

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Summer-13 EXAMINATION

Model Answer

Subject & code:EVT(12298)

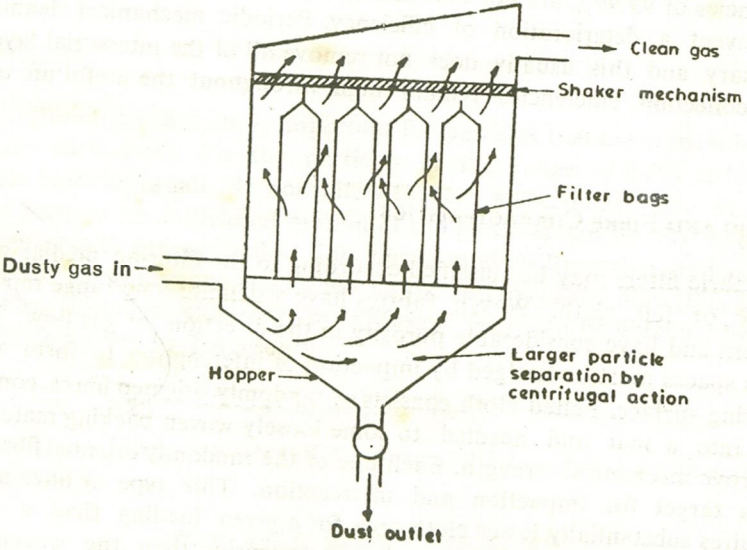
Important instructions to examiners :

1. The answers should be examined by keywords and not as word to word as given in the model answer scheme.
2. The model answer and the answer written by candidate may vary, but the examiner may try to assess the understanding level of the candidate.
3. The language errors such as grammatical, spelling errors should not given more importance.
4. While assessing figures, examiner may give credit for principal components indicated in a 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 answer and model answer.
6. In case of some questions credit may be given by judgment of relevant answer based on candidates understanding.

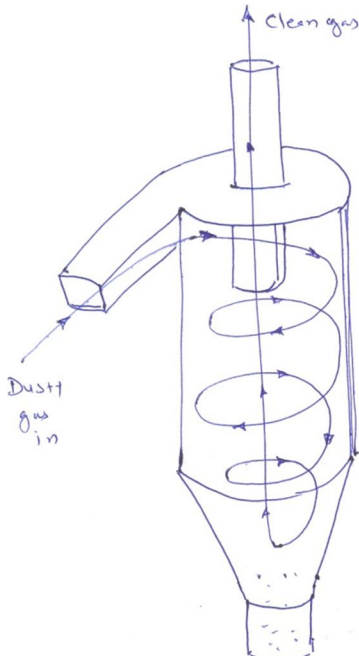
Q no:	Answer	mark	Total marks
1A i	<p>A substance in the air that can be harmful to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment.</p> <p>Manmade sources</p> <ul style="list-style-type: none">• Motor Vehicles• Industries• Power Plants• Refuse Disposal• Transportation Services <p>Commercial and agricultural activities</p>	1+3	4

ii.	Functions of Pollution control board <ul style="list-style-type: none">• Advise the Central Government on any matter concerning prevention and control of water pollution• Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water pollution;• Plan and organise training of persons engaged in programmes for prevention, control or abatement of water pollution;• Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water pollution;• Collect, compile and publish technical and statistical data relating to water pollution and the measures devised for their effective prevention, control and abatement;• Establish or recognize laboratories to enable the Board to perform tests To collect Cess on water use	4	4												
iii.	Sources of solid waste <table><tr><th>Source</th><th>Typical waste generators</th><th>Types of solid wastes</th></tr><tr><td>Residential</td><td>Single and multifamily dwellings</td><td>Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).</td></tr><tr><td>Industrial</td><td>Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.</td><td>Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.</td></tr><tr><td>Commercial</td><td>Stores, hotels, restaurants,</td><td>Paper, cardboard, plastics, wood, food wastes, glass,</td></tr></table>	Source	Typical waste generators	Types of solid wastes	Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).	Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.	Commercial	Stores, hotels, restaurants,	Paper, cardboard, plastics, wood, food wastes, glass,	1 mark each for Any four	4
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		markets, office buildings, etc.	metals, special wastes, hazardous wastes.		
	Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.		
	Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.		
	Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.		
	Process (manufacturing, etc.)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay, tailings.		
	Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).		
iv	<p>Step Aeration</p>			4	4

