Important Instruction to Examiners:-

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

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

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

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

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

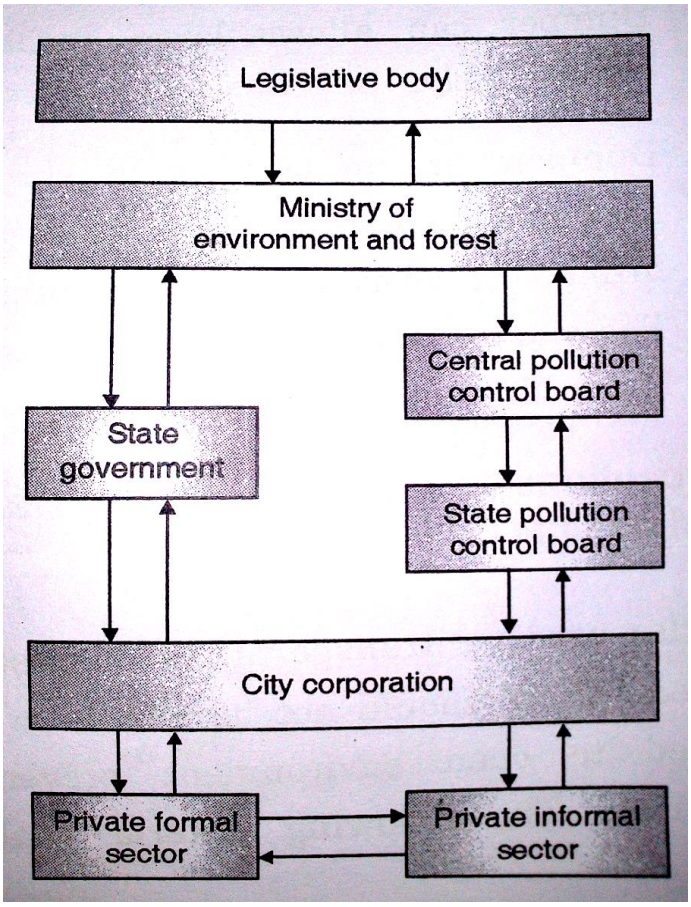
5) Credit may be given step wise for numerical problems. In some cases, the assumed contact values may vary and there may be some difference in the candidate's answers and model answer.

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

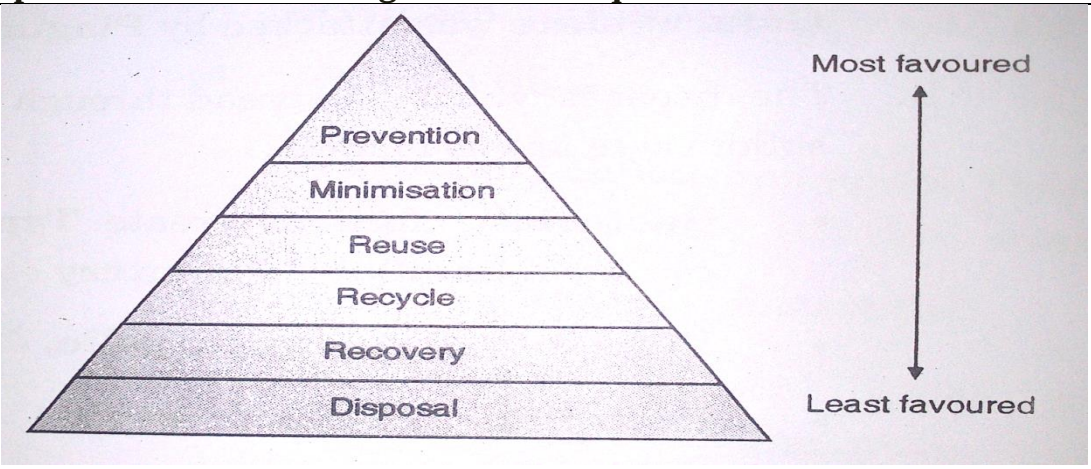
7) For programming language papers, credit may be given to any other programme based on equivalent concept.

