Important Instruction to Examiners:-

1) The answers should be examined by key words & not as word to word as given in the model answers scheme.

2) The model answers & answers written by the candidate may vary but the examiner may try to access the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance.

4) While assessing figures, examiners, may give credit for principle components indicated in the figure.

5) The figures drawn by candidate & model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credit may be given step wise for numerical problems. In some cases, the assumed contact 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 judgment on part of examiner of relevant answer based on candidates understanding.

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

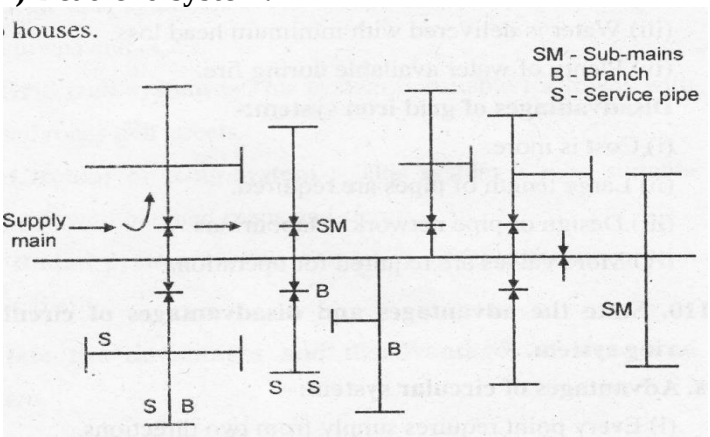
Important notes to examiner

Q .NO	SOLUTION	MARKS
Q1. A)	**Attempt ANY THREE of following:**	**12**
a	**State the importance of Public Health Engineering with respect to water supply and sanitation.**	**04M**
	➢ Environmental engineers also design municipal water supply system and provide safe drinking water or secure water supplies for potable and agricultural use. ➢ To achieve these, they examine the watersheds with a hydrological or geological point of view as well as engineering treatment systems for water purification. ➢ Various water treatment methods are used, including membrane technology, desalinization, biological water treatment, etc. Water distribution systems are also designed and built. ➢ Environmental engineers also develop collection and treatment systems to carry domestic or industrial waste water discharges away and remove some of the pollutants before discharging it into the environment.	**04M**
b	**State the precautions required to be taken during water sampling.**	**04M**
	➢ Avoid faucets (taps) that are seldom used (i.e. the taps which are rarely used) ➢ Avoid sampling from a dead-end. ➢ Avoid a faucet (taps) that leaks around the stem ➢ Avoid any faucet (taps) that is dusty, dirty or corroded ➢ Avoid swing faucets(taps) ➢ Avoid faucets (taps) that cannot deliver a smooth stream of water ➢ Avoid sampling from a flexible hose, garden hose ➢ Avoid sampling from faucets(taps) with aerators or screen ➢ Avoid sampling from faucets(taps) that have a point-of-use carbon filter attached ➢ Avoid sampling from: i. a dripping faucet(taps) ii. a frost free yard hydrant or wall hydrant iii. an outside hose bib with an unremovable vacuum breaker iv. a faucet (taps) with an unremovable aerator v. a metal fixture with external plastic or rubber inserts ➢ Choose cold water faucets (taps) only ➢ Choose a faucet(taps) that is NOT connected to the water softener ➢ Choose a smooth-end faucet (taps) over a threaded-end faucet	**½ M each Write any Eight**
c	**State the objectives of aeration process and describe any one method of aeration.**	**04M**
	1. Removes taste and odours caused due to organic gases. 2. Increases dissolved oxygen content 3. Removes Hydrogen Sulphide and odour due to it. 4. Decreases CO_2 content and raises pH. 5. Removes Iron and Manganese. 6. Due to agitation bacteria may get killed. 7. Can be used for mixing chemicals	**½ M each Write any Four**

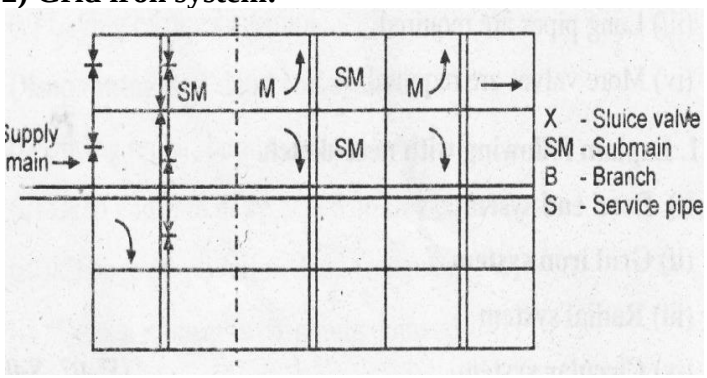
Q .NO	SOLUTION	MARKS
c) contnd.	**Method of Aeration:** **1. Cascades:** Itconsist of concrete steps over which water flow down in the form of thin sheet. Weir may be provided at the edge of each step. Thin sheet of water which comes down over steps comes in contact with the atmosphere. More surface area of water is exposed to aatmosphere and thus more oxygen is absorbed by water. **2. Spray nozzle:** In this method, water is sprinkled in air or atmosphere through special nozzle which breaks the water into droplets thus permitting the escape of dissolved gases. Carbon dioxide gas is thus considerably removed in this method and more oxygen is absorbed by water. **3. By air diffusion:** In this method, compressed air is bubbled through the water, so as to thoroughly mix it with water. Perforated pipes are, installed at the bottom of the settling tanks, and the compressed air is blown through them. The compressed air is thus bubbled up from the bottom of the tank. During its upward movement through the water body, it gets thoroughly mixed up with the water contained in the tank, therefore completing the aeration process. **4. Trickling bed filter:** In this method, the water is allowed to trickle down the beds of coke, supported over the perforated bottomed trays, and arranged vertically in series. Generally three beds are used, the depth of each being about 0.6m with clear distance of about 0.45 m in between. The water is applied from the top through perforated distribution pipes and allows trickling down. During this downward motion, the water gets mixed up with air and aeration takes place. This method gives better results than what can be obtained by cascades, but is fewer effectives than the method of spray nozzles.	**02M For any One Method**
d)	**Define coagulation and state any four coagulants commonly used.**	**04M**
	Coagulation is the process by means of which the colloidal particles are brought togather (i.e. colloidal particles is changed so that they form floc through the process of flocculationand that can be separated from the water). It can be achieved through the addition of chemicals (called coagulants) to the water. **The most common ones** -Alum(Al2(SO4)3.18H2O). -Ferrous Sulfate(FeSO4.7H2O). -Lime Ca(OH)2. -Ferric Chloride (FeCl3). -Ferric Sulfate (Fe2(SO4)3)	**02 M** **1/2M each Any Four**
B	**Solve any one of the following :**	**06M**
a)	**Describe Ground water Recharging with respect to Necessity and Advantages.**	**06 M**
	A. Necessity of Ground water Recharging ➢ To maximize storage(long-term & seasonal) ➢ Water quality improvement through dilution ➢ Preventing saline-water intrusion & land subsidence ➢ Reducing reduction volumes from river flow ➢ Controlling effects of climate change	**1 M Each Write any Three**