1 b i	<p>Advantages</p> <ul style="list-style-type: none"> • Very high efficiency • Retention of fine particles • Low pressure drop • Collection of particle in dry form <p>Disadvantages</p> <ul style="list-style-type: none"> • Required large space • High construction cost • Operation temperature of gas below 285 °C <p>Application</p> <ul style="list-style-type: none"> • Power plants • Cement plant • Metallurgical industries • Food industry • Foundry • Incineration plants 	3+1+1 +1	6
1.b.ii	<p>Activated Sludge Process</p> <p>The most common suspended growth process used wastewater treatment is the activated sludge process as shown in figure. Activated sludge plant involves:</p> <ol style="list-style-type: none"> 1. wastewater aeration in the presence of a microbial suspension, 2. solid-liquid separation following aeration, 	2+4	6

	<p>3. discharge of clarified effluent,</p> <p>4. wasting of excess biomass, and</p> <p>5. Return of remaining biomass to the aeration tank.</p> <p>In activated sludge process wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolize the suspended and soluble organic matter. Part of organic matter is synthesized into new cells and part is oxidized to CO₂ and water to derive energy. In activated sludge systems the new cells formed in the reaction are removed from the liquid stream in the form of a flocculent sludge in settling tanks. A part of this settled biomass, described as activated sludge is returned to the aeration tank and the remaining forms waste or excess sludge.</p> <p>1. Pretreatment 2. Primary clarifier 3. Aeration tank 4. Secondary clarifier 5. Thickener 6. Sludge digestion</p> <p>— Liquid flow --- Sludge flow</p>		
2a	<p>Cyclone separator</p> <p>A dust laden gas enters in a cyclone separator takes spiral motion. It utilizes a centrifugal force generated by spinning gas stream to separate particle matter from the gas. The centrifugal force on a particles in spinning gas stream is much greater than gravity, there for it is effective in removing small particles. The gas spirals downwards to the bottom of</p>	4+1+3	8

	<p>the cone and at, and at the bottom the gas flow reverses to form an inner vortex which leaves through the outlet pipe.</p> <p>Application</p> <p>Cyclone separator is used to separate gas-solid, gas-liquid</p> <ul style="list-style-type: none"> • Cement industry • Oil refinery • Petrochemical Plant • Power plants • Metallurgical Industry 		
2.b	<p>Environmental audit</p> <p>An environmental audit is typically undertaken in three phases:</p> <ul style="list-style-type: none"> • Pre-audit • On-site audit • Post-audit <p>Each of these phases comprises a number of clearly defined Objectives, with each objective to be achieved through specific Actions, and these actions yielding results in the form of Outputs at the end of each phase.</p> <p>Pre-Audit Activities</p> <p>Objectives</p>	6+2	8

