WINTER– 17 EXAMINATION
Model Answer

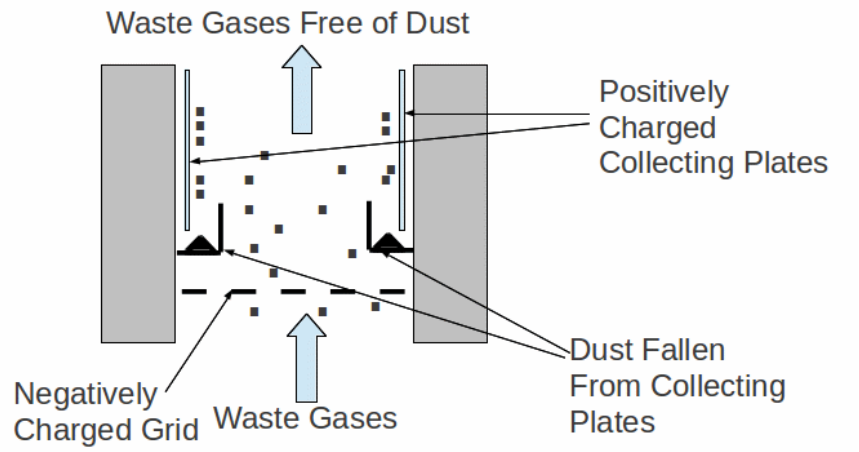
Subject Name: Environment Technology **Subject Code:** 17646

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	**Air Pollution:** Air pollution is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing disease, death to humans and damage to other living organisms such as food crops, or the natural or built environment. **Manmade sources(any 4)** • Rapid Industrialization • Transportation • Burning of fossil fuel and fires • Agricultural activities • Solid waste disposal • Construction activities	2 ½ mark each
1	b	**Definition:** **BOD: -** It is the amount of oxygen required to degrade organic waste present in water by purely biological means.	2

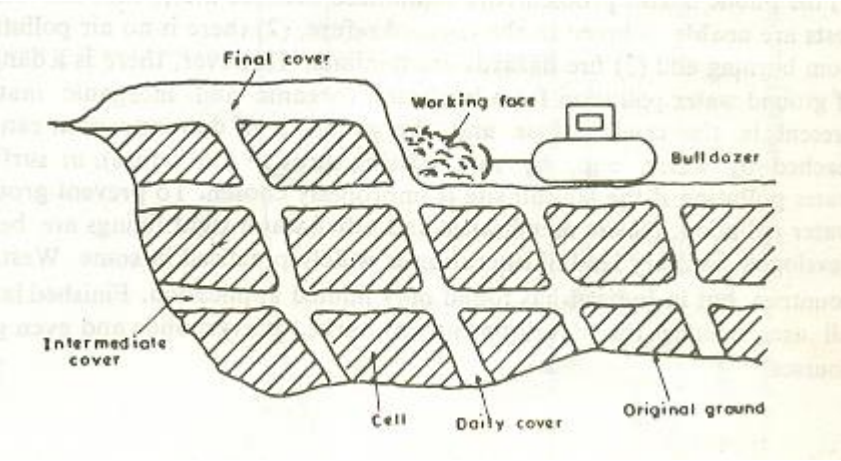
		COD: - It is the amount of oxygen required to degrade organic waste present in water by purely chemical means.	2
1	c	**Methods used for pollution control in Pulp and Paper industry:** • Sedimentation and floatation • Chemical Flocculation • Activated carbon absorption • Ultra Filtration • Reverse Osmosis • Chemical Oxidation • Activated Sludge Process • Aerated Lagoons	4
1	d	**Classification of Biomedical Waste** The World Health Organization (WHO) has categorized the BMW into eight categories, includes, • General Waste • Infectious or dangerous waste • Radioactive • Chemical • Pathological • Pressurized containers • Pharmaceuticals	4
1	**B**	**Attempt any one of the following**	**6**
1	a	**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	3

