

removed. It should be boiled at least for 10-15mins. Boiling also removes some of the dissolved salts. It is the most effective method of disinfection. But, this method is not suitable on large scale. It is suitable for domestic purpose, i.e. to boil water before its use as drinking water. The water should be cooled down to a comfortable temperature before drinking. In case of an epidemic, the consumers should always boil water to check the water-borne diseases.

(*Give credit for explanation of any one method from above)

Q.2. Attempt ANY FOUR of the following:

16M

(a) Define design period and state factors affecting on it.

4M

ANS:-

Design period:-The number of years for which a provision is made in designing the capacities of the various components of the water supply scheme is known as design period.

2M

Factors affecting design period:-

- i) Useful life of component structure and the chances of their becoming old and obsolete. Design period should not exceed those respective values.
- ii) Ease and difficulty that is likely to be faced in expansions. If under taking at future dates.
- iii) Amount and availability of additional investment likely to be incurred for additional provision.
- iv) The rate of interest on the borrowings and the additional money invested.
- v) Anticipated Rate of population growth including possible shift's in communities, industries and commercial establishment.

**2M
(1M each
for any
two)**

b) Compare on any four points between slow sand filter and rapid sand filter.

4M

ANS:-

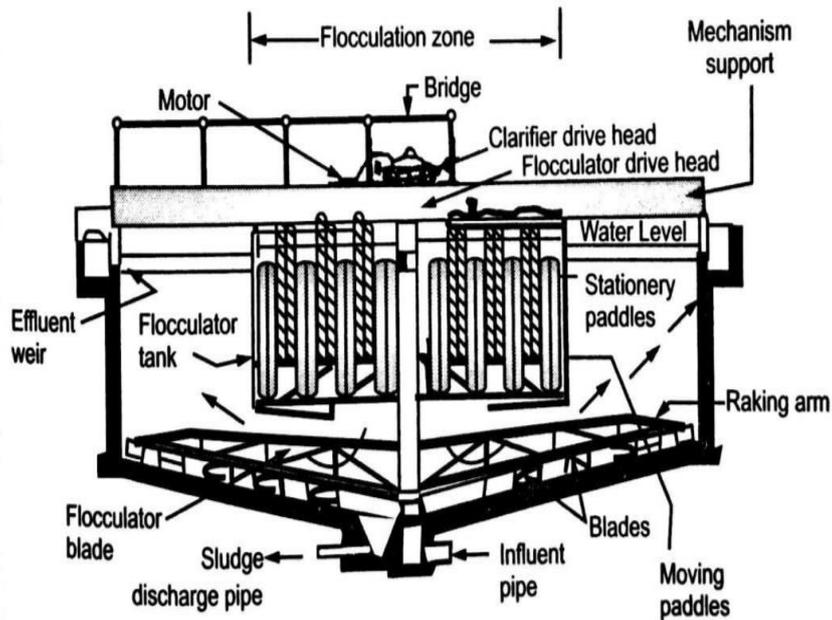
Comparison Points	Slow Sand Filter	Rapid Sand Filter
1. Coagulation	Not Required	Essential
2. Compactness	Requires large area for its installation.	Requires small area for its installation.
3. Construction	Simple	Complicated as separate under drainage system is required to be design.
4. Cost of operation	Low	High
5. Period of cleaning	1-3 months	2-3 days
6. Method of clearing	Long and laborious method	Due to back washing short and speedy method.
7. Skilled supervision	Not essential	Essential
8. Suitability	For small towns and villages.	For big cities where land cost is high and variation in water demand.
9. Base material	Varies from 3-65mm in size with 300-750mm depth.	Varies from 3-40mm in size with 600-900mm depth.
10. Loss of head	150-750mm	3m-3.50m
11. Rate of Filtration	100-200lit/hr/m ²	3000-6000 lit./hr/m ²

**1M
(for any
four
point)**

c) Draw a neat sketch of **classiflocculator**.

