



**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION  
(Autonomous)**

(ISO/IEC -270001 – 2005 certified)

**WINTER -2019 EXAMINATION**

**Subject code: 17503**

**Model Answer**

**Total pages : 16**

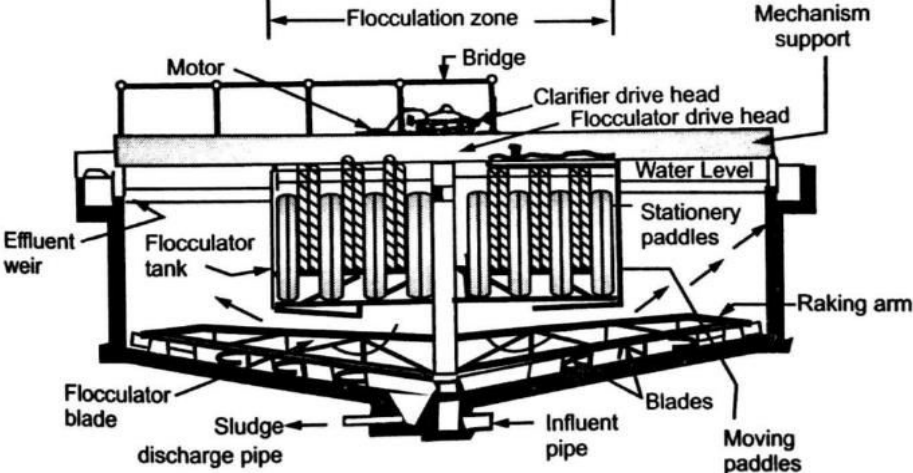
**Important Instructions to examiners:**

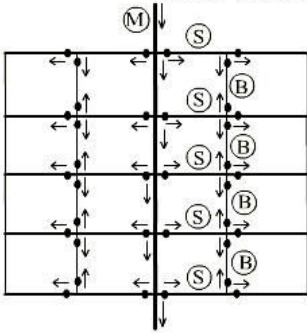
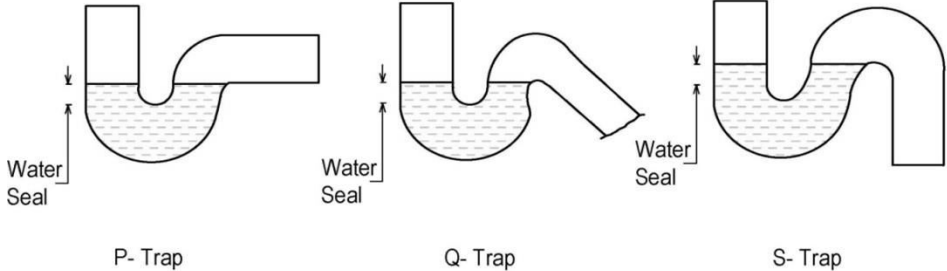
- 1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language error such as grammatical, spelling 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 constant values may vary and there may be some difference in the candidate's 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.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

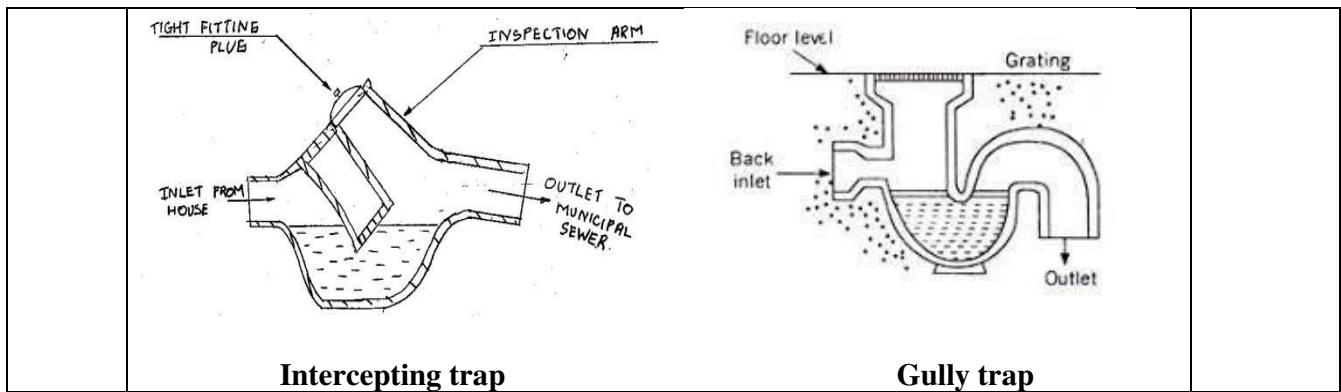
Q. No.	Question and Model Answers	Marks
<b>1. a)</b>	<b>Attempt any THREE of the following:</b>	<b>12M</b>
<b>1a.i)</b>	<b>Draw the flow diagram of water supply scheme</b>	<b>4M</b>
	<p>Ans:</p> <p><b>Flow diagram of water supply scheme</b></p> <pre> graph LR     RawWater[Raw water] --&gt; Screening[Screening]     Screening --&gt; Aeration[Aeration]     Aeration --&gt; FlashMixer[Flash Mixer]     FlashMixer --&gt; Clariflocculator[Clariflocculator]     Clariflocculator --&gt; RapidSandFilter[Rapid sand filter]     RapidSandFilter --&gt; Disinfection[Disinfection]     Disinfection --&gt; PureWaterSump[Pure water sump]     PureWaterSump --&gt; ESRGSR[ESR/GSR]     ESRGSR --&gt; DistributionSystem[Distribution system]     </pre> <p align="center"><b>OR</b></p>	<p align="center"><b>2M (for Units)</b></p> <p align="center"><b>2M (for Correc t sequen ce)</b></p> <p align="center"><b>OR</b></p>

