MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)

(ISO/IEC -270001 – 2005 certified)

WINTER -2019 EXAMINATION

Subject code: 22504 **Model Answer** **Total Pages: 13**

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).

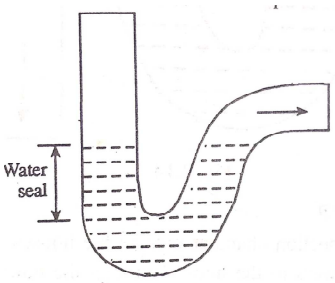
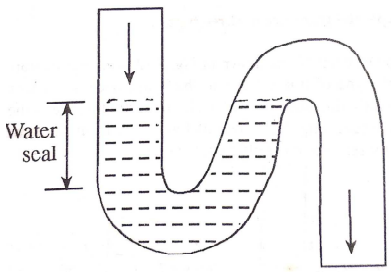
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

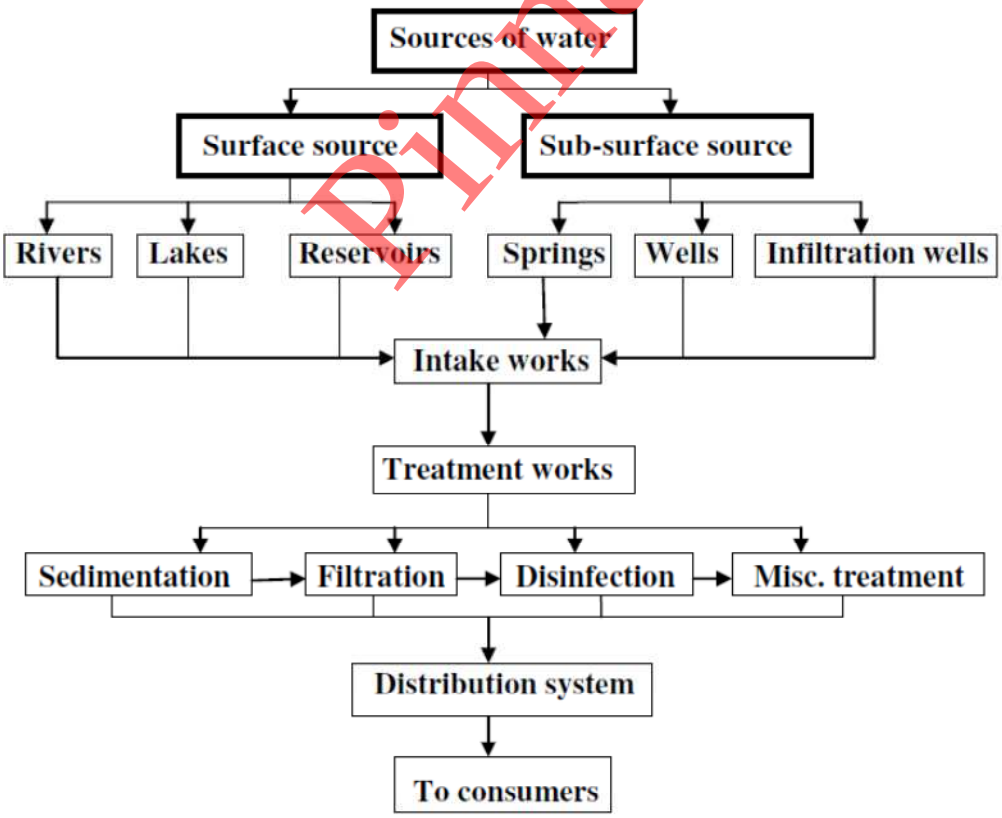
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constant values may vary and there may be some difference in the candidate's answer and model answer.

