population data, actually after decade 1991 it should be 2001, but may be due to print mistake it is printed as 2011. so, it is expected that students should calculate considering last year as 2001.) (And if the students has solved problem by calculating population of year 2001 considering past population, and then by further calculations, if calculated the population of 2021, then for correct calculations give full credit.)	02 M 01M
ii) draw a neat sketch of European type water closet	06M
Flushing Cistern 750 mm Cover Cover Seat Perspective view of European type water closet	03M (sketch) 03M (Label ing)
Q.5 Attempt Any FOUR of the following.	16 M
(a) Explain any two steps in laying of sewers.	04 M
Steps in laying of sewers:- 1) Marking center lines of sewers and locating the position of sewers appurtenances 2) Excavation of trenches. 3) Sheeting, bracing and dewatering of trenches. 4) Laying of pipe sewers and their jointing 5) Testing of sewers lines. 6) Back filling of trenches.	Any two steps.
of Dack Hilling of Helicites.	

1) Marking center lines of sewers: The center lines of sewers are marked on the stresses
and roads from the plans starting from the lowest point of the main proceeding upwards
.the setting out of work is done by means of chain and theodolite or compass.

2) Excavation of trenches: After marking the layout of sewers lines on the ground the first step is the removal of pavement .After removal of pavement the excavation of trenches is started the excavation is done manually or by means of machinery

- 02 M for each step.
- 3) Sheeting, bracing and dewatering of trenches: In case of soft soils the trench side required shoring and strutting to prevent their collapse till the sewers are laid and tested .when sewers lines are to be lead below the ground water table. The ground water enters the trench and causes much difficulties .Therefore the de watering of tranches is compulsory.
- 4) Laying of pipe sewers and their jointing: The sewers pipes are not laid directly on the soil in the tranches. Before actual laying the concreting is done. The center line of sewers and their grades are trans ford from the ground dimension of sight rail and boning rod. Smaller size pipes can be laid by the pipe- layers by hand only but larger size pipes are lowered in the trenches by passing rope around them and supporting through a hook. Then jointing of sewers is done by usual method.
- **5**) **Testing of sewers lines**: The testing of the sewers is done with the help of water test or air test by usual method.
- 6) Back filling of trenches: After testing and removing defects of pipe line the tranches are back-filled with earth generally the Excavated soil of trench is used for back filling. Back filling is done step by step.

(b) Define BOD. State its significance.

04 M

BOD: The Biological oxygen demand of a sewage is the quantity of oxygen required for the biochemical oxidation of the biodegradable organic matter at specified temperature within the specified time.

02 M

Significance-:

- i) Only the biodegradable organics are measured.
- ii) It is important in natural water self-purification systems.

02 M for any two

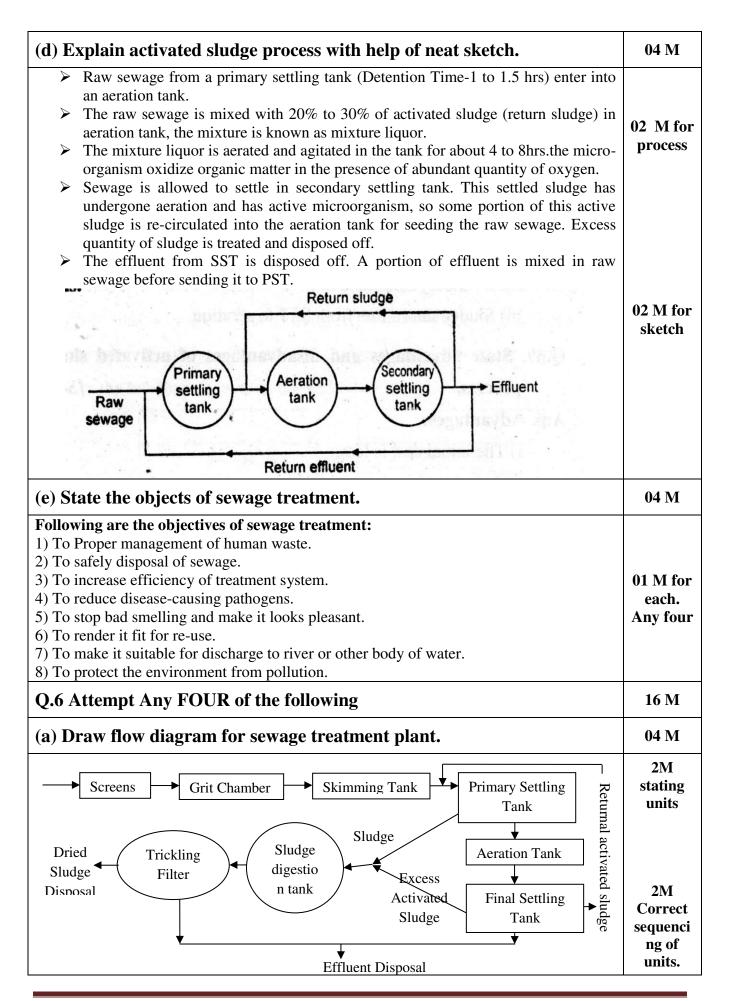
- iii) To get idea about biodegradability of any sample.
- iv) To judge the efficiency of any treatment plant.

(c) Differentiate aerobic and anaerobic process.