Important notes to examiner

Q .NO	SOLUTION	MARKS
Q1.	**Attempt Any Five of the following:**	20M
a)	**Define the following:** **(i) E-waste** **(ii) Biomedical waste**	04 M
	(i) E-waste i) E-waste is any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use. ii) Examples-: computers, office electronic equipment, entertainment device electronics, mobile phones, television sets, and refrigerators. **(ii) Biomedical waste** In this course, **This is** medical waste **and** includes all infectious waste, hazardous (including low-level radioactive wastes), and any other wastes that are generated from all types of health care institutions, including hospitals, clinics, doctor's (including dental and veterinary) offices and medical laboratories.	02M 02M
b)	**State various methods of storage of municipal solid waste.**	04M
	• Large numbers of open communal storage sites and unofficial dumps. • Plastic buckets (with lids), with capacities between 7 and 10 L, • Plastic bins (with lids), with capacities between 30 and 60 L and equipped with handles • Galvanized steel or plastic bins (with lids), with a capacity between 50 and 70 L, • Disposable plastic bags have a number of advantages. • Other items commonly used for the storage of wastes include cardboard boxes, kerosene cans, and containers made out of truck tires. • DEPOTS a depot typically consists of a single-story building about the size of a large garage. • ENCLOSURES an enclosure is probably the most common communal storage method in Asia. Enclosures can have capacities from 1 to 10 m3 • FIXED storage bins this type of container usually is built from concrete blocks.	½ M Each (Write any Eight)
c)	**What are the sources of solid waste?**	04 M
	➢ Residential ➢ Commercial ➢ Institutional ➢ Construction and Demolition ➢ Municipal Services ➢ Treatment Plant Sites ➢ Industrial ➢ Agricultural	½ M Each
d)	**List the various transportation equipment of municipal waste.**	04 M
	➢ Animal carts ➢ Auto vehicles ➢ Tractors or Trailers ➢ Trucks ➢ Dumper ➢ Compactor vehicles	01M Each

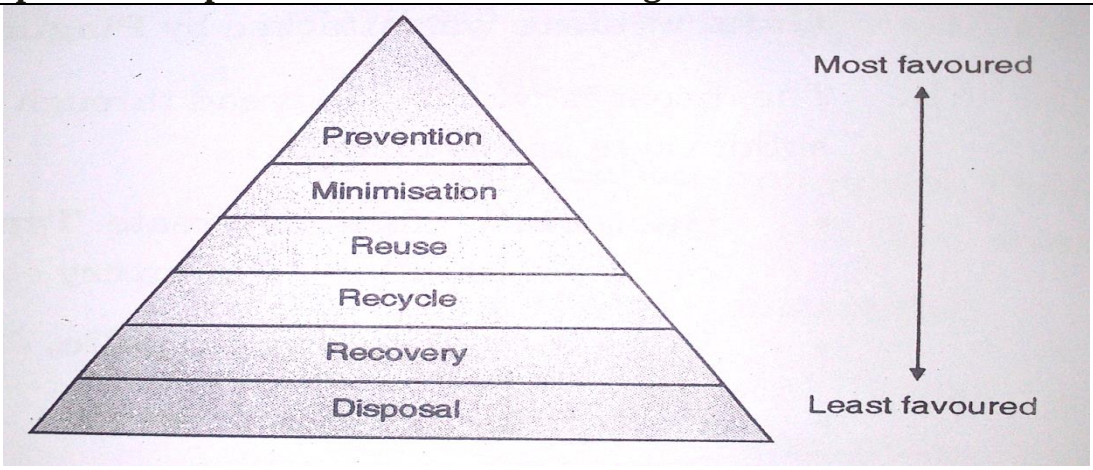
e)	**State the factors affecting the solid waste generation**	**04 M**
	➢ Source reduction/recycling ➢ Geographic location ➢ Season ➢ Collection Frequency ➢ Per capita income ➢ Public attitudes ➢ Size of households ➢ Population density ➢ Population increase	**½ M Each**
f)	**Draw the organization pattern of solid waste management.**	**04M**
		**04M For Diagram**

g)	**State the impact of solid waste on environment.**	**04 M**
	➢ Waste breaks down in landfills to form methane, which causes greenhouse gas. Carbon dioxide and Methane produced from solid waste are extremely harmful to the environment. ➢ Change in climate and destruction of ozone layer due to waste biodegradable ➢ Due to waste pollutions, illegal dumping, Leaching: is a process by which solid waste enter soil and ground water and contaminating them and Pollute water bodies. ➢ Open air dumping creates unhygienic and poses enormous threat to the people. ➢ Causes aesthetic problem and nuisance due to nauseating pungent odor. ➢ Promotes spreading of diseases. ➢ The situation further aggravated by the indiscriminate disposal of Hospital and Clinical Waste. ➢ Presence of extremely high level of total and Fecal E-coli forms.	**04M**
Q No.2	**Attempt Any FOUR of the following**	**16 M**
a)	**Define Industrial waste and Biomedical waste.**	**04M**
	i. **Industrial waste-:** Industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, mills, and mining operations. It has existed since the start of the Industrial Revolution **ii. Biomedical waste.** In this course, **This is** medical waste **and** includes all infectious waste, hazardous (including low-level radioactive wastes), and any other wastes that are generated from all types of health care institutions, including hospitals, clinics, doctor's (including dental and veterinary) offices and medical laboratories.	**02M** **02M**
b)	**What is transfer station and state its necessity.**	**04M**
	i) Transfer station: These are the open or closed structures built by competent authority at various locations in city and waste collected by hauling vehicles is initially transferred to these stations. **Necessity of transfer stations:** Transfer stations are necessary due to following reasons 1. They prevent the scattering of MSW. 2. To have ease in proper storage and collection of MSW from different locations. 3. To prevent nuisance due to scattered solid waste to nearby area. 4. To reduce the haul distance.	**02M** **02M**