Q .NO	SOLUTION	MARKS
a) contd.	**B. Advantages** ➢ Artificial recharge has several potential advantages, namely: ➢ The use of aquifers for storage and distribution of water and removal of contaminants by natural cleansing processes that occur as polluted rain and surface-water infiltrate the soil and percolate down through the various geological formations. ➢ The technology is appropriate and generally well understood by both the technologists and the general population. ➢ Very few special tools are needed to dig wells. ➢ In rock formations with high structural integrity, few additional materials may be required (concrete, soft stone or coral rock blocks, metal rods etc.) to construct the wells. ➢ Groundwater recharge stores water during the wet season for use in the dry season, when demand is the highest. ➢ The quality of the aquifer water can be improved by recharging with high-quality injected water. ➢ Recharge can significantly increase the sustainable yield of an aquifer. ➢ Recharge methods are environmentally attractive, particularly in arid regions. ➢ Most aquifer recharge systems are easy to operate. ➢ In many river basins, control of surface-water run-off to provide aquifer recharge reduces sedimentation problems. ➢ Recharge with less-saline surface waters or a treated effluent improves the quality of saline aquifers, facilitating the use of the water for agriculture.	**1 M Each Write any Three**
b)	**State the advanced methods of water treatment and suggest type of treatment to be given** **To raw water in following cases.** **i) River water in rainy season with partially contaminated** **ii) Ground water with hardness-400 ppm and fluoride content- 2 mg/lit.**	**06M**
	1) Membrane filtration 2) Ion exchange 3) Zeolite process 4) Lime soda process 5) Deminerlization or de-ionisation process 6) Reverse osmosis 7) For defluoridation Calcium Phosphate, Bone Charcoal, Synthetic tricalcium phosphate, Fluorex, Lime, Aluminim compounds or activated carbon can be used.	**02M**

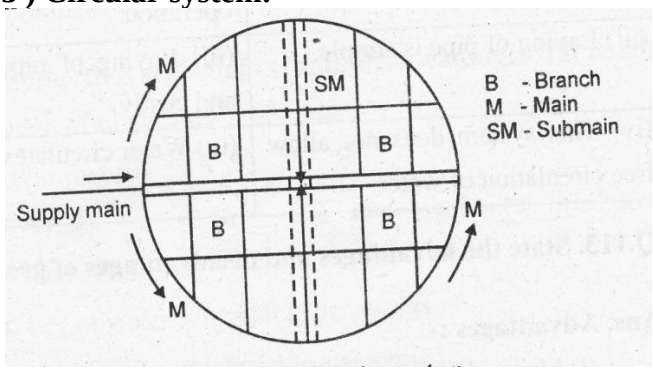
	River water in rainy season with partially contaminated: Means it contains lots of mud and clay particles which are causing turbidity. Hence, at water treatment plant, specific treatment shall be given to remove turbidity. i.e. Coagulation, flocculation and sedimentation or Clarifloculation. This will help in removing turbidity of water. Since it is contaminated and it is rainy season prechlorination, superchlorination or double chlorination is required to assure the disinfection of water. All this shall be accompanied by usual filteration process. Further the advanced treatments like Membrane filtration or Ion exchange process may be adopted. **Ground water with hardness-400 ppm and fluoride content- 2 mg/lit** It indicates hardenss is more as well as fluorides are also more. To remove Hardenss Ion exchange or reverse osmosis may be adopted. Or any of the hardness removal method shall be adopted like: Lime soda process, Zeolite process, Deminerlization or de-ionisation process. To remove the excess flourided from water any of the following processes can be used, which are usually called as defluoridation. Defluoridation can be carried out by any of the following methods: Use of calcium Phosphate, Use of Bone Charcoal, Synthetic trycalcium phosphate, Fluorex, Ion-exchanger, Lime, Aluminim compounds or activated carbon. This shall be carried out along with usual water treatment methods.	**2M** **2M**
Q.No.2	**Attempt ANY FOUR of following:**	**16M**
a)	**Describe need of protected water supplies.**	**04M**
	➢ The contamination of water sources that resulted in loss of human life and illness showed the importance of protecting the sources water. ➢ Protecting Source Water is the most cost-effective and reliable way to protect our drinking water for generations to come. It is much more expensive to treat contaminated groundwater than to protect it from getting contaminated in the first place ➢ **Protecting our Source Water is important because:** • Not all forms of contamination can be easily removed or treated (i.e. many chemical compounds). • Many people in Ontario, especially in rural areas, are not connected to municipal water. These people supply their own drinking water from a private well or surface water intake. For these people, protecting source water from contamination may be the only barrier they have against contaminated drinking water. • It is often far more expensive to treat contaminated source water than it is to protect it from contamination.	**04M**
b)	**Describe theory of filtration.**	**04M**
	Ans. The filtration process takes place on the basis of following four actions : **(i) Mechanical staining:-** The suspended particles which are unable to pass through the voids of sand grains, arrested and reduce the pore size and removed by the action of mechanical staining. **(ii) Sedimentation:–** The voids between the sand bed act as small settling basins. The particles are arrested due to – presence of gelatinous film or coating developed on sand by previously caught bacteria and colloidal matters. – Physical attraction between two particle matters.	**1M** **1M**

	(iii) Biological action:- When bacteria are caught in the voids of sand grains, a zoological jelly or film is formed around the sand grains. This film consists of large colonies of living bacteria. The bacteria feed on organic impurities in water. They convert such impurities into harmless compounds by complex biochemical action. **(iv) Electrolytic changes:-** Filter action is also explained by ionic theory. It states that when two substances with opposite electric charges are brought into contact with each other, the electric charges are neutralized and in doing so, new chemical substances are formed. At this stage, it becomes necessary to clean the filter. Sand (electric charged with some polarity) —Contact→ Impurities ⇒ (Opposite polarity) – neutralized each other – electric power of sand get exhausted.	**1M** **1M**
c)	**Describe working of Rapid Sand filter.**	**04M**
	➢ The working and washing of rapid sand filter is controlled by six valves I, II, III, IV, V, VI. Valve I is inlet valve or influent valve, through which water from coagulation-clarification basin enters the filter unit. Valve II is the filtered water storage tank valve. Valve III is the waste water valve to drain water from main drain. Valve IV is the waste water valve to drain water from inlet chamber. Valve V is the wash water storage tank valve, fitted after a wash water rate controller. Valve VI is the compressed air valve. ➢ For normal working of the unit, all the valves are kept closed except valves I (Inlet valve) and II (Filtered water storage tank valve). Valve I is open to permit water from coagulation-sedimentation basin to enter the inlet chamber. Valve II is open to carry the filtered water to the filtered water storage tank. The filter operates under gravity flow, there being about 2m head (or more) of water over the bed. Filters are normally designed for a filtration rate of 3000-6000lit/hr/sq.m. of filter area. ➢ Back washing of rapid sand filter must be done between 2 to 4 days.	**04M**
d)	**Draw neat sketch of any two methods of distribution of water.**	**04M**
	1) Dead end system: 	**02M Each Draw any Two**

