SUMMER– 19 EXAMINATION

Model Answer

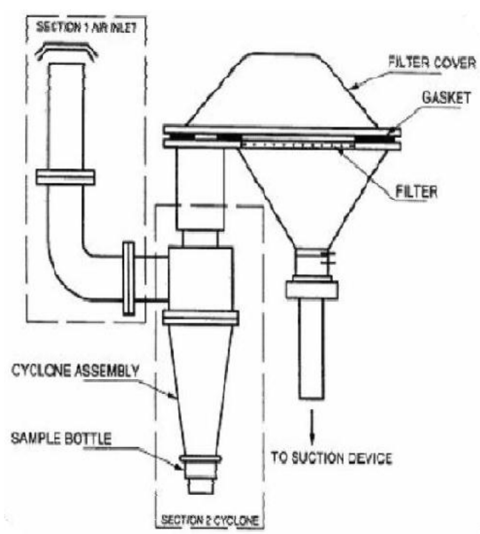
Subject Name: Environment Technology **Subject Code: 17646**

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**	12
	a	**Effect of air pollutant on human health** 1) **Sulfur dioxide (SO_2)** i)SO2 is an irritant gas which can easily get oxidized to sulfur trioxide and in the presence of water, these can form sulfurous and sulfuric acid ii) The health problems related to the mucous membrane and respiratory tract are due to sulfate aerosols. iii) Chronic effects of SO2 include increased probabilities of bronchitis, "colds" of long duration and suppression of immune system. 2) **Hydrocarbons** iv) The health effects of hydrocarbons have been noted in occupational exposures to tetra methyl lead, benzene, etc. v) Inhaling formaldehyde can cause irritation. vi) It is a major contributor to eye and respiratory irritation caused by photochemical smog. 3) **Carbon monoxide** vii) Carbon monoxide has a great affinity for the hemoglobin in the blood and combines with	1 mark each for any four

		blood to form carboxyhemoglobin. This reduces the ability of hemoglobin to carry oxygen to the body tissues. 4) **Oxide of Nitrogen** viii) NO reduces the oxygen carrying capacity of blood.	
	b	**BOD** It is the amount of oxygen required to degrade organic waste present in water by purely biological means. **COD** It is the amount of oxygen required to degrade organic waste present in water by purely chemical means. **DO** It is the amount of oxygen that is present in the water. It is measured in milligrams per liter (mg/L), or the number of milligrams of oxygen dissolved in a liter of water. **TDS** It is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form.	1 mark each
	c	**Pollutants from fertilizer plant (any four)** • Oil and grease • Ammonia • Fluorides • Phosphate • NaOH • Urea • Ammonium nitrate • Methanol • Carbon dioxide • Carbon monoxide • Nitrogen oxide	1 mark each for any four

	d	**Type of material present in Biomedical Waste** • General waste • Sharps • Culture and stocks of infectious agents and associated biological • Bulk human blood and blood products • Pathological wastes • Isolation wastes • Animal wastes • Radio-active wastes • Chemical waste • Containers • Pharmaceuticals	1 mark each for any four
1	**B**	**Attempt any ONE of the following**	**6**
	a	**High Volume Sampler**  **Construction** High volume sample consists of blower which sucks air from outside. Cyclone separator is attached to inlet for separation of solid particles entering into sampler. Filter paper is placed at inlet and it tightened with gasket. Speed of blower can be adjusted and pressure difference can be measured with u-tube manometer placed inside assembly.	2

		Working The sampler uses a continuous duty blower to suck in an air stream. When fitted with a particle size classifier, it separates particles greater than 10µm size from the air stream. The air stream is then passed through a filter paper to collect particles lesser than 10µm size (PM10). Gravimetric measurements yield values of suspended particulate matter (SPM), as the sum of the two fractions, and PM 10, the material retained on the filter paper. The sampler can also be used to sample gaseous pollutants. A stream of unfiltered air is bubbled through a reagent, which either reacts chemically with the gas of interest or into which the gas is dissolved. Wet chemical techniques are then used to measure the concentration of the gas. **Application** Measurement of concentration of particulate matter in air .	3 1
	b	**3R principle** **Reuse:** In today's world use and through materials is increasing and hence solid waste. Instead of throwing that material or item if it is used again, energy and environment can be saved. Solid waste generation also will be reduced. In industry various boxes, cans, pallets etc are used for material handling. These can be used again for same purpose. e.g. Catalyst drums can be used again to fill catalyst. **Recycle :** Recycling is a process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, and Recycle" waste hierarchy. Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. In the strictest sense, recycling of a material would produce a fresh supply of the same material-for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. e.g. Plastic water bottles can be recycled to get plastic again.	3

		Reduce: When you avoid making garbage in the first place, you don't have to worry about disposing of waste or recycling it later. Changing your habits is the key - think about ways you can reduce your waste when you shop, work and play. There's a ton of ways for you to reduce waste, save yourself some time and money, and be good to the Earth at the same time. Buy products in bulk. Larger, economy-size products or ones in concentrated form use less packaging and usually cost less per ounce. e.g. Unnecessary use of plastic and paper can be avoided in packing. **Application in Chemical industry** Reduction in waste generation. Reduction in catalyst loss. Reduction in energy consumption. Reduction in flue gas. Reduction in loss of cooling water, steam and compressed air. Recycling of treated waste water. Recycling of unreacted raw material which otherwise send to flare. Reuse of containers used for material or catalyst. Reuse of catalyst.	3
2		**Attempt any four of the following**	**16**
	a	**Sources of air pollution (any four)** 1. Industries 2. Transportation 3. Burning of fossil fuel and fires 4. Agricultural activities 5. Solid waste disposal 6. Construction activities 7. Deforestation **Pollutants (any four)** 1. Dust 2. Mist	2 2