4M

ANS:-



Clariflocculator

2M
(for sketch)
&
2M
(for labeling)

(Note- In question it is printed as classiflocculator, But it should be Clariflocculator)

d) State the location and function of the following pipe fittings:

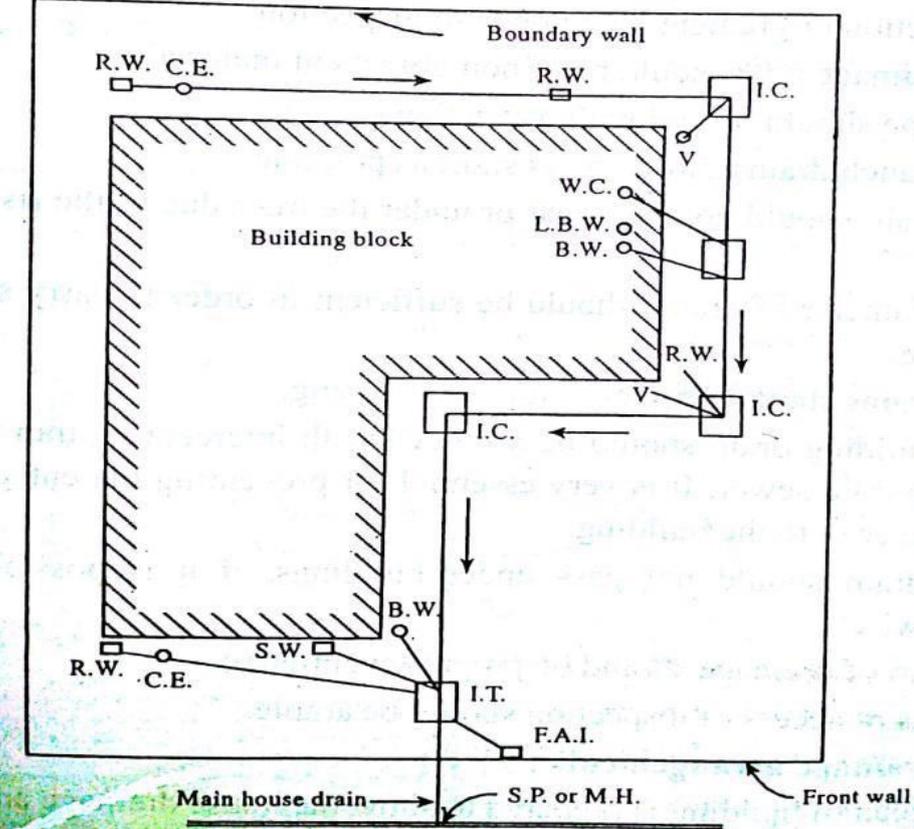
- (i) Air valve
- (ii) Non-return valve
- (iii) Scour valve
- (iv) Foot valve

4M

ANS:-

Type Of Valve	Location	Function
Air valve	They are provided at summit points in the alignment of pipes.	To release accumulated air that can obstruct the flow of water.
Non-return valve	A non-return valve is fitted to ensure that a medium flows through a pipe in the right direction, where pressure conditions may otherwise cause reversed flow.	To allows water to flow one direction only
Scour valve	They are located at the dead ends and depression or at lowest points in mains.	To remove sand and silt deposited in pipeline.
Foot valve	They are at the end of the suction line.	To prevent siphoning and loss of prime in diaphragm

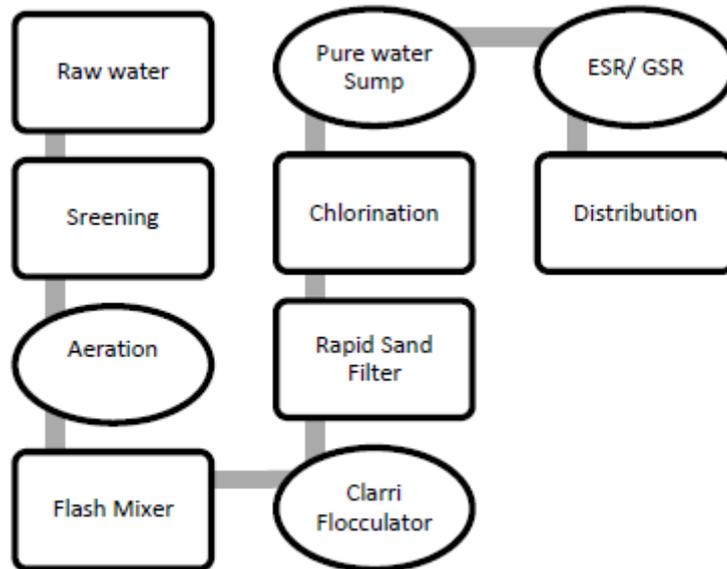
1M
Each
(Of
½ M for location
&
½ M for function)