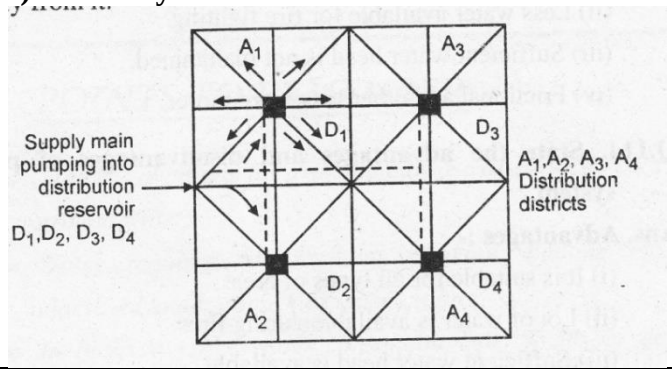
2) Grid iron system:



3) Circular system:



4) Radial System:



02M Each Draw any Two

e) State any four points of importance and necessity of Sanitation **04M**

a) importance of Sanitation

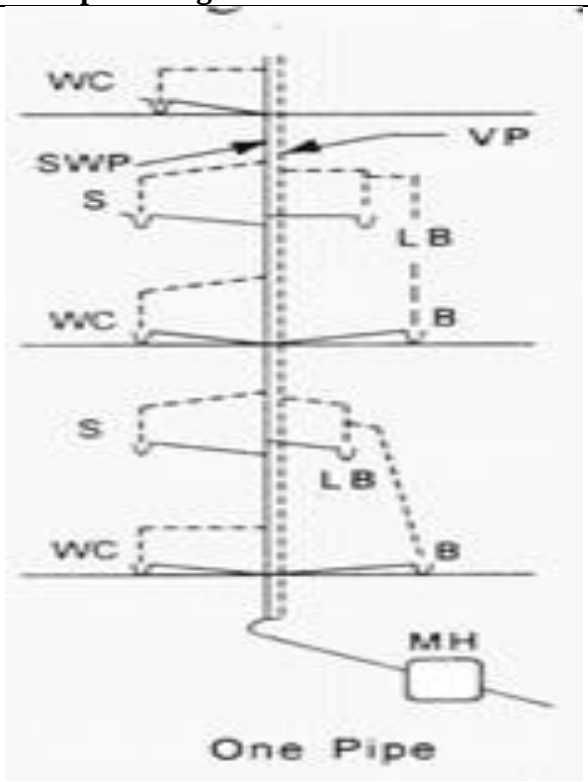
1. To maintain healthy condition in the building.
2. To dispose of the waste water as early and quickly as possible.
3. To avoid the entry of foul gases form sewer or septic tank.
4. To facilitate quick removal of foul matter (e.g. Human excreta).
5. To collect and remove waste matters systematically.

02M

b) necessity of Sanitation

- Importance of Environmental Sanitation
- It promotes health
- It prevents disease transmission
- It eliminates breeding places of insects and rodents that may be carrier of diseases
- It improves the quality of life

02M

f)	**State Necessity of Rain Water harvesting.**	**04M**
	➢ Surface water is inadequate to meet our demand and we have to depend on ground water. ➢ To arrest ground water decline and augment ground water table ➢ To beneficiate water quality in aquifer ➢ To conserve surface water runoff during monsoon ➢ To reduce soil erosion ➢ Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished.	**04M**
Q.No.3	**Attempt ANY FOUR of following:**	**16M**
a)	**Describe one pipe system of plumbing with a neat sketch.**	**04M**
	 One Pipe **(SWP=Soil & waste pipe, S= sink,WC= Water closet,LB=lavatory basin, B = Bath, MH = manhole,VP = Vent pipe)** **One Pipe System** ➢ A Separate vent pipe is provided in this system. It is clear from the study of sketch that in comparison to single stack system: ➢ This system is costly and difficult to construct ➢ Ventilation is provided to sullage pipe and soil pipe too. ➢ Arrangement of pipe work is difficult.	**02M** **02M**