	<p>To develop an audit plan for the on-site activities</p> <p>To make the necessary preparation and arrangements for the on-site audit.</p> <p>Actions</p> <p>1. Develop an Audit Plan</p> <p>The Audit Plan should address:</p> <p>Where: audit site & boundary with overview</p> <p>What: scope & objectives</p> <p>How: site personnel interview, site inspection, audit protocols; site logistics and administrative arrangement</p> <p>Who: audit team and site facilitation arrangement</p> <p>When: audit schedule and milestones</p> <p>The Audit Team is subsequently to:</p> <ul style="list-style-type: none"> • Seek agreement from AMC on audit plan • Establish the reporting structure <p>Prepare Pre-Audit Questionnaire</p> <p>To prepare questionnaire and document checklists on the "hard" issues:</p> <ul style="list-style-type: none"> • Overall environmental management • Procurement policy • Energy management • Materials management • Water and wastewater management • Waste management • Noise monitoring and control • Air quality monitoring and control • Emergency response procedures <p>The "soft" issues:</p> <ul style="list-style-type: none"> • Transportation and travelling • Staff awareness and training • Publicity of environmental information • Response to public enquiries and complaints <p>The questionnaire and checklists are to be forwarded to the relevant site personnel for completion.</p> <p>Review Background Information</p> <p>To gain familiarity with audit site through review of:</p> <ul style="list-style-type: none"> • Site layout plan(s) • Site history, use and activities 		
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	<ul style="list-style-type: none"> • Blue prints/as built drawings • Organisational structure at audit site(s) • Internal environmental policies, procedures and guidelines <p>Review Operational Information</p> <p>To gain appreciation of site activities and operational practices onsite through review of:</p> <ul style="list-style-type: none"> • Operational activities and process descriptions • Management system policies, procedures and program documentation • Relevant records (compliance, monitoring, training, maintenance, calibration etc.) • Other relevant information pertaining to environmental management practices <p>Conduct Initial Site Visit</p> <p>To arrange with the site facilitator(s) for an initial visit during normal operation of audit site to:</p> <ul style="list-style-type: none"> • Meet with officer-in-charge to explain purpose of audit • Assess whether background information gathered is up to date and accurate • Follow-up on the list of preliminary audit impressions • Identify and request additional site information as necessary • Confirm thoroughness of audit scope • Establish adequacy of resources for audit <p>Develop On-Site Questionnaire and Audit Protocols</p> <p>To develop a series of step-by-step questions and evaluation criteria to assess:</p> <ul style="list-style-type: none"> • Compliance with pertinent legislative and regulatory requirements • Conformance with internal environmental policies, procedures and guidelines • Status of current environmental practices • Staff awareness of internal environmental policies, procedures and guidelines <p>Review Audit Plan and Arrange Logistics</p> <p>All documents and arrangements should be updated or revised to reflect current knowledge and conditions. Key points to review include:</p>		
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	<ul style="list-style-type: none"> • Audit scope • Audit schedule • Audit protocols • Allocated resources <p>Certification of Audit</p> <p>ISO 14001 is a voluntary international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004 gives general EMS guidelines. An EMS meeting the requirements of ISO 14001:2004 is a management tool enabling an organization of any size or type to:</p> <ol style="list-style-type: none"> 1. Identify and control the environmental impact of its activities, products or services; 2. Improve its environmental performance continually, and 3. Implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved. <p>Organizations implementing ISO 14001 usually seek to obtain certification by independent Certification Bodies. Certification indicates that the documentation, implementation and effectiveness of the EMS conform to the specific requirements of ISO 14001.</p>		
2.c	<p>For solid waste management 3R principle is used. It Reuse, Recycle and Reduce.</p> <p>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. Other examples are</p> <ul style="list-style-type: none"> • Reuse used glass and plastic containers as receptacles. • Reuse your old mouse pad as an insulator for placing hot containers that have just been removed from stove or oven, or as a beer mat. • Use unwanted plastic bags to bag garbage. • Use old clothing as rags for cleaning. • Convert scrap paper into memo pads. • Pass old textbooks, story books, and toys to others. 	2+3+3	8

	<ul style="list-style-type: none"> • Donate good quality but unwanted items to old folks' homes, charitable organisations etc. • Repair and recondition faulty electronic appliances to extend their useful lives. <p>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.</p> <p>Benefits of Recycling</p> <ul style="list-style-type: none"> • Reduces the amount of waste sent to landfills and incinerators; • Conserves natural resources such as timber, water, and minerals; • Prevents pollution caused by reducing the need to collect new raw materials; • Saves energy; • Reduces greenhouse gas emissions that contribute to global climate change; • Helps sustain the environment for future generations; • Helps create new well-paying jobs in the recycling and manufacturing industries in the United States. <p>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.</p> <p>Buy products in bulk. Larger, economy-size products or ones in concentrated form use less packaging and usually cost less per ounce.</p>		
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	v) Environmental audit focuses itself to conduct quality audit, which takes care of ambient air quality, stack emissions, solid/ hazardous wastes and noise pollution.		
3.b	<p>Preliminary treatment consists of screening and grit removal.</p> <p>Large quantities of floating rubbish such as cans, cloth, wood and other larger objects present in waste water are usually removed by metal bars, acting like strainers as the waste water moves beneath them in an open channel.</p> <p>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.</p> <p>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.</p> <p>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.</p>	<p>01</p> <p>01</p> <p>01</p> <p>01</p>	4
3.c	<p>Sludge characteristics are:</p> <p>i) A key physical characteristic is the solids concentration because this defines the volume of sludge that must be handled. It also determines whether the sludge behaves as a liquid or a solid. Sludges tend to act like plastic fluids as the solids concentration increases until a relatively solid state is reached. The total sludge volume is inversely proportional to the solids concentration.</p> <p>ii) colour and odour</p> <p>iii) PH</p>	<p>01</p> <p>03</p> <p>Any</p>	04