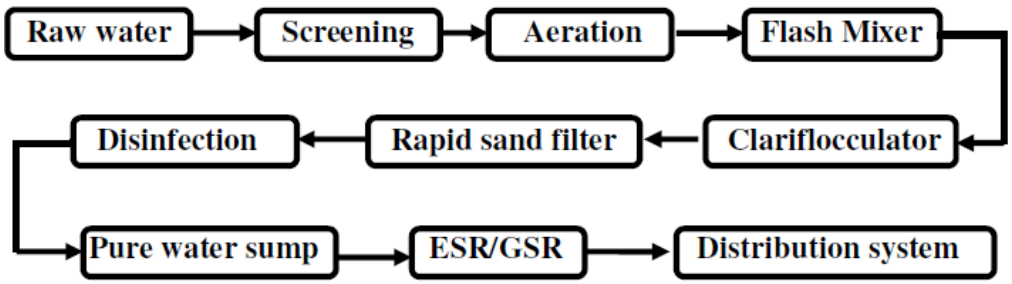
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Question and Model Answers	Marks
1.	**Attempt any FIVE of the following:**	**10M**
1.(a)	**Define : (i) Forecasting of population** **(ii) Intake structure**	**2M**
	Ans: **(i) Forecasting of population -** The process of calculating or estimating future population or demand is called population forecasting. **(ii) Intake structure-** An intake is a well type structure, which is constructed across the surface of water, so as to permit the withdrawal of water from source.	**1M** **1M**
1.(b)	**State any four factors affecting rate of demand of water**	**2M**
	Ans: **Factors affecting rate of demand of water-** i) Climatic Conditions ii) Cost of Water iii) Distribution Pressure iv) Habits of Population	**½M each (for any four)**

	v) Industries & it's types vi) Policy of Metering vii) Quality of Water viii) Sewerage System ix) Size of City x) System of Supply (Continuous or Intermittent)	
1.(c)	**Enlist any four types of valves provided in water supply scheme.**	**2M**
	Ans: **Types of valves provided in water supply scheme-** i. Sluice valve ii. Air valve iii. Scour valve iv. Reflux valve v. Pressure Relief valve vi. Butterfly valve	**½M each (for any four)**
1.(d)	**State any two advantages and disadvantages of dead end system.**	**2M**
	Ans: **Advantages of dead end system:** 1) Relatively economical. 2) Determination of discharges and pressure easier due to less number of valves. 3) Laying the water pipe is simple. 4) It is suitable for old towns and cities having no definite pattern of roads. **Disadvantages of dead end system:** 1) Due to many dead ends, stagnation of water occurs in pipes. 2) During repairs, a large portion of the distribution area is affected. 3) Due to limited discharge in the mains, the water available for firefighting will be limited in quantity.	**½ M each (any two)** **½ M each (any two)**
1.(e)	**Define trap. Sketch P-trap and S-trap.**	**2M**
	Ans **Trap-** It is a bent tube, which provides a water seal between atmosphere and the sewer gas. **OR** The devices, which are used to stop the escape of foul gases inside or outside the houses, are known as traps.  P-trap  S-trap	**1M** **½ M each**

1.(f)	**Define: (i) sewage (ii) garbage**	**2M**
	Ans: **i) Sewage** - It is liquid waste from the community and it includes sullage, discharge from latrines, urinals, stables, industrial waste and storm water. **ii) Garbage** - It consists of solid or semisolid waste food and product such as vegetables, waste meat, peelings of fruits etc.	**1M** **1M**
1.(g)	**State any four objects of sewage treatment.**	**2M**
	Ans: **Objects of sewage treatment-** 1. To remove organic solids. 2. To remove inorganic matter (sand, etc.) 3. To prevent nuisance & offensive odour. 4. To prevent water borne diseases. 5. To safeguard the natural resources from pollution. 6. To remove toxic & hazardous matter. 7. To convert solids into stable products by biological decomposing. 8. To make environment pollution free.	**½M each (for any four)**
Q.2.	**Attempt any <u>THREE</u> of the following:**	**12M**
2.(a)	**Draw flow diagram of water treatment plant.**	**4M**
	Ans: **Flow diagram of water treatment plant**  **<u>OR</u>**	**2M (for units)** **2M (for correct sequence)** **<u>OR</u>**



2M (for units)

2M (for correct sequence)

2.(b) State the precautions to be taken for collection of sample of water. — **4M**

Ans:

Precautions to be taken for collection of sample of water-

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.
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.
3. In case of sub-surface source sufficient water should be pumped out before collecting the sample.
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 & finally sterilization is done.
5. After collecting the sample, stopper of the bottle should be well secured and the bottles containing samples of water should be labelled stating the source, date and time of collection.