	<div style="text-align: center;"> <pre> graph TD     A[Sources of water] --&gt; B[Surface source]     A --&gt; C[Sub-surface source]     B --&gt; D[Rivers]     B --&gt; E[Lakes]     B --&gt; F[Reservoirs]     C --&gt; G[Springs]     C --&gt; H[Wells]     C --&gt; I[Infiltration wells]     D --&gt; J[Intake works]     E --&gt; J     F --&gt; J     G --&gt; J     H --&gt; J     I --&gt; J     J --&gt; K[Treatment works]     K --&gt; L[Sedimentation]     K --&gt; M[Filtration]     K --&gt; N[Disinfection]     K --&gt; O[Misc. treatment]     L --&gt; M     M --&gt; N     N --&gt; O     L --&gt; P[Distribution system]     M --&gt; P     N --&gt; P     O --&gt; P     P --&gt; Q[To consumers] </pre> </div> <p><b>(*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.)</b></p>	<p>2M (for Units)</p> <p>2M (for correct sequence)</p>
1a.ii)	State the points to be considered while collecting a water sample	4M
	<p>Ans:</p> <p><b>Points to be considered while collecting a water sample-</b></p> <ol style="list-style-type: none"> <li>1. If a sample is to be collected from tap/faucet, sufficient quantity of water should be allowed to pass through the tap before collecting the sample, to eliminate the stagnant water.</li> <li>2. If water is to be collected from streams, water sample should be taken at least 40-50cm below the surface, to avoid collection of surface impurities, oils, tree leaves, etc.</li> <li>3. In case of sub-surface source sufficient water should be pumped out before collecting the sample.</li> <li>4. For bacteriological tests- The person who collects the water must be firstly free from any disease. Container bottles must be cleaned with sulphuric acid, potassium dichromate and then rinsed with distilled water &amp; finally sterilization is done.</li> <li>5. After collecting the sample, stopper of the bottle should be well secured and the bottles containing samples of water should be labeled stating the source, date and time of collection.</li> </ol>	<p>1M Each (for any four)</p>

<b>1a.iii)</b>	<b>Explain the principle behind sedimentation with coagulation</b>	<b>4M</b>																					
	<p>Ans.-</p> <p><b>Principle of Sedimentation with coagulation</b></p> <p>a) Floc formation – When a coagulant is added to water and mixed thoroughly, a thick gelatinous precipitate is formed known as ‘floc’. As floc settles down, it attracts and arrests the colloidal particles and makes them settle.</p> <p>b) Electrical charges – Ions from floc possess positive electric charge. Colloidal particles possess negative charged ions. The floc thus attracts colloidal particles and makes them settle down.</p>	<p><b>2M</b></p> <p><b>2M</b></p>																					
<b>1a.iv)</b>	<b>Define Disinfection and state its object also.</b>	<b>4M</b>																					
	<p>Ans:</p> <p><b>Disinfection</b> – The process of killing the pathogenic or harmful bacteria from water and making it safe to user is called disinfection.</p> <p><b>Objects of disinfection-</b></p> <p>a) To kill bacterial impurities.</p> <p>b) To make water safe for drinking.</p> <p>c) To remove Taste, colour and odour.</p>	<p><b>2M</b></p> <p><b>1M each (for any two)</b></p>																					
<b>1.b)</b>	<b>Attempt any ONE of the following</b>	<b>6M</b>																					
<b>i)</b>	<b>State the permissible limits of drinking water as per I.S.:-</b> <b>(1) Colour (2) Hardness (3) Calcium (4) B-Coli (5) Chloride (6) MPN</b>	<b>6M</b>																					
	<p>Ans:</p> <table border="1"> <thead> <tr> <th>Sr.No.</th> <th>Characteristic</th> <th>Permissible limit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Colour</td> <td>5 Hazen units 10-20 ppm (platinum cobalt scale)</td> </tr> <tr> <td>2</td> <td>Hardness</td> <td>200 mg/lit as CaCO<sub>3</sub></td> </tr> <tr> <td>3</td> <td>Calcium</td> <td>75 mg/lit</td> </tr> <tr> <td>4</td> <td>B- Coli</td> <td>Shall not be detectable in any 100 ml sample</td> </tr> <tr> <td>5</td> <td>Chloride</td> <td>250 mg/lit</td> </tr> <tr> <td>6</td> <td>MPN</td> <td>Shall not be detectable in any 100 ml sample</td> </tr> </tbody> </table>	Sr.No.	Characteristic	Permissible limit	1	Colour	5 Hazen units 10-20 ppm (platinum cobalt scale)	2	Hardness	200 mg/lit as CaCO <sub>3</sub>	3	Calcium	75 mg/lit	4	B- Coli	Shall not be detectable in any 100 ml sample	5	Chloride	250 mg/lit	6	MPN	Shall not be detectable in any 100 ml sample	<b>1M each</b>
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<b>ii)</b>	<b>Describe in brief fluoridation and de-fluoridation.</b>	<b>6M</b>																					
	<p>Ans.-</p> <p><b>1) Fluoridation-</b> Water fluoridation is the controlled adjustment of fluoride to a public water supply to reduce tooth decay. Fluoridated water contains fluoride at a level that is effective for preventing cavities; this can occur naturally or by adding fluoride. The common compounds used for adding fluoride in the water are- Sodium Fluoride b) Sodium silico fluoride (Na<sub>2</sub>SiF<sub>6</sub>) c) Hydro-fluosilic acid (H<sub>2</sub>SiF<sub>6</sub>)</p> <p><b>2) Defluoridation-</b> The process of removing the excess amount of fluoride from water is called defluoridation. The presence of excess fluoride (more than 1.5 mg/lit) cause spotting and discoloration of teeth. The following methods are used for defluoridation- a) Lime soda process b) Bringing water in contact with tricalcium phosphate c) By a cation exchanger d) using activated carbon</p>	<p><b>2M</b></p> <p><b>1M</b></p> <p><b>2M</b></p> <p><b>1M</b></p>																					