<p>e) Enlist the qualities of good trap.</p>	<p>4M</p>
<p>ANS:- Qualities of good trap are:-</p> <ul style="list-style-type: none"> ➤ 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 access door should be provided for cleaning the trap. ➤ It should be made up of non-adsorbent material. 	<p>1M (for each point)</p>
<p>f) With the help of line diagram show arrangement of the sanitary plumbing for residential building.</p>	<p>4M</p>
<p>ANS:-</p>  <p>R.W.- Rain water pipe C.E.- Cleaning eye S.W. Sink waste V- Vent pipe W.C.- Water closet L.B.W.- Lavatory basin waste</p> <p>B.W.- Bath waste I.C.- Intercepting chamber I.T.- Intercepting trap F.A.I.- Fresh Air Inlet S.P.- Saddle point M.H.- Manhole</p>	<p>2M (for line diagram) & 2M (for labeling)</p>

Q.3 Attempt any FOUR of the following		16M																		
a) Define Sewage, Sullage, effluent and Garbage.		4M																		
<p>i) Sewage- The liquid waste from the community and it includes Sullage, discharge from latrines, urinals, stables and storm water.</p> <p>ii) Sullage – The liquid waste (not foul in nature) collected from wash basin, baths and kitchen sink is called as sullage.</p> <p>iii) Effluent - Effluent is an outflowing of water or gas from a natural body of water, or from a manmade structure</p> <p>iv) Garbage -The putreciable solid waste constituents produced during the preparation or storage of meat, fruit, and vegetables is known as garbage</p>		1M each																		
b) State the I.S. Standards for drinking water		4M																		
<p>i) pH - 6.5 to 8.5</p> <p>ii) Turbidty- 5-10 PPM (Silica scale) or 01 NTU</p> <p>iii) Total Solids - 500PPM</p> <p>iv) MPN/100ml - 1 per 100mls</p>		1M each																		
c) Difference between one pipe and two pipe system of plumbing		4M																		
	<table border="1"> <thead> <tr> <th></th> <th>One pipe system of plumbing</th> <th>Two pipe system of plumbing</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>One pipe carrying all types of liquid waste.</td> <td>Two separate pipes one soil pipe and other waste pipe</td> </tr> <tr> <td>2</td> <td>Single vent pipe</td> <td>Two separate vent pipes for both soil and waste pipe.</td> </tr> <tr> <td>3</td> <td>Gully trap Not required</td> <td>Gully trap required</td> </tr> <tr> <td>4</td> <td>Less costly</td> <td>More costly than one pipe system</td> </tr> <tr> <td>5</td> <td>Low maintenance</td> <td>High maintenance</td> </tr> </tbody> </table>		One pipe system of plumbing	Two pipe system of plumbing	1	One pipe carrying all types of liquid waste.	Two separate pipes one soil pipe and other waste pipe	2	Single vent pipe	Two separate vent pipes for both soil and waste pipe.	3	Gully trap Not required	Gully trap required	4	Less costly	More costly than one pipe system	5	Low maintenance	High maintenance	1M each (for any four point)
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5	Low maintenance	High maintenance																		

d) Draw a neat sketch of flow diagram of water treatment plant.

