WINTER– 17 EXAMINATION

Subject Name: Public Health Engineering **Model Answer** Subject Code: 17503

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	(A)	**Attempt any THREE of the following**	12Marks
	(a) Ans.	**State any four types of demand of water. State the four factor affecting rate of demand.** **Following are the demands of water.** 1) Domestic demand. 2) Public and industrial demand. 3) Losses and wastages. 4) Fire demand. 5) Commercial and Institutional demand. **Following are the factors affecting rate of demand.** i) Size of city ii) Habits of people iii) Climatic conditions iv) Cost of water v) Commerce and industry vi) Quality of water vii) Efficiency of water supply system viii) System of sanitation. ix) System of supply x) Metering of supply	***(02 Marks) Any four 1/2 Marks each*** **(02 Marks) *Any four 1/2 Marks each***

1. (A) (b) Ans. **State desirable limit as per IS for thr following parameters of drinking water**

Following are the desirable limit as per IS

Characteristics	Desirable
(i) Color	10
(ii) Turbidity	5 NTU
(iii) Total dissolved solids	500 mg/lit
(iv)Total hardness	300 mg/lit
(v) Chlorides	250 mg/lit
(vi) Iron (Fe)	0.3 mg/lit
(vii) pH	6.5 to 8.5
(viii) Fluorides	0.6 to 1.2 mg/lit

(04 Marks) 1/2 Marks each

1. (A) (c) Ans. **State different forms of chlorination and give significance of residual chlorine.**

Depending upon the stage of application of chlorine , chlorination are classified as:

1) Plain chlorination.
2) Pre Chlorination.
3) Post Chlorination.
4) Double Chlorination.
5) Break point chlorination.
6) Super Chlorination.
7) Dechlorination.

(02 marks) Any four 1/2 Marks each

Significance of residual chlorine.

Residual chlorine 0.2 mg/lit is maintain in order to take care of all the bacteria which will be added in distribution system may be because of exposure of water to atmosphere.

(02 marks)

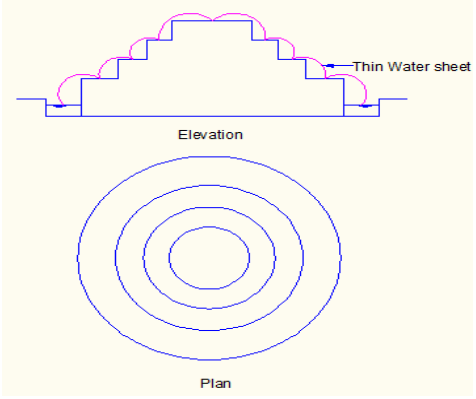
1. (A) (c) Ans. **State methods of aeration. Explain any one method with sketch.**

Following are the methods of aeration.

a) Cascade aerator.
b) Spray Nozzles.
c) Air diffusion method.
d) Trickling bed method.

(01 mark for Any four Methods)

a) Cascade aerator.



(01 mark for Fig.)

They consist of concrete steps over which water comes down in thin sheet. Weir may be provided at the edge of each step.

(02

Thin sheet of water which comes down over steps comes in contact with the atmosphere thus aeration is achieved.
(Students may explain any one method of aeration) — *marks)*

1. (B) Attempt any ONE of the following — **06 Marks**

(a) Ans. **Compare the quality and quantity of water from surface source and sub surface source**
Comparison between surface and sub surface source of water. — *(06 marks.)*

Surface Source Water	Sub Surface Source Water
1. Water found on the surface of the earth like water in the river , lake is known as surface water.	1.Water that is trapped under the earth's surface is known as Sub Surface water.
2. Amount of water available in surface source is comparatively less than sub surface source.	2. Large amount of water available in sub surface source.
3. Surface water is exposed to evaporation.	3.Sub surface water is not exposed to evaporation.
4. Surface water alters temperature according to surroundings.	4. Sub surface water mainatain constant temperature.
5.Surface water may contain patheogenic bacteria.	5. Sub surface water free from patheogenic bacteria.
6.Cost of treatment is more for surface water.	6. Treatment cost is less.

01 mark each

1. (B) (b) Ans. **State different Advanced Water Treatment methods. Explain any one method with neat sketch.**
Following are the different Advanced Water Treatment methods. — *(02 marks) for Any four Methods ½ each.*

- Reverse Osmosis
- Electrodialysis
- Ion exchange
- Micro straining

Reverse Osmosis

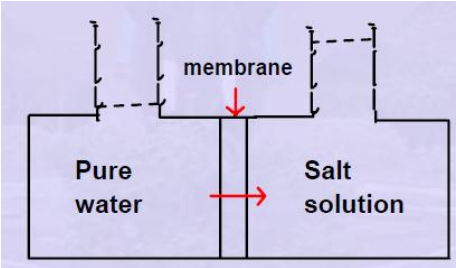


Fig. 1

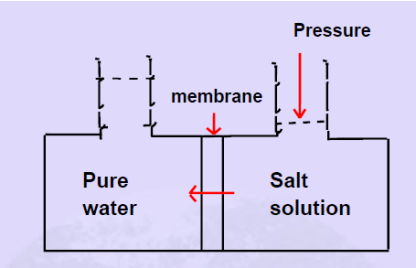


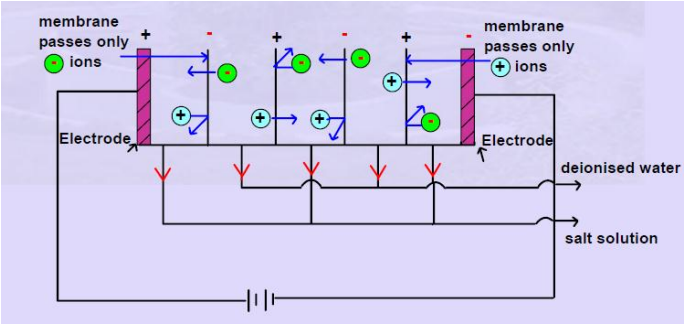
Fig. 2 — *(02 marks)*

In the reverse osmosis process, demineralization water is produced by forcing water through semipermeable membranes at high pressure. In ordinary osmosis, if a vessel is divided by a semipermeable membrane (one that is permeable to water but not the dissolved material), and one compartment is filled with water and other with concentrated salt solution, water diffused through the membrane towards the compartment containing salt solution until the difference in water levels on the two sides of the membrane creates a sufficient pressure to counteract the original water flow. The difference in levels represents — *(02 marks)*

the osmotic pressure of the solution.**(Shown in fig 1)**
The process can be reversed by applying sufficient pressure to the concentrated solution to overcome the osmotic pressure force the net flow of water through the membrane towards the dilute phase. The solute concentration (impurity) builds up on one side of the membrane while relatively pure water passes through the membrane . In order to obtain adequate solvent (water) flux through the membrane, pressures of the order of 4000 to 7000 kN/m2 are required. **(Shown in fig 2)**

Electrodialysis:

Electrodialysis uses ion-selective membranes and an electrical potential difference to separate anions and cations in solution.



02 marks

In the past electrodialysis was most often used for purifying brackish water, but it is now finding a role in hazardous waste treatment. Metal salts from plating rinses are sometimes removed in this way.

Fig. shows a simple dialysis cell in which waste water may be deionised. As shown in the figure two types of membranes (anionic and cationic) are arranged alternatively to form many compartments between the electrodes placed at the two ends. When the voltage is applied across the cell containing mineralised water, the anions migrate to the positive electrode and the cations migrate to the negative electrode. This causes solution in alternate compartments to become more concentrated while that in the remaining becomes more dilute. The electric power requirement is proportional to the number of ions removed from the water.

02 marks

In the electrodialysis process, organic molecules are not removed and they can collect on and clog the membranes. Another disadvantage of this method is that it still leaves concentrated waste water to be disposed of by some appropriate scheme. The process does not require any chemical additives and has low energy requirements and as such it can be an economically feasible means of demineralisation.

Ion exchange:

This technique has been used extensively to remove hardness, and ironand manganese salts in drinking water supplies. It has also been used selectively to remove specific impurities and to recover valuable trace metals like chromium, nickel, copper, lead and cadmium from industrial waste discharges. The process takes advantage of the ability of certain natural and synthetic materials to exchange one of their ions.

A number of naturally occuring minerals have ion exchange properties. Among them the notable ones are aluminium silicate minerals, which are called zeolites

In the water softening process, the hardness producing elements such as calcium and magnesium are replaced by sodium ions. A cation exchange resin in sodium form is normally used. The water-softening capability of cation exchange can be seen when sodium ion in the resin is exchanged for calcium ion in solution. **(no need of diagram)**

04 marks

Microstraining:

It is a special type of filtration procedure which makes use of filters oven from stainless steel wires with opening only 60-70 µm across to remove very small particles. High flow rates and low back pressures are normally achieved. **(no need of diagram)**

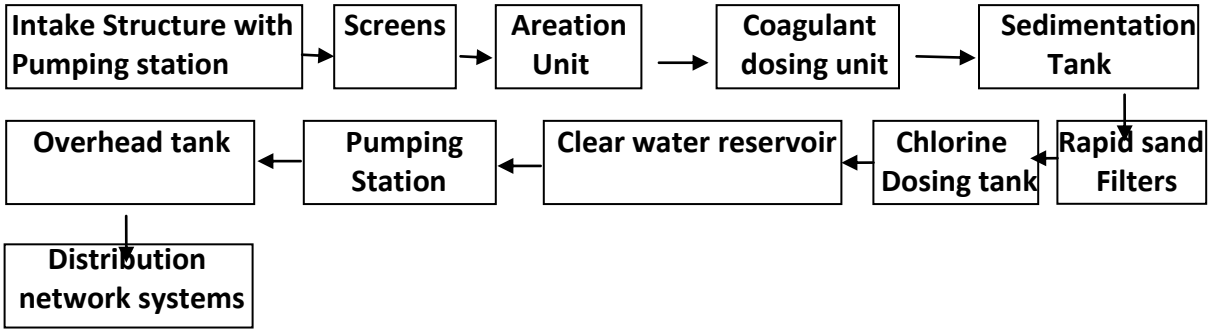
04 marks

NOTE: Students may explain any one advance water treatment method.

2. Attempt any FOUR of the following **16Marks**

(a) Ans. **Draw layout of city water supply with rapid sand filter , label the parts and state the work carried out by each part.**

Layout of city water supply with rapid sand filter

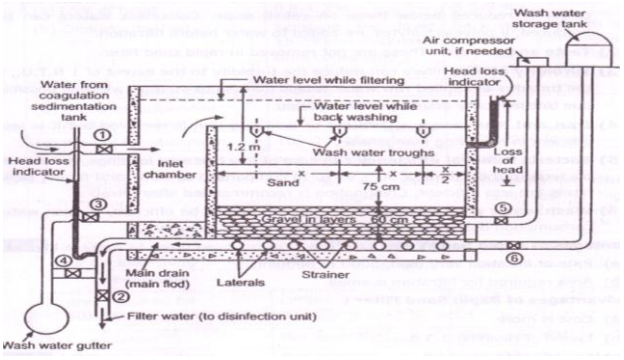


(02 marks)

Sr. No.	Unit	Function
1	Intake structures with Pumping station	To draw water from source.
2	Screens	To remove floating matter.
3	Aeration Unit	To add oxygen in water. To remove dissolve gases from water.
4	Coagulants dosing tank	To add coagulant in water.
5	Sedimentation tank	To remove suspended impurities like silt, clay sand etc.
6	Rapid Sand Filter	To remove very fine and colloidal matter which are not removed by sedimentation.
7	Chlorine dosing tank	To add chlorine for disinfection.
8	Clear water reservoir	To store treated water
9	Pumping station	To pump water into overhead tank
10	Overhead tank	To store water
11	Distribution network systems	To distribute water to consumer

(02 marks) for any eight

2. (b) What is principle behind sedimentation with coagulation? State any two types of

	Ans.	**coagulant.** **Principle behind sedimentation with coagulation** Coagulants are chemical, added to water to remove the colloidal particles or impurities of raw water and reduce turbidity of water. Principle of coagulation can be explained by two considerations. **a) Floc formation** **b) Electrical charges.** **(a) Floc formation:** When a coagulant is added to water and mixed thoroughly and thick gelatinous precipitate 'Floc' is formed. Flocattracts and arrests the colloidal particles and makes them settle down. **(b) Electrical charges:** Ions from floc possess positive electric charge. Colloidal particles possess negatively charged ions. The floc thus attracts colloidal particles and makes them settle down. **Types of Coagulants:** Following are the main types of coagulants : a) Aluminum sulphate Al2 (SO4)3 b) Chlorinated coppers. c) Ferrous sulphate and lime. d) Magnesium carbonate. e) Polyelectrolytes. f) Sodium aluminate.	**(03 Marks) 1 ½ each** **(01 Mark) For any Two ½ each**
2.	**(C) Ans.**	**Explain in brief the process of backwashing in rapid sand filter.** **Back washing :**  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. **Operation:** Initially, the valves (1) and (4) are closed and valves (5) and (6) are opened out. The wash water and compressed air are thus forced upwards from the under-drainage through the gravel and sand beds. Valve (5) is closed after supplying the required amount of air. 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. Now open valve (1) and (4) for some time then close valve (4) and put filter in normal working condition by opening valve (2).	**(02 Marks for Fig.)** **(02 Marks)**

2. (d) Ans. **What are valves? Why are they required? State two types of valves with their suitable location.** **(01 Mark)**

The fixtures, which are fixed along the distribution system, are known as valves.

They are provided for the following purposes : **(01 Mark) for any two ½ each**

(a) To control the rate of flow of water.
(b) To release or admit air into the pipeline.
(c) To prevent or detect leakage.
(d) To meet the demand during emergencies.
(e) To make the distribution system more efficient.

Air Relief Valve.

Location: In order to provide an exit for accumulated air, air valves are provided at summits along the pipe lines. **(02 Marks)**

Sluice valve. **One mark each**

Location:

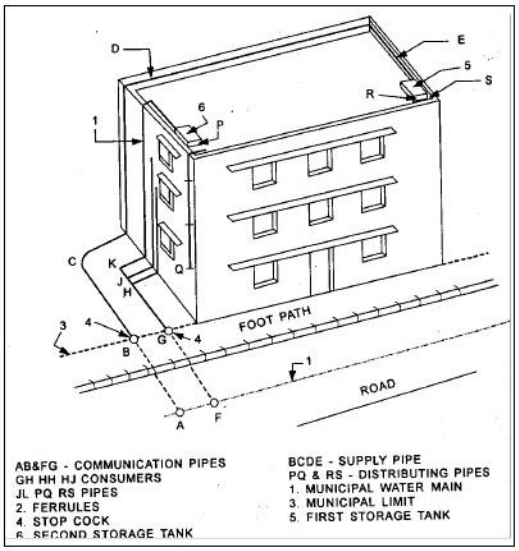
1) They are generally placed at a distance about 150 m to 200 m and at all junctions.
2) For long straight mains, the sluice valves can be be installed about 1 km.

2. (e) Ans. **Differentiate between one pipe and two pipe systems of plumbing** **(04 Marks) 01 mark each *any four***

Difference between One pipe and Two pipe plumbing system.

One Pipe System	Two Pipe System
1. Waste from sanitary fittings , bath, sinks, basins etc. carried through single pipe.	1. Waste water from W.C. and waste water from other fitting like bath, sink, basins etc. carried through separate pipe.
2. Waste water from bath, sinks, basins un-necessarily gets polluted.	2. Waste water from bath, sinks, basins can directly used for irrigation purpose.
3. Easy to install in high rise building.	3. Difficult to install in high rise building.
4. Require less space for duct and shaft.	4. Require more space for duct and shaft.
5. Increases load on waste water treatment plant.	5. Less load on waste water treatment plant.
6. Economical as less pipes are required.	6. Uneconomical as more pipes are required.

2. (f) Ans. **Draw a typical layout for water supply arrangement for residential building indicating type of pipe material, sizes etc.** **(02 Marks)**



General layout of water supply arrangements single storey buildings:

Type of Pipe material	Size
Municipal water main (Cast iron pipe/ Concrete pipe)	125 mm to 250 mm
Communication pipes (PVC / GI pipe)	50 mm to 75 mm
Supply pipe (PVC / GI pipe)	25 mm to 50 mm
Consumers pipes (PVC / GI /Copper Pipe)	25 mm to 50 mm

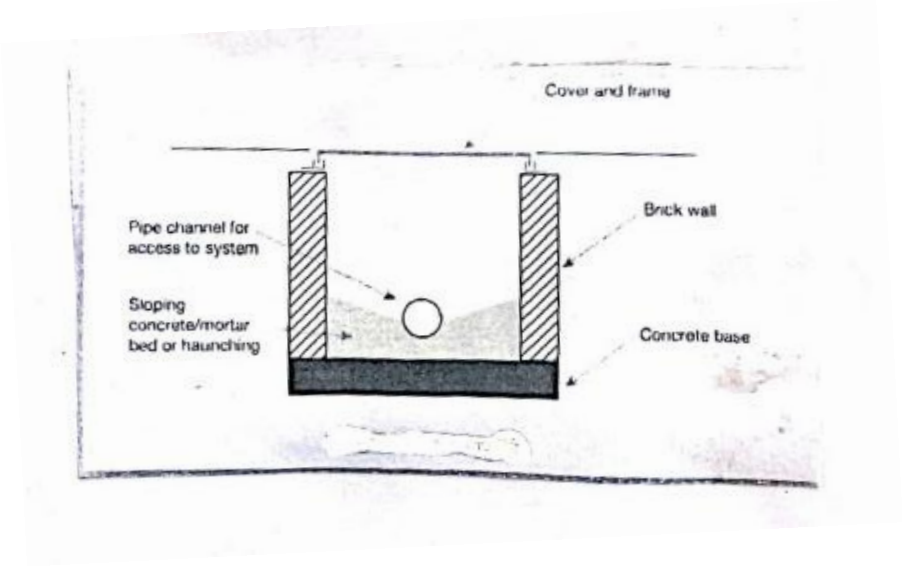
(Students may show the arrangement for different plan and appropriate size of pipes)

(02 Marks) For any four ½ each

Q.3 **a) Ans**

Draw sketch of inspection chamber and give it's necessity.

Inspection Chamber:



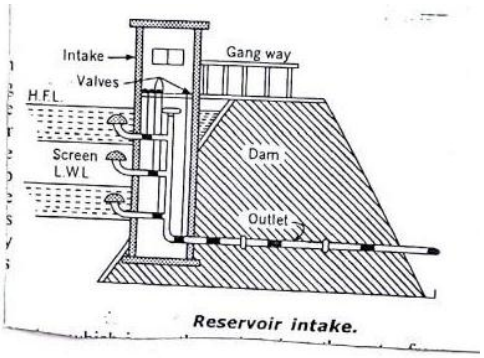
02 marks for fig

Inspection chamber is provided for inspection, cleaning, repair and maintenance of sewer line.

02 marks

Q.3 **b) Ans**

Draw a labeled sketch of reservoir intake.



04 marks

Q.3 **c) Ans**

List the component parts of a drop manhole and state its necessity.

1. Working chamber: For inspection and cleaning of sewer.
2. Inspection arm and plug: For cleaning, inspection and maintenance of the branch sewer and plug is providing restriction.
3. Vertical shaft: For connecting branch sewer to main sewer.
4. Rungs (Stairs): For ascending and descending for man.
5. Benching: For proper laying of the main sewer in concrete.
6. Manhole cover: For covering manhole drop manhole cover is provided.

02 marks for parts 02 marks for necessity

Q.3	**d)** **Ans**	State measures for prevention of pollution of bores and well waters. 1. We should not wash the cloths near bore and well. 2. We should not wash utensils near the well. 3. We should not wash animals near the well. 4. Septic tank should be far away from bore and well to protect ground water from pollution.	**04 marks**
Q.3	**e)** **Ans**	Describe 'water test' and 'air test' with reference to testing of sewers. Water test: Each section of the sewer is tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to backfill the pipes up to top, keeping at least 90 cm length of the pipe open at the joints. But in case of shorter pipe lengths of stoneware and RCC pipes, it is not possible. With concrete encasement or concrete cradle, partial covering of pipe is not necessary. In the case of the concrete and stoneware pipes with cement mortar joints, the testing shall be done after making joints. It is necessary that the pipelines are filled with water for about a week before commencing the application of pressure to allow for the absorption by the wall of the pipe. The testing of the sewer is done by plugging the upper end with a provision for an air outlet pipe with stopcock. The water is filled through a funnel connected at the lower end provided with a plug. After expelling the air through the air outlet, the stopcock is closed and water level in the funnel is raised to 2 m above the invert at the upper end. Water level is noted after 30 minutes in the funnel and the quantity of water required to restore the original level in the funnel is determined. The pipe line under pressure is then inspected while the funnel is still in position. There should not be any leaks in the pipe or joints except small sweating on the pipe surface which is allowed. Leakage in 30 minutes determined by measuring the replenished water in the funnel should not exceed 15 ml in the smaller diameter and 60 ml in the larger diameter per cm diameter of pipe for 100 m length. Any sewer or part that does not meet the test shall be emptied and repaired or re-laid as per requirements and tested again. Air test: It is done by subjecting the stretch of pipe to an air pressure of 100 mm of water by means of a hand pump. The joints shall be assumed to be water tight. The exact point of leakage can be detected by applying soap solution to all the joints in the line and looking for the air bubble.	**02 marks** **02 marks**
Q.4	**A)a** **Ans**	List the operations carried out during periodical cleaning of drainage system. 1. Use of the flexible sewer rod with manila rope for sewer cleaning. 2. The composite flexible rod composed of rope tied together with bamboo strips is lowered inside the manhole by a person on top, while another person inside the manhole thrusts the same in to the sewer in the direction of flow. 3. Flushing of sewers is carried out periodically to clear laterals and sewers laid within sufficient slope for maintaining a velocity so as to remove settled material.	**04 marks**
Q.4	**A)b** **Ans**	Explain general principles of building drainage. 1. The drain should be laid in such a way so as to remove the sewage quickly from the building. The drain should be laid at such a slope that self-cleaning velocity is developed in them. 2. All the drainage system should be properly ventilated on the house sides. All the inspection chambers should be provided with fresh air inlets. 3. All the drains should be laid in such a way so as to ensure their safety in future.	**Any four 01 mark for each**

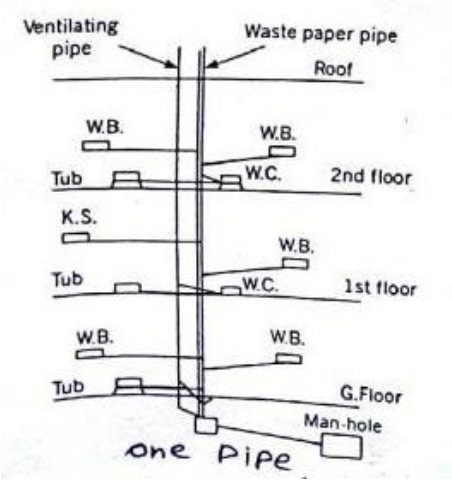
<table>
<tr><td></td><td></td><td>4. The drain should be laid in such a way that in future extension can be done easily if desired.
5. All the rain water pipes, sweeping from house and bath water should be discharged over gully traps and should be connected from the drain.
6. All soil pipes should be carried direct to the manholes without gully traps.</td><td></td></tr>
<tr><td>Q.4</td><td>A)c
Ans</td><td>State function of (i) air relief valve, (ii) Non-return valve.
i. Air relief valve: When water enters in pipe lines, it carries some air with it which tends to accumulate at high points of pipe. When the quantity of air increases, it cause serious blockage to the flow of water. Therefore it is most essential to remove the accumulated air from the pipe line. Air relief valve is used for this purpose.
ii. Non-return valve: Non-return valve allow water to flow only in one direction and prevent it from flowing in reverse direction.</td><td>02 marks

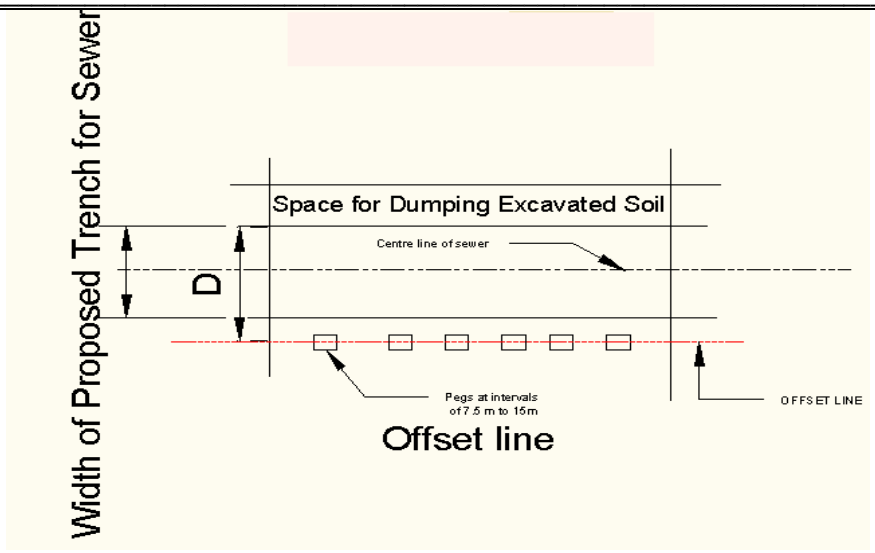
02 marks</td></tr>
<tr><td>Q.4</td><td>A)d
Ans</td><td>State norms for maintenance of domestic sanitary units.
1. Sanitary fittings should be laid in such a way so as to remove the sewage quickly from the building.
2. The pipe line in the sanitary fittings should be properly ventilated on the house sides.
3. Sanitary fittings shall be leak proof.
4. Sanitary fittings joints should be water tight.
5. Sanitary fittings should be cleaned periodically.</td><td>Any four
01 mark
for each</td></tr>
<tr><td>Q.4</td><td>B)a

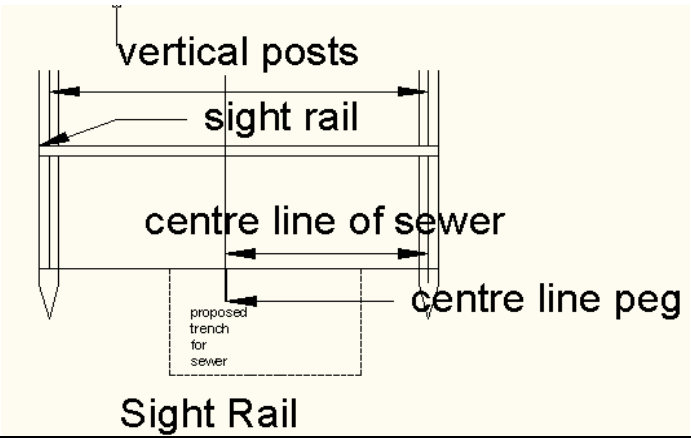
Ans</td><td>The following data is collected regarding population. Calculate demand of water for small residential area/colony and forecast the population of area in 2021 by geometrical increase method.
<table>
<tr><td>Year</td><td>1961</td><td>1971</td><td>1981</td><td>1991</td><td>2001</td></tr>
<tr><td>Population</td><td>4,320</td><td>5,200</td><td>7,120</td><td>8,000</td><td>9,150</td></tr>
</table>
Geometric increase method:
<table>
<tr><td>Year</td><td>Population</td><td>Increase in population</td><td>Percentage increase in population</td></tr>
<tr><td>1961</td><td>4320</td><td></td><td></td></tr>
<tr><td>1971</td><td>5200</td><td>880</td><td>880 x 100/4320 = 20.37%</td></tr>
<tr><td>1981</td><td>7120</td><td>1920</td><td>1920 x 100/5200 = 36.92%</td></tr>
<tr><td>1991</td><td>8000</td><td>880</td><td>880 x 100/7120 = 12.36%</td></tr>
<tr><td>2001</td><td>9150</td><td>1150</td><td>1150 x 100/8000 = 14.38%</td></tr>
<tr><td>Average per decade</td><td></td><td>IG</td><td>21.0%</td></tr>
</table>
P2011 = P[1 + (IG/100)]n
= 9150[1 + (21/100)]1
= 11072
P2021 = 9150[1 + (21/100)]2
= 13359
The water supply demand = 13359 x 270
= 3606930 lit/day.</td><td>03 marks

01 mark

01 mark
01 mark</td></tr>
</table>

Q.4	**B)a** **Ans**	State the reason for suitability of two pipe system over one pipe system. Draw a neat labeled sketch of one pipe system partially ventilated. Two pipe system: This method provides an ideal solution. All the traps used in this system are fully ventilated. Waste pipes are connected through the gully trap. The soil pipes are connected to the drain.  One pipe system partially ventilated	**03 marks** **03 marks**
Q.5	**a)** **Ans**	Attempt any FOUR of the following: Explain the procedure of lying of sewers. • The boring or trial holes are dug along the proposed sewer line to ascertain the nature of ground. • From the longitudinal section of the sewer line, the position of manhole are studied and located on the ground. • The center line of the sewer line should be properly maintains There are two methods which are employed for this purpose. In the first method, a line parallel to the sewer line is marked on one side. This is known as an offset method it is usually marked at distance of D which is about one half the trench width plus 600mm .the other side is used to dump the excavated material. The offset line should be drawn on that side of the trench which is not likely to be disturbed during the process of excavation of the trench. The temporary bench mark at the intervals of about 200m to 300m should be established along the offset line by carrying the levels from the permanent bench mark. The offset line helps in locating the sewer-line when excavation is carried out to lay sewers. In the second method the two vertical post are driven in to the ground at a distance from the centre line peg.one horizontal rail known as the sight rail is fixed between these posts at a convenient height from the ground level.	**03 marks**



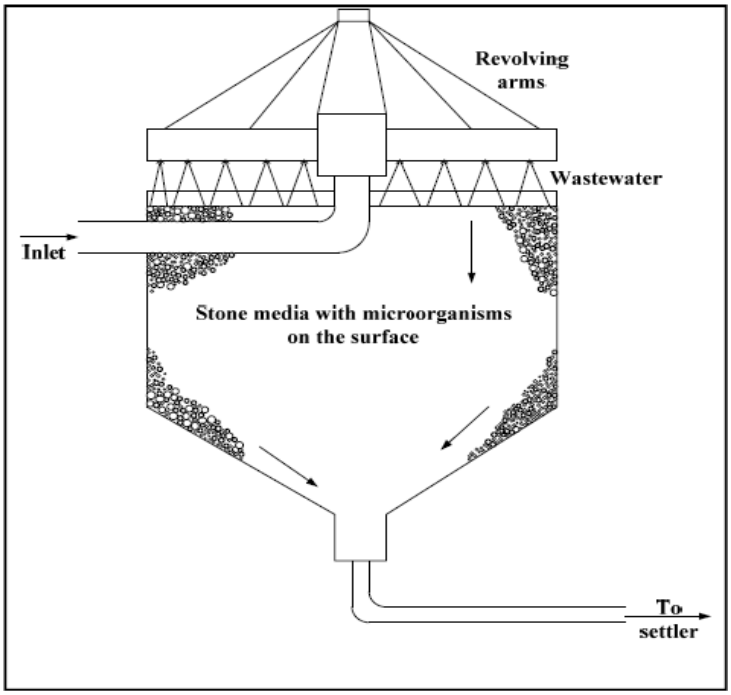


01 mark

Q.5 **b)** **Ans**

Explain with neat sketch working of 'trickling filter'

Components of Trickling Filter



02 marks

- A rotary or stationary distribution mechanism distributes wastewater from the top

<table>
<tr><td></td><td></td><td>of the Filter percolating it through the interstices of the film-covered medium.
• As the wastewater moves through the filter, the organic matter is adsorbed onto the film and degraded by a mixed population of aerobic microorganisms.
• The oxygen required for organic degradation is supplied by air circulating through the Filter induced by natural draft or ventilation.
• As the biological film continues to grow, the microorganisms near the surface lose their ability to cling to the medium, and a portion of the slime layer falls off the filter. This process is known as sloughing.
• The sloughed solids are picked up by the under-drain system and transported to a clarifier for removal from the wastewater.
• Microorganisms used
The microorganisms used are mainly facultative bacteria that decompose the organic material in the wastewater along with aerobic and anaerobic bacteria. It includes Achromobacter, Flavobacterium, Psudomonas, and alcaligenes. In the lower reaches of the filter, the nitrifying bacteria are usually present.</td><td>02 marks</td></tr>
<tr><td>Q.5</td><td>c) Ans</td><td>State role of Maharashtra pollution control board in prevention of pollution.
• To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof
• To collect and disseminate information relating to pollution and the prevention, control or abatement thereof,
• To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted,
• Supporting and encouraging the developments in the fields of pollution control, waste recycle reuse, eco-friendly practices etc.
• To educate and guide the entrepreneurs in improving environment by suggesting appropriate pollution control technologies and techniques
• Creation of public awareness about the clean and healthy environment and attending the public complaints regarding pollution.</td><td>04 marks</td></tr>
<tr><td>Q.5</td><td>d) Ans</td><td>Differentiate between i) Aerobic and Anaerobic process ii) B.O.D. and C.O.D.
i) Aerobic and Anaerobic process
<table>
<tr><th>Aerobic process</th><th>Anaerobic process</th></tr>
<tr><td>1. It occurs in majority of organisms.</td><td>1. It occurs in a few organisms (e.g. yeast, and some bacteria and parasitic worms).</td></tr>
<tr><td>2. Oxygen is used</td><td>2. Oxygen is not used.</td></tr>
<tr><td>3. It always releases CO2.</td><td>3. It may or may not release CO2</td></tr>
<tr><td>4. It generated water.</td><td>4. It does not produce water</td></tr>
<tr><td>5. It releases entire energy available in glucose as it is fully oxidized</td><td>5.It releases only 5% of energy available in glucose as it (glucose) is not fully oxidized.</td></tr>
<tr><td>6. Aerobic respiration involves five principal steps: glycolysis, pyruvate oxidation, TCA cycle, ETS and chemiosmotic ATP synthesis.</td><td>6. It includes just two steps: glycolysis and incomplete breakdown of pyruvate.</td></tr>
<tr><td>7. It yields inorganic end products</td><td>7. In yields organic end product with or without inorganic ones.</td></tr>
</table></td><td>02 marks (01 mark for one point)</td></tr>
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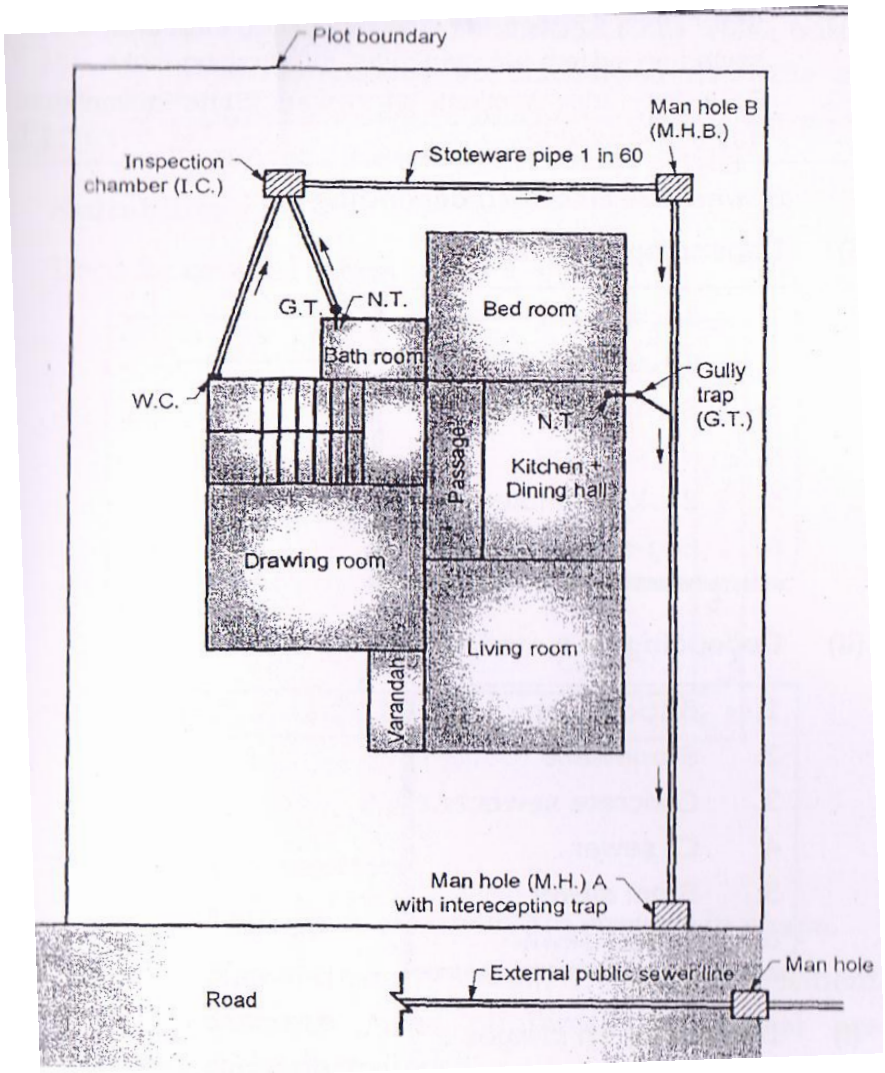
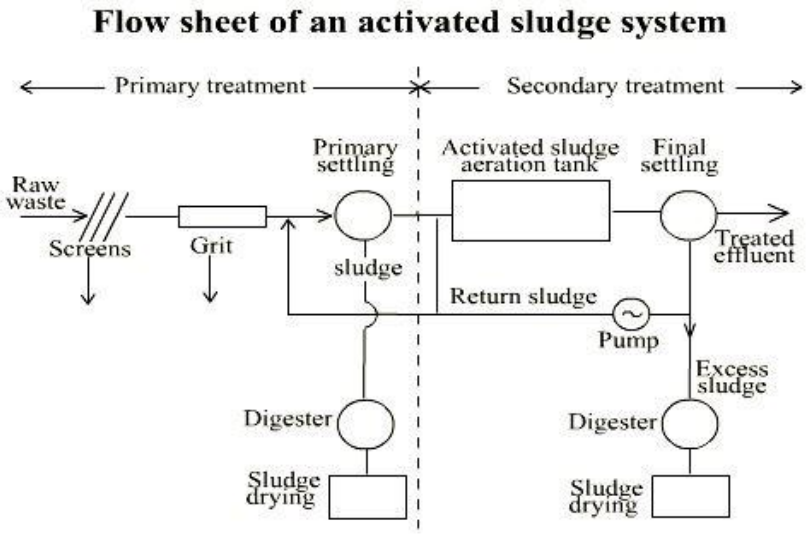
		8. Aerobic reparation takes place in cytoplasm and mitochondria. | 8. Anaerobic respiration takes place cytoplasm only	
		ii) B.O.D. and C.O.D.	**02 marks (01 mark for one point)**

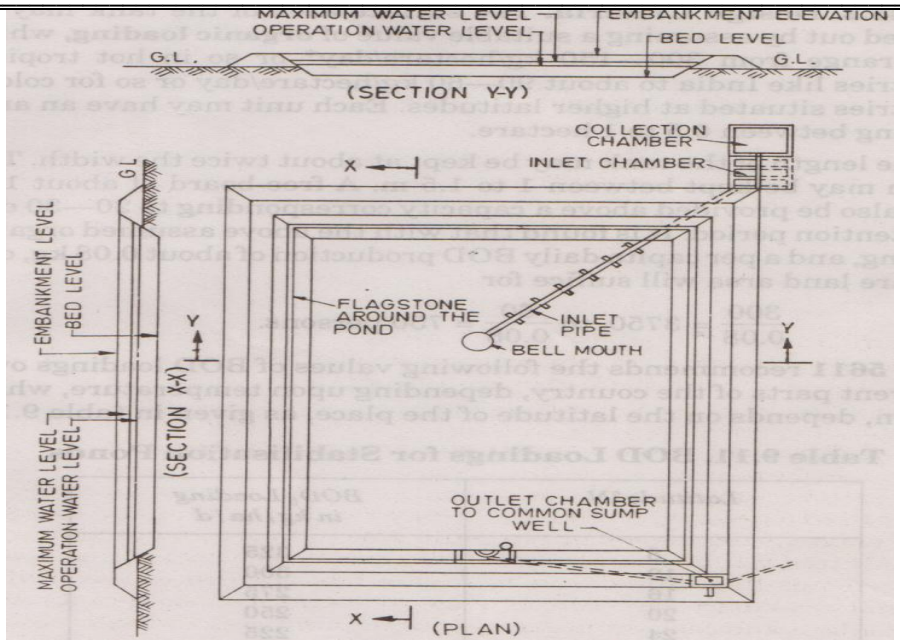
B.O.D.	C.O.D.
1. Is the oxygen required for the biochemical oxidation of the decomposable matter at specified temperature within the specified time.	It is the measure of amount of carbon in organic matter
The slandered time and temperature are 5 days 200 C.	The standard time for this test is 5 hour

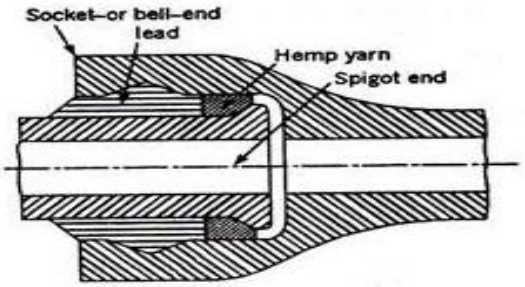
Q.5 **e) Ans** Draw the layout of sanitary plumbing and sewage collection of residential building. **04 marks**



Note: Students may draw different layout.

Q.5	**f)** **Ans**	Draw flow diagram of activated sludge process plant and explain its working.  Working:- 1. The raw sewage is given the primary treatment in the primary settling tank. The detention period is kept short 1-1.5 hours. The primary settling tank removes less percentage of settable solids. Due to less removal of solids the filter media des not clog. 2. After primary treatment the raw sewage is mixed up with the required quantity of activated sludge which is called return sludge and sent in the aeration tank. The mixer is called as mixed liquor. 3. In the aeration unit the mixed liquor is aerated and simultaneously agitated for 4-10 hr. depending on the degree of purification desired and the strength of the sewage. 4. The aerated mixed liquid is sent in the final settling tank. 5. The effluent from the final settling tank which is clear is disposed of. 6. A part of settled sludge is sent back in the aeration unit for seeding the raw sewage and the excessive quantity is treated and disposed off.	**02marks** **02 marks**
Q.6	**a)** **Ans**	Write any two reasons for necessity of pre-treatment before trickling filter process in view of activated sludge process. 1. The main object of primary object of primary treatment process is to remove suspended matters, oils, sand and grit and floating matters etc. 2. In the primary treatment process the sewage is passed through screens, grit chambers, detritus tank and sedimentation tank. 3. The primary settling tank remove less percentage of settable sand due to less removal of solids the filter media does not clog.	**04 marks (Any two 02 marks For 01 point)**
Q.6	**b)** **Ans**	Explain with neat sketch working of oxidation pond.	

		Working Of Oxidation Pond:  • The oxidation pond purify sewage by dual action of aerobic and algae. • The sewage is stored under climatic condition which are favorable for the growth of algae, namely sunshine and warmth. • Aerobic bacteria uses oxygen of the atmosphere, whereas the algae is active in the sunlight. • Due to the dual process of photosynthesis acting on the sewage, it breaks up the carbon dioxide produced during the carbon cycle from the carbohydrates present in the sewage. • This carbon is used in producing more carbohydrates and released oxygen keeps the dissolved oxygen content of water at high level.	**02 marks** **02 marks**
Q.6	**c)** **Ans**	Explain bell and spigot joint with sketch. Sometimes this is called bell and spigot joint. This type of joint is mostly used for cast iron pipes. For the construction of this joint the spigot or normal end of one pipe is slipped in socket or bell end of the other pipe until contact is made at the base of the bell. After this yarn of hemp is wrapped around the spigot end of the pipe and is tightly filled in the joint by means of yarning iron up to 5 cm depth. The hemp is tightly packed to maintain regular annular space and for preventing jointing material from falling inside the pipe. After packing of hemp a gasket or joint runner is clamped in place round the joint so that it fits tightly against the outer edge of the bell. Sometimes wet clay is used to make tight contact between the runner and the pipe so that hot lead may not run out of the joint space. The molten lead is then poured into the V-shaped opening left in the top by the clamped joint runner. The space between the hemp yarn and the clamp runner is filled with molten lead. When the lead has hardened, the runner is removed. The lead which shrinks while cooling is again tightened by means of chalking tool and hammer. The quantity of lead required per joint varies from 3.5 to 4 kg for 15 cm. dia pipe, to about 45-50 kg for 120 cm diameter pipe. This is somewhat slightly flexible joint; allow the pipes to be laid on flat curved without pipe specials. Now a days sometimes to reduce the cost of filling lead, certain patented compounds of sulphur and other materials are filled in the joints, but these materials do not provided flexibility equal to that of lead	**02 marks**

		 Chalking tool.  Spigot and Socket-Joint.	02 marks
Q.6	**d)** **Ans**	Give importance of (i) Non-scouring velocity, (ii) Self cleansing velocity. i) Non-scoring velocity. The interior surface of the sewer pipe gets scored due to the continuous abrasion caused by suspended solids present in sewage. The scoring is pronounced at higher velocity than what can be tolerated by the pipe materials. This wear and tear of the sewer pipes will reduce the life span of the pipe and their carrying capacity. In order to avoid this, it is necessary to limit the maximum velocity that will be produced in sewer pipe at any time. This limiting or non- scouring velocity mainly depends upon the material of sewer. i) Self-cleaning velocity. The velocity that would not permit the solids to settle down and even scour the deposited particles of a given size is called as self-cleansing velocity. This minimum velocity should at least develop once in a day so as not to allow any deposition in the sewers. Otherwise, if such deposition takes place, it will obstruct free flow causing further deposition and finally leading to the complete blocking of the sewers	**02 marks** **02 marks**
Q.6	**e)** **Ans**	List any four types of pipes used for conveyance of water and state the advantage of cost iron pipes. a) cast iron pipe b) wrought iron pipe c) Steel pip d) Concrete pipe e) Cement line cast iron pipe f) Asbestos cement pipe g) Copper and lead pipe h) Wooden pipe i) Vitrified clay pipe. Advantage of cost iron pipes:- • Cast iron pipe is the preferred choice for handling high pressures and loads of water. • Cast iron pipe have long life.	**Any four ½ mark for each** **02 marks**