2.	<b>Attempt any FOUR of the following:</b>	<b>16M</b>																												
2.a)	<b>List the various types of demand of water with their percentage for a town.</b>	<b>4M</b>																												
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2.b)	<b>Draw a neat sketch of clariflocculator.</b>	<b>4M</b>																												
	<p>Ans:</p>  <p style="text-align: center;"><b>Clariflocculator</b></p>	<p><b>2M (for sketch)</b></p> <p><b>2M (for labeling)</b></p>																												
2.c)	<b>Compare any four points between slow sand filter and rapid sand filter.</b>	<b>4M</b>																												
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	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	100-200 lit/hr/m <sup>2</sup>	3000-6000 lit./hr/m <sup>2</sup>	
	12. Filter sand	D <sub>60</sub> /D <sub>10</sub> = 1.8-2.5	D <sub>60</sub> /D <sub>10</sub> = 1.2-1.8	
<b>2.d)</b>	<b>Describe Grid iron system layout of distribution of water with suitable sketch.</b>			<b>4M</b>
	<p style="text-align: center;"><b>Grid-iron System</b></p>  <p style="text-align: center;">     (M) : Main Pipe      (B) : Branch      (S) : Sub Mains      • : Cut off Valves   </p> <p><b>Advantages:</b></p> <ol style="list-style-type: none"> <li>1. Water is kept in good circulation due to the absence of dead ends.</li> <li>2. In the cases of a breakdown in some section, water is available from some other direction.</li> </ol> <p><b>Disadvantages</b></p> <ol style="list-style-type: none"> <li>1. Exact calculation of sizes of pipes is not possible due to provision of valves on all branches.</li> </ol> <p style="text-align: center;"><b>(*Note: Student may write advantages and disadvantages to describe the method. Give credit accordingly.)</b></p>			<p>Ans:</p> <p>In this system the water mains and branches are laid in rectangles.</p> <p>The sub-mains, mains and branches are interconnected with each other.</p> <p>It is suitable for cities with rectangular layout, where the water mains and branches are laid in rectangles.</p> <p style="text-align: right;"><b>2M Sketch</b></p> <p style="text-align: right;"><b>2M* for description</b></p>
<b>2.e)</b>	<b>Define trap and draw labeled sketch of any two traps.</b>			<b>4M</b>
	<p>Ans:</p> <p><b>Trap-</b> It is a bent tube, which provides a water seal between atmosphere and the sewer gas.</p> <p style="text-align: center;"><b>OR</b></p> <p>The devices, which are used to stop the escape of foul gases inside or outside the houses, are known as traps.</p>  <p style="text-align: center;">     P- Trap                      Q- Trap                      S- Trap   </p>			<p style="text-align: right;"><b>1M</b></p> <p style="text-align: right;"><b>1.5M each (for any two sketches)</b></p>

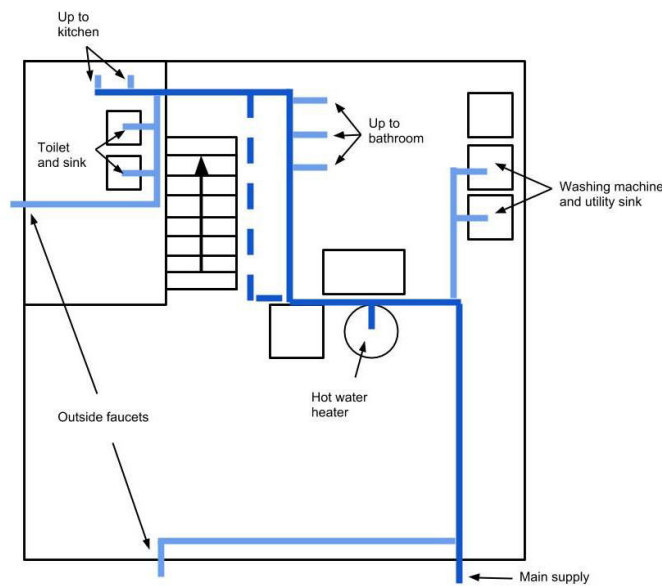


**Intercepting trap**

**Gully trap**

**2.f) Draw layout of water supply arrangement for residential building. 4M**

Ans:



**Layout of water supply arrangement for residential building**

**(\*Note: Student may draw sectional view or plan to show water supply arrangement. Give credit accordingly.)**

2M  
(for sketch)

2M  
(for labeling)

**3. Attempt any FOUR of the following: 16M**

**3.a) Explain in brief flushing cistern. 4M**

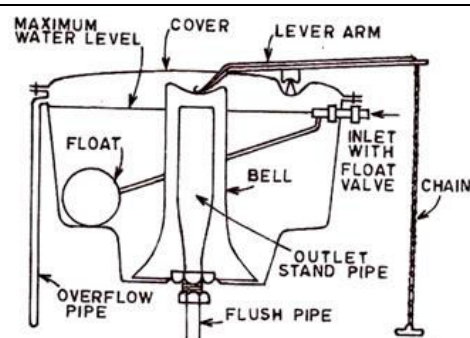
Ans:

**Flushing Cistern** - Used for flushing water closets & urinals after use. They are may be of Cast Iron, glazed earthen ware, glazed vitreous ware or pressed steel ware. Height of installation may be - 0.6m, 1.25m, 2 m

There are two types of flushing cistern.

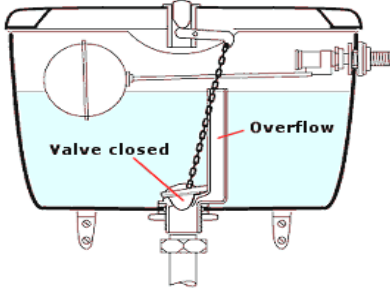
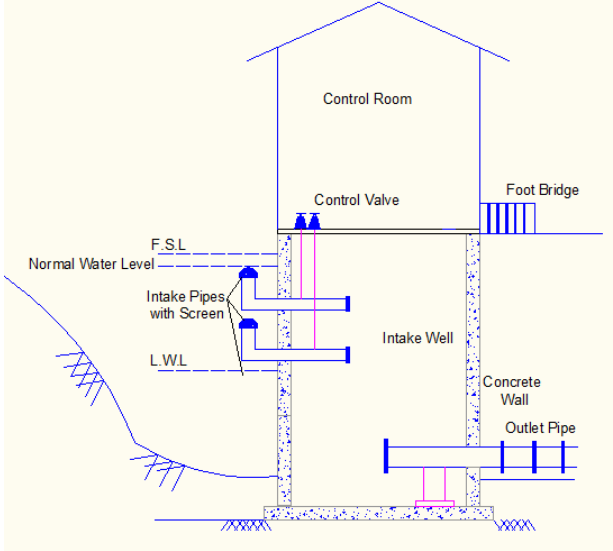
1) Bell type without valve –

Bell is kept over outlet. The flushing chain is pulled by hand by the lever action, the bell inside the cistern is lift up. As a result of this action, the partial vacuum is created at the crown flushed water to outlet, under syphonic action. Capacity -10 to 15 lit.