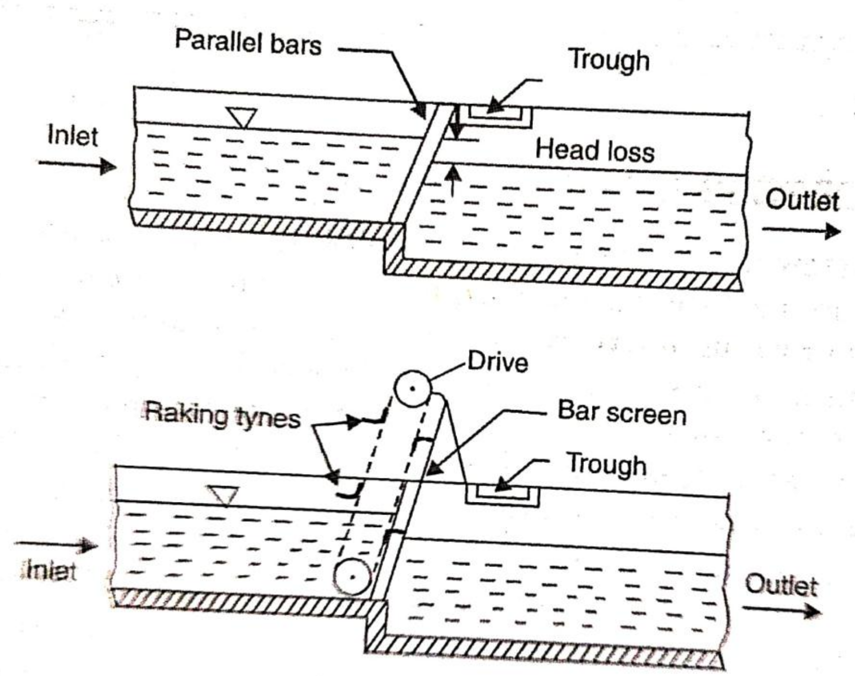
		3. Smoke 4. Carbon dioxide 5. Sulfur dioxide 6. Carbon monoxide 7. Nitrogen oxide 8. Methane	
	b	**Role of pollution control board** 1) Advise the Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air; 2) Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution; 3) Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution; 4) Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution; 5) Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control and abatement; 6) Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devises, stacks and ducts; 7) Disseminate information in respect of matters relating to water and air pollution and their prevention and control; 8) Lay down, modify or annul, in consultation with the State Government concerned, the standards for stream or well, and lay down standards for quality of air; 9) Establish or recognize laboratories to enable the Board to perform; 10) To issue directions to any industry, local bodies, or other authority for violation of the notified general emission and effluent standards, and rules relating to hazardous waste, bio-medical waste, hazardous chemicals, industrial solid waste, municipal solid waste including plastic waste under the Environment (Protection) Rules, 1986.	1 mark each for any four

c **Working of bar screen** 2

A bar screen is a mechanical filter used to remove large objects, such as rags and plastics, from wastewater. It is part of the primary filtration flow and typically is the first, or preliminary, level of filtration, being installed at the influent to a wastewater treatment plant. They typically consist of a series of vertical steel bars spaced between 1 and 3 inches apart.

Bar screens come in many designs. Some employ automatic cleaning mechanisms using electric motors and chains, some must be cleaned manually by means of a heavy rake. Items removed from the influent are called screenings and are collected in dumpsters and disposed of in landfills. As a bar screen collects objects, the water level will rise, and so they must be cleared regularly to prevent overflow.