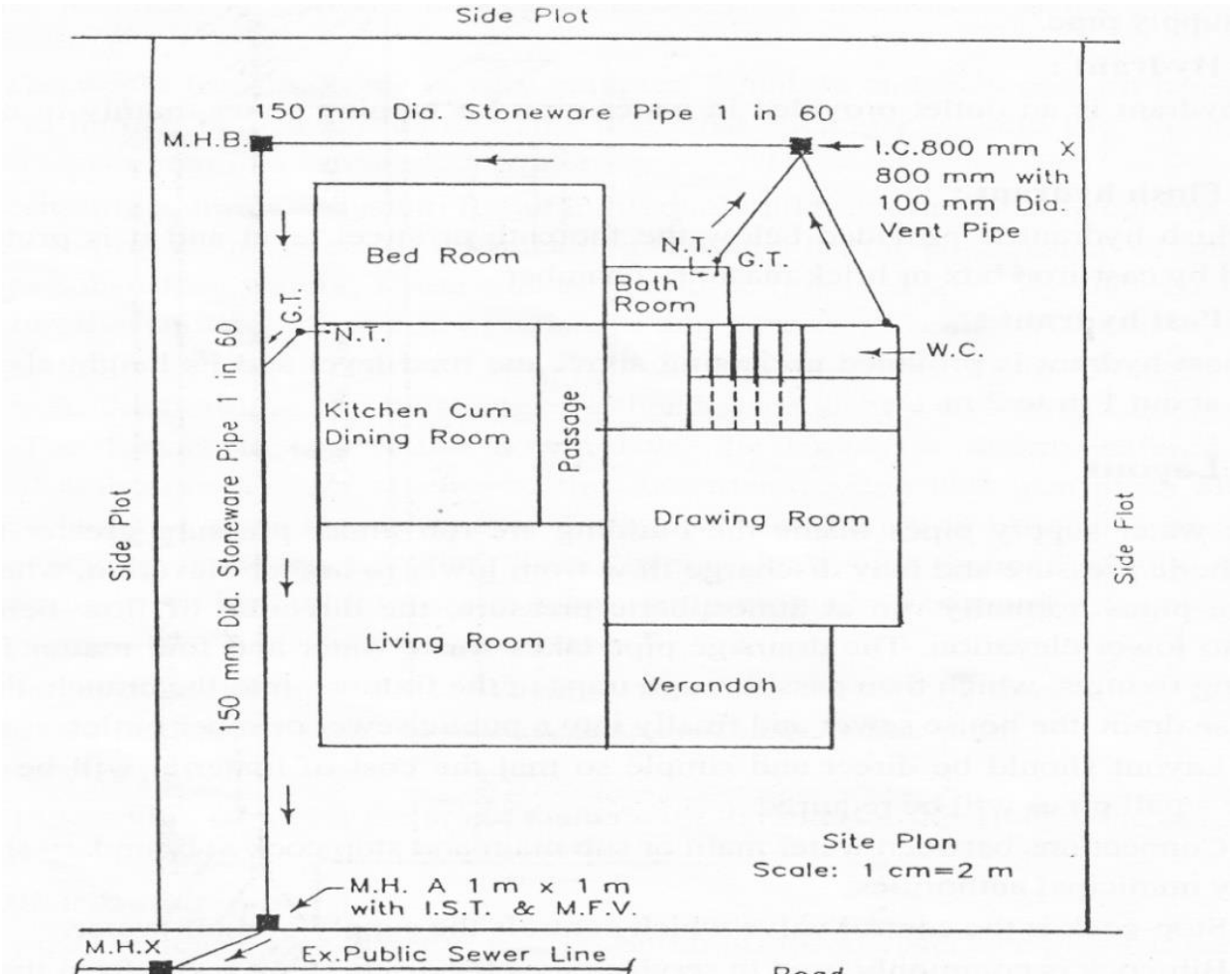
b)	Explain different surface and subsurface sources of water.	04M
	Water Resources Sources of Water **A) Surface Sources** a) Rivers b) Lakes c) Ponds d) Streams e) Oceans **B) Subsurface Sources** a) Wells b) Tube wells c) Infiltration galleries d) Infiltration Wells **A) Surface Sources-:** River runoff and regime depend on precipitation, evaporation, water accumulation in soils, land use, vegetation, basin slope, etc. River water forms at the expense of precipitation onto the land surface. The sources of river alimentation include snow, rain, ground water, and glaciers. **a) Rivers-:** A River is a natural watercourse, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. Rivers have been used as a source of water, for obtaining food, for transport, as a defensive measure, as a source of hydropower to drive machinery, for bathing, and as a means of disposing of waste. **b) Lakes and Pond-:** A natural large sized depression formed on the surface of the earth, when gets filled up with water is known as a pond or a lake. If the size of depression is small, it is termed as a pond and when the size is large it may be termed as lake. **c) Streams-:** Stream: Stream is a flowing body of water with a current, confined within a bed and stream banks. Streams are important as conduits in the water cycle, instruments in groundwater recharge. **d) Oceans-:** On Earth, an ocean is one of the major conventional divisions of the World Ocean, which covers almost 71% of its surface. These are, in descending order by area, the Pacific, Atlantic, Indian, Southern, and Arctic Oceans **B) Subsurface Sources-:** The water is available below ground level from any point but saturated strata. They are mainly divided in two groups 1. Wells 2. Percolation Tanks Any saturated strata having ability to transmit stored water can develop for withdrawal 0f water .It must have capacity to transmit water at reasonable rate This type of saturated stratum is termed as Aquifer. **a) Wells-:** Water well is an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers. **b) Tube wells-:**To obtain large discharges tube wells which is a long pipe or a tube, is bored or drilled deep into the ground, intercepting one or more water bearing stratum the quantity of water available from tube well is of order of 200 to 220 l/sec. the depth of tube well ranges from 70 m to 300 m. the diameter of tube well is 0.5 to 0.6 m.	**02M Surface sources** **02M Surface sources**

	c) Infiltration galleries-: Infiltration Galleries (IG) or wells can be constructed near perennial rivers or ponds to collect infiltrated surface waters for all domestic purposes. Since the water infiltrate through a layer of soil/sand, it is significantly free from suspended impurities including microorganisms usually present in surface water. Again, surface water being the main source of water in the gallery/well, it is free from arsenic. If the soil is impermeable, well graded sand may be placed in between the gallery and surface water source for rapid flow of water. **d) Infiltration Wells-:** Infiltration wells are shallow wells constructed along the banks of the river in order to collect the river water seeping through their bottom. • These wells are constructed of brick masonry with open joints. They are generally covered at the top and kept open at the bottom	
c)	**Describe Recycling and Reuse of domestic waste.**	**04M**
	Recycling of domestic waste: ➢ It's the process of recycling the domestic waste by adopting various techniques for minimizing the quantity of waste in landfill site. Many of the items used in the home can be recycled. The benefits of recycling include a cleaner environment, the safe disposal of hazardous materials. ➢ 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, etc. Recycling helps to create hygienic environment in the society and thus reduces the load on treatment and disposal units. **Reuse of domestic waste:** ➢ Reuse office furniture and supplies, such as interoffice envelopes, file folders, and paper. ➢ Use durable towels, tablecloths, napkins, dishes, cups, and glasses. ➢ Use incoming packaging materials for outgoing shipments. ➢ Encourage employees to reuse office materials rather than purchase new ones	**02M** **02M**

<table>
<tr><th>Q .NO</th><th>SOLUTION</th><th>MARKS</th></tr>
<tr><td>d)</td><td>Differentiate between Slow Sand filter and Rapid Sand filter.</td><td>04M</td></tr>
<tr><td></td><td>
<table>
<tr><th>Comparison Points</th><th>Slow Sand filter</th><th>Rapid Sand Filter</th></tr>
<tr><td>1. Coagulation</td><td>Not required</td><td>Essential</td></tr>
<tr><td>2. Compactness</td><td>Requires large area for its installation.</td><td>Requires small area for its installation.</td></tr>
<tr><td>3. Construction</td><td>Simple</td><td>Complicated as separate under drainage system is required to be design.</td></tr>
<tr><td>4. Cost of operation</td><td>Low</td><td>High</td></tr>
<tr><td>5. Period of cleaning</td><td>1-3 Months</td><td>2-3 days</td></tr>
<tr><td>6. Method of clearing</td><td>Long and laborious method</td><td>Due to back washing short and speedy method.</td></tr>
<tr><td>7. Skilled supervision</td><td>Not essential</td><td>Essential</td></tr>
<tr><td>8. Suitability</td><td>For small towns and villages.</td><td>For big cities where land cost is high and variation in water demand.</td></tr>
<tr><td>9. Base material</td><td>Varies from 3-65mm in size with 300-750 mm depth.</td><td>Varies from 3-40mm in size with 600-900 mm depth.</td></tr>
<tr><td>10. Loss of head</td><td>150-750mm</td><td>3m -3.50m</td></tr>
<tr><td>11. Rate of filtration</td><td>100-200lit/hr/m^2</td><td>3000-6000lit/hr/m^2</td></tr>
</table>
</td><td>1M for each Points</td></tr>
<tr><td>e)</td><td>Define the following terms :
i)Self cleaning velocity ii) Non-scouring velocity</td><td>04M</td></tr>
<tr><td></td><td>i) Self-Cleaning velocity: - The minimum velocity which will prevent thesilting or deposition of particles of solid matter in sewers is known as selfcleaning velocity. The gradient of sewer should be such that this velocity isdeveloped at least once in a day preferably twice in a day. Usually it is800mm to 900mm per second for normal sewage.