2M  
(for descripti  
on of  
any one  
type)

2M  
(for sketch of

	<p>2) Flat bottom type with valve -</p> <p>When handle is pressed, it lifts the disc which also suddenly lifts the water above it &amp; starts syphonic action. The valve allows the water to rush in the outlet pipe.</p> <p>Capacity -10 to 15 lit.</p>		<p>any one type)</p>
<p><b>3.b)</b></p>	<p><b>Explain river intake with neat sketch.</b></p>		<p><b>4M</b></p>
	<p>Ans:</p> <p><b>River Intake –</b></p> <p>is circular masonry tower of 4 to 7 m diameter. It is constructed along the river bank at a place from where water can be drawn in required quantity. It is either located sufficiently inside the river or they may be located near the river bank where a sufficient depth of water is available. Sometimes, an approach channel is constructed and water is led to the intake tower. River intake may be- a) Wet intake b) Dry Intake c) Movable intake.</p>  <p style="text-align: center;"><b>River Intake</b></p>		<p><b>2M (for description)</b></p> <p><b>2M (for sketch)</b></p>
<p><b>3.c)</b></p>	<p><b>Describe in brief reuse and recycling of domestic waste also state its necessity.</b></p>		<p><b>4M</b></p>
	<p>Ans:</p> <p><b>Reuse and recycling of domestic waste-</b></p> <ul style="list-style-type: none"> <li>• Domestic waste includes various types of dry, semi dry &amp; liquid waste, like vegetable peelings, paper, used glass, bulbs, worn clothes, ashes, sullage, etc.</li> <li>• Recycling or Reuse of domestic waste means finding an alternate use of waste material &amp; making it useable item.</li> <li>• The items most commonly recycled are: Glass bottles and jars, Paper (newspapers, magazines, telephone books, office paper, junk mail, comics and light cardboard), Laminated or waxed papers like paper cups, Plastic bottles, Plastic bottle tops, metal and Aluminum lids, Batteries, broken glass items, etc.</li> <li>• Reuse office furniture and supplies, such as inter office envelopes, file folders, and paper. Use durable towels, tablecloths, napkins, dishes, cups, and glasses.</li> </ul>		<p><b>3M</b></p>

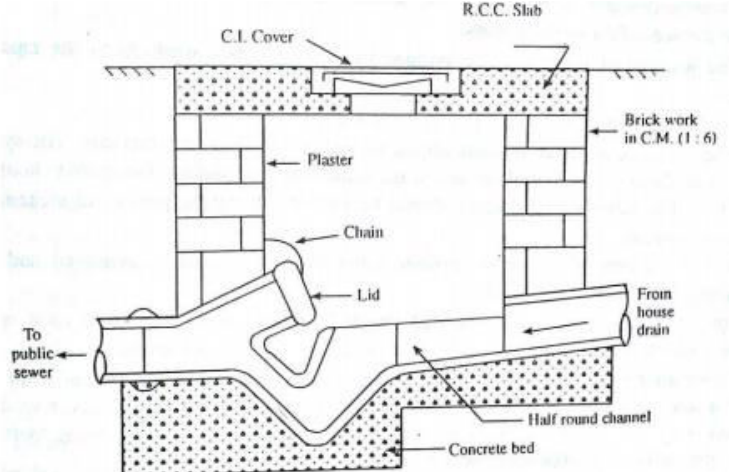
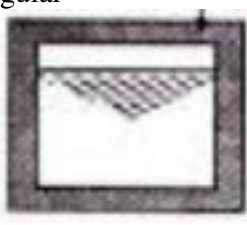
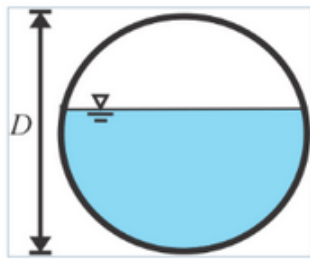
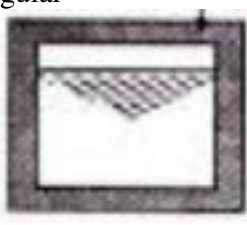
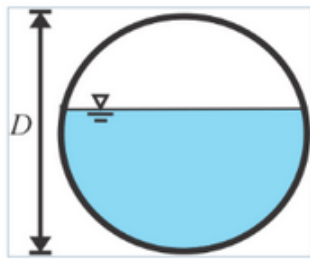
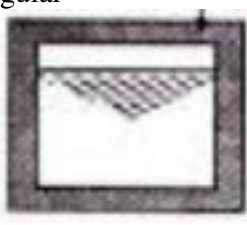
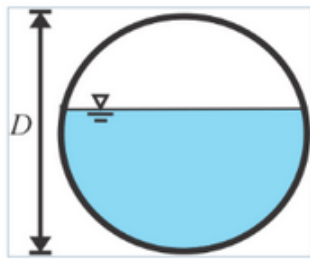