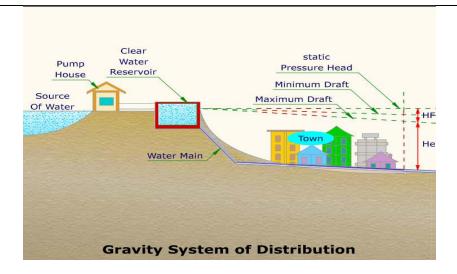
04 M

Points	Aerobic process	Anaerobic process
i) Process	In the presence of oxygen.	In the absence of oxygen.
ii) Organism involved	Aerobic bacteria.	Anaerobic bacteria.
iii) Oxygen source for	Dissolved oxygen initially	Chemically bound oxygen
bacterial metabolism	present or supplied to the	such as Nitrates, sulphates,
	waste by some means.	CO ₂ ,organic compounds etc.
iv) End Product	CO_2 , H_2O .	CH_4 , CO_2 , H_2S , etc.
v) Economical Product	No methane gas recovery.	Methane gas produces in
		this process.
vi) Nuisance due to end	Inoffensive.	Offensive
products		
vii) Applicability of	Moderate waste.	Strong organic waste.
Process		
viii) Effectiveness process	End product requires	Well stabilized end product.
	some treatment.	
	Some treatment.	

01 M For Each Any four points



(b) Explain the working of trickling filter with help of neat sketch.	04 M
Working- Trickling filter is an artificial bed of stones or broken bricks material over which waste water is distributed or applied in drops, films or sprays through which it trickles to the under drains. A slime layer is formed on the surface of media, in which bacteria are present which consumes organic matter present in sewage and waste water is collected through under drains. Working is simple so it does not requires any skilled supervision and it removes 80% colloidal matter, reduces B.O.D. up to 75%. It gives highly nitrified and stabilized effluent and flexibility in operation. But it requires large area and high construction cost. Also there is problem of bad smell and fly nuisance. Mosquito-proof dome Guy ropes Rotary pipe (Circular or rectangular) Orifices	02 M For Working
Seal Underdrain Filter media Underdrain Fig. Trickling Filter	02 M For Fig.
(c) Enlist the method of distribution of water explain any one.	
Depending upon the topography of the town, the water may be distributed by the following methods- 1. Gravity Distribution 2. Pumped Distribution 3. Combined Distribution	02 M for list of methods,
 1) Gravity Water distribution Method: This method is adopted when source of supply, such as lake, river or reservoirs, is at sufficient height than the city. In this system water flows in the main due to gravitational force. Advantage- a) No pumping required b) The system is simple, reliable and economical. Disadvantage- a) This system can not provide high pressure for fire demand. 	02 M for any one explain. (<u>sketch*</u> is optional)



Gravity Distribution

2) Pumping Method:

In this system water is directly pumped in the mains. Since the pumps have to work at different rates in a day, the maintenance cost increases.

It is preferred to have number of pumps & only the required numbers may work at various times to meet the varying demands. In place of providing pumps of variable speed, high lift pumps are required.

If the power fails, the whole supply of the town will be stopped. Therefore it is better to have diesel pumps also in addition to electric pumps as stand by.

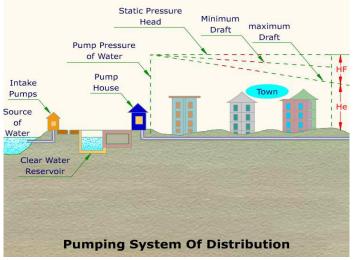


Fig. Pumping System

3) Combined Method:

This is also known as combined gravity & pumping system. The pump is connected to the mains as well as to the elevated reservoir.

In the beginning when demand is small, the water is stored in the elevated reservoir. But when demand increases the rate of the flow in the distribution system comes from both the pumping station as well as elevated reservoir.

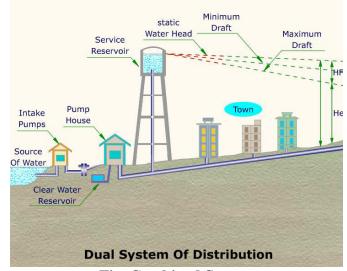


Fig. Combined System

(Note- * The students may draw fig. instead of explanation, for that 1M should be given)

(d) Draw neat sketch of drop man hole.

04 M

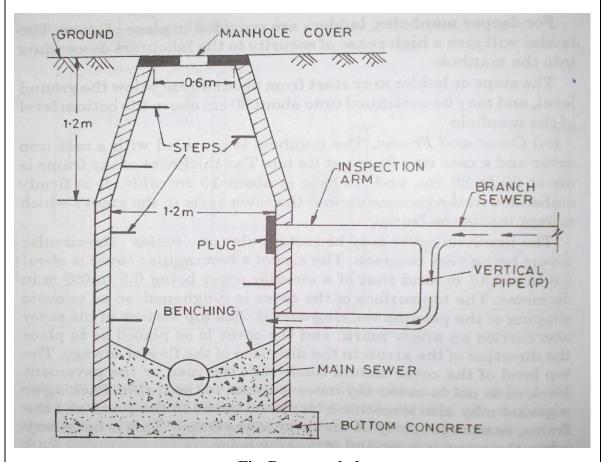


Fig. Drop manhole

02 M for sketch

And

02M for labelling

(e) State the factors affecting choice of pipe material for distribution of water.	04 M
Following factors are affecting while selecting pipe material for water distribution: 1) Carrying capacity of the pipe. 2) Durability and life of the pipe.	Any four factors.
 3) Type of water to be conveyed and its possible corrosive effect on the pip material. 4) Availability of funds. 5) Maintenance cost, repair etc. 	01 M for each factor.
(f) State norms for maintenance of domestic sanitary units.	04 M
Norms for maintenance of domestic sanitary units: The house drainage system should be properly maintained and cleaned at regular intervals for its efficient workings. Following points should be carefully noted:-	
 i) Entry of undesired elements ii) Flushing iii) Inspection iv) Quality of materials v) Use of disinfectants vi) Workmanship 	Any four norms. 01 M for each.
(Note- The students may write check list regarding maintenance of sanitary units, so credit may give accordingly)	