2

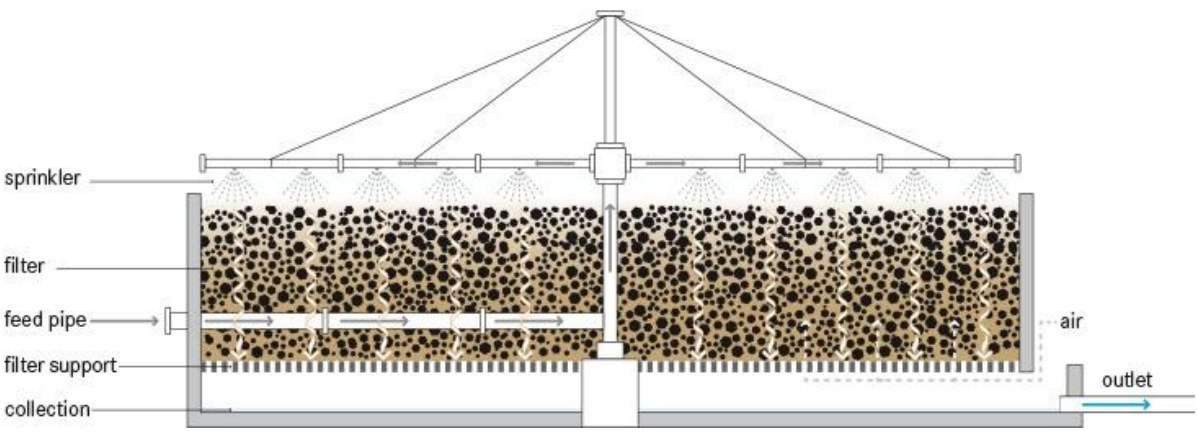


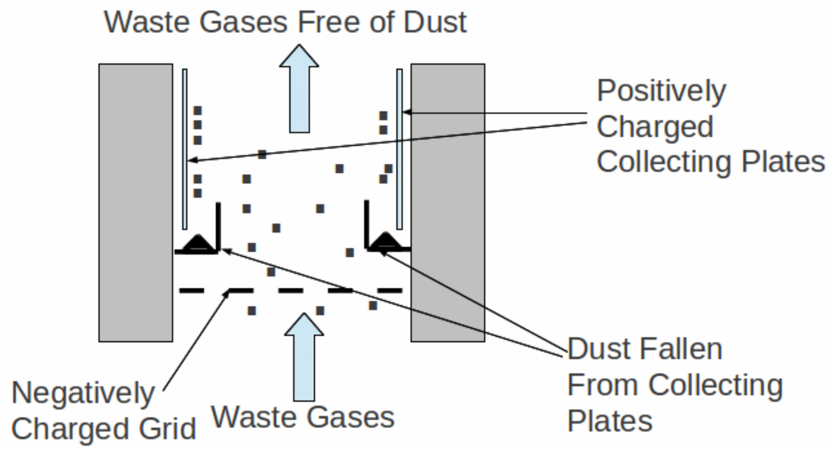
d **Classification of domestic solid waste** 4

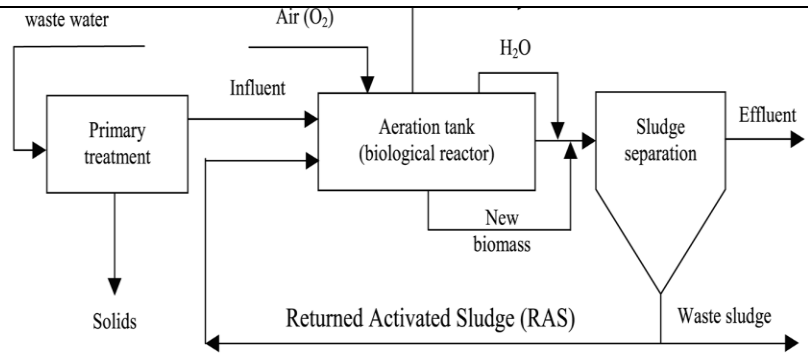
Types	Example of sources
Food wastes	Animal, fruits and vegetable residues resulting from the handling and preparation, cooking and eating of foods
Rubbish	1. Combustible papers, plastics, leather, cardboard, wood, rubber etc. 2. Non-combustible glass, aluminum

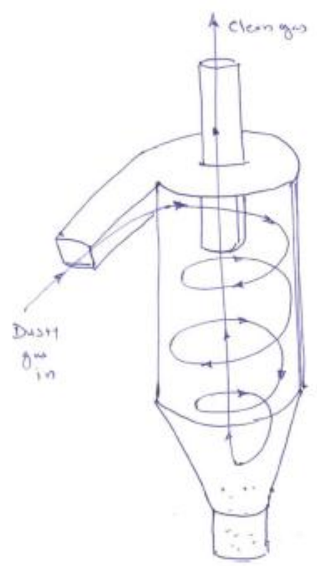
		<table><tr><td></td><td>cans crockery, tin cans, dirt, and construction wastes.</td></tr><tr><td>Ashes and residue</td><td>Material remaining from the burning of wood, coal, and coke and other combustible wastes in homes,</td></tr><tr><td>Demolition and construction waste</td><td>Wastes from construction, remolding, repairing of residential , commercial and industrial buildings</td></tr></table>	
	e	**Business Benefits of ISO14000** 1. Efficiency, discipline and operational integration with ISO 9000 2. Greater employee involvement in business operations with a more motivated workforce 3. Easier to obtain operational permits and authorizations 4. Assists in developing and transferring technology within the company 5. Helps reduce pollution 6. Fewer operating costs 7. Savings from safer workplace conditions 8. Reduction of costs associated with emissions, discharges, waste handling, transport & disposal 9. Improvements in the product as a result of process changes 10. Safer products 11. Minimizes hazardous and non-hazardous waste 12. Conserves natural resources - electricity, gas, space and water with resultant cost savings	1 mark each for any four
	f	**Grab sampling** Grab samples consist of either a single discrete sample or individual samples collected over a period of time not to exceed 15 minutes. The grab sample should be representative of the wastewater conditions at the time of sample collection. **Freeze out Sampling** In freeze out sampling a series of cold traps, which are maintained at progressively lower temperature, are used to draw the air sample, whereby the pollutants are condensed. The traps are brought to the laboratory, the samples are removed and analyses by means of gas chromatographic, infrared or ultraviolet, spectrophotometer, and mass spectrometry or by wet chemical means.	1 mark each