c)	**Explain-solid waste management techniques.**	**04 M**
	 **Solid waste management hierarchy** The main aim of waste hierarchy is to generate minimum amount of waste and obtain maximum benefits from products. Following are the various stages in SWM Hierarchy: 1. Prevention: preventing the use of such raw material in production which produces maximum solid waste and selecting the alternative raw materials. 2. Minimization: if such alternative raw materials are less possible then minimize the use of raw materials producing more waste by implementing different techniques. 3. Reuse: it is the next desirable option in which materials some materials are repeatedly used again and again for same purpose. 4. Recycle: In this stage collection, sorting of recyclable products is done and then they are manufactured into new products. 5. Recovery: in this stage the recoverable materials are processed which includes activities like recycling and composting. 6. Disposal: It is the last option and should be considered after all other possible actions to recover that waste matter. It may includes incineration, dumping.	**02 M For Diagram** **02 M For Explain-ation**
d)	**Explain waste prevention and waste management.**	**04M**
	i) Waste prevention-: ➢ Waste prevention is often called source reduction which means reducing waste by not producing it. ➢ Waste prevention actually avoids waste generation, it is the preferred waste management activity ➢ Overall, waste prevention conserves resources, protects the environment, and prevents the formation of greenhouse gases. ii) **waste management-:** ➢ Solid Waste Management is the collection, transport, processing, recycling or disposal and monitoring of waste materials	**02M** **02M**

OR

d)	**Explain waste prevention and waste management.**	**04M**



Solid waste management hierarchy

02 M For Diagram

02 M For Explain-ation

The main aim of waste hierarchy is to generate minimum amount of waste and obtain maximum benefits from products.

Following are the various stages in SWM Hierarchy:

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e)	**Describe the process of Indoor method of composting.**	**04M**
	➢ **Indoor** method layers of vegetable and night soil is alternatively piled into trench, the depth of pile is 1.5-2m and a width is about 3-8m or above the ground forms a mound called windrow. ➢ Normally windrows are conical in shape and about 50m in length. ➢ The aeration is achieved by periodically turning the piles. Manual turning is ➢ Adopted for small plants and mechanical turning is adopted for larger plants. ➢ Refuse should be turn once or twice per week which introduce oxygen and helps to control temperature. ➢ Turning continued for about 4-5 weeks during which biodegradable organic are Consumed. The solid waste is allowed to keep for 2-8 weeks with turning the Composting in windrow may take 21-28 days for stabilization. ➢ The composted waste is removed from windrow and allowed to mature in maturing yards for 1-3 months, after which the compost becomes ready for being taken out for use.	**04M**
f)	**State the products of incineration process with their use.**	**04M**
	1. After the incineration process the left out products can be used as aggregate for Preparation of low grade concrete or even sometimes it can also be used as Road metal. 2. The incineration ash is used for making bricks or block manufacturing. 3. Also the steam generated during incineration can be used for electricity generation by running the turbines. 4. The products of incineration can also be used as filler material. ***(Note: Student may Write any appropriate explanation for Any factor so credit may be Given accordingly.)***	**1M Each**