ii) Non-Scouring velocity: - The maximum permissible velocity at which noscouring action by the solid particles of sewage on inside smooth surface ofsewers will occur is known as non-scouring velocity. It mainly depends onmaterial of sewer.</td><td>02M

02M</td></tr>
</table>

Q.04 A)	Attempt ANY THREE of the following: (03x04=12)	MARKS
a)	**State different types of traps. Enlist qualities of good trap.**	**04M**
	1) According to shape ➢ P- trap ➢ Q- trap ➢ S- trap **2) According to use** ➢ Gully trap ➢ Floor trap ➢ Intercepting trap	**02 M**
	Qualities of good trap ➢ It should provide enough water seal **around 50mm** with large surface area. ➢ Interior should be smooth so that water flow should not obstruct. ➢ Good trap should achieve the self-cleansing velocity. ➢ An assess door should be provided for cleaning the trap. ➢ It should be made up of non-adsorbent material.	**02 M**
b)	**Draw a layout plan for building drainage**.	**04M**
		**04 M**

c)	**State any eight type of pipes used for conveyance of water.**	**04M**
	The various types of pipe materials used for conveyance of water are as follows: ➢ Cast iron pipes ➢ Wrought iron pipes ➢ Steel Pipes ➢ Concrete Pipes ➢ Wooden Pipes ➢ Vitrified pipes ➢ Copper and lead pipes ➢ Asbestos cement pipes ➢ Cement lined cast iron pipes	**½ M each**
d)	**Design a circular Sewer for following data-** **Zone population- 8500 souls.** **Rate of water supply-110lp.c.d.** **n = 0.015, Maximum Flow = 2 x Average Flow**	**04M**
	Data: Population= 8500 Rate of water supply = 110lpcd i=1/400 **(assume)** Average water supply = (**m^3/sec**) = 8500 X 110 /24 X 60 X 60 X 1000 = 0.010822**m^3/sec** Max discharge of sewage produced = 2 X 0.010822 = **0.021644m^3/sec** Q= AV **Q=0.021644 m^3/sec,A=$\frac{\pi}{4} XD^2$, V=$\frac{1}{N} X m^{2/3} X i^{1/2}$** **1) Running Full (m=D/4)** Q= AV $0.021644=\frac{\pi}{4} XD^2$ X $\frac{1}{0.015} X (\frac{D}{4})^{2/3} X (\frac{1}{400})^{1/2}$ **D=0.234m** **1) Running Full (m=D/2)** Q= AV $0.021644=\frac{\pi}{4} XD^2$ X $\frac{1}{0.015} X (\frac{D}{2})^{2/3} X (\frac{1}{400})^{1/2}$ **D=0.197m** **Note-:Student may assume hydraulic Gradient(i) value different, so accordingly check the answer**	**02M** **02M**

4 B) Attempt ANY ONE of following: 06M

a) a) Estimate the probable population for a town with following census data in the year 2041. 06M

Year	1981	1991	2001	2011
Population	78000	122000	178500	227500

Use incremental increase method.

Incremental increase method:

Year	Population	Increment	Incremental increase
1981	78,000	-	-
1991	1,22,000	44,000	-
2001	1,78,500	56,500	+12,500
2011	2,27,500	49,000	-7,500
	Total	**1,49,500**	**+5,000**
	Average	$\frac{149500}{03} = 49,833.33$	$\frac{5000}{02} = 2500$

04M

$$P_n = P + nI + \frac{n(n+1)}{2}r$$

Where,

P = Population in 2011 =2,27,500

n = number of decades = (2041-2011)/10 =03

I = Average increase per decade = 1,49,500/03 = 49833.33

r = Average incremental increase = 5000/02 = 2500

01M

$$\therefore P_{2041} = 227500 + 3 \times 49833.33 + \frac{3(3+1)}{2} \times 2500$$

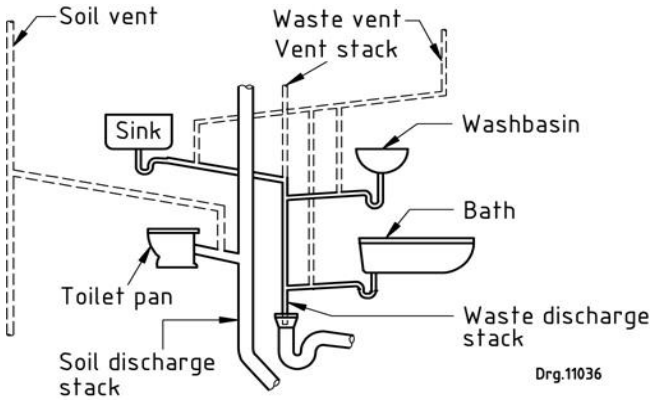
$$\therefore \boldsymbol{P_{2041} = 3,92,000}$$

Therefore the population at the end of year 2041 will be 3,92,000. 01M

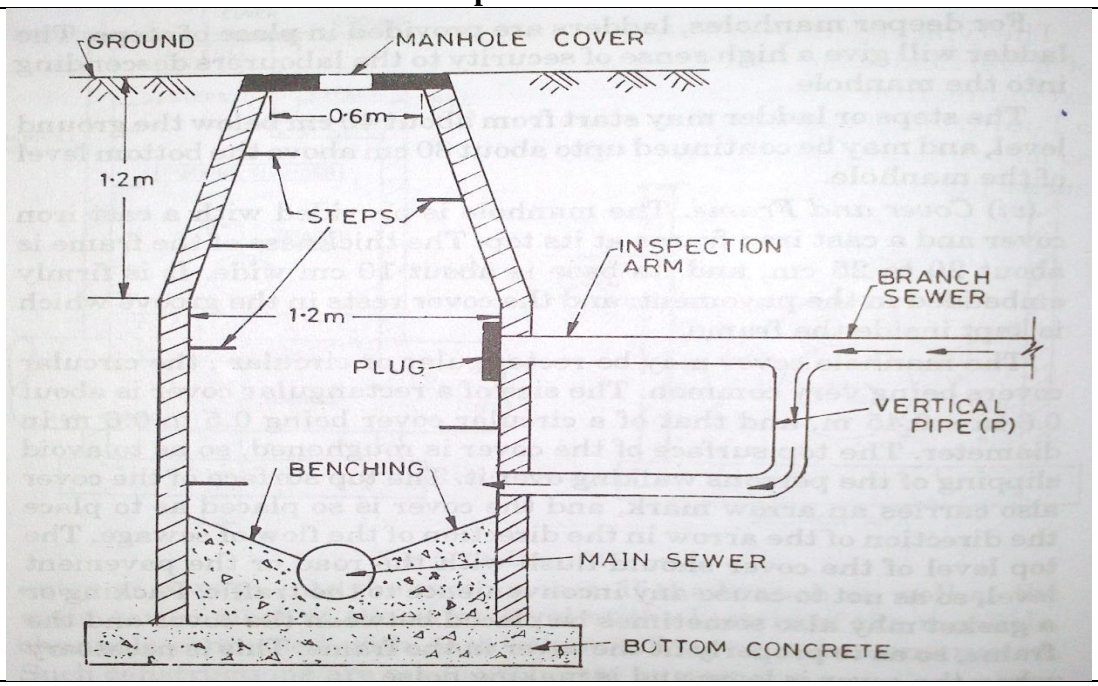
b) State suitability of two pipe plumbing system and draw a labelled sketch of it. 06M