		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.  	3
1	b	**Solid waste collection methods** **Methods for collecting solid waste(any 2)** **Communal storage point:-** Waste is collected in concrete bins located at one point. Daily it is transferred to deposal area by vehicle. **Block collection:-** in block collection the waste is brought in a container by individuals to a waiting vehicle which travels a regular route twice or thrice a week. The containers are emptied by the vehicle crew and returned to the individuals. **Kerbside collection:-** In this method waste is brought in containers and placed on the footway in advance of the collection time to be retrieved latter. **Ghanta Gadi: -** In this method vehicle is coming near the building by sounding bail.	2

Peoples are transferring waste from their house to ghantagadi

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. — 2



— 2

2 **Attempt any four of the following** — **16**

2 a **CPCB air quality standards: (any 4)** — 1 mark each

Sr. No	Pollutant	Total Weighted Average	Concentration in Ambient Air	
			Industrial, Residential,	Ecologically sensitive

				Rural and other area	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) µg/m^3	Annual* 24 hours**	40 60	40 60
		7	Carbon monoxide mg/m^3	8 hours** 1 hour**	02 04	02 04
2	b	**Function of pollution control board :-** 1. To promote cleanliness of streams and wells in different areas of the States through prevention, control and abatement of water pollution; 2. To improve the quality of air and to prevent, control or abate air pollution in the country; 3. Advise the Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air; 4. Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution;				1 mark each for any four

		5. Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution; 6. Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution; 7. 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; 8. 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; 9. Disseminate information in respect of matters relating to water and air pollution and their prevention and control; 10. 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; 11. Establish or recognize laboratories to enable the Board to perform; 12. Perform such other functions as and when prescribed by the Government of India. 13. 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.	
2	c	**Difference between primary and secondary waste treatment methods(any 2)**	2 marks each

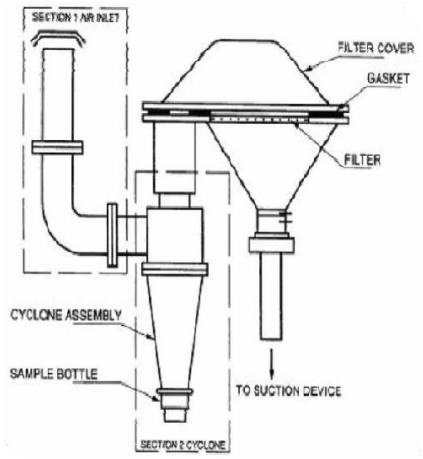
Sr. No	Primary sewage treatment	Secondary sewage treatment
1.	It is a physical method of treatment	It is a biological method of treatment
2.	It involves in removal of large particles	It involves the removal of fine suspended

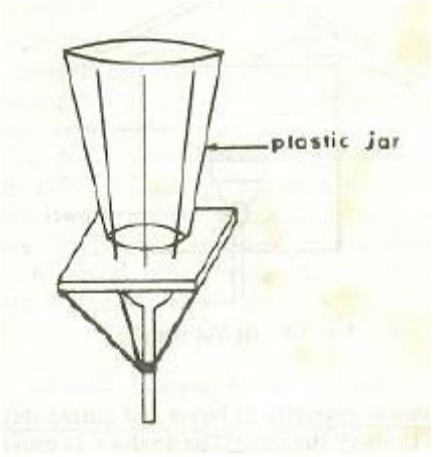
			and floating materials such as sand, grit and oily substances	and dissolved organic matter.	
		3.	It makes the used of sedimentation and filtration process	It makes the use of aerobic or anaerobic biological units	
		4.	It is relatively simple and less time consuming process	It is relatively complex and takes a long time for its completion	
2	d	**Biomedical waste disposal methods:** **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	2 mark each for any 2