	iv) Alkalinity v) Moisture content vi) Energy content vii) Oil and grease viii) Protein content	six points (½ mark each)	
3.d	Effect of Thermal pollution on water are: i) Reduction in dissolved oxygen ii) Decreases the oxygen saturation percentage iii) Increase in BOD iv) Early hatching of fish eggs. v) Failure of trout (cold water fish) eggs to hatch and salmon to spawn vi) Direct fish mortality due to failure in respiratory, nervous or essential cell processes. vii) Bacteria multiply rapidly, which in turn become the food of protozoans. viii) Undesirable changes in algal population. ix) Excessive eutrophication. x) increases the toxicity of some chemical pollutants xi) migration of aquatic biota xii) Decrease in solubility of gases in water. xii) Rapid setting of sediment load in water affecting aquatic food supply.	Any eight points (½ mark each)	04
3.e	Advantages of wet scrubber are : i) Simultaneous removal of gases and particulates. ii) Effective performance over a wide loading range iii) it occupies a moderate amount of space as compared to dry collectors iv) Hazards of explosive dust-air mixtures are reduced v) Indifference to the temperature and moisture content of gas	02 Any four points may given 2 mark (1/2 mark each)	04

	<p>vi) Corrosive gases may be neutralized by proper choice of scrubbing liquid.</p> <p>Disadvantages of wet scrubber are :</p> <p>i) Relatively high energy cost</p> <p>ii) Problem of wet sludge disposal</p> <p>iii) Corrosion problem</p> <p>iv) Visible wet plume, reduction in buoyancy</p> <p>v) Very small particles may not be captured</p>	<p>02</p> <p>Any four points may given 2 mark (1/2 mark each)</p>																
4.a-i	<p>Major uses of given adsorbent:</p> <table><tr><th>Sr. No.</th><th>Adsorbent</th><th>Major uses</th></tr><tr><td>1</td><td>Activated carbon</td><td>Eliminating odours, adsorb organic solvent vapour</td></tr><tr><td>2</td><td>Bauxite</td><td>Treating petroleum fractions, drying gases and liquids</td></tr><tr><td>3</td><td>Bone char</td><td>Decolourising sugar solutions.</td></tr><tr><td>4</td><td>Fuller's earth</td><td>Refining animal oils, lube oils, vegetable oils, fats and waxes</td></tr></table>	Sr. No.	Adsorbent	Major uses	1	Activated carbon	Eliminating odours, adsorb organic solvent vapour	2	Bauxite	Treating petroleum fractions, drying gases and liquids	3	Bone char	Decolourising sugar solutions.	4	Fuller's earth	Refining animal oils, lube oils, vegetable oils, fats and waxes	<p>Any one use of respective adsorbent may given 1 mark (1 mark for each adsorbent)</p>	04
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4.a-ii	<p>Various certifying agencies for environmental Audit in operation are:</p> <p>i) Bureau of Indian Standard</p> <p>ii) Det Norske(DNV)</p> <p>iii) Korea management association quality Assurance(KMAQA)</p> <p>iv) Lloyd's Register Quality Assurance(LRQA)</p> <p>v) International Certifications Limited(ICL)</p> <p>vi) KPMG Quality Register</p> <p>vii) Bureau Veritas Quality International (BVQI)</p> <p>viii) TUV India Private Limited</p>	<p>Any four points (1 mark each)</p>	04															
4.a-iii	<p>Effects of oxides of sulphur on human health;</p> <p>i) it causes intense irritation</p> <p>ii) Increase in SO₂ concentration in the atmosphere, may lead to lung</p>	<p>Any eight points</p>	04															