Q .NO	SOLUTION	MARKS
Q3.	**Attempt Any Four of the following:**	16M
a)	**Describe the process of disposal of solid waste by trench method of land filling.**	04 M
	Trench method ➢ The trench method is suited to areas where an adequate depth of cover material is available at the site ➢ Where the water table is well below the surface. ➢ To start the process, a portion of the trench is dug with a bulldozer and the dirt is stockpiled to form an embankment behind the first trench. ➢ Wastes are then placed in the trench, spread into thin layers and compacted. ➢ The operation continues until the desired height is reached. ➢ Cover material is obtained by excavating an adjacent trench or continuing the trench that is being filled	04 M
b)	**State the factors affecting on composting process of solid waste.**	04 M
	i) Particle size: Smaller particle size increases conversion rate during composting. **ii) Moisture content**: ➢ The moisture of the compost influences temperature and aeration, as well as the types and activity of micro-organisms. Optimal moisture conditions are around 60% (wet weight). If the level is below 40%, the activity of micro-organisms falls sharply and the organic matter does not compost quickly. If the moisture content is too high, anaerobic conditions may set in. **iii) Carbon nitrogen ratio:** ➢ Micro-organisms consume between 15 and 30 times more carbon than nitrogen during the composting process. They use carbon as a source of energy, while nitrogen is used to produce the protein they need to develop. ➢ If the C/N ratio is too high, the composting time increases because the available nitrogen is used up quickly and the micro-organisms must find it elsewhere. ➢ If the C/N ratio is too low, the nitrogen is released as gas, causing an unpleasant odour of ammonia ➢ The C/N ratio decreases during the composting process because carbon is consumed more quickly and is lost as CO2. ➢ It *It* has often been shown that green, moist matter contains a high level of nitrogen, while brown, dry matter tends to contain more carbon. **iv) pH:** ➢ During the composting process, the pH level will fluctuate according to the different reactions produced by the micro-organisms. For example, the pH will fall when the thermophilic phase begins, because the micro-organisms produce CO2 and lactic acids. It subsequently rises again to neutral or alkaline. In practice, this factor is not a cause for concern because it stays within acceptable limits for the development of micro-organisms (a pH level of approximately 6 to 7.5). **v) Temperature:** ➢ Composting is most efficient when the temperature of the composting material is with in the two ranges known as Mesophilic (80^o-120^o F) and Thermophilic (105^o-150^o F). ➢ To providing oxygen, aeration removes heat, water vapor and other gases trapped within the composting materials. **vi) Air circulation:** Air is important for aerobic composting.	**1mark for any Four**

Q .NO	SOLUTION	MARKS
	vii) Nutrients ➢ Carbon (C), nitrogen (N), phosphorus (P) and potassium (K) are the primary nutrients required by the microorganisms involved in composting. Nitrogen, phosphorus and potassium are also the primary nutrients for plants, so nutrient concentrations also influence the value of the compost.	
c)	**State four advantages and four disadvantages of landfilling method.**	**04 M**
	Advantages: ➢ Volume can increase with little addition of equipment. ➢ Filled land can be reused for other community purposes. ➢ Low cost and ease of application, no high-tech. ➢ Absorb massive amounts of solid wastes. ➢ Replanting the area with trees. ➢ Access to methane. **Disadvantages**: ➢ Leakage of air pollutant gases: methane, carbon dioxide. ➢ Possibility of contamination of water sources by waste water resulting from landfill. ➢ R**equires** proper planning, design, and operation	**02 M** **02 M**
d)	**What do you mean by Pyrolysis of waste and State its methods?**	**04 M**
	Pyrolysis can be defined as the thermal decomposition of organic material through the application of heat without the addition of extra air or oxygen. In this process thermal decomposition of organic matter at high temperature take place. Pyrolysis is an endothermic process which requires heat for an external source. In this method solid waste material is heated in specially designed chamber which is called as pyrolysis reactor. In pyrolysis reactor, heating is carried out in closed environment which is almost oxygen free at an average temperature above 650^{o} c which may rise to 1000^{o} c. The end products are Hydrogen, methane, carbon mono-oxide, tar or oil, char, inert material. **Methods of Pyrolysis:** 1. **Dry pyrolysis** ➢ Process of thermal decomposition without access of oxygen (O_2) ➢ Products of dry pyrolysis are gas with high heat of combustion, liquid and solid carbon residue. ➢ Type of dry pyrolysis depend on the temperature of the process i.e. Low Temperature Analysis ,Medium Temperature Analysis ,High Temperature Analysis **2. Oxidizing pyrolysis** ➢ It's impossible to achieve a completely oxygen-free atmosphere. ➢ Thus, a small amount of oxidation occurs. If volatile or semi-volatile materials are present in the waste, thermal desorption will also occur. ➢ Thermal decomposition of industrial waste by its partial burning or direct contact with end product of fuel combustion This method is used for neutralization of most wastes including "inconvenient" ones for burning are present in the waste, thermal desorption will also occur. ➢ Thermal decomposition of industrial waste by its partial burning or direct contact with end product of fuel combustion ➢ This method is used for neutralization of most wastes including "inconvenient" ones for burning	**02 M** **1M for Two Method**