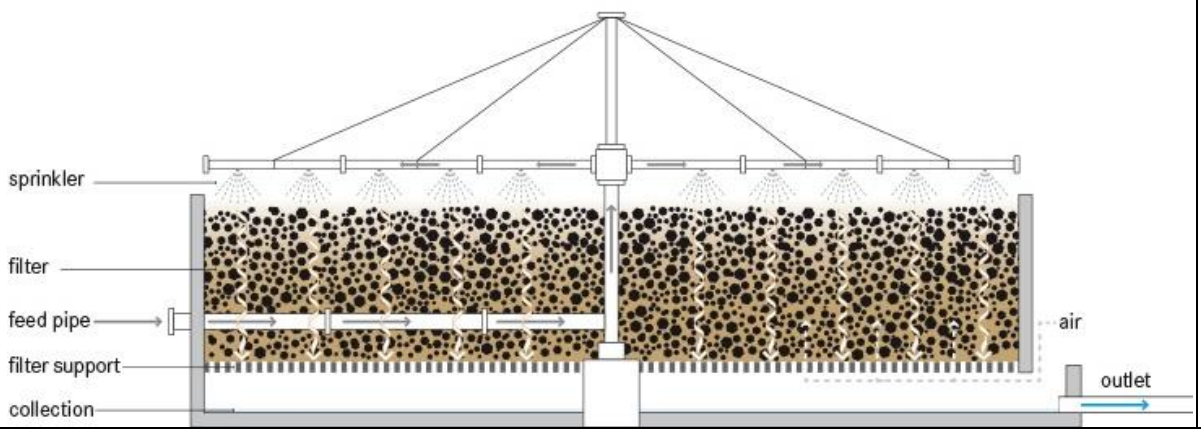
		through the microwave section and temperature holding section, respectively for disinfection. The outlet of the temperature holding section protrudes near the back end of the unit and is designed to transport the disinfected waste into waste disposal containers (or compaction units). From there the material 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	
2	e	**Business Benefits of ISO 14000:(any 4)** 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	1 mark each

		10. Safer products 11. Minimizes hazardous and non-hazardous waste 12. Conserves natural resources - electricity, gas, space and water with resultant cost savings 13. Prevents pollution and reduces wastage 14. Demonstrates to customers that the firm has met environmental expectations. 15. Meets potential national and international government purchasing requirements. 16. Delivers profits from marketing "green" products 17. Provides a competitive marketing tool 18. Improves international competitiveness 19. Improves the organization's relationship with insurance companies 20. Elimination of costs associated with conformance to conflicting national standards 21. Process cost savings by reduction of material and energy input 22. Satisfying investor / shareholder criteria 23. Helps reduce liability and risk 24. Improved access to capital	
3		**Attempt any four of the following**	**16**
3	a	**Classification of air pollutants** **According to origin** 1) Primary Pollutants: These are directly emitted to environment from source. CO, CO_2, SO_2, HC 2) Secondary Pollutants: These are derived from primary pollutants.	2

		Ozone, PAN, smog **According to State of Matter** 1) Gaseous pollutants: In gaseous form. CO, CO_2, SOx, NOx, HC 2) Particulate matter: Dispersed in air. Other than gas a) Dust : Particle size 1 to 200 micrometer b) Smoke : Particle size 0.01 to 1 micrometer c) Fumes : Particle size 0.1 to 1 micrometer d) Mist : Liquid droplets smaller than 10 micrometers condensed in air. e) Fog : Water droplets in air. f) Aerosols : All air born suspension either liquid or gases.	2
3	b	**Effect of SO_2 and CO on human health** **Sulfur dioxide (SO_2)** :(any 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. **Carbon monoxide :(any 2)** vii) Carbon monoxide has a great affinity for the hemoglobin in the blood and combines with blood to form carboxyhemoglobin. This reduces the ability of hemoglobin to carry oxygen to the body tissues.	2 2
3	c	**Types of water pollutants** 1. Oxygen demanding waste: Organic waste, sewage, food industry waste, distillery.	1 mark each for any four

		2. Disease causing waste : Pathogens 3. Synthetic organic compounds: Industrial waste from petrochemical Plant. 4. Plant nutrients: Fertilizer from farms. 5. Inorganic chemicals: Waste from fertilizer, acid and chloro alkali Industry. 6. Thermal discharge: condenser water from thermal power plant. 7. Oil: oil from industrial equipment, crude oil tankers.	
3	d	**Techniques used for particulate sampling** 1. Sedimentation (Dust Fall Jar) 2. High Volume filtration (High Volume Sampler) 3. Tape Sampler 4. Electrostatic precipitation **High Volume Sampler**  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.	1 3 marks for any one method