		Absorption In this method desired pollutant can be separated from gas stream by using satiable solvent. Absorbed gas is then separated and analyzed. **Adsorption** In this method desired pollutant gas is adsorbed on suitable adsorbent. Gas is desorbed and analyzed in laboratory.	
3		**Attempt any FOUR of the following**	**16**
	a	**Bag Filter** **Advantages** • Very high efficiency • Retention of fine particles • Low pressure drop • Collection of particle in dry form **Disadvantages** • Required large space • High construction cost • Operation temperature of gas below 285 ^{o}C **Application** Power plants, steel mills, pharmaceutical producers, food industry, chemical industry	2 1 1
	b	**Working of Gas absorber for pollution control** Gas absorption is commonly conducted in equipment which is designed to provide intimate contact between the two phases. The contact between gas and liquid can be accomplished by dispersing the liquid in the gas or vice versa. Some of the commonly used absorbers in pollution control are Packed towers, plate and spray towers and venturi scrubbers. Packed towers are very efficient absorption devices involving a continuous contact of two phases. These use a variety of packing materials ranging from specially designed ceramic packing to crushed rock. The liquid is distributed over the packing, which provides high interfacial surface area and flow down the packing surface in the form of thin film or	4

		subdivided streams. Normally the liquid and gas flow counter current to each other, the gas flowing upward and the liquid flowing downward. The use of packed towers is limited to clean gases, as any precipitate or slurry will cause plugging of packing. OR Explanation of working any one type of gas absorber may given 04 marks.	
	c	**Trickling filter** 	4
	d	**Electrostatic Precipitator** **Working:** The most basic precipitator contains a row of thin vertical wires, and followed by a stack of large flat metal plates oriented vertically, with the plates typically spaced about 1 cm to 18 cm apart, depending on the application. In cylindrical design a wire is hanged with weight inside a cylinder. The air or gas stream flows horizontally through the spaces between the wires, and then passes through the stack of plates. A negative voltage of several thousand volts is applied between wire and plate. If the applied voltage is high enough an electric (corona) discharge ionizes the gas around the electrodes. Negative ions flow to the plates and charge the gas flow particles. The ionized particles, following the negative electric field created by the power supply, move to the grounded plates.	2

			2
	e	**Activated sludge process** **Principle** - a biological wastewater treatment process which speeds up waste decomposition. Activated sludge is added to wastewater, and the mixture is aerat-ed and agitated. After a certain amount oftime, the activated sludge is allowed to settleout by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank) **Working** A basic activated sludge process consists of several interrelated components: • An aeration tank where the biological reactions occur • An aeration source that provides oxygen and mixing • A tank, known as the clarifier, where the solids settle and are separated from treated wastewater Aerobic bacteria thrive as they travel through the aera- tion tank. They multiply rapidly with sufficient food and oxygen. By the time the waste reaches the end of the tank (between four to eight hours), the bacteria has used most of the organic matter to produce new cells. The organisms settle to the bottom of the clarifier tank, separating from the clearer water. This sludge is pumped back to the aeration tank where it is mixed with the incoming wastewater or removed from the system as excess, a process called wasting. The relatively clear liquid above the sludge, the supernatant, is sent on for further treatment as required	2

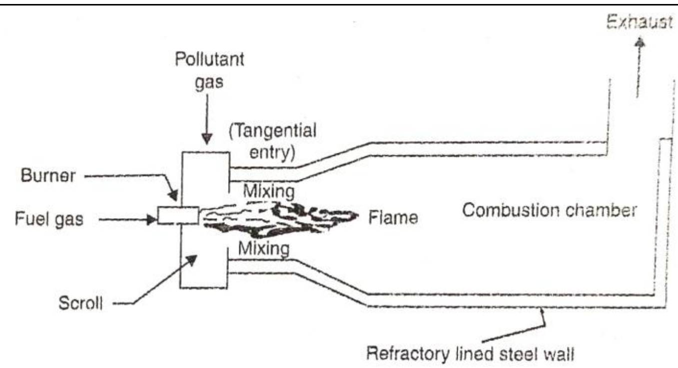
			2
	f	**Sludge Thickening Process** The sludge thickening involves removal of water from the sludge and reduces sludge volume as much as possible so that the sludge can be handled more efficiently. The common method for thickening is gravity settling. **Working of gravity thickener** In gravity thickener the sludge is subjected to gentle agitation by means of a slow stirrer which enhances settling. The stirring action serves to release trapped water and gases from the sludge, allowing it to become denser or thicker. The thickened underflow of sludge is withdrawn from the bottom of the tank; the effluent or supernatant overflows a weir and is pumped back to the inlet of the treatment plant. In this manner the combined sludge from primary and secondary settlers can be thickened so as to contain 5-9% solids	4
4	**A**	**Attempt any THREE of the following**	**12**
	a	**Physical Characteristics of waste water(any 4)** • Temperature • Odor • Color • Total dissolved solids • Turbidity **Chemical Characteristics of waste water (any 4)** • Chemical oxygen demand(COD) • pH • Acidity or alkalinity	½ mark each ½ mark each

		• Hardness • Total carbon • Chlorine demand	
	b	**Sources of water pollution:(any 4)** • Oxygen demanding waste: Organic waste from industry, sewage from domestic waste, food industry waste, distillery. • Disease causing waste : Pathogens from domestic waste • Synthetic organic compounds: Industrial waste from petrochemical Plant. • Plant nutrients: Fertilizer from farms. • Inorganic chemicals: Waste from fertilizer, acid and chloro alkali Industry. Thermal discharge: condenser water from thermal power plant. • Oil: oil from industrial equipment, crude oil tankers. **MPCB** - Maharashtra Pollution Control Board **WHO** - World Health Organization	½ mark each 1 1
	c	**Cyclone separator**  **Cyclone separator is used in (any two)** • cement dust in Cement industry to control cement dust	2 2