Q .NO	SOLUTION	MARKS
e)	**What is vermi-composting? State its concept.**	**04 M**
	➢ **Vermicompost** is the product or process of composting using various worms, usually red wigglers, white worms, and other earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast. **Vermicomposting- Concept** ➢ Take a small wooden box or dig a small pit. ➢ Spread a net on your box. ➢ Also spread 1 or 2 cm thick layer of sand. ➢ Put some kitchen wastes such as peels of fruits etc., to cover the sand. ➢ Use green leaves to cover over the sand. ➢ Sprinkle some water to make this layer wet. ➢ Buy some red worms and put them in your pit. ➢ Give them vegetable and fruit wastes as food. ➢ After 3 to 4 weeks you will see loose, soil like material in the pit. ➢ Remove the material from the box, dry it in the sun. ➢ Use this as manure.	**2 M** **2 M**
f)	**What is leachate? How it can be controlled.**	**04 M**
	Leachate is the liquid that drains or 'leaches' from a landfill. It varies widely in composition regarding the age of the landfill and the type of waste that it contains. It usually contains both dissolved and suspended material. **Control measures.** ➢ Leachate is carefully collected and shall be treated before its release on ground if possible. ➢ Prevention of migration of leachate from landfill sides and landfill base to the sub-soil by a suitable liner system should be provided. ➢ Used leachate treatment method like Natural system, Biological treatment physicochemical treatment.	**02 M** **02 M**
Q4.	**Attempt Any Four of the following:**	**16M**
a)	**Explain the types of incinerators.**	**04 M**
	i) Mass burner Incinerator: ➢ This incinerator consists of two or three incineration unit ranging from 50 to 1000 tons per day. These are design to incinerate the municipal solid waste as collected without prior processing. It is flexible and convenient. ➢ It is continuously fed to a grate system the waste in take are usually includes tipping floor a pit, a crane and sometimes a conveyors. Truck dumps solid waste on floor or directly into a pit. ➢ When waste is dumped on floor bulldozer is used to push them into a pit or conveyor and the its is fed to grate system which moves waste through combustion chamber **ii) RDF based incinerator:** ➢ RDF is homogeneous system and better control on combustion and can recover more energy. ➢ Various components like metal, glass and non-combustible material can be removed to produce RDF. ➢ In this system process solid waste refuse derived fuel is burnt.	**02 M each Write Any Two**

Q .NO	SOLUTION	MARKS
	iii) Modular Incinerators: These are prefabricated units with relatively small capacities. The capacity range between 5 to 120 tones solid day. The capital cost per tone of capacity is lower than other MSW incineration option. Modular incinerator includes two combustion chambers, which ensures complete combustion. It has better control of pollution. **iv) Fluidized bed incineration:** This type of combustion system includes steel vertical cylinder lined from inside with bricks and sand is placed as bed. Air nozzles are provided to inject air at high pressure. Solid fuel is injected into chamber along with natural gas or oil initially to increase temperature of incinerator. This system is suitable for burning sewage sludge and other chemical waste.	**02 mark for any TWO**
b)	**State the control measures of industrial waste.**	**04 M**
	➢ Treatment before disposal of waste materials. ➢ Using alternative source such as petrol. ➢ Awareness and educational program. ➢ Managing and treating industrial waste by using modern technology such as electrostatic convertor. ➢ Control use of pesticides and fertilizers. ➢ Law, regulation and enforcement. ➢ Manufacturing and use of ozone depleting chemicals should be stopped. ➢ Toxic gases should be treated before they released into the air. ***(Note: Student may Write any appropriate explanation so credit may be given accordingly.)***	**04 M**
c)	**What are the sources and generation of bio-medical waste? Give its health aspect.**	**04 M**
	Following are the various sources and generation of biomedical waste: ➢ Waste generated by hospitals. ➢ Waste generated by nursing homes. ➢ Waste generated by funeral homes. ➢ Waste generated by clinics. ➢ Waste generated by dentist clinic. ➢ Waste generated by blood bank. ➢ Waste generated by pathological laboratory. ➢ Waste generated by pharmacies. **Health aspect of bio- medical waste during handling:** ➢ There is skin and blood infection caused with direct contact or handling with waste and from infected wounds. ➢ There is eye and respiratory infections caused by the exposure to infected dust especially during land fill operation. ➢ There are intestinal infections which are transmitted by flies feeding on the waste. ➢ Increase in hospitalization of diabetic residents living near hazard waste sites	**½ M each Write ANY Four** **02 M**

Q .NO	SOLUTION	MARKS
d)	**Define E-Waste. State the dangers of E-waste.**	**04 M**
	i) Define E-Waste Electronic waste or e-waste describes discarded electrical or electronic devices. Used electronics which are destined for reuse, resale, salvage, recycling or disposal are also considered e-waste.	**01 M**