4M

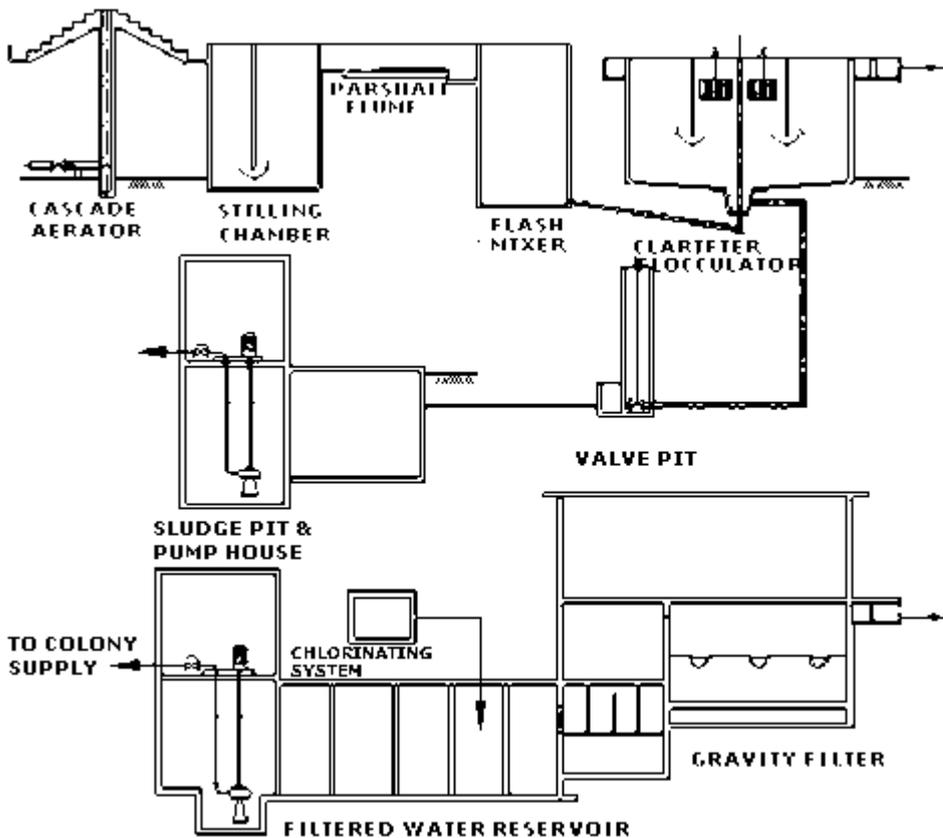


2M
stating
units

2M
Correct
sequenci
ng

OR

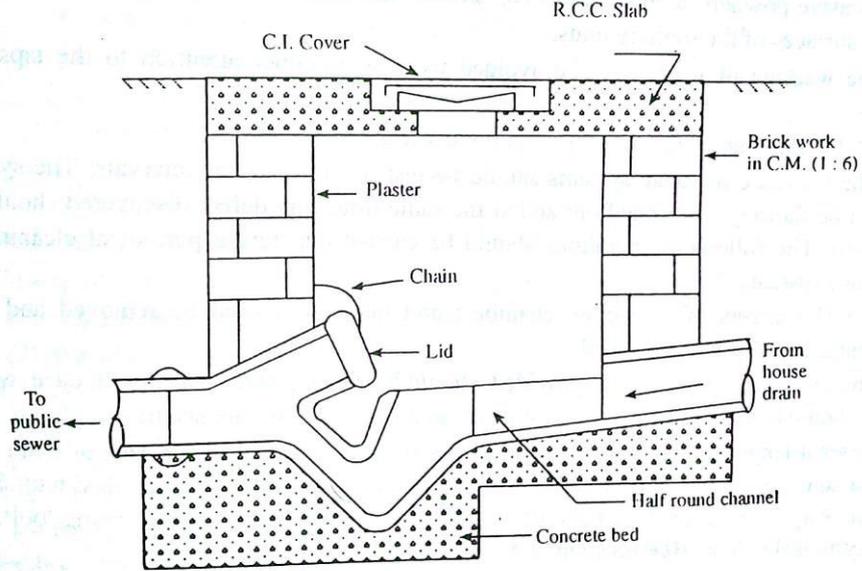
OR



2M
stating
units

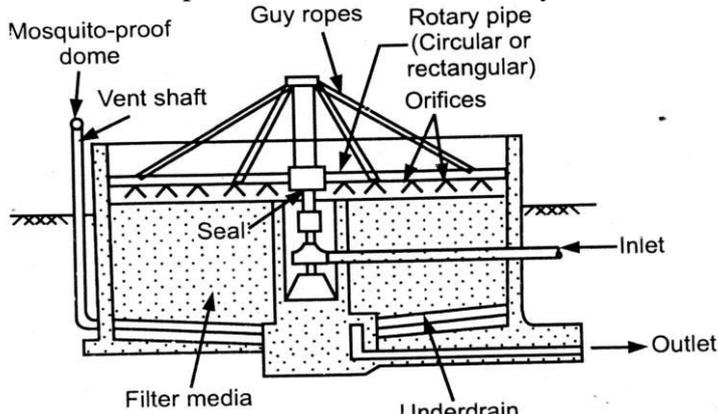
2M*
Correct
sequenci
ng of
units.