1M each (for any four)

2.(c) The following is the population data for a town. Water supply scheme is to be designed for this town with a design period of 30 years. Find the population at the end of the year 2040 by incremental increase method. — **4M**

Year	1970	1980	1990	2000	2010
Population	35000	37500	43500	52000	57500

Ans:

Population forecasting-

Year	Population	Increase in population	Incremental increase
1970	35000	--	--
1980	37500	2500	--
1990	43500	6000	3500
2000	52000	8500	2500
2010	57500	5500	-3000
	Total	22500	3000

1M

X = Mean increase in population = 22500/4 = 5625

Y = Mean of Incremental increase in population = 3000/3 = 1000

1M

P = Last known population = 57500

	n = $\frac{\text{(Future year – last known year)}}{10}$ = $\frac{\text{(2040 – 2010)}}{10}$ = 3 By Incremental Increase Method – Probable population Pi = P + nX + $\frac{n(n+1)}{2}$ Y P_{2040} = 57500 + (3x5625) + $\frac{3(3+1)}{2}$ 1000 = 57500 + 16875 + 6000 **P_{2040} = 80375 souls**	**1M** **1M**
2.(d)	**Define Aeration. State objectives of aeration.**	**4M**
	Ans: **Aeration –** The process of bringing the water in intimate contact with air, to increase the dissolved oxygen content in water is called Aeration. **Objectives of aeration –** i) To remove the dissolved gases (H_2S, CO_2, NO_2) from raw water. ii) To increase the dissolved oxygen content in water. iii) To remove colour & odour considerably. iv) To remove Iron & Manganese precipitate.	**1M** **3M (for any three)**
3.	**Attempt any <u>THREE</u> of the following:**	**12M**
3.(a)	**Describe the principle behind sedimentation with coagulation.**	**4M**
	Ans: Principle of coagulation can be explained by following two considerations. **(a) Floc formation:** When a coagulant is added to water and mixed thoroughly and thick gelatinous precipitate 'Floc' is formed. Floc attracts 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.	**2M** **2M**
3.(b)	**Describe the theory of filteration.**	**4M**
	Ans: **Theory of Filteration-** The filtration process is carried out in following four actions- **1) Mechanical Straining:** Sand consists of small pores, therefore suspended particles which are larger in size, can not pass through sand bed. Small particles of suspended impurities adhere causing further reduction in pore size. This increase the straining action. **2) Sedimentation:**	**1M each (for four steps)**

The voids act as small settling basins. The particles are arrested due to gelatinous film formation and attraction between particles.

3) **Biological Action:**
Suspended impurities contain some portion of organic impurities like algae, etc. and form a layer. This food consumed by micro organisms with chemical and biological action.

4) **Electrolytic action:**
Sand particles of filter media carry electrical charges of opposite nature. They therefore attract each other and are neutralized. The characteristics of water are thus changed. Washing of filter media renews the electrical charges.

3.(c) Differentiate between gravity distribution system and pumping distribution system. **4M**

Ans:

Sr. No.	Gravity distribution system	Pumping distribution system
1)	Suitable when source of supply is at sufficient height than the city.	Suitable for any type of topography.
2)	Water flows under gravity, therefore pumping is not required.	Water flows under pressure and pumping is required.
3)	This system cannot provide high pressure for fire demand.	Sufficient water is available with pressure for fire fighting.
4)	Less leakages and wastages.	There are more losses and wastages.
5)	This method is simple, reliable and economical.	This system is not economical due to pumping cost.
6)	Less maintenance cost.	More maintenance cost.
7)	Sufficient pressure is not available for farther sections.	Sufficient pressure is available in distribution system due to pumps.
8)	Power supply is not necessary, hence more reliable.	This system is not reliable in case of power failure as pumps will stop working.