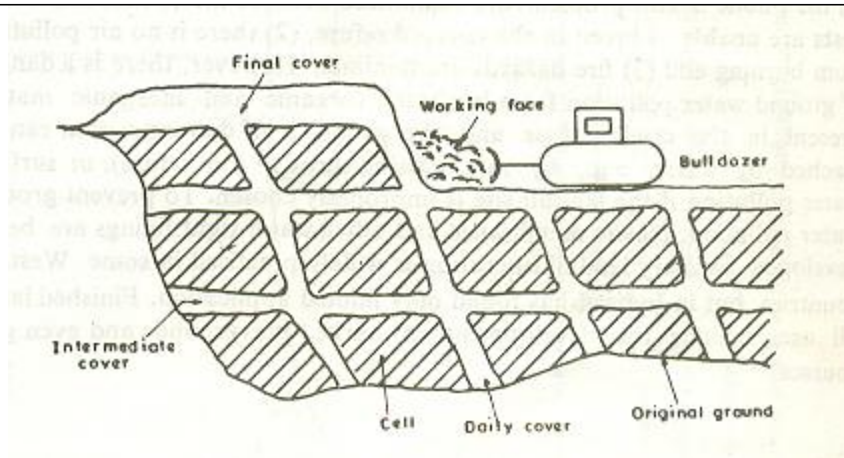
		• Oil refinery to control catalyst dust • Power plant to control ash • In metallurgical industry to control metal dust	
	d	**Environment Audit Procedure** The general approach followed for environmental audit overs three main phases, namely collection of information, evaluation of information collected and formulation of conclusions, including identification of aspects needing improvement. These phases cover pre audit preparation, a site visit normally involving interviews with personnel and inspection of facilities and post-visit activities. Environmental Audit procedure involve following activities viz., the pre-audit, at site and post-audit phases. **Pre Audit Activities**: The activities in the pre audit phase cover the nomination of the audit team, setting out of terms of reference and priorities, making all concerned aware of the objectives and scope of environmental audit and preparation of a background note. **On site Audit Activities**: In the on site phase, it is ensured the audit team and interact staff interact throughout, a thorough inspection is made in the field, sampling and tests are made as necessary, relevant records are reviewed, various persons are interviewed and tentative findings are discussed with the management. **Post Audit Activities:** In the post audit phase, the draft report is circulated for review and comments based on which the final report is prepared, and action plan is evolved. The feedback from the follow up action is provided for the next audit.	4
	B	**Attempt any ONE of the following**	**6**
	a	**Recovery of Chemicals from Black liquor** The black liquor that comes out of the pulping sequence is approximately 10-15% solids. In order to maximize the burning efficiency and get out as much energy as possible from the recovery boiler, the black liquor solids content must be increased to somewhere in the vicinity of 60-80% solids. The most common way of doing this is via multiple-effect evaporators. These evaporators remove the bulk of the water by operating in series while at different pressures. Therefore the vapor from one evaporator body can be the steam supply	6

		for the next unit. In this approach the original feed steam performs the final concentration and the vapor becomes the steam for the next less-concentrated evaporator (i.e., countercurrent operation). The recovery furnace smelt is dissolved in water to form the green liquor. The green liquor is clarified (filtered) to remove insolubles (dregs) and reacted with lime (CaO) to form the white liquor. The white liquor is then clarified to remove the precipitated lime mud ($CaCO_3$). At this point the white liquor can be submitted to the digester for chip delignification. The lime mud is reburned to form CaO in the lime kiln, and the material can be used again in converting the $NaCO_3$ to NaOH.	
	b	**Importance of Environment Management in Chemical Industry** Environmental issues are commanding considerable attention internationally. Climate change, water availability, pollution and waste generation and disposal are among the leading challenges in this regard. As a major user of raw materials and energy, and a major source of pollutants and waste, industry is an important player. Growth of industrial processing, guided mostly by the necessity of increasing productivity, has led to serious environmental degradation of water resources, soil and air around these plants. A proper Environment management plan in chemical industry can i) It helps in assessing whether the existing environmental practices being followed are satisfactory and whether the environmental protection regulations are compiled with. ii) It provides an opportunity for comprehensive review of environmental policies, management systems, organizations and practices and to assess whether introduction of new innovative practices are necessary to comply with the stringent regulations from time to time. iii) It protects against possible penalties or regulatory risk. iv) It contributes its modest share towards sustainable development and gives due credit for environmental management. v) It provides an up to date environmental data base which may be useful in emergencies and also while making decision on plant modifications. **Example (any one)** Reduction of pollution can be achieved through improvements in process chemistry, reaction	6

		kinetics, stoichiometry, conversion and yields. Similar approaches also include using different physical forms of catalysts, using water instead of volatile organic compounds (VOCs) in paints and coatings, using oxygen instead of air in oxidation reactions and thus preventing side reactions, using pigments and fluxes free of heavy metals and so on. Extensive hazard and risk analysis using techniques such as hazard operability (HAZOP) Studies and quantitative risk assessment (QRA) are conducted based on which safe systems, work practices and risk reduction measures are adopted for processing facilities. Environment management plans of the production units are capable of mitigating the risk from most expected crisis situations barring those from nightmare incidents such as earthquakes, sabotage, etc.	
5		**Attempt any FOUR of the following**	**16**
	a	**Thermal incinerator** A thermal incinerator is a process unit for air pollution control in many chemical plants that decomposes hazardous gases at a high temperature and releases them into the atmosphere. They typically used to destroy hazardous air pollutants (HAPs) and volatile organic compounds (VOCs) from industrial air streams. These pollutants are generally hydrocarbon based and when destroyed via thermal combustion they are chemically oxidized to form CO_2 and H_2O. Three main factors in designing the effective thermal oxidizers are temperature, residence time, and turbulence. The temperature needs to be high enough to ignite the waste gas.A polluted stream with hazardous gases is preheated and then introduced into a firing box through or near the burner and enough residence time is provided to get the desired destruction removal efficiency (DRE) of the VOCs. Most direct-fired thermal oxidizers operate at temperature levels between 980 °C (1,800 °F) and 1,200 °C (2,190 °F) with air flow rates of 0.24 to 24 standard cubic meters per second.	2