DANGERS OF E-WASTE

Material	Occurrence in E-waste	Health and Environmental Impact
Beryllium	Copper-beryllium alloys, springs, relays and connections	• beryllium sensitization/chronic beryllium disease • **human carcinogens** • released as beryllium oxide dust or fume during high temperature metal processing
Cadmium	Contacts, switches, nickel-cadmium (Ni-Cd) batteries, printer inks and toners	• persistent and mobile in aquatic environments (ATSDR 2000) • **damage to the kidneys and bone toxicity**, released if plastic is burned or during high temperature metal processing
Lead	Circuit boards/ cathode ray tubes CTR	• Risk for small children and fetuses • **Damage to the nervous system, red blood cells, kidneys and potential increases in high blood pressure;** • Incineration can result in release to the air

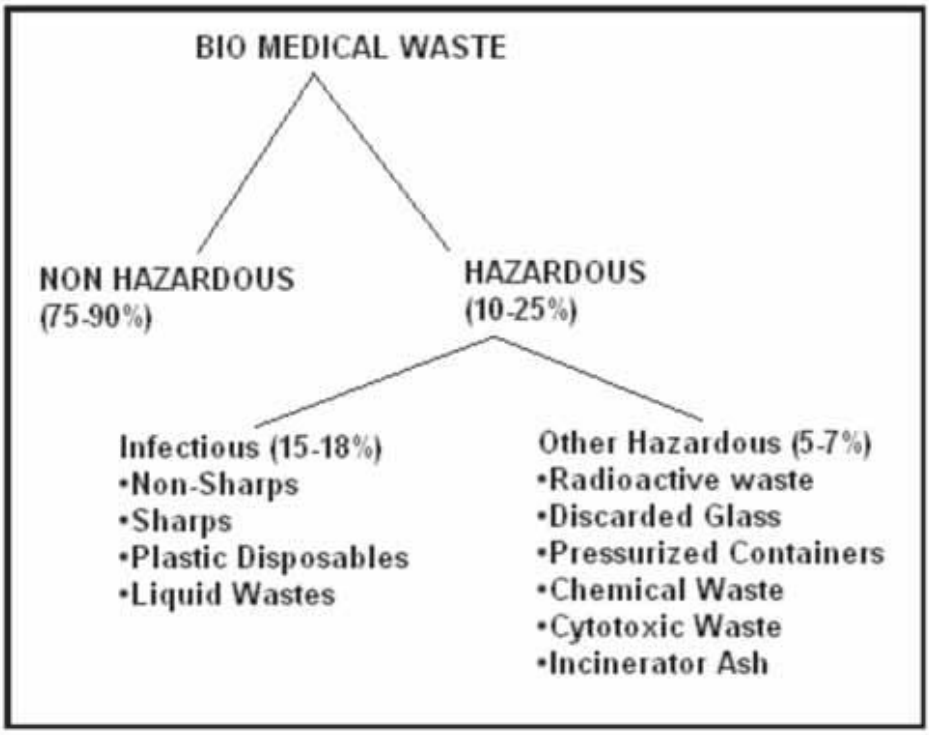
01 M Each Write Any Three

DANGERS OF E-WASTE

Material	Occurrence in E-waste	Health and Environmental Impact
Mercury	Lighting devices that illuminate flat screen displays, switches and relays	• **Impacts the central nervous system** • Land filling and incineration of flat panel displays results in the release to the environment
PCBs (polychlorinated biphenyls)	Insulating fluids for transformers and capacitors, flame-retardant plasticizers	• **Suppression of the immune system, liver damage, cancer promotion, damage to the nervous system** • Damage to reproductive systems