4M (for any four points of differences)

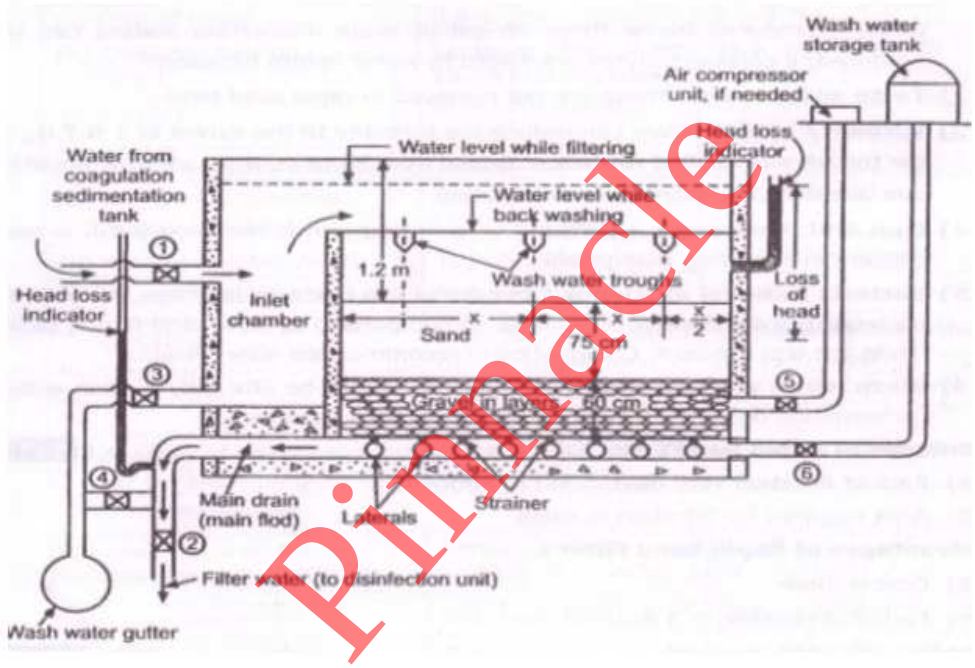
3.(d) Describe the backwashing of rapid sand filter with neat labeled sketch. **4M**

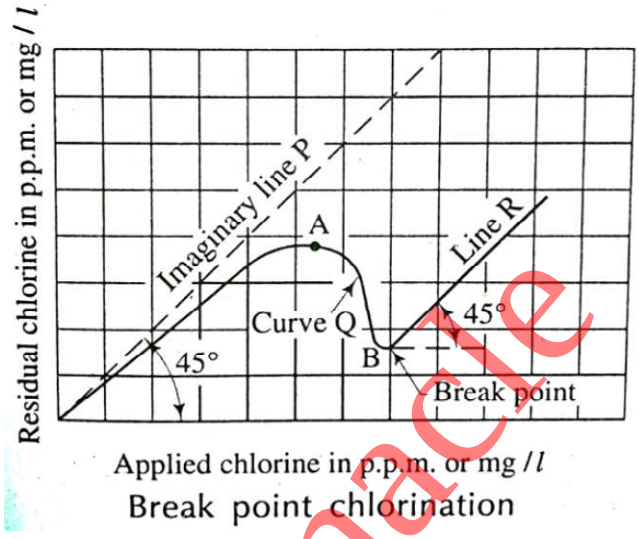
Ans:

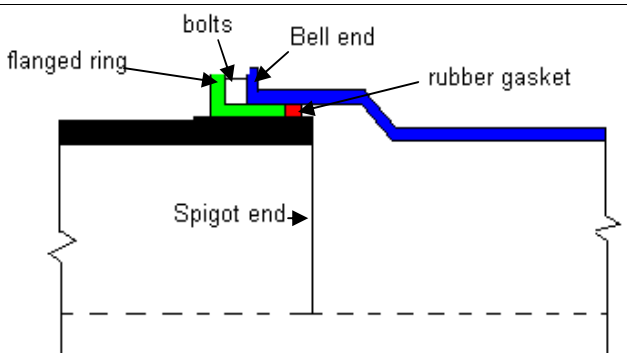
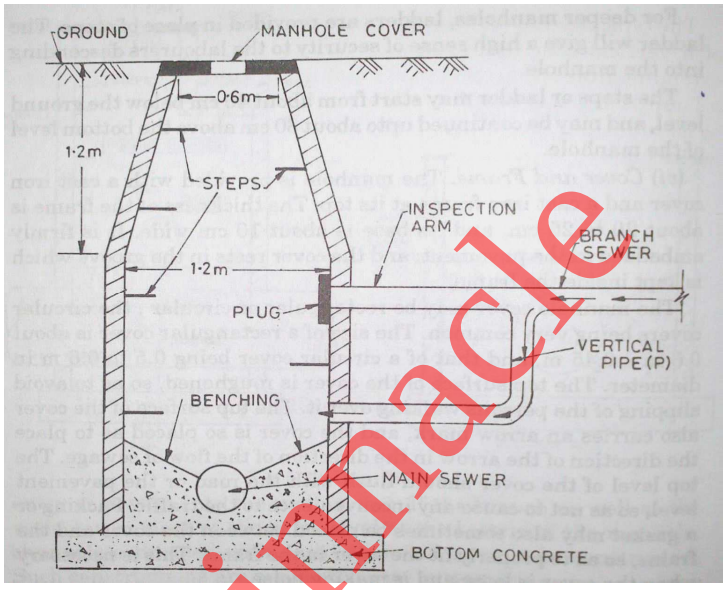
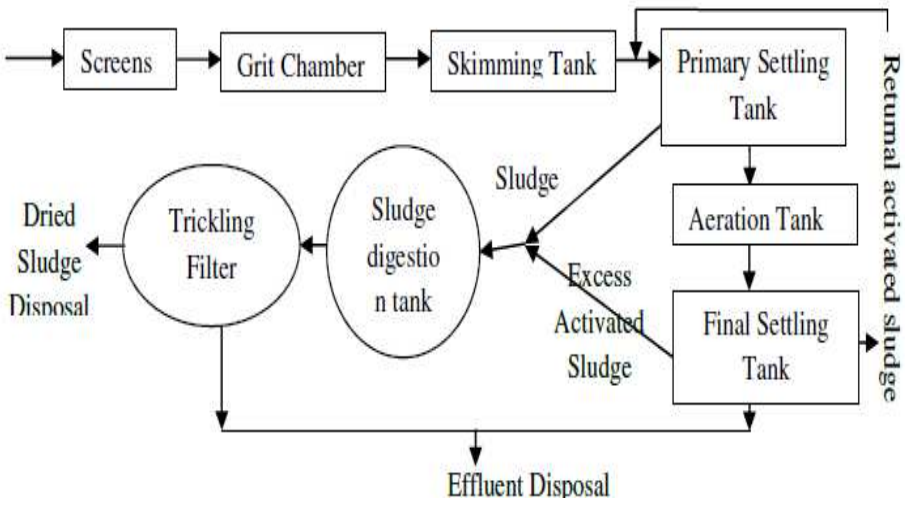
Back washing of rapid sand filter-

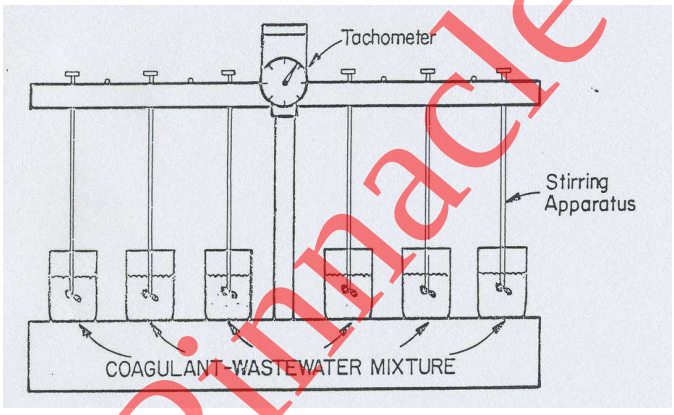
A separate overhead tank is constructed near the filter house to store the water required for back washing of filter.