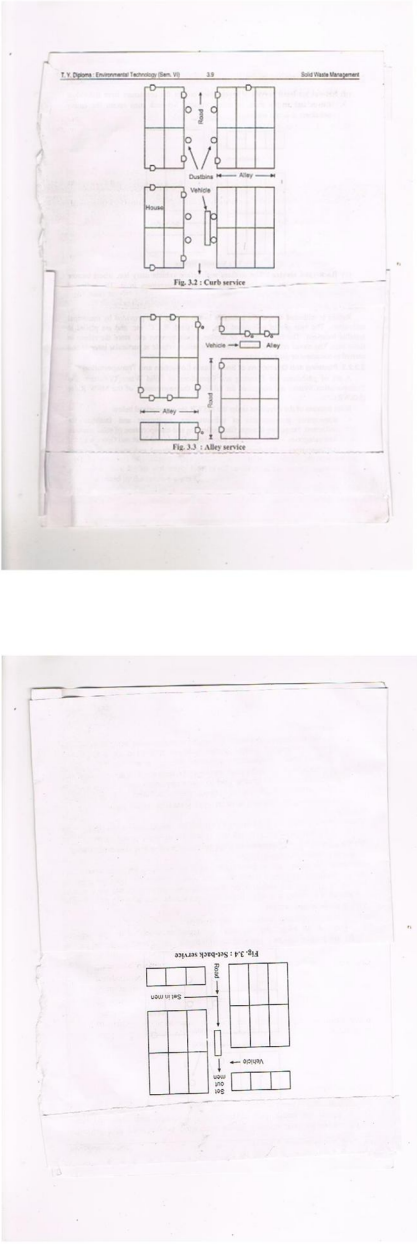
	<p>cancer.</p> <p>iii) SO₂ inhalation causes the symptoms of bronchitis and other lung diseases</p> <p>iv) SO₂ may obstruct breathing.</p> <p>v) SO₂ may lead to reduction in surface area of gaseous exchange on lungs causing suffocation.</p> <p>vi) SO₂ leads to formation of H₂SO₄ which is 5 to 20 times as irritant as SO₂.</p> <p>vii) SO₂ is a severe allergenic agent.</p> <p>viii) At 20 ppm concentration it causes eye irritation and cough.</p> <p>ix) At 1-5 ppm, it causes tightness to chest.</p> <p>x) Higher concentration of SO₂(400-500 ppm) is dangerous even for short exposure.</p>	<p>may given marks (1/2 mark each)</p>	
4.a - iv	<p>Solid waste: Any unwanted or discarded material from residential commercial, industrial, mining and agricultural activities that cause environmental problems may be treated as solid waste.</p> <p>Solid wastes can be broadly classified as:</p> <p>i) Domestic waste: These includes waste from household preparation, cooking and serving of food; waste paper and plastics; cloth etc.</p> <p>ii) Municipal Wastes : These include garbage and rubbish from households, offices, hotels, markets, etc. and also the street refuse</p> <p>iii) industrial wastes: these include</p> <p>a) Non-process waste such as office and cafeteria wastes, packing wastes etc. which are common to all industries.</p> <p>b) Process waste which depend upon the type of the products being manufactured, such as tannery wastes, weaving and dying wastes, food processing wastes, plastic wastes etc. from the respective industrial establishments. Mineral wastes from mining and mineral processing units also fall under this category.</p> <p>iv) Agricultural wastes: These wastes result from farms, feed lots and livestock yards. The agricultural wastes include paddy husk, bagasse</p>	<p>01</p> <p>03</p> <p>Any three points may given marks (1 mark each point)</p>	04

	<p>from sugarcane etc.</p> <p>v) Special Wastes: These includes hazardous wastes from different sources e.g.</p> <p>a) Radioactive wastes from power plants etc.</p> <p>b) Toxic substances such as heavy metal sludges, pesticides etc.</p> <p>c) Biological products such as enzymes, antibiotics, pathogenic and pathological waste, etc.</p>		
4.b-i	<p>Principle of green house effect: The transparent walls and roof of the green house are such that these allow the visible sunlight to enter, but prevent the long wavelength infra-red radiations to go out. Thus the sunlight is absorbed by the soil and structure of the green house. It is then reemitted as heat which cannot pass through the glass. The amount of energy in the greenhouse thus increases and warms the atmosphere.</p> <p>In similar way, the earth's atmosphere bottles up the energy of the sun and acts like green house. Here CO₂ acts like glass windows. CO₂ and water vapour in the atmosphere transmit short wavelength solar radiations but reflect the longer wavelength heat radiation from warm surface of the earth. CO₂ molecules are transparent to sunlight but not to heat radiation. So they trap and reinforce the solar heat stimulating the green house effect.</p> <p>Green House gases:</p> <p>i) Carbon dioxide (CO₂)</p> <p>ii) Methane (CH₄)</p> <p>iii) Nitrous oxide (N₂O)</p> <p>iv) Chlorofluoro Carbons(CFCs)</p> <p>v) Ozone</p> <p>vi) SO₂</p> <p>Sources of Green House effect (gases) :</p> <p>i) Burning of coal, oil and natural gases in the factories.</p> <p>ii) Burning of fossil fuel at power stations.</p>	<p>02</p> <p>02 Any four points may given marks (½ mark each)</p> <p>02 Any four points</p>	06