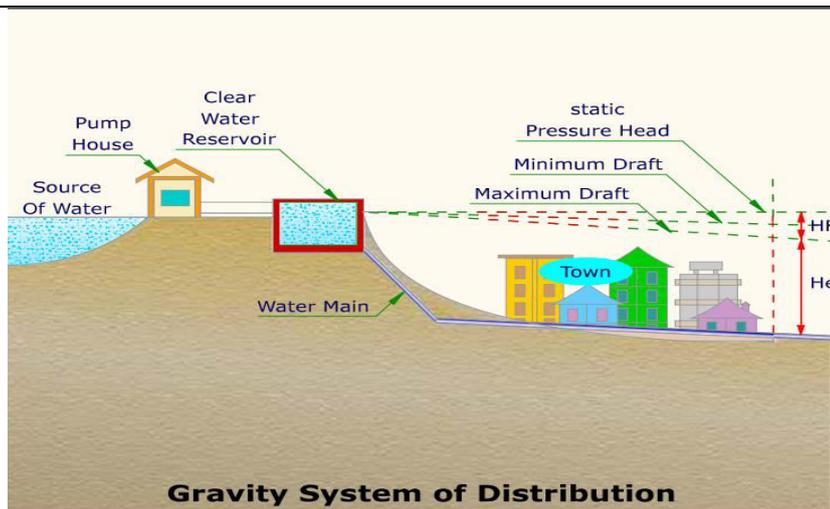
(*Note: Student may draw flow diagram in any manner
i.e. either lay out or flow diagram. so give credit 02 marks for naming components and 02
marks for correct sequence of units.)

<p>e) Define self-cleaning and non-scouring velocity.</p>	<p>4M</p>
<p>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.</p>	<p>2M</p>
<p>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.</p>	<p>2M</p>
<p>Q 4 (A) Attempt Any three of the following</p>	<p>12 M</p>
<p>(i) Define the terms water pipe, soil pipe, sullage pipe, vent pipe</p>	<p>4M</p>
<p>a) Water pipe – Pipe which is used to carry the water under pressure is known as water pipe</p> <p>b) Soil pipe – The pipe carrying waste water from water closet is known as soil pipe.</p> <p>c) Sullage pipe – The pipe carrying waste water from sink and bathroom is known as sullage pipe.</p> <p>d) Vent pipe – The pipe used for the purpose of ventilation is known as vent pipe.</p>	<p>1M each</p>
<p>ii) Draw a neat sketch of inspection chamber and label it.</p>	<p>4M</p>
	<p>2M for sketch & 2M for labelling</p>
<p>iii) State the Advantages and disadvantages of dead end system of distribution of water</p>	<p>4M</p>
<p>Advantages of dead end system</p> <p>a) Cheap in initial cost</p> <p>b) Easy determination of pipe sizes</p> <p>c) Laying of pipes simple</p> <p>d) Less no of Valves are required</p> <p>Disadvantages of dead end system</p> <p>a) Due to stagnation, water gets polluted</p> <p>b) In case of repairs, the whole locality beyond that point gets affected</p> <p>c) This system cannot meet fire demand</p>	<p>01 M (each for any two)</p> <p>01 M (each for any two)</p>