A pump is installed to lift the sufficient quantity of filtered water to be stored in wash water tank.

	Operation - 1. Initially, the valves (1) and (4) are closed and valves (5) and (6) are opened out. 2. The wash water and compressed air are thus forced upwards from the under- drainage through the gravel and sand beds. 3. Valve (5) is closed after supplying the required amount of air. 4. The dirty water, resulting from washings, overflows into the wash water troughs and is removed by openingthe valve (3) through the inlet chamber into the wash water drain. 5. Now open valve (1) and (4) for some time then close valve (4) and put filter in normal working condition by opening valve (2).  **Fig. - Backwashing of Filter**	**2M** **2M (for sketch)**
4.	**Attempt any <u>THREE</u> of the following:**	**12M**
4.(a)	**State different forms of chlorination. Describe break point chlorination.**	**4M**
	Ans: **Forms of Chlorination-** 1) Plain Chlorination 2) Pre Chlorination 3) Post Chlorination 4) Re chlorination 5) Super Chlorination 6) De chlorination 7) Break point chlorination	**1M**

	Break point chlorination- (Ref. fig.) • The chlorine, when added to the water, forms the function of killing bacteria first and then starts accumulating up to point **A,** as shown in graph. • Further addition of chlorine shows sudden decrease in residual chorine up to point **B**. This is because of oxidation of organic matter in water. • The point B on graph Q is called Breakpoint. • As any chlorine that is added beyond this point breaks through the water and appears as residual chlorine. This type is called as break point chlorination.  Break point chlorination	**3M**
4.(b)	**List any eight types of pipes used for conveyance of water.**	**4M**
	Ans: **Types of pipes used for conveyance of water -** 1. Cast Iron (C.I.) Pipe 2. Ductile Iron (D.I.) Pipe 3. Wrought Iron or Galvanised Iron (or G.I.) Pipe 4. Steel / Mild Steel (M.S.) Pipe 5. Concrete Pipe (R.C.C.) Pipe 6. Asbestos Cement (A.C.) Pipe 7. P.V.C. / Polyethylene Pipe 8. Prestressed Concrete Pipe 9. Glass Reinforced (G.R.P.) Pipe 10. Bar Wrapped Steel Cylinder (B.W.S.C.) Pipe 11. Copper Pipe 12. Lead pipe	**½M each (for any eight)**
4.(c)	**Describe expansion joint with sketch.**	**4M**
	Ans: **Expansion joint-** It is used when pipes are subjected to severe changes in temperature leading to the expansion and contraction of pipes. A rubber gasket is inserted between the spigot and bell ends and it adjusts in every position to keep the joint watertight. The flanged ring is bolted to bell and it expands or contracts along with the bell end.	**2M**

	 **Fig. - Expansion joint**	**2M (for sketch)**
4.(d)	**Draw neat sketch of drop manhole.**	**4M**
	Ans:  **Fig. - Drop Manhole**	**2M (for sketch)** **2M (for labelling)**
4.(e)	**Draw layout of sewage treatment plant.**	**4M**
	Ans:  **Fig. - Layout of Sewage Treatment Plant**	**2M (for units)** **2M (for correct sequence)**