			2
	b	**Biomedical waste treatment (any one)** **Autoclaving**:- In this method steam is used for the sterilization. It is brought in direct contact with waste. Steam, autoclaving combines moisture, heat, and pressure to inactivate microorganisms. This process has been used for sterilizing medical instruments in hospitals for many years and the validation of autoclaving as a sterilization technique for medical equipment and supplies is well documented. All autoclaves are constructed with a metal chamber to withstand the increased pressure/temperature required to insure destruction of bacteria, viruses, and bacterial spores. Autoclaves come in two basic varieties, gravity displacement autoclaves and pre vacuum autoclaves. The size of the device may vary from bench top models designed to hold a single bag of waste to large commercial devices that can treat more than a ton of waste per cycle. Any test method developed for assessing the efficacy of treating biomedical waste in a steam autoclave should be applicable to all types and sizes of autoclaves that may be used as waste treatment devices. **Microwave treatment method:-** In microwaving, microbial inactivation occurs as a result of the thermal effect of electromagnetic radiation spectrum lying between the frequencies 300 and 300,000 MHz. Microwave heating is an inter-molecular heating process. The heating occurs inside the waste material in the presence of steam. The Microwave disinfection unit (MDU) disinfects infectious medical waste through the application of steam and microwave radiation. The infectious material is temporarily held in a waste container(s), which in turn, are emptied into an in-feed hopper via a charging system. The charging system is located at the front of the MDU. The infectious waste is fed to a shredder by the feed arm where it is shredded. The shredded material is conveyed through	4 marks for any 1 method

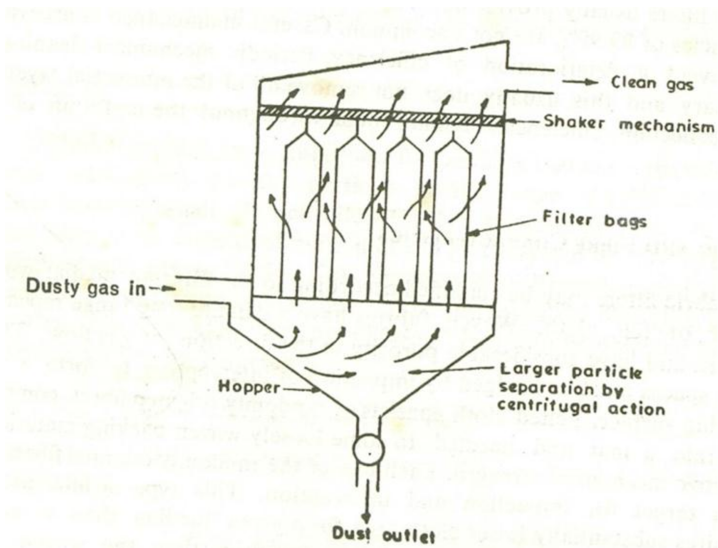
		the microwave section and temperature holding section, respectively for disinfection. The outlet of the temperature holding section protrudes near the back end of the unit and is designed to transport the disinfected waste into waste disposal containers (or compaction units). From there the material can be transported to a local municipal landfill for disposal or to a refuse recycling plant or wherever ordinary household solid waste is disposed. **Incineration** Incineration destroys harmful microorganisms and toxic substances often contained in biomedical waste. It is also the method for destroying recognizable human anatomical remains at very high temperature using fuel. The disadvantage of this method is that it releases persistent pollutants to the air, including dioxin and toxic metals such as mercury. Medical waste incinerators are a major contributor of dioxin pollution to the environment	
	c	**Sanitary landfill method** In sanitary landfill operation, refuse is spread and compacted in this layers within a small area. This layered structure is usually referred to as a cell. To allow for proper compaction, the cell depth should not exceed about 2 meters. The cell is then covered with a layer of soil which is spread uniformly and then compacted. To provide as adequate seal the 'cover' should normally be at least 20 cm thick. If the refuse includes large irregular objects it may be necessary to increase the thickness of the cover. On the other hand , a cover thickness of less than 15 cm may be satisfactory if the refuse has been pulverized. When a number of cells reach the final desired elevation, a final cover of about one meters of earth is placed and it is again compacted. This final cover is necessary to prevent rodents from burrowing into the refuse. The following figure is shows the cross-sectional area of a typical sanitary landfill.	4



	d	**Need of ISO14001** i) Environmental improvements ii) Regulatory compliance iii) Improvement of corporate image iv) Cost containment & cost saving v) Competitive advantage vi) Opening of international market & partners vii) Improvement in employee awareness about environment viii) An ethical or social commitment	1 mark each for any four
	e	**Significance of BOD and COD** **BOD:** - It is the amount of oxygen required to degrade organic waste present in water by purely biological means. The biological oxygen demand, ie, BOD in wastewater, is a measure of the quantity of bio-organic substances in wastewater. These can be in the form of fat, oils, carbohydrates and proteins. BOD also helps determine the quantum of organic chemicals contained in wastewater that are synthetic and biodegradable **COD**: - It is the amount of oxygen required to degrade organic waste present in water by purely chemical means. COD can help gauge the quantum of both biodegradable and non-biodegradable organics. It is quick method to determine strength of waste in water. Strength of waste waster can be	2 2