Q .NO	SOLUTION	MARKS
e)	**State the benefits of recycling of Industrial waste.**	**04 M**
	➢ Reduces the amount of waste sent to landfills and incinerators. ➢ Conserves natural resources such as timber, water and minerals. ➢ Saves energy. ➢ Prevents pollution by reducing the need to collect new raw materials. ➢ Helps sustain the environment for future generations. ➢ Reduce greenhouse gas emissions that contribute to global climate change.	**01 M Each Write any Four**
f)	**Describe method of collection and disposal of E-Waste.**	**04 M**
	Disposal of E-waste is done by following four method: 1) **Land filling:** In land filling, trenches are made on the flat surfaces. Soil is excavated from the trenches and waste material is buried in it, which is covered by thick layer of soil. Now a day's secure land filling are provided with some facilities like impervious liner made up of plastic or clay, leachate collection basin that collect and transfer the leachate to wastewater treatment plant. Environmental risk from land filling of e-waste cannot be neglected because the condition of land filling site are different from a native soil, particularly concerning the leaching behavior of metals. 2) **Incineration:** It is controlled and complete combustion process, in which the waste material is burned in specially designed incinerators at a high temperature. Advantages of incineration of e-waste are the reduction of waste volume and utilization of the energy content of combustible materials. Disadvantages of incineration are the emission to air of substances escaping flue gas cleaning and the large amount of residue from gas cleaning and combustion. 3) **Recycling of e-waste:** Monitors and CRT, keyboards, laptops, modems, telephone bards, hard drives, floppy drives, compact disk, mobiles, fax machines, printers, CPUs, memory chips, connecting wires and cables can be recycled. Recycling involves dismantling and recovery of valuable materials. Recycling is the best possible option for the management of e- waste because the existing dumping grounds in India are full and overflowing beyond capacity and it is difficult to get new dumping sites due to Scarcity of land. 4) **Re-use:** It is commonly used for electronic equipments like computers, cell phones etc. It constitutes direct second hand use or use after slight modification to the original functioning equipment. This method also reduces the volume of e-waste generation.	**02 mark for any Two Methods**

Q .NO	SOLUTION	MARKS
Q.5	**Attempt any FOUR of the following**	**16 M**
a)	**Describe Biomedical waste management and handling as per rule 1998**	**04 M**
	Rules for BMW: 1. Rules for duty of occupier. 2. Rules for treatment and disposal. 3. Rules for segregation, packaging, transportation and storage. 4. Rules for prescribed authority. 5. Rules for authorization. 6. Rules for advisory committee. 7. Rules for annual report. 8. Rules for maintenance of records. 9. Rules for accident reporting. 10. Rules for appeal.etc	**½ M Each Write any Eight**
b)	**List the various types of special waste.**	**04 M**
	Following are the various types of special waste 1. Biomedical waste 2. E- waste 3. Industrial waste	**04 M**
c)	**Explain the various variety of E-waste.**	**04 M**
	Telecommunication Waste: •Mobile phones •Telephones •Telephone exchanges Wireless Equipment cables and related scrap material •PC and TV **Electrical Waste:** •Switches •Relays •Connectors and related Scrap Material. **Electronic Waste:** •Electronic – metal waste •Printed Circuit Boards •E – Equipment and Machinery •IC •Sockets Connectors. **Cable Waste:** •PVC •Pre Insulated Copper and Aluminium Cable waste.	**1 M for each types**

Q .NO	SOLUTION	MARKS
d)	**State the classification of Biomedical waste.**	**04 M**
		**04 M**
e)	**State the importance of public involvement in solid waste management.**	**04 M**
	Public involvement and participation in SWM is very important because of following points: 1. To increase the awareness of solid waste management among the people. 2. To increase the efficiency and effectiveness of planning process and Implementation of solid waste management. 3. To understand the planning importance and significance. 4. To play an important role in the permitting process in case of hazardous waste as well as municipal waste facilities. 5. To improve the waste management strategies, negotiations with municipal authorities for better involvement in decision making. 6. To achieve the 3R principles. 7. To reduce littering of waste on streets and into drains, open spaces, etc. 8. To encourage and assists the local composting and recycling initiatives.	**½ M For Each**
f)	**State the benefits of recycling of solid waste.**	**04 M**
	➢ It reduces the amount of waste sent to landfills and incinerators. ➢ It conserves natural resources such as timber, water and minerals. ➢ It saves energy. ➢ It prevents pollution by reducing the need to collect new raw materials. ➢ It helps sustain the environment for future generations. ➢ Reduce greenhouse gas emissions that contribute to global climate change.	**01 M For Each (Any Four)**