5.	**Attempt any TWO of the following:**	**12M**
5.(a)	**Describe the process of coagulation. Explain the procedure of Jar test with neat labeled sketch.**	**6M**
	Ans: **Coagulation-** The process of adding certain chemicals in water, in order to form insoluble, and gelatinous precipitation (or floc) which becomes heavier and finally settles down is known as Coagulation. **Jar Test-** This test is performed to determine optimum chemical dose in the laboratory. **Procedure-** 1) Fill the 6 jars with 1000 ml water sample. 2) Add the coagulant dose in increasing order and stir the sample with 60-80 RPM for one minute. 3) After one minute reduce the speed of stirrer to 30 RPM for 15 minutes. 4) Then turn off the mixer and allow water to settle for 30 minutes. 5) Observe and measure the turbidity of each jar sample. 6) The coagulant quantity, with good floc formation, will be the optimum dose of coagulant.  **Fig. - Jar test apparatus**	**1M** **3M** **2M**
5.(b)	**Describe in detail, the procedure of laying sewers.**	**6M**
	Ans: **Procedure of laying sewers-** For laying sewers as per the alignment, first trial holes are dug to know the strata and positions of manholes is finalized. Rest of the procedure is as follows- **1) Marking centre lines of sewers:** The centre lines of sewers are marked on the streets and roads by driving the pegs at 7.5 to 15 m c/c & locating sewer appurtenances by offset line method. **2) Excavation of trenches:** After marking the layout of sewers lines on the ground the first step is the removal of pavement and then excavation of trenches is done manually or by means of machinery **3) Sheeting, bracing and dewatering of trenches:** In case of soft soils the trench side required shoring and strutting to prevent their collapse till the sewers are laid and tested. When sewers lines are to be lead below the ground water table, the	**1M Each (for six steps)**

ground water enters the trench, dewatering of tranches is compulsory.

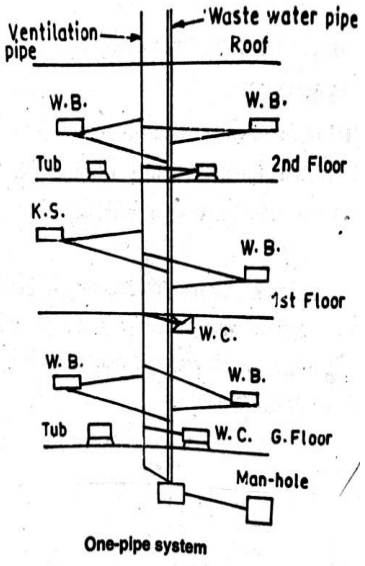
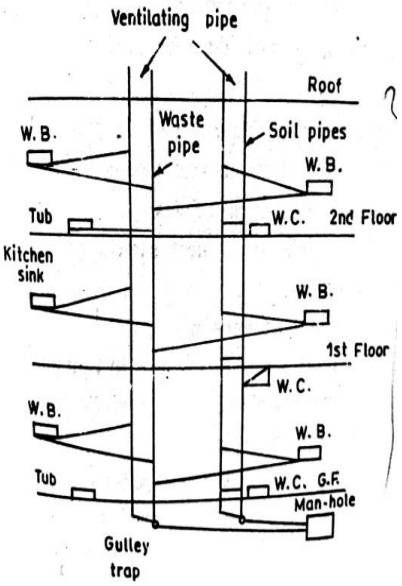
4) Laying of pipe sewers and their jointing: The sewers pipes are not laid directly on the soil in the tranches. Before actual laying, the concreting is done. Smaller size pipes can be laid by the pipe layers by hand only but larger size pipes are lowered in the trenches by passing rope around them and supporting through a hook. Then jointing of sewers is done by usual method.

5) Testing of sewers lines: The hydraulic testing of the sewers is done with the help of water test or air test by usual method.

6) Back filling of trenches: After testing and removing defects of pipe line the tranches are back-filled with earth. Generally the excavated soil of trench is used for back filling. Back filling is done step by step.

5.(c) Differentiate between one pipe plumbing and two pipe plumbing system with neat labeled sketch. **6M**

Ans:

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.
7)	 One-pipe system	

3M (for any three points of differences)

3M (for both sketches)