		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. **Dust fall jar** It is a simple device used for sampling air particles larger than 10 micrometer in diameter. A typical collector consists of plastic jar of about 20-35 cm height and 10-15 cm diameter at the base with a slight tapering of the wall from top to bottom. A holder is provided to ensure safe and upright position of the collector. The sample is deposited over a period of one month and the material is dried and weighed. Usually only water insoluble dust fall is reported in 4mg/cm2. Since dust particles larger than 10 micrometer are seldom carried for the distance in excess of 1 km, dust fall station must be closely spaced for any meaningful data. 	
3	e	**Methods used for Wastewater sampling are**: i) **grab sampling ii) composite sampling**.	01 Explanation

		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.	of any one with example may be given 03marks
3	f	**Trickling Filter**  	**4**

4	**A**	**Attempt any three of the following**	**12**
	A-a	**Importance of dewatering of sludge in sludge management:** 1. The costs for trucking sludge to the ultimate disposal site become substantially lower when the volume is reduced by dewatering 2. Dewatered sludge is generally easier to handle than thickened or liquid sludge. 3. Dewatering is required normally prior to the incineration of the sludge to increase the calorific value by removal of excess moisture. 4. Dewatering is required before composting to reduce the requirements for supplemental bulking agents. 5. In some cases removal of excess moisture may be required to render sludge odorless and non putrescible 6. Dewatering is required prior to land filling sludge to reduce leachate production of the landfill site	4
4	A-b	**Physical Characteristics of waste water**:(any 4) i) Temperature ii) Odor iii) Color iv) Total dissolved solids v) Turbidity **Chemical Characteristics of waste water**:(any 4) i)Chemical oxygen demand(COD) ii) pH iii)Acidity or alkalinity iv) hardness v) Total carbon vi) Chlorine demand	2 2
4	A-c	**Effect of air pollution on material:(any 4)** 1. The particulate matter i.e. fumes, soot, mist, etc. causes severe damage to buildings & monuments.	1 mark each

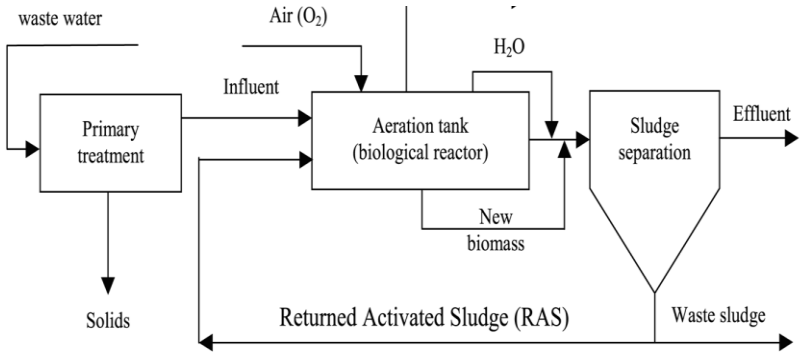
		2. The corrosive activity is enhanced in the presence of particulate pollutants. 3. Corrosive particulates cause severe damage. 4. Particulates cause cracks & fading in pointed surfaces. 5. Particulates accumulate on the soil surfaces causing soil erosion. 6. Particulates cause smog formation which may be dangerous to materials. 7. Particulate pollutants can damage cotton and rayon fibers. 8.Ozone causes weathering effect to fabrics and rubber.	
4	A-d	**The necessity of environmental audit for any chemical plant**: 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.	4
4	**B**	**Attempt anyone of the following**	**6**
4	B-a	**Effluent treatment in Urea Plant** **Gas** Main emissions sources from the production of urea are continuous process vents from the	2

		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 H2O/t urea) is the main source of waste water arising from urea production. The major part of the condensate arises in the evaporation unit. The condensates contain large amounts of NH3, urea and CO2, 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 37 g/l to 66 mg/l. Table 28 presents specific waste water emissions from the production of urea. Waste water is daily analysed and discharged into the running water together with cooling water.	2

		Solid For all fertilizers plants, solid materials may be found in storage piles, settled dust and other similar forms. The following are the major solid wastes in different production lines of fertilizers. Prills coating material in the bagging section are collected and recycled.	2
4	B-b	**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.	02 02 02
5		**Attempt any four of the following**	**16**
5	a	**Advantages and disadvantage of electrostatic precipitator:(2 each)**	2 marks for advantages and 2 marks