Q .NO	SOLUTION	MARKS
Q.6	**Attempt any FOUR of the following (04 x 04 = 16)**	**16 M**
a)	**Explain the health problem during the time of segregation, reuse, and recovery recycling of solid waste.**	**04 M**
	Health problem during the time of segregation 1. Workers and rag pickers can be infected during picking of biodegradable and Non biodegradable waste. 2. If biodegradable and non biodegradables or wet and dry wastes are not put separately, it can creates bad odour **Health problem during reuse** 1. Health risk can be arises from transportation and handling of organic waste, processing application of organics from mixed municipal waste to soil, cultivation on old dumps and feeding of animal with waste and hence many factor are involved over the risk of human –animal disease links. **Health problem during recovery recycling** 1. During the recovery and recycling process of the solid waste, it creates the various health problems because in production of electricity, there is the generation of gas evolved in the environment in which some toxic gases are present, which affects on the respiration system of the surrounding peoples and working people there on. 2. Recovery and recycling process creates bad odour, particulate matter emissions that lead to air pollution and also creates metal illness to the humans	**01 M** **01 M** **02 M**
b)	**State hazardous solid waste.**	**04 M**
	Following are the hazardous solid waste. 1. Reactive waste 2. Ignitable waste 3. Medical waste 4. Radioactive waste 5. Corrosive waste	**04 M**
c)	**Describe the methods of collecting recyclables.**	**04 M**
	Following are the methods of collection of recyclables: **1.Curbside Collection:** ➢ Curbside Collection, or curbside collection, is a service provided to households, typically in urban and suburban areas, of removing household waste. ➢ A curbside collection of recyclable material is a method of collection whereby the resident sorts their domestic waste according to type of material. ➢ This is collected in the household in specially provided bins. The bins are then placed on the curb side or nearest collection point outside the property by the householder on a fortnightly basis. **2.Buy-back Centers :** ➢ When it comes to Buy-back Centers, the recyclers are similarly required to bring the recyclables to a central location. However, at the Buy-back Centers, the Cleaned recyclates are purchased from the recyclers. ➢ This method of recycling waste collection provides an incentive for recyclers to send their used items for recycling, hence ensuring a stable supply of recyclables. ➢ In turn, the post-processed materials are then sold, hopefully with a profit. Given that the resale value of post-processed materials may sometimes be lower than the processing cost, government subsidies may be required for the system of Buy-back Centers to be viable.	**01 M For Each Method**

Q .NO	SOLUTION	MARKS
	3.Drop-off Centers: ➢ These centers require the recyclers (e.g. the homemaker) to bring the recyclables to a central location, either an installed or mobile collection station or the reprocessing plant itself. ➢ This form of recycling waste collection is the easiest to establish. However, since the use of such centers is on a voluntary basis, it often suffers from Low and unpredictable supply of recyclables. **4.Deposit Programs:** ➢ Customers pay an additional fee when purchasing beverage containers but receive fee back once they return the container to the purchase point. ➢ As an incentive, the deposit beverage Container Program places a certain amount as redeemable deposit on each beverage container. ➢ Consumers get back their amount when they return their containers to a redemption Centre.	
d)	**State the purpose of recycling**	**04 M**
	➢ To Make Environment Clean ➢ Conservation of Materials ➢ To Save Energy ➢ Reduce Garbage in Landfills ➢ Reduce the pollution.	**01 M For Each (Any Four)**
e)	**Enlist collection methods of municipal solid waste. Explain any one.**	**04 M**
	A) Classification of collection system Based on the availability of service 1. Curb Service 2. Alley Service 3. Set out Set Back Service 4. Backyard Service **1. Curb (*Kerb-side*)** ➢ Kerbside collection, or curbside collection, is a service provided to households, typically in urban and suburban areas, of removing household waste. ➢ House owner is responsible for placing solid waste containers at the curb on scheduled day. ➢ The works man come, collect and empty the container and put back at the curb. ➢ House owner is required to take back the empty containers from the curb to his house. ➢ Quickest/ economical ➢ Crew: 1 driver + 1 or 2 collectors ➢ No need to enter property **2. Alley Service** The containers are placed at the alley line from where they are picked up by workmen from refuse vehicle who deposit back the empty container. **3. Set out Set Back Service** Set out man go to the house collect containers and empty them in the refuse vehicle. Another group of persons return them to the house owner's yard. **4. Backyard Service** The workers with the vehicles carry a bin, wheel-barrow or sack or cloth to the yard and empty the solid waste container in it. The wheel barrow or bin is then taken to solid waste vehicle where it is emptied.	**02 M For Classification** **02 M For Any One Method Explain**

Q .NO	SOLUTION	MARKS
	B) Collection Method Based on mode of operation: **1. Hauled Container System** **2. Stationary Container system** **1. Hauled Container System** An empty storage container (Known as a drop- off box) is hauled to the storage site to replace the container that is full of waste, which is then hauled to the processing point, transfer station or disposal site. **2. Stationary Container System** In this system, containers used for the storage of waste remain at the point of collection. The collection vehicles generally stop alongside the storage containers, and collection crews load the waste from the storage containers into the collection vehicles and then transport the waste to the processing, transfer or disposal site.	
f)	**State the factor affecting on composting process of solid waste.**	**04 M**
	Factors affecting composting process: 1. Particle size 2. Moisture content 3. pH 4. Temperature 5. Carbon Nitrogen ratio 6. Blending and seeding 7. Air circulation	**01 M For Each (Write Any Four)**