6.	**Attempt any TWO of the following:**	**12M**
6.(a)	**State the systems of sewerage. Describe separate system with merits and demerits.**	**6M**
	Ans: **Systems of Sewerage are-** 1) Combined System 2) Separate System 3) Partially Separate System	**½M each (for three)**
	Separate system- • When two different sewers are laid to carry sanitary sewage & storm water, it is called separate system. The storm water collected can be directly discharged into the water body since, the run-off is not as foul as sewage and no treatment is generally provided. Whereas, the sewage collected from the city is treated adequately before it is discharged into the water body or used for irrigation to meet desired standards.	**1½M**
	• **Merits** -1) Quantity of treatment is small, hence economical design of treatment works, 2) Cheaper than combined system, 3) No fear of stream pollution, 4) Storm water can be discharged in to natural streams, 5) Suitable in heavy rainfall areas.	**1½M (any three)**
	• **Demerits**- 1) Self cleansing velocity is not available, 2) Risk of entry of storm water during rains, 3) Inconvenience to traffic in busy lanes, while repairs 4) Initial cost is more.	**1½M (any three)**
6.(b)	**Differentiate between** **(i) Aerobic and anaerobic process (ii) BOD and COD**	**6M**
	Ans:	**3M (for any three points of difference)**

(i)	Aerobic Process	Anaerobic process
1)	When the decomposition of organic matter takes place in the presence of oxygen, it is called aerobic process.	When the decomposition of organic matter takes place in the absence of oxygen, it is called aerobic process.
2)	Aerobic bacteria involved.	Anaerobic bacteria involved.
3)	Process in presence of oxygen and light.	Process in absence of oxygen and light.
4)	Not offensive.	Offensive.
5)	End products- CO_2, H_2O, NO_3, SO_4	End products- CH_4, H_2S, CO_2
6)	Applied for moderate waste.	Applied for strong waste.
7)	End product requires another treatment.	Well stabilized end product.
8)	No methane gas produced.	Methane gas produced.
9)	e.g. aerated lagoon.	e.g. bio gas plant.

(ii)	BOD	COD
1)	The amount of oxygen required for decomposition of biological degradable matter under aerobic condition is called Biochemical Oxygen Demand or B.O.D.	The amount of oxygen required for decomposition of biological degradable and inorganic matter under acidic condition is called Chemical Oxygen Demand or C.O.D.
2)	This test is conducted at standard temperature of $20^{o}C$.	No standard temperature is required.
3)	This test requires 5 days.	This test requires 3 to 5 hours.
4)	No oxidizing agent is required.	Strong oxidizing agent is required.
5)	B.O.D. is generally less than C.O.D.	C.O.D. is always higher than B.O.D.
6)	Higher B.O.D. means higher organic matter.	Higher C.O.D. means higher pollution.
7)	It is affected by temperature.	It is not affected by temperature.
8)	Apparatus required for test – Incubator, B.O.D. Bottle, titration unit	8) Apparatus required for test – Reflux apparatus, B.O.D. Bottle, hot plate, titration unit

3M (for any three points of difference)

6.(c) Describe working of trickling filter with neat sketch. **6M**

Ans:

Working of trickling filter- 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. **1M**

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. It removes 80% colloidal matter, reduces B.O.D. up to 75%. It gives highly nitrified and stabilized effluent and flexibility in operation **2M**

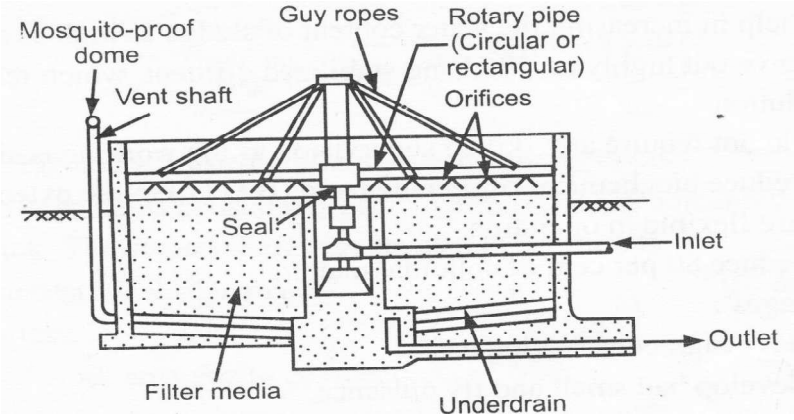


Fig. - Trickling filter

2M (for sketch)

1M (for labeling)