(iv) Enlist the different methods of testing of sewers and explain any one		4M		
<p>Testing of Sewers</p> <p>a) Water test b) Air test c) Smoke test d) Test for straightness and obstruction</p> <p>a) Water Test</p> <p>1) This test is carried out for sewer lines between two manholes. 2) Plugging is done by rubber plug at its lower end. 3) Rubber plug is connected with air blown. 4) The upper end of sewer is plugged with a connection to the funnel. 5) The sewer is filled with water and to maintain the required head, water level in the funnel is kept 2 m above the upper end. 6) This head varies with the material of sewer. 7) In case of cast iron sewer, the head should be at 9m. 8) The acceptable loss or head loss should not exceed 2 liters/cm of length of the sewer. 9) To perform this test sufficient amount of water should be available.</p> <p style="text-align: center;"><u>OR</u></p> <p>b) Air Test</p> <p>1) When sufficient amount of water is not available, then air test is to be carried out. 2) Air is pumped into the pipeline, usually via a hand-pump with a control valve, until the reading on the manometer is around 125-150mm. 3) The set-up is then left for 5-10 minutes to allow for temperature stabilization within the pipe before the pressure is reduced to exactly 100mm on the manometer scale. 4) The manometer is then monitored for a period of 5 minutes; the level of water in the manometer should not fall below the 75mm mark during this period. 5) This is deemed to be a 'pass' and the pipeline is declared satisfactory and can be backfilled. 6) However, if the level in the manometer does fall below the 75mm mark, then the equipment should be checked and cleaned and the pipeline examined for leaks or defects. 7) If any problems are identified, they should be rectified before re-testing.</p> <p>(Note-Any other relevant method should be considered)</p>		<p>01 M</p> <p>3M for correct sequential procedure (any one)</p>		
Q 4 (B) Attempt any ONE of the following		06M		
(i) Estimate the population at the end of year 2021 by incremental increase method				
Year	1971	1981	1991	2011
Population	79560	120320	160530	190670
Ans.				
Year	Population	Increment(I)	Incremental increase(r)	
1971	79560	---	----	
1981	120320	40760	---	
1991	160530	40210	-550	
2001	190670	30140	-10070	
	Total	111110	-10620	
	Average	111110/3 I =37037	-10620/2 r = -5310	
			01M (Avg .I)	
			01M (Avg .r)	

<p>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.</p> <p>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</p> <p>3) Sheetting, 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.</p> <p>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.</p> <p>5) Testing of sewers lines: The testing of the sewers is done with the help of water test or air test by usual method.</p> <p>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.</p>	<p>02 M for each step.</p>																											
<p>(b) Define BOD. State its significance.</p>	<p>04 M</p>																											
<p>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.</p> <p>Significance:-</p> <p>i) Only the biodegradable organics are measured.</p> <p>ii) It is important in natural water self-purification systems.</p> <p>iii) To get idea about biodegradability of any sample.</p> <p>iv) To judge the efficiency of any treatment plant.</p>	<p>02 M</p> <p>02 M for any two</p>																											
<p>(c) Differentiate aerobic and anaerobic process.</p>	<p>04 M</p>																											
<table border="1"> <thead> <tr> <th>Points</th> <th>Aerobic process</th> <th>Anaerobic process</th> </tr> </thead> <tbody> <tr> <td>i) Process</td> <td>In the presence of oxygen.</td> <td>In the absence of oxygen.</td> </tr> <tr> <td>ii) Organism involved</td> <td>Aerobic bacteria.</td> <td>Anaerobic bacteria.</td> </tr> <tr> <td>iii) Oxygen source for bacterial metabolism</td> <td>Dissolved oxygen initially present or supplied to the waste by some means.</td> <td>Chemically bound oxygen such as Nitrates, sulphates, CO₂,organic compounds etc.</td> </tr> <tr> <td>iv) End Product</td> <td>CO₂, H₂O.</td> <td>CH₄, CO₂, H₂S, etc.</td> </tr> <tr> <td>v) Economical Product</td> <td>No methane gas recovery.</td> <td>Methane gas produces in this process.</td> </tr> <tr> <td>vi) Nuisance due to end products</td> <td>Inoffensive.</td> <td>Offensive</td> </tr> <tr> <td>vii) Applicability of Process</td> <td>Moderate waste.</td> <td>Strong organic waste.</td> </tr> <tr> <td>viii) Effectiveness process</td> <td>End product requires some treatment.</td> <td>Well stabilized end product.</td> </tr> </tbody> </table>	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 bacterial metabolism	Dissolved oxygen initially present or supplied to the waste by some means.	Chemically bound oxygen such as Nitrates, sulphates, CO ₂ ,organic compounds etc.	iv) End Product	CO ₂ , H ₂ O.	CH ₄ , CO ₂ , H ₂ S, etc.	v) Economical Product	No methane gas recovery.	Methane gas produces in this process.	vi) Nuisance due to end products	Inoffensive.	Offensive	vii) Applicability of Process	Moderate waste.	Strong organic waste.	viii) Effectiveness process	End product requires some treatment.	Well stabilized end product.	<p>01 M For Each Any four points</p>
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<p>(b) Explain the working of trickling filter with help of neat sketch.</p>	<p>04 M</p>
<p>Working-</p> <p>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.</p> <p>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.</p>  <p style="text-align: center;">Fig. Trickling Filter</p>	<p>02 M For Working</p> <p>02 M For Fig.</p>
<p>(c) Enlist the method of distribution of water explain any one.</p>	<p>04 M</p>
<p>Depending upon the topography of the town, the water may be distributed by the following methods-</p> <ol style="list-style-type: none"> 1. Gravity Distribution 2. Pumped Distribution 3. Combined Distribution <p>1) Gravity Water distribution Method:</p> <p>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.</p> <p>Advantage-</p> <ol style="list-style-type: none"> a) No pumping required b) The system is simple, reliable and economical. <p>Disadvantage-</p> <ol style="list-style-type: none"> a) This system can not provide high pressure for fire demand. 	<p>02 M for list of methods,</p> <p>02 M for any one explain. (sketch* is optional)</p>