		finding out by knowing COD value.	
	f	**Methods used for Wastewater samplings** **Grab sampling** Grab samples consist of either a single discrete sample or individual samples collected over a period of time not to exceed 15 minutes. The grab sample should be representative of the wastewater conditions at the time of sample collection. The sample volume depends on the type and number of analyses to be performed. This involves manual sampling and minimal equipment but may be unduly costly and time-consuming for routine or large-scale sampling programs. As the name implies 'Grab samples' are simple scoops of the wastewater being sampled and are appropriate where conditions are constant or well mixed and slow to change. This type of sample can be used for instance for Balance Tank sampling or measuring sludge solids in the aeration basin (MLSS). Care should always be taken that a grab sample is representative of the whole, and should be taken from well-mixed areas on all occasions. **Composite sampling** consists of a collection of numerous individual discrete samples taken at regular intervals over a period of time, usually 24 hours. The material being sampled is collected in a common container over the sampling period. The analysis of this material, collected over a period of time, will therefore represent the average performance of a wastewater treatment plant during the collection period. When wastewater flow and composition are relatively uniform grab samples of a fixed volume can be manually taken at given time intervals and composite sample obtained. If the flow rate varies the volume of the grab sample collected is proportional to the flow.	2 2
6		**Attempt any FOUR of the following**	**16**
	a	**Working of fabric filter** Dust-laden gas or air enters the fabric filter through hoppers (large funnel-shaped containers used for storing and dispensing particulate) and is directed into the fabric filter compartment. The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it. When sufficient pressure drop (delta P) occurs, the cleaning process of bag begins. Cleaning can take place while the fabric filter is online (filtering) or is offline (in	4

isolation).When the compartment is clean, normal filtering resumes.



b **CPCB air quality standards: (any 4)** — 1 mark each for any four

Sr. No	Pollutant	Total Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural and other area	Ecologically sensitive area
1	Sulphur dioxide (SO2) µg/m^3	Annual* 24 hours**	50 80	20 80
2	Nitrogen dioxide(NO2) µg/m^3	Annual* 24 hours**	40 80	30 80
3	Particulate matter (size <10µm) µg/m^3	Annual* 24 hours**	60 100	60 100
4	Particulate matter (size <2.5µm)	Annual* 24 hours**	40 60	40 60

	μg/m^3			
7	Carbon monoxide mg/m^3	8 hours** 1 hour**	02 04	02 04

c **Trickling filter** — 4

A trickling filter is used for treatment of waste water. It consists of a bed of highly permeable media on whose surface a mixed population of microorganisms is developed as a slime layer. Passage of wastewater through the filter causes the development of a gelatinous coating of bacteria, protozoa and other organisms on the media. With time, the thickness of the slime layer increases preventing oxygen from penetrating the full depth of the slime layer. In the absence of oxygen, anaerobic decomposition becomes active near the surface of the media. Parts of trickling filter are

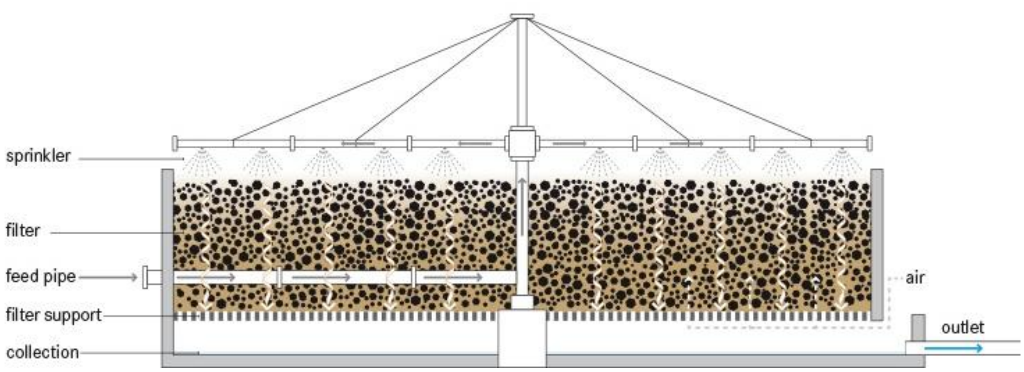
Sprinkler : To sprinkle waste water on filter