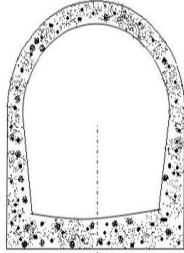
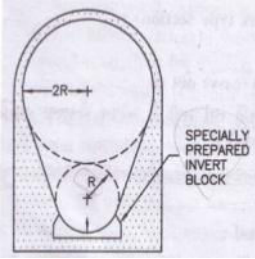
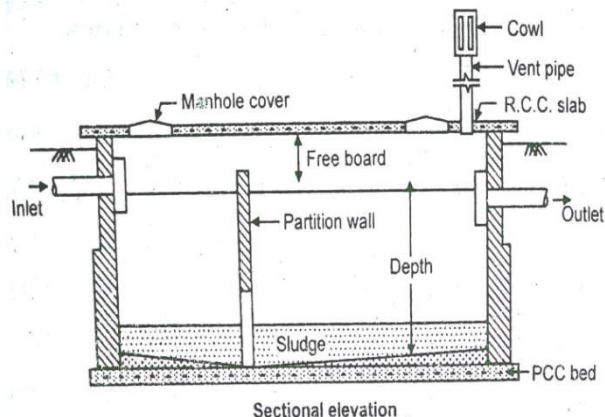
	<p><b>Necessity of Reuse and recycling of domestic waste-</b></p> <ol style="list-style-type: none"> <li>1) Leads to less utilization of raw materials.</li> <li>2) Reduces environmental impacts arising from waste treatment and disposal.</li> <li>3) Makes the surroundings cleaner and healthier.</li> <li>4) Saves on landfill space.</li> <li>5) Saves money.</li> <li>6) Reduces the amount of energy required to manufacture new products.</li> </ol>	<p><b>1M</b> <b>(for any two points)</b></p>
<p><b>3.d)</b></p>	<p><b>Explain about back washing of rapid sand filter.</b></p>	<p><b>4M</b></p>
	<p>Ans:</p> <p><b>Back washing of rapid sand filter-</b> A separate overhead tank is constructed near the filter house to store the water required for back washing of filter. A pump is installed to lift the sufficient quantity of filtered water to be stores in wash water tank.</p> <p><b>Operation -</b></p> <ul style="list-style-type: none"> <li>• Initially, the valves (1) and (4) are closed and valves (5) and (6) are opened out.</li> <li>• The wash water and compressed air are thus forced upwards from the under- drainage through the gravel and sand beds.</li> <li>• Valve (5) is closed after supplying the required amount of air.</li> <li>• The dirty water, resulting from washings, overflows into the wash water troughs and is removed by opening the valve (3) through the inlet chamber into the wash water drain.</li> <li>• Now open valve (1) and (4) for some time then close valve (4) and put filter in normal working condition by opening valve (2).</li> </ul> <div style="text-align: center;"> <p><b>Backwashing of Filter</b></p> </div>	<p><b>2M</b></p> <p><b>2M</b></p>
<p><b>3.e)</b></p>	<p><b>Define self cleansing velocity and state the factors affecting it.</b></p>	<p><b>4M</b></p>
	<p>Ans:</p> <p><b>Self cleansing velocity-</b> 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><b>OR</b> The minimum velocity at which no solids get deposited in the invert of the sewer is called self cleaning velocity.</p>	<p><b>2M</b></p>

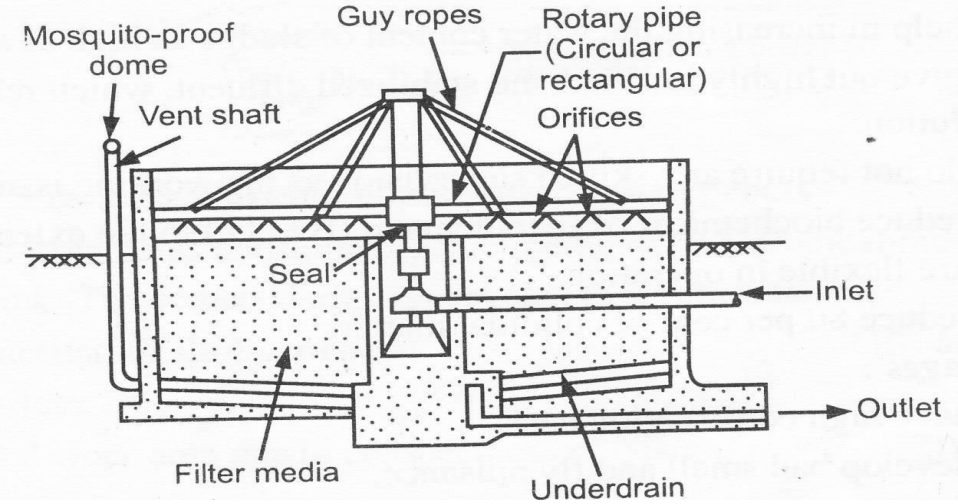


	<b>Factors affecting self cleansing velocity –</b> <ol style="list-style-type: none"> <li>1) Pipe material</li> <li>2) Coefficient of friction</li> <li>3) Gradient of sewer line</li> <li>4) Specific gravity of material</li> <li>5) Volume of flow</li> <li>6) Diameter of pipe</li> </ol>	<b>2M (for any four)</b>																					
<b>4.a)</b>	<b>Attempt any THREE of the following:</b>	<b>12M</b>																					
<b>4a(i)</b>	<b>Differentiate between one pipe system and two pipe system.</b>	<b>4M</b>																					
	<p>Ans:</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>One Pipe System</th> <th>Two Pipe System</th> </tr> </thead> <tbody> <tr> <td>1)</td> <td>Only one main waste pipe is used to collect both foul &amp; un foul waste.</td> <td>Two separate main waste pipes, one for foul &amp; other for un foul waste, are used.</td> </tr> <tr> <td>2)</td> <td>Cheap &amp; economical.</td> <td>Costly, than one pipe system.</td> </tr> <tr> <td>3)</td> <td>Less accessories required.</td> <td>More accessories required.</td> </tr> <tr> <td>4)</td> <td>Popular in multi storied building.</td> <td>Popular in single storey building.</td> </tr> <tr> <td>5)</td> <td>Volume of waste water is more.</td> <td>Volume of waste water in a pipe is less due to bifurcation of waste.</td> </tr> <tr> <td>6)</td> <td>Waste water from wash basin, bath and kitchen gets unnecessarily polluted.</td> <td>Waste water from wash basin, bath and kitchen can be used directly for gardening.</td> </tr> </tbody> </table> <p><b>(*Note: If figure is drawn to explain, give credit accordingly.)</b></p>	Sr. No.	One Pipe System	Two Pipe System	1)	Only one main waste pipe is used to collect both foul & un foul waste.	Two separate main waste pipes, one for foul & other for un foul waste, are used.	2)	Cheap & economical.	Costly, than one pipe system.	3)	Less accessories required.	More accessories required.	4)	Popular in multi storied building.	Popular in single storey building.	5)	Volume of waste water is more.	Volume of waste water in a pipe is less due to bifurcation of waste.	6)	Waste water from wash basin, bath and kitchen gets unnecessarily polluted.	Waste water from wash basin, bath and kitchen can be used directly for gardening.	<b>1M * Each (for any four points)</b>
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<b>4a(ii)</b>	<b>Describe in brief maintenance of house drainage.</b>	<b>4M</b>																					
	<p>Ans:</p> <p><b>Maintenance of house drainage-</b> For a smooth working of house drainage system, regular maintenance of drainage system is highly important. Maintenance of drainage system include removal of blockage of toilet, clogging of pipes, stopping the leakages of pipes, replacing broken appurtenances or accessories, cleaning of traps, cleaning of inspection chambers, etc. Methods of house drainage maintenance are –</p> <ol style="list-style-type: none"> <li>1) The very first step in preventing clogged drains is to clean them as regularly as possible.</li> <li>2) Use a drain guard on plug holes to reduce the amount of waste that gets washed down kitchen sink.</li> <li>3) To remove clog, use a chemical-free, natural remedy of vinegar and hot water poured down drain to flush it out.</li> <li>4) Regularly look for tree roots that could sprout up and break pipes.</li> <li>5) Clean inspection chambers and cover it properly to avoid external splashing.</li> <li>6) Replace the broken accessories immediately.</li> </ol>	<b>2M  2M (for any two)</b>																					
<b>4a(iii)</b>	<b>Explain in brief step by step procedure of laying of pipes.</b>	<b>4M</b>																					
	<p>Ans:</p> <p><b>Procedure of laying of pipes-</b></p> <ol style="list-style-type: none"> <li>1) Pipes are laid either under ground or over ground.</li> <li>2) Preparation of detailed map of roads, gas pipes, cables, etc.</li> <li>3) Locating alignment.</li> </ol>																						