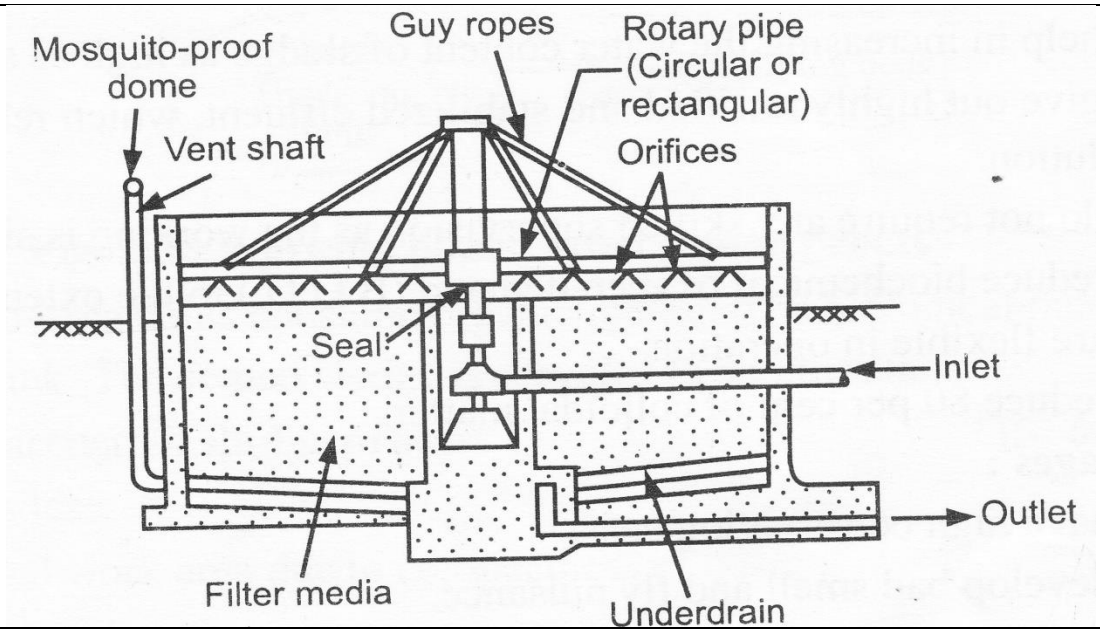
Suitability of Two pipe system of plumbing- 03M

1) This system consists of two sets of pipe (total four pipes).
2) Soil pipe carries waste from W.C., urinals i.e. lavatory waste and waste pipe carries waste water from kitchen, bathroom, rain water etc.
3) Separate ventilation pipes are connected to both soil pipe and waste pipe.
4) This system is costly and requires more maintenance.
5) This system is very common in India and used for three or four storey buildings where sanitary fittings are not grouped together.



03M For Fig

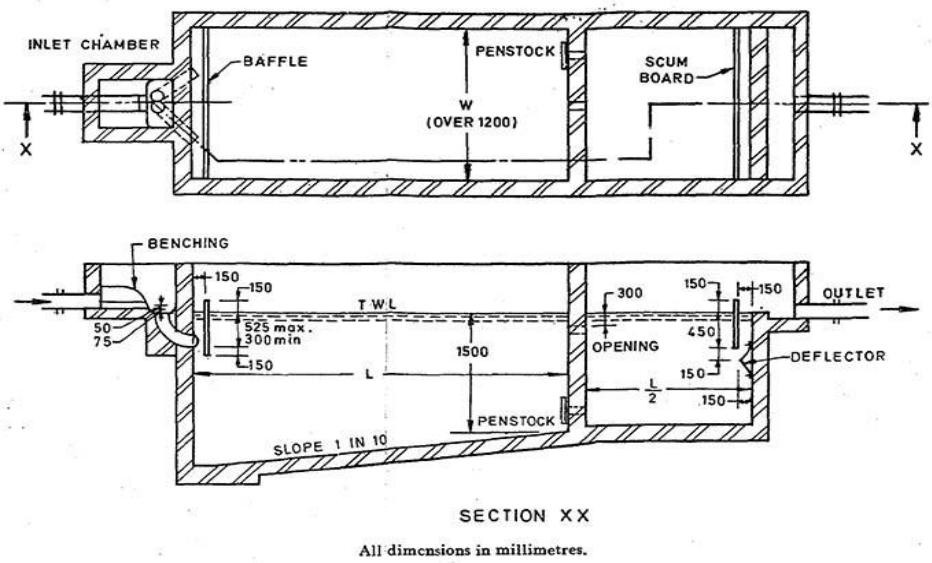
Q No.5	**Attempt any Four of the following**	**16M**
(a)	**Draw a neat labelled sketch of drop manhole.**	**04M**
		**04M**
b)	**DescribeAerobicTreatment process.**	**04M**
	1) This treatment process is carried by aerobic bacteria in the presence of oxygen. 2) Aerobic bacteria use dissolved oxygen present in sewage. Sometimes it is supplied to waste water by some means. 3) There is no recovery of methane gas and end products obtained are CO_2,H_2O 4) This process does not cause nuisance. It is inoffensive. 5) It is useful for moderate waste and end products obtained requires some treatment 6) Unstable organic matter is converted into stable and harmless inorganic matter under aerobic condition.	**04M**
c)	**Describe working of trickling filter.**	**04M**
	Working- Trickling filter is an artificial bed of stones or broken bricks material over which waste water is distributed or applied in drops, films or sprays through which it trickles to the underdrains. A slime layer is formed on the surface media, in which bacteria are present which consumes organic matter present in sewage and waste water is collected in underdrains. Working is simple so it does not requires any skilled supervision and it removes 80% colloidal matter, reduces B.O.D. up to 75%.It gives highly nitrified and stabilized effluent and flexibility in operation. But it requires large area and high construction cost. Also there is problem of bad smell and fly nuisance.	**02M**