Filter: To hold biological slime

Feed pipe : Inlet for waste water

Filter support: To hold filter media

Effluent channel: to take out treated waste water

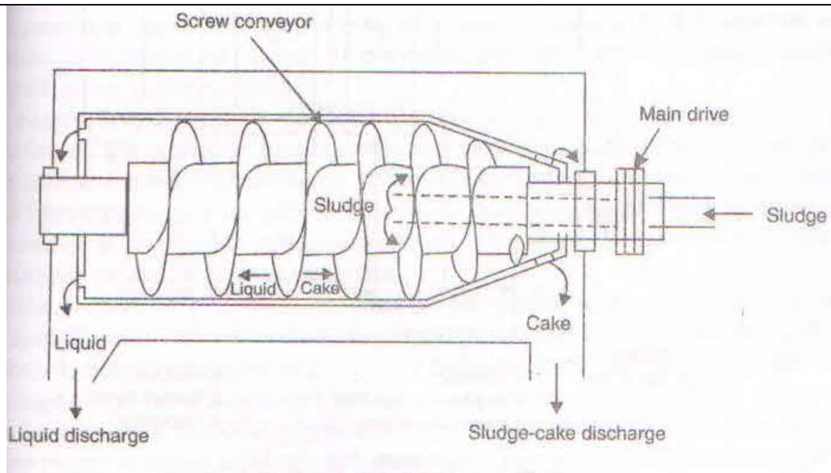


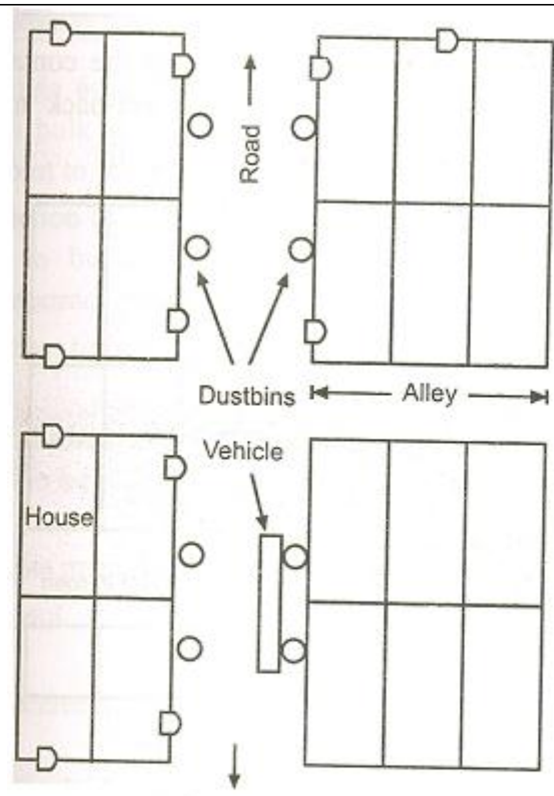
d **Pollution control in fertilizer plant** — 4 marks for any one method

Air

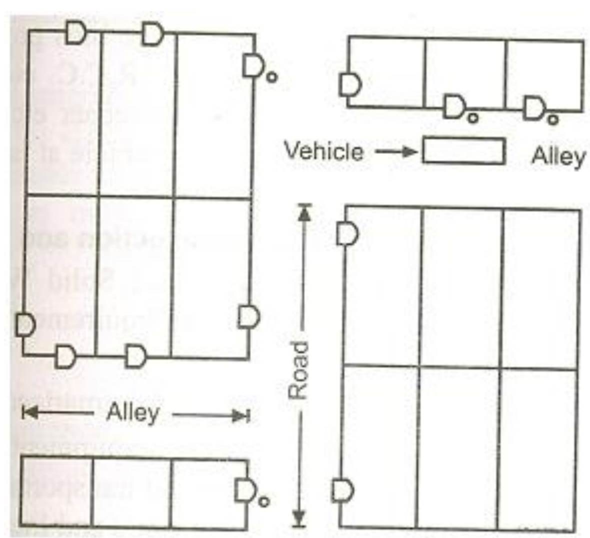
Main emissions sources from the production of fertiliser are continuous process vents from the synthesis section containing ammonia, and waste gases from solid formation (prilling or granulation) containing ammonia and dust (solid urea particles). Ammonia emissions result

		from the decomposition of urea during solid formation. Off-gases from prilling towers contain significant amounts of dust. The ratio of particles with a size below 10 μm is typically rather high in off-gases of prilling towers. Conventional absorption equipment is used for removing ammonia emissions from continuous process vents. Off-gases from solid formation processes are treated by wet scrubbing techniques, in order to reduce ammonia and dust emissions. Process condensate arising from the evaporation of urea solution is usually used for scrubbing liquor. An acidic washing solution can be used for scrubbing liquor, in order to increase the efficiency for NH3 removal. In that case the scrubbing solution cannot be recycled into the urea production process, due to the high content of ammonium nitrate. The scrubbing liquor can be recycled into fertiliser production processes if there is fertiliser production at the same site. **Liquid** Process condensate (about 300 kg H_2O/t urea) is the main source of waste water arising from fertilizer production. The major part of the condensate arises in the evaporation unit. The condensates contain large amounts of NH_3, urea and CO_2, which are recovered from the process condensate and recycled into the urea synthesis. Purified process condensate is sent to a waste water treatment plant or discharged into running waters. Exhaust vapours from evaporation of the urea solution are washed before they are condensed. Ammonia is separated and recovered from the process water by distillation. By way of distillation, the ammonia concentration in the process condensate is reduced from 66 mg/l to 37 mg/l. Waste water is daily analyzed and discharged into the running water together with cooling water.	
	e	**Sludge dewatering** is accomplished by mechanical methods, the most common being centrifugation and filtration, which includes pressure filtration and vacuum filtration. In centrifugation, conditioned sludge is added to a rotating bowl that separates the sludge into a cake and a dilute stream. The solid cake is transported within the bowl and is removed by a screw conveyor at one end of the bowl the liquid is removed at the opposite end. Centrifugation is a compact method which requires careful control of process variables.	4

		 Solid-bowl centrifuge	
	f	**Solid waste collection method** **Curbside collection, or Kerbside collection,** is a service provided to households, typically in urban and suburban areas, of removing household waste. It is usually accomplished by personnel using purpose built vehicles to pick up household waste in containers acceptable to or prescribed by the municipality.Kerbside collection is today often referred to as a strategy of local authorities to collect recyclable items from the consumer. Kerbside collection is considered a low-risk strategy to reduce waste volumes and increase recycling rates. Materials are typically collected in large bins, coloured bags, or small open plastic tubs, specifically designated for content. **Alley service**: this method is similar to the previous one, except that the containers are placed at the alley line instead of curb.	4 marks for any one method



Curb service



Alley service