	<p>4) Excavating the trenches in case of under ground pipe. Width = 0.30 to 0.45 + pipe diameter.</p> <p>5) Lowering pipe on prepared murum bed, with cranes or pulley.</p> <p>6) Laying &amp; jointing in uphill direction.</p> <p>7) Hydraulic testing of pipe.</p> <p>8) Backfilling of trenches &amp; levelling.</p> <p>9) If pipeline is to be laid over ground, chairs shall be used to support pipes.</p>	<b>4M</b>																																			
<b>4a(iv)</b>	<p><b>Design the diameter of combined sewer having the following data-</b></p> <p><b>1) Area = 500 hectares , 2) Population = 100000, 3) Water Supply = 150 lits / capita / day, 4) Intensity of rainfall = 20 mm / hr, 5) Impermeability Factor = 0.50, 6) Maximim permissible velocity = 2.0 m/sec</b></p> <p><b>Assume reasonable data if necessary.</b></p>	<b>4M</b>																																			
	<p>Ans:</p> <p><b>Given-</b> Area = A = 500 Ha  Population = P = 100000  Water supply rate = 150 lpcd  Intensity of rainfall = i = 20 mm/hr  Impermeability factor = C = 0.50  Max. permissible velocity = V = 2.0 m/s</p> <p><b>Design of Combined Sewer</b></p> <p>Combined sewer is to be designed for domestic sewage and runoff.</p> <p>(I) Domestic sewage discharge  Quantity of water supply = <math>\frac{10000 \times 150}{24 \times 60 \times 60 \times 1000} = 0.174 \text{ m}^3/\text{s}</math></p> <p>Avg. sewage flow = 80% of water supply = <math>0.80 \times 0.174 = 0.139 \text{ m}^3/\text{s}</math></p> <p>Max. sewage flow = Peak factor x Avg. sewage flow = <math>2 \times 0.139</math>  <math>Q_1 = 0.278 \text{ m}^3/\text{s}</math></p> <p>(II) Runoff discharge  By Rational formula <math>Q_2 = CiA = \frac{0.50 \times 20 \times 500 \times 10000}{1000 \times 1 \times 24 \times 60 \times 60}</math>  <math>Q_2 = 0.579 \text{ m}^3/\text{s}</math></p> <p>(III) Design discharge <math>Q = Q_1 + Q_2 = 0.278 + 0.579</math>  <math>Q = 0.857 \text{ m}^3/\text{s}</math></p> <p>(IV) <math>Q = \text{Area of sewer} \times \text{Max. Velocity}</math>  Area of sewer = <math>0.857/2 = 0.4285 \text{ m}^2 = \frac{\pi}{4} \text{ dia.}^2</math>  <b>Dia. Of sewer = 0.7386 m Say 74 cm</b></p>	<p><b>1M</b></p> <p><b>1M</b></p> <p><b>1M</b></p> <p><b>1M</b></p>																																			
<b>4.b)</b>	<b>Attempt any ONE of the following:</b>	<b>6M</b>																																			
<b>4b(i)</b>	<p><b>Determine population in 2021.</b></p> <table border="1"> <thead> <tr> <th>Year</th> <th>1961</th> <th>1971</th> <th>1981</th> <th>1991</th> <th>2001</th> </tr> </thead> <tbody> <tr> <td>Population</td> <td>37500</td> <td>39300</td> <td>44200</td> <td>54900</td> <td>57700</td> </tr> </tbody> </table> <p><b>Use decrease rate of growth method.</b></p>	Year	1961	1971	1981	1991	2001	Population	37500	39300	44200	54900	57700	<b>6M</b>																							
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	<p>Avg. % decrease = <math>r = -0.30/3 = -0.1</math></p> <p>Probable population = <math>P_i = P + P\left(\frac{d-r}{100}\right)</math>  where <math>d =</math> latest % increase</p> <p><math>P_{2011} = 57700 + 57700\left\{\frac{5.10 - (-0.1)}{100}\right\} = 60700</math> souls</p> <p>For year 20121, <math>d = 5.1 - (-0.1) = 5.20</math></p> <p><math>P_{2021} = 60700 + 60700\left\{\frac{5.20 - (-0.1)}{100}\right\} = 63917</math> souls</p> <p><b>P2021 = 63917 souls</b></p>	<p><b>1M</b></p> <p><b>1M</b></p> <p><b>1M</b></p> <p><b>1M</b></p>						
<b>4b(ii)</b>	<b>Explain the location and use of inspection chamber with a neat labelled sketch.</b>	<b>6M</b>						
	<p>Ans:</p> <p><b>Location of Inspection chamber-</b> It is provided in house drainage system at change in alignment, change in levels, at junction of house drain &amp; public sewer.</p> <p><b>Use of Inspection chamber-</b> The use of inspection chamber is to provide a means of access for inspecting the drain or sewer and to allow cleaning.</p>  <p style="text-align: center;"><b>Inspection Chamber</b></p>	<p><b>1M</b></p> <p><b>1M</b></p> <p><b>2M</b></p>						
<b>5.</b>	<b>Attempt any FOUR of the following:</b>	<b>16M</b>						
<b>5.a)</b>	<b>Draw a neat sketch of different sewers also suggest its favourable condition.</b>	<b>4M</b>						
	<p>Ans:</p> <table border="1" data-bbox="252 1400 1299 2016"> <thead> <tr> <th data-bbox="252 1400 778 1440">Type of Sewer</th> <th data-bbox="778 1400 1299 1440">Favourable condition</th> </tr> </thead> <tbody> <tr> <td data-bbox="252 1440 778 1713"> <p>1) Rectangular</p>  </td> <td data-bbox="778 1440 1299 1713"> <p>This is constructed with RCC which may be precast or cast in situ. This type of section used only for large discharges because for small discharges self-cleansing velocity will not be developed.</p> </td> </tr> <tr> <td data-bbox="252 1713 778 2016"> <p>2) Circular</p>  </td> <td data-bbox="778 1713 1299 2016"> <p>These shape are more common now a days. This section gives the least perimeter for high area. This section is economical, can be easily manufactured, transported. These pipes may be made of precast asbestos, RCC or steel.</p> </td> </tr> </tbody> </table>	Type of Sewer	Favourable condition	<p>1) Rectangular</p> 	<p>This is constructed with RCC which may be precast or cast in situ. This type of section used only for large discharges because for small discharges self-cleansing velocity will not be developed.</p>	<p>2) Circular</p> 	<p>These shape are more common now a days. This section gives the least perimeter for high area. This section is economical, can be easily manufactured, transported. These pipes may be made of precast asbestos, RCC or steel.</p>	<p><b>1M each (for any four)</b></p>
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	<p>3) Semi elliptical</p> 	<p>This section is suitable for sewer carrying large discharge over long periods. It is structurally more stable, has good hydraulic properties, it is usually constructed with RCC.</p>	
	<p>4) Horse shoe type</p> 	<p>This section has semicircular shape on the top with the side inclined. The invert may be circular or parabolic. It is constructed with RCC and is used for heavy discharge.</p>	
	<p>5) Egg shaped</p> 	<p>These type of sewer section are commonly used, because in dry weather self-cleansing velocity is available due to greater depth as compared to other sections. It has good hydraulic properties, even better than circular section.</p>	
<p><b>5.b)</b></p>	<p><b>Describe the working of septic tank.</b></p>		<p><b>4M</b></p>
	<p>Ans:  <b>Working of septic tank –</b></p> <ol style="list-style-type: none"> <li>1. Septic tank is closed water tight chamber where combined sedimentation and digestion of sludge are carried out under anaerobic conditions.</li> <li>2. The sewage is detained for some period (12-36 Hrs.) when suspended solids are settled down which are treated by anaerobic digestion and results in reduction of volume and release of CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S gases.</li> <li>3. The foul gases are escaped through vent pipe and the offensive effluent is disposed off into the ground through soak pit.</li> <li>4. The digested sludge is periodically removed once in year or twice.</li> </ol>  <p style="text-align: center;">Sectional elevation</p> <p style="text-align: center;"><b>Septic Tank</b></p>		<p><b>2M</b></p> <p><b>2M</b></p>