	iii) Use of diesel and petrol for automobiles, railway, aircraft etc. iv) Burning of fire wood and deforestation. v) Trees and plants release carbon as CO ₂ after oxidizing it vi) Fires in the forest contribute to the release of CO ₂ vii) Growing paddy or live-stock releases methane. viii) The use of sprays release CFCs into the atmosphere	may given marks (½ mark each)	
4.b- ii	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.	1 mark each	6
5.a	These pollutants are present in lower atmosphere i.e. troposphere and stratosphere. These pollutants stay here for a long period. They consist of smoke, dust, fumes, mist, & spray particles. These may be organic or inorganic in nature. Effects on Human Health, animal : 1. The particulate pollutants of size less than one micron enter into the alveoli of lungs & damage lung tissues. 2. Asbestos fibers may cause cancer to the industrial workers. This occurs in the tissue lining the abdomen.	6	8

	<p>3. Lead from automobile exhaust may cause effect on children's brain.</p> <p>4. Lead interferes with the development & maturation of red blood cells.</p> <p>5. Insoluble aerosols may create toxicity to respiratory system.</p> <p>6. Silicosis, a chronic disease of lung is caused by inhalation of dust containing free silica, SiO_2.</p> <p>7. Black lung disease is common to coal miners, while white lung disease occurs in textile workers.</p> <p>8. Arsenic is absorbed through the lungs & skin & cause diarrhoea, conjunctivitis, lung & skin cancer.</p> <p>9. Traces of mercury cause nerve damage & death.</p> <p>10. The acid particulates & aldehydes cause eye, nose & throat irritation.</p> <p>Effects on materials :</p> <p>1. The particulate matter i.e. fumes, soot, mist, etc. causes severe damage to buildings & monuments.</p> <p>2. The corrosive activity is enhanced in the presence of particulate pollutants.</p> <p>3. Corrosive particulates cause severe damage.</p> <p>4. Particulates cause cracks & fading in painted surfaces.</p> <p>5. Particulates accumulate on the soil surfaces causing soil erosion.</p> <p>6. Particulates cause smog formation which may be dangerous to materials.</p>	2	
5.b	<p>Secondary treatment is an additional step in which wastewater effluent is treated to a higher quality before discharge to a disposal field and final infiltration into the soil.</p> <p style="padding-left: 40px;">secondary treatment: a type of wastewater treatment used to convert dissolved and suspended pollutants into a form that can be removed, producing a relatively highly treated effluent. Secondary treatment normally utilizes biological treatment processes (activated sludge, trickling filters, etc.)</p>	8	8

	followed by settling tanks and will remove approximately 85% of the BOD and TSS in wastewater. Secondary treatment for municipal wastewater is the minimum level of treatment required by the Clean Water Act		
5.c	<p>Methods for collection of solid waste from house to house are as given below-</p> <ol style="list-style-type: none"> 1. Curb service: The refuse containers placed at the curb on the scheduled day by house-owner are collected by workers from refuse vehicle & emptied into vehicle. The empty containers, placed at the curb by workers are taken back by the house owner. 2. Alley service : This method is similar to previous one, except that the containers are placed at the alley line instead of curb. 3. Set –out service : The workers with refuse vehicles collect the containers from individual houses & empty them in refuse vehicles. The empty containers are collected by the house-owners. 4. Set-back service: Set out men collect the containers from individual houses & empty in reuse vehicle. Set-back men return the empty containers to house owner. 5. Back-yard service 	8	8

