SUMMER – 13 EXAMINATION

Subject Code: **12173** **Model Answer**

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 judgment 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.

Q1.a) How are pollution and pollutants are classified?	04
Ans: **Any two types for each** **Types of pollution** i) By Source of pollution a) Anthropogenic (Human Caused) Sources of Pollution ▪ Industries ▪ Automobiles ▪ Domestic fuels etc. ii) By the object of pollution: a) Air pollution b) Water pollution c) Soil pollution (contamination) / Land pollution iii) By the economic source (originator) of pollution: a) Agricultural pollution b) Industrial pollution c) Transport pollution d) Car pollution / Heavy vehicle pollution e) Ship pollution f) Airplane pollution g) Commercial