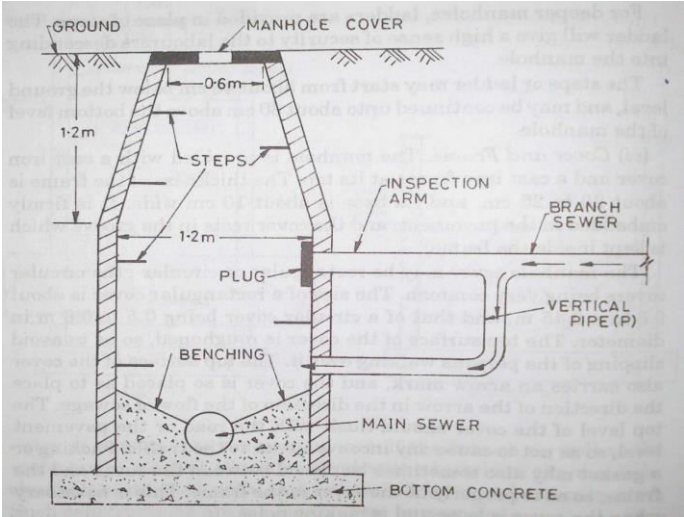
5.c)	<b>Define B.O.D. state its significance in sewage treatment plant.</b>	<b>4M</b>
	<p>Ans:  <b>B.O.D.-</b>  The amount of oxygen required by the microorganisms to carry out the biological decomposition of organic matter (or bio degradable matter) in sewage under aerobic condition at standard temperature is known as the Bio chemical Oxygen Demand or B.O.D.</p> <p><b>Significance of B.O.D.-</b></p> <ol style="list-style-type: none"> <li>1. B.O.D. is the principal test, which gives an idea of the biodegradability of any sample and strength of the waste.</li> <li>2. B.O.D. is an important parameter in the design of treatment plant to determine the size of certain units particularly trickling filters and activated sludge process.</li> <li>3. B.O.D. is useful to decide the type of treatment to be adopted.</li> <li>4. B.O.D. is used in studies to measure the self-purification capacity of streams and serves as a means of check to regulatory authorities on the quality of effluents discharged.</li> <li>5. From B.O.D. of the influent and effluent discharged, the efficiency of treatment plant can be judged.</li> </ol>	<p><b>2M</b></p> <p><b>2M (for any two points)</b></p>
5.d)	<b>Describe working of trickling filter.</b>	<b>4M</b>
	<p>Ans:  <b>Working of trickling filter-</b></p> <p>Trickling filter consists of RCC rectangular or circular tank provided with filter media (stones or broken bricks material) and under drainage system to collect the effluent. Revolving distributor having four arms.</p> <p>Sewage is distributed or sprays by distribution arms through which it trickles to the under drains. As sewage trickles through the filter media, a biological slime layer consisting of aerobic bacteria build up around the media surfaces in two weeks makes the filter ready for use. Organic matter in sewage is absorbed by bacteria in slime layer.</p> <p>It removes 80% colloidal matter, reduces B.O.D. up to 75%. It gives highly nitrified and stabilized effluent and flexibility in operation</p>  <p style="text-align: center;"><b>Trickling filter</b></p>	<p><b>2M</b></p> <p><b>2M</b></p>