			Advantages	**Disadvantages**	for disadvantages
			Power requirement is less compared to other equipments	Higher intimal coat	
			Simple to operate	Large space requirement	
			99+ efficiency can be obtained.	Sensitive to variable particulate loading	
			Can handle both gases and mist	Safeguard of operating personnel is required due to high voltage	
			Very few moving parts, hence less maintenance	Collection efficiency can deteriorate gradually.	
5	b	**Incineration for solid waste** Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas and heat. The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas. The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. In some cases, the heat generated by incineration can be used to generate electric power. Incineration with energy recovery is one of several waste-to-energy technologies such as gasification, pyrolysis and anaerobic digestion. While incineration and gasification technologies are similar in principle, the energy product from incineration is high-temperature heat whereas combustible gas is often the main energy product from gasification. Incinerators reduce the solid mass of the original waste by 80–85% and the volume (already compressed somewhat in garbage trucks) by 95–96%, depending on composition and degree of recovery of materials such as metals from the ash for recycling. This means			4

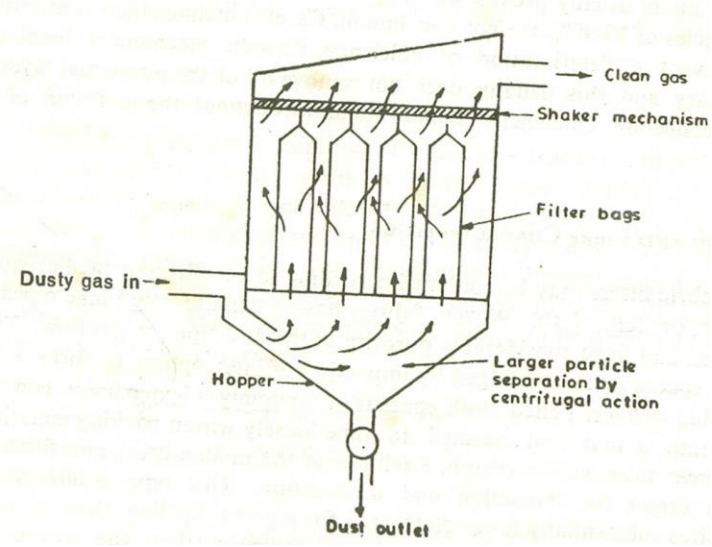
		that while incineration does not completely replace landfilling, it significantly reduces the necessary volume for disposal. Garbage trucks often reduce the volume of waste in a built-in compressor before delivery to the incinerator. Alternatively, at landfills, the volume of the uncompressed garbage can be reduced by approximately 70% by using a stationary steel compressor, albeit with a significant energy cost. In many countries, simpler waste compaction is a common practice for compaction at landfills. Incineration has particularly strong benefits for the treatment of certain waste types in niche areas such as clinical wastes and certain hazardous wastes where pathogens and toxins can be destroyed by high temperatures. Examples include chemical multi-product plants with diverse toxic or very toxic wastewater streams, which cannot be routed to a conventional wastewater treatment plant.	
5	c	**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 clari-fier, where the solids settle and are separated from treated wastewater • A means of collecting the solids either to return them to the aeration tank, (return activated sludge [RAS]), or to remove them from the process (waste activated sludge [WAS]).	2

		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
5	d	**Need of ISO14001: (any 8)** 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	1/2 mark each
5	e	**Preliminary treatment** consists of screening and grit removal. **Large quantities of floating rubbish** such as cans, cloth, wood and other larger objects	1 mark