			
6.a	<p>Acid rain" is a broad term referring to a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulfuric acids. Acid rain, more accurately termed acid deposition.</p> <p>Numerous environmental effects have been attributed to acid deposition. Perhaps one of the best-known is acidification, a condition in which lakes and streams have a low pH level, resulting in the death of fish and other animal and plant life. Acidification can be</p>	4	4

	chronic, where a given surface water body has a constantly low pH value, or episodic, where pH levels decrease for brief periods due to runoff from melting snow or heavy rain.		
6.b	1.Rapid Industrialisation 2. Transportation 3. Burning of fossil fuels & fires. 4. Deforestation 5.Increase in population 6. Agricultural Activities 7. Solid waste Disposal 8. Radioactive fall out 9. wars 10. Construction activites	4	4

6.c	<p>Flow diagram of types of solid wastes is as shown in Fig. 3.1.</p> <pre> graph TD A[Types of Solid Wastes] --> B[Food Wastes] A --> C[Rubbish] A --> D[Ashes and Residues] A --> E[Demolition and Construction Wastes] A --> F[Special Wastes] B --> G[Treatment plant wastes] C --> G D --> G E --> G F --> G C --> H[Hazardous wastes] D --> H E --> H F --> H C --> I[Agricultural wastes from agricultural activities like] D --> I E --> I F --> I </pre> <p>Fig. 3.1 : Flow diagram of types of solid wastes</p>	4	4
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6.d	<p>Typical composition of domestic waste water</p> <table> <tr> <th></th><th></th><th colspan="3">Concentration</th></tr> <tr> <th>Contaminants</th><th>Unit</th><th>Weak</th><th>Medium</th><th>Strong</th></tr> <tr> <td>Solids, total (TS)</td><td>mg L⁻¹</td><td>350</td><td>720</td><td>1200</td></tr> <tr> <td>Dissolved, total (TDS)</td><td>mg L⁻¹</td><td>250</td><td>500</td><td>850</td></tr> </table>			Concentration			Contaminants	Unit	Weak	Medium	Strong	Solids, total (TS)	mg L ⁻¹	350	720	1200	Dissolved, total (TDS)	mg L ⁻¹	250	500	850	4	4
		Concentration																					
Contaminants	Unit	Weak	Medium	Strong																			
Solids, total (TS)	mg L ⁻¹	350	720	1200																			
Dissolved, total (TDS)	mg L ⁻¹	250	500	850																			

		Fixed	mg L ⁻¹	145	300	525			
		Volatile	mg L ⁻¹	105	200	325			
		Suspended solids (SS)	mg L ⁻¹	100	220	350			
		Fixed	mg L ⁻¹	20	55	75			
		Volatile	mg L ⁻¹	80	165	275			
		Settleable solids	mg L ⁻¹	5	10	20			
		BOD ₅ at 20° C	mg L ⁻¹	110	220	400			
		Total organic carbon (TOC)	mg L ⁻¹	80	160	290			
		Chemical oxygen demand (COD)	mg L ⁻¹	250	500	1000			
		Nitrogen (total as N)	mg L ⁻¹	20	40	85			
		Organic	mg L ⁻¹	8	15	35			
		Free ammonia	mg L ⁻¹	12	25	50			
		Nitrites	mg L ⁻¹	0	0	0			
		Nitrates	mg L ⁻¹	0	0	0			
		Phosphorus (total as P)	mg L ⁻¹	4	8	15			
		Organic	mg L ⁻¹	1	3	5			
		Inorganic	mg L ⁻¹	3	5	10			
		Chlorides	mg L ⁻¹	30	50	100			
		Sulfate	mg L ⁻¹	20	30	50			
		Alkalinity (as CaCO ₃)	mg L ⁻¹	50	100	200			
		Grease	mg L ⁻¹	50	100	150			

		Total coliform	CFU 100 mL ⁻¹	10 ⁶ -10 ⁷	10 ⁷ -10 ⁸	10 ⁸ -10 ⁹			
		Volatile organic compounds (VOCs)	mg L ⁻¹	<100	100-400	>400			
6.e	Physical Characteristic - Sources 1. Color - Domestic and industrial wastes, natural decay of organic materials 2. Odor - Decomposing wastewater, industrial wastes 3. Solids - Domestic water supply, domestic and industrial wastes, soil erosion, inflow/infiltration 4. Temperature - Domestic and industrial wastes							4	4