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.

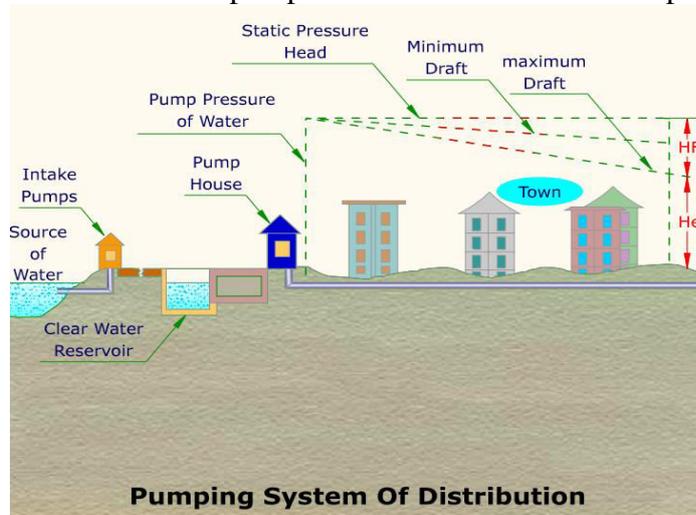
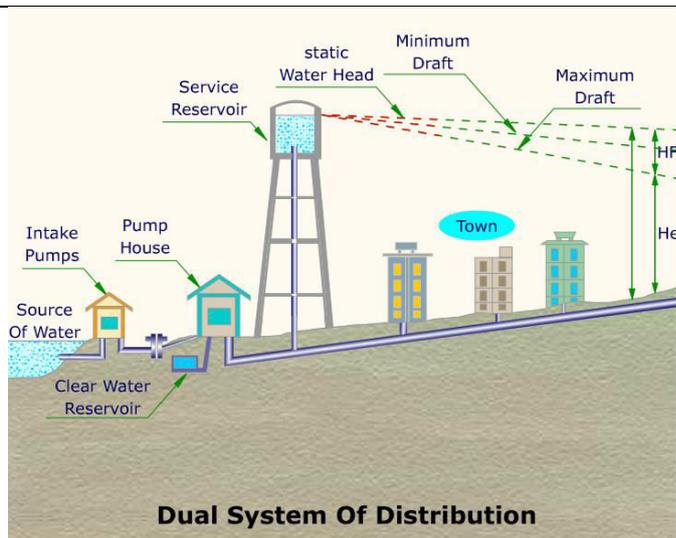


Fig. Pumping System

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.