02M

d) Explain the working of a septic tank. **04M**

Ans **02M**



SECTION XX

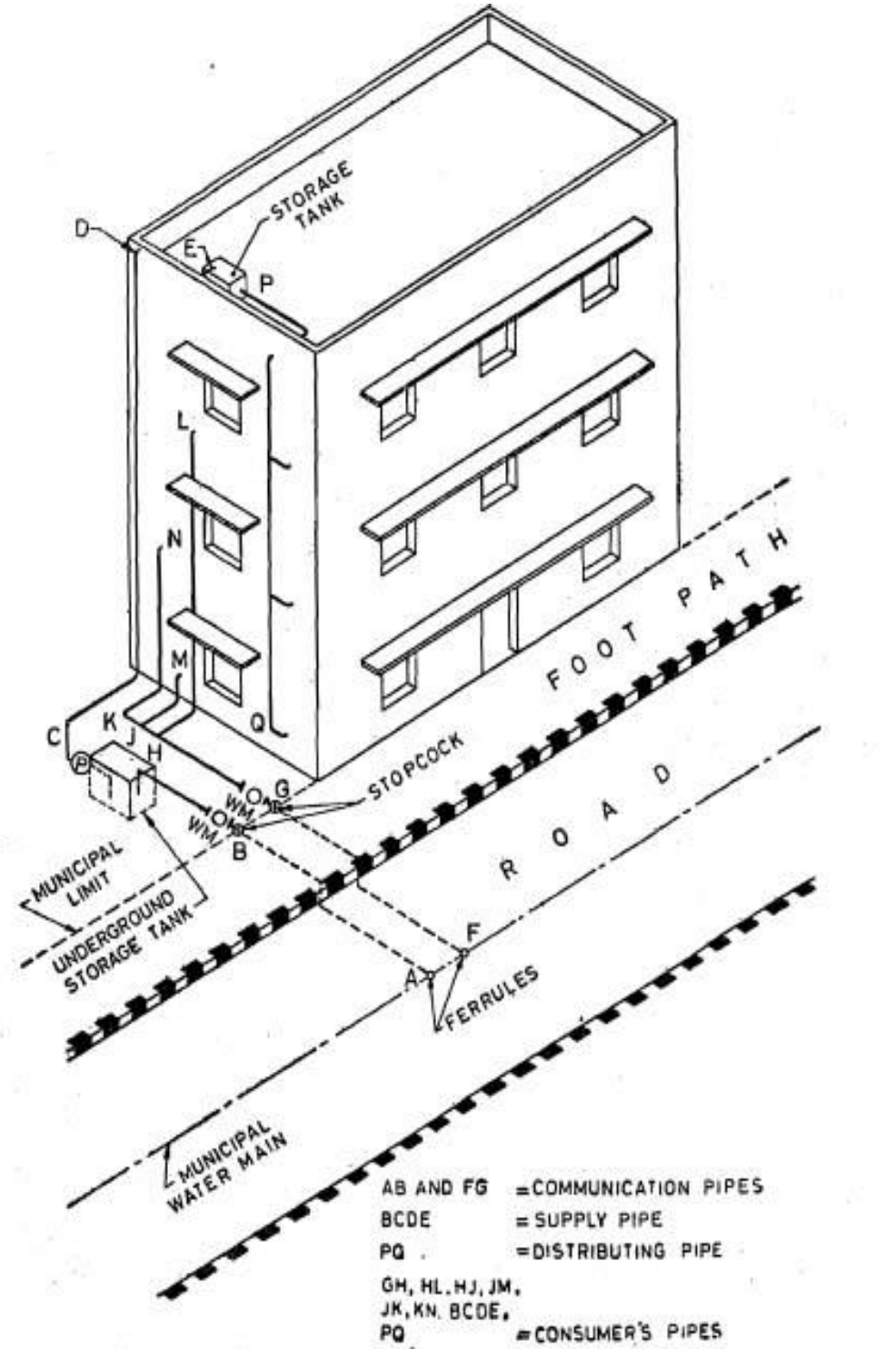
All dimensions in millimetres.

working of septic tank **02M**

A septic tank is closed water tight chamber where combined sedimentation and digestion of sewage are carried out under anaerobic activity.

The sewage and sludge are detained for some period when suspended solids are settled down which are treated by anaerobic digestion and results in reduction of volume and release of CH_4, CO2, H2S gases. The foul gases are escaped through vent pipe and the offensive effluent is disposed off into the ground through soak pit. The digested sludge is periodically removed once in year or twice. the septic tank is useful for individual houses, hostel and small groups of population

e)	Draw a line diagram of water supply arrangement for residential building.	04M



NOTE — The illustration is not intended to indicate recommended positions of underground storage tank (where provided), pipes, etc, and this will depend on local situations.

04M

Note-: Student May Draw any other suitable diagram so appropriate marks should be given

f) Differentiate between oxidation pond and oxidation ditch. **04M**

04M

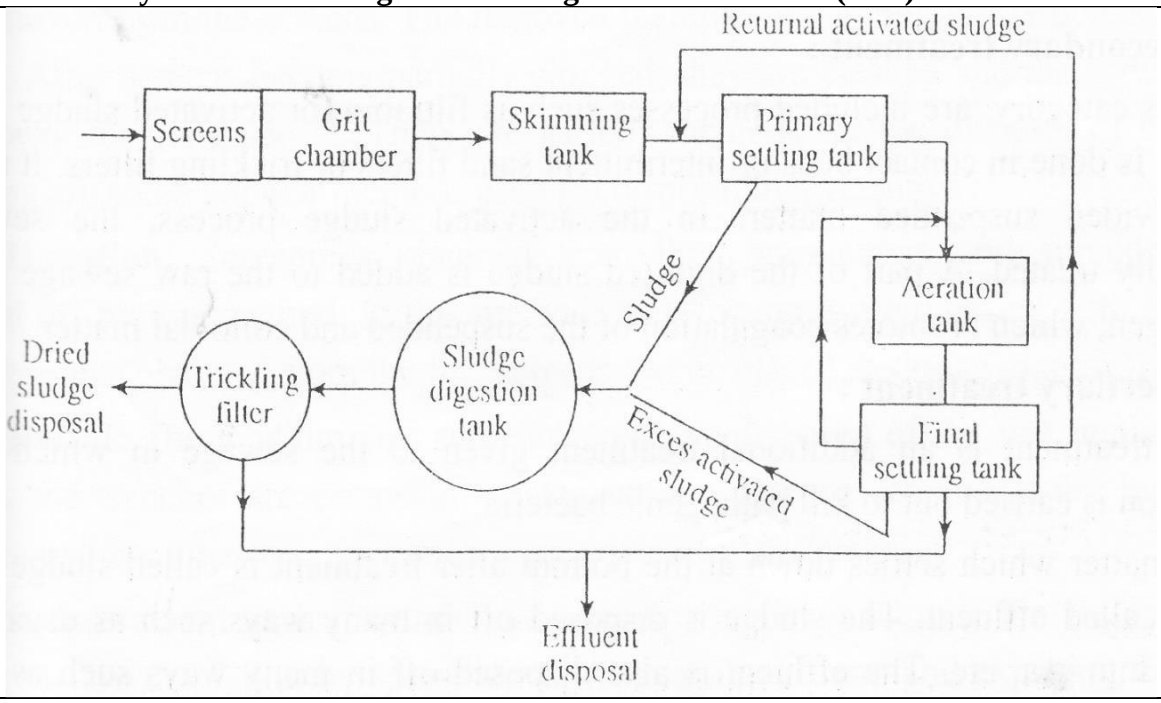
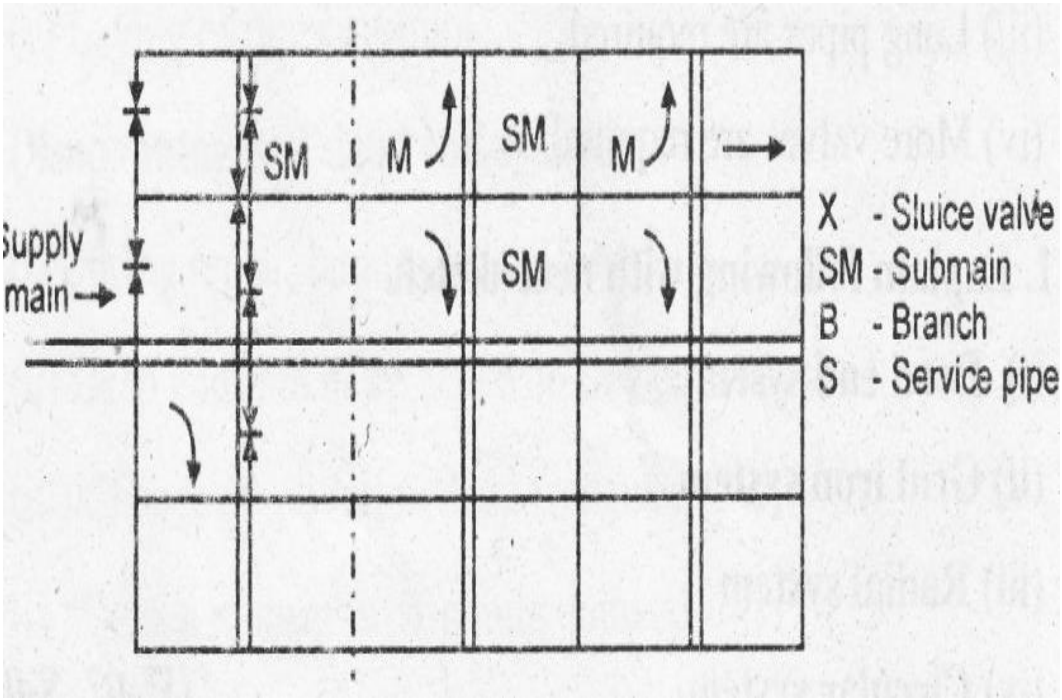
Sr.No.	Oxidation pond	Oxidation ditch
1	It consist of a shallow pond of depth about 1m.	It consist of a long continuous channel usally oval in plan.
2	Sewage is treated with the help of bacteria and algea.	Sewage is treated by activated sludge process.
3	More land is required.	Land required is less.
4	Detention time is 10 to 15 days.	Detention time is 12 to 15 hours.

Q. No.6	Attempt any Four of the following	16M
(a)	State MPCB norms for discharge of treated sewage	04M

Characteristics of effluent	Tolerance limit for sewage effluents discharged into inland surface water (I)	Tolerance limits for indusrialefluents discharged into		Tolerance limits for inland surface water, when used as raw for public water for supplies and bathing ghats (IV)
		Inland surface water (II)	Public sewers (III)	
B.O.D. (mg/l)	20	30	500	3
C.O.D. (mg/l)	-	250	-	-
pH	-	5.5-9.0	5.5-9.0	6.0-9.0
Total Suspended Solids (mg/l)	30	100	600	-
Temperature	-	40	45	-
oil and greese (mg/l)	-	10	100	0.1
Phenolic compound (mg/l)	-	1	5	0.005
Cynides (mg/l)	-	0.2	2	0.01
Sulphides (mg/l)	-	2	-	-
fluorides (mg/l)	-	2	-	1.5
total residual chlorine (mg/l)	-	1	-	-
Insecticides ,mg/l	-	0	-	0
Arsenic (mg/l)	-	0.2	-	0.2
Cadmium ,mg/l	-	2	-	-
Chromium ,mg/l	-	0.1	2	0.05
Sulphates, mg/l	-	-	-	1000
Copper,mg/l	-	3	3	-
lead,mg/l	-	0.1	1	0.1
Mercury,mg/l	-	0.01	-	-
Nickel,mg/l	-	3	2	-
Zinc,mg/l	-	5	15	-
Chlorides ,mg/l	-	-	600	600

Note:- Students can write any four points from any of the columns (I), (II), (III), (IV).

04M

(b)	**Draw a layout and flow diagram of Sewage Treatment Plant (STP)**	**04M**
		**04M**
(c)	**Describe Grid Iron system layout of distribution of water with suitable sketch.**	**04M**
	Grid iron system: This is improvement over dead end system. All the dead ends are interconnected to each other and water circulates freely. Main line is laid along main roads and streets from this sub main and branches are taken out and are interconnected. This system removes all disadvantages of dead end system.	**02M**
		**02M**

(d) Describe testing of sewers after construction. — 04M

i)Water Test — 02M

- This test is carried out for sewer lines between two manholes.
- Plugging is done by rubber plug at its lower end.
- Rubber plug is connected with air blown.
- The upper end of sewer is plugged with a connection to the funnel.
- The sewer is filled with water and to maintain the required head, water level in the funnel is kept 2 m above the upper end.
- This head varies with the material of sewer.
- In case of cast iron sewer, the head should be at 9m.
- The acceptable loss or head loss should not exceed 2 litres/cm of length of the sewer.
- To perform this test sufficient amount of water should be available.

ii) Air Test — 02M

- When sufficient amount of water is not available, then air test is to be carried out.
- Air is pumped into the pipeline, usually via a hand-pump with a control valve, until the reading on the manometer is around 125-150mm.
- The set-up is then left for 5-10 minutes to allow for temperature stabilisation within the pipe before the pressure is reduced to exactly 100mm on the manometer scale.
- The manometer is then monitored for a period of 5 minutes; the level of water in the manometer should not fall below the 75mm mark during this period.
- This is deemed to be a 'pass' and the pipeline is declared satisfactory and can be backfilled.
- However, if the level in the manometer does fall below the 75mm mark, then the equipment should be checked and cleaned and the pipeline examined for leaks or defects**.**
- If any problems are identified, they should be rectified before re-testing.

(e) e) State different types of valves used in conveyance of water and write the location where they are used. — 04M

01 Marks Each Write ANY FOUR

Types of valve	Location
Sluice Valve	These valves are provided in straight pipe length at 150-200m interval and when pipe line is inserted, valves are fixed on both the sides of intersection. It divides pipeline in sections.
Air Relief Valve	They are provided at summit points in the alignment of pipe to release accumulate air that can obstruct flow of water.
Pressure Relief Valve	At every point along the water pipe where pressure is likely to be maximum.
Scour Valve	They are located at the dead ends and depression or at lowest points in mains to remove sand and silt deposited in pipeline.
Reflux Valve	These valves are used in water pipe, which obtains water directly from pump. When pump fails or stops, the water will not return back to pump and thus pumping equipment will be saved from the damage.