		present in waste water are usually removed by metal bars, acting like strainers as the waste water moves beneath them in an open channel. **Removal of gross solids** is generally accomplished by passing waste water through mixed or moving screens. The modern mechanical screens cum filters include rotary, self-cleaning, gravity type units and circular overhead fed vibratory units which are effective in reducing the suspended solid and BOD. **Grit is removed** in the early stages of treatment in grit channels or tanks. Grit, being heavier than organic solids, can be separated from organic solids by careful regulation of the flow velocity in the grit tanks. **If the waste water contains appreciable quantities of oil and grease,** then it is advisable to remove as much of these as possible, in the preliminary treatment itself to avoid adverse effects on the rest of plant. This is achieved by passing the waste water through skimming tanks where oil and grease are skimmed off.	1 mark 1 mark 1 mark
5	f	**Advantages and Disadvantages of grab and composite sampling** **Grab Sampling:** It is sampling of waste water is a single sample taken at specific time. *Advantages:* It is useful to determine effects of extreme conditions. Grab samples do provide an immediate sample, and are thus to be preferred for some tests. *Disadvantages:* It is showing only prevailing conditions at the time of sampling. Grab samples are most appropriate to small plants with low flows. **Composite sampling** : A composite sample, also known as an integrated sample, is a sample which consists of a mixture of several individual grab samples collected at regular and specified time periods, each sample taken in proportion to the amount of flow at that time. *Advantages:* It takes into account changes in flow and other characteristics of the water	2 2

		over time. Hence provide meaningful data. *Disadvantages:* Composite samples cannot be used for tests of water Characteristics which change during storage (such as dissolved gases) or of water characteristics which change when samples are mixed together (such as pH.)	
6		**Attempt any four of the following**	**16**
6	a	**Application of wet scrubber:(any 4)** For removal of pollution like • HCl fumes • Lime kiln dust • Phosphoric acid mist • Odorous mist • Aluminum refining furnace exhaust • Various chemical process **Application of electrostatic precipitator:(any 4)** For the collection of dust, fumes and smoke in • Steel industry • Metallurgical industry • Cement industry • Kraft paper mill • Sulfuric acid plant • Petroleum refinery • Power plant	2 2
6	b	**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	2

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



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6 c **Drinking water quality standards specified by WHO(any 4)**

Sr. No.	constituent	Recommended max. concentration in mg/l	Max. permissible concentration in mg/l
	Physical:		
1	Turbidity(units)	5	25
2	Color(units)	5	50
	Chemical		
3	pH, units	7-8.5	6.5 or 9.2

1 mark each for any four points

			4	Total solids	500	1500	
			5	Calcium	75	200	
			6	Magnesium	50	150	
			7	Iron	0.3	1.0	
			8	Copper	1.0	1.5	
			9	Sulphate	200	400	
			10	Phenols	0.001	0.002	
				Toxic			
			11	Arsenic	-	0.2	
			12	Chromium	-	0.05	
			13	Cyanide	-	0.01	
			14	Lead	-	0.1	

6 d **Necessity of recovery of chemicals from black liquor :** 4

1) The dark color of the effluent is due to the lining compounds which are not easily biodegradable and hence it imparts persistent color to the receiving water streams and inhibits photosynthesis and other natural self-purification process of the water streams.

2) The immediate oxygen demand of the effluent brings about depletion of oxygen of the receiving stream create adverse effects to aquatic life.

3) The chemicals present in the effluent, e.g. sulfites, phenols, free chlorine, methyl mercaptant are harmful to fauna and flora of the receiving water.

4) The settleable materials present may sink to the bottom and interfere with aquatic life.

		5) Raw material cost can be reduced after recovery of chemicals.	
6	e	**DO:-** Dissolved oxygen (DO) 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. In order to metabolize food and reproduce, each microor-ganism (or bug) must have at least 0.1 to 0.3 mg/L DO. In waste water treatment oxygen must be provided for the microorganism by forcing it into water by aerator. **TDS:-** Total dissolved solids (TDS) 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. It is generally agreed that the total dissolved solids concentration of good, palatable drinking water should not exceed 500 mg/L. However, higher concentrations may be consumed without harmful physiological effects and may indeed even be more beneficial. This limit was primarily set on the basis of taste thresholds. Livestock and wildlife may be injured by drinking water that contains excessive dissolved solids. **TSS :-** Total suspended solids (TSS) is the dry-weight of particles trapped by a filter. It is a water quality parameter used for example to assess the quality of wastewater after treatment in a wastewater treatment plant. **pH:-** pH adjustment by addition of acidic/basic chemicals is an important part of any wastewater treatment system as it allows dissolved waste to be separated from water during the treatment process. By chemically adjusting the pH we can remove heavy metals and other toxic metals from water.	1 1 1 1
6	f	**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	4

		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. **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.	