5.e)	<b>Explain methods of rain water harvesting system.</b>	<b>4M</b>																																																																																		
	<p>Ans:  <b>Methods of rain water harvesting system-</b></p> <p>1) <b>Storage of surface rain water :-</b>  In this method water is collected from roof of buildings and it is collected through gutters or pipes then filtered through mechanical filter, lastly stored in tank made from RCC or bricks.</p> <p>2) <b>Recharging the underground aquifer :-</b>  In this method water is stored for its later use .It can be achieved through, canals, water traps, cut water, surface runoff drainage wells, trough dug wells etc. There are two types of structures for artificial recharge :- Shallow structures and Deeper structures.</p>	<p><b>2M</b></p> <p><b>2M</b></p>																																																																																		
5.f)	<b>State the type of impurities which are removed in skimming tank and state how it helps in improving further biological treatment.</b>	<b>4M</b>																																																																																		
	<p>Ans:  <b>Impurities which are removed in skimming tank -</b> floating matter like oil, fat, grease etc.  <b>Skimming tank helps in improving further biological treatment -</b> As oily matters</p> <ol style="list-style-type: none"> <li>1) Form scum in sedimentation tank.</li> <li>2) Clog fine screens.</li> <li>3) Reduce efficiency of activated sludge process.</li> <li>4) Decrease biological growth.</li> <li>5) Decrease efficiency of overall process.</li> </ol>	<p><b>1M</b></p> <p><b>3M (for any three)</b></p>																																																																																		
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	Mercury,mg/l	-	0.01	-	-																
	Nickel,mg/l	-	3	2	-																
	Zinc,mg/l	-	5	15	-																
	Chlorides ,mg/l	-	-	600	600																
<b>6.b)</b>	<b>Explain the purpose of Grit chamber and state its location also.</b>					<b>4M</b>															
	<p>Ans:</p> <p><b>Purpose of Grit chamber-</b></p> <ol style="list-style-type: none"> <li>To protect moving mechanical equipment from abrasion and accompanying abnormal wear.</li> <li>To reduce formation of heavy deposits in pipelines, channels and conduits.</li> <li>To remove grit from the sewage.</li> <li>To minimizes the load of subsequent treatment.</li> </ol> <p><b>Grit chamber location -</b></p> <p>Grit chambers are usually located ahead of pumps or comminuting devices, and if mechanically cleaned, should be preceded by coarse bar rack screens.</p>					<p><b>2M</b> <b>(for any two)</b></p> <p><b>2M</b></p>															
<b>6.c)</b>	<b>State the location and function of the following pipe fittings:-</b>					<b>4M</b>															
	<p><b>(i) Air valve, (ii) Reflux valve, (iii) Scour valve, (iv) Sluice valve</b></p> <p>Ans:</p> <table border="1"> <thead> <tr> <th>Type of Valve</th> <th>Location</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>(i) Air valve</td> <td>To remove accumulated air from the pipeline.</td> <td>At summit points in pipeline or above the hydraulic gradient.</td> </tr> <tr> <td>(ii) Reflux valve</td> <td>To allow water to flow only in one direction &amp; prevent it from flowing in reverse direction.</td> <td>In rising main near pumping machinery.</td> </tr> <tr> <td>(iii) Scour valve</td> <td>To drain sand or deposited silt in pipeline.</td> <td>To drain sand or deposited silt in pipeline.</td> </tr> <tr> <td>(iv) Sluice valve</td> <td>1) To control or regulate flow, 2) To isolate pipe section by stopping flow</td> <td>1) 3 to 5 km interval on main line, 2) 150m to 200 m interval on distribution line, 3) at all junctions</td> </tr> </tbody> </table>					Type of Valve	Location	Function	(i) Air valve	To remove accumulated air from the pipeline.	At summit points in pipeline or above the hydraulic gradient.	(ii) Reflux valve	To allow water to flow only in one direction & prevent it from flowing in reverse direction.	In rising main near pumping machinery.	(iii) Scour valve	To drain sand or deposited silt in pipeline.	To drain sand or deposited silt in pipeline.	(iv) Sluice valve	1) To control or regulate flow, 2) To isolate pipe section by stopping flow	1) 3 to 5 km interval on main line, 2) 150m to 200 m interval on distribution line, 3) at all junctions	<p><b>1M each (i.e. ½ M for location and ½ M for correct function )</b></p>
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6.d)	<b>Draw a neat sketch of drop manhole.</b>	<b>4M</b>
	<p>Ans:</p>  <p style="text-align: center;"><b>Drop Manhole</b></p>	<p style="text-align: center;"><b>2M (for sketch)</b></p> <p style="text-align: center;"><b>2M (for labeling)</b></p>
6.e)	<b>State the advantages and disadvantages of gravity system.</b>	<b>4M</b>
	<p>Ans:</p> <p><b>Gravity Water distribution system:</b></p> <p><b>Advantages:-</b></p> <ol style="list-style-type: none"> <li>1) This method is simple, reliable and economical</li> <li>2) Water flows under gravity, therefore pumping is not required.</li> <li>3) Less leakages and wastages.</li> <li>4) Less maintenance.</li> <li>5) This system requires small size of pipes.</li> </ol> <p><b>Disadvantages: -</b></p> <ol style="list-style-type: none"> <li>1) It is not suitable if the source of water is not at sufficient elevation to cause flow under gravity.</li> <li>2) This system cannot provide high pressure for fire demand.</li> <li>3) Sufficient water may not be available for farther ends due to head loss.</li> </ol>	<p style="text-align: center;"><b>2M (for any two)</b></p> <p style="text-align: center;"><b>2M (for any two)</b></p>

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