Dual System Of Distribution
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

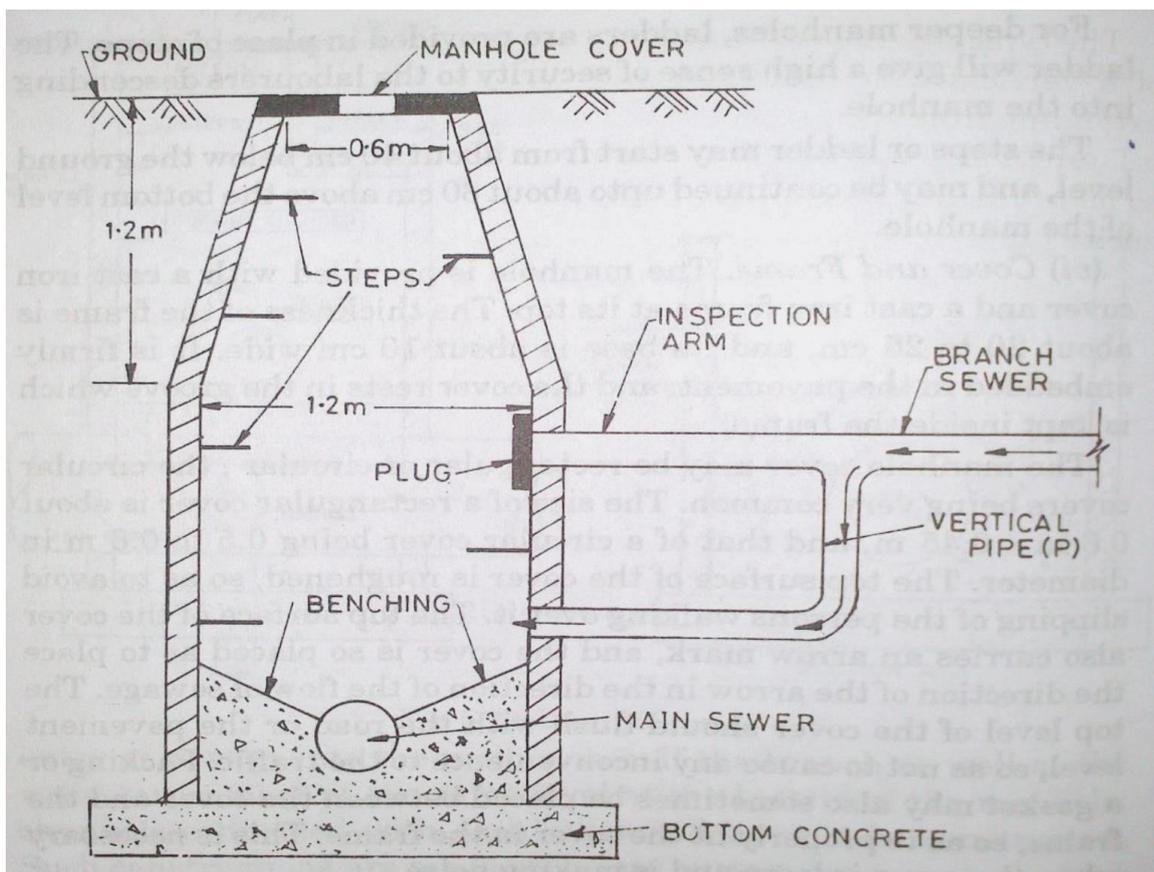


Fig. Drop manhole

02 M for sketch

And

02M for labelling

(e) State the factors affecting choice of pipe material for distribution of water.	04 M
<p>Following factors are affecting while selecting pipe material for water distribution :-</p> <ol style="list-style-type: none"> 1) Carrying capacity of the pipe. 2) Durability and life of the pipe. 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. 	<p>Any four factors.</p> <p>01 M for each factor.</p>
(f) State norms for maintenance of domestic sanitary units.	04 M
<p>Norms for maintenance of domestic sanitary units:</p> <p>The house drainage system should be properly maintained and cleaned at regular intervals for its efficient workings. Following points should be carefully noted :-</p> <ol style="list-style-type: none"> i) Entry of undesired elements ii) Flushing iii) Inspection iv) Quality of materials v) Use of disinfectants vi) Workmanship <p><i>(Note- The students may write check list regarding maintenance of sanitary units, so credit may give accordingly)</i></p>	<p>Any four norms.</p> <p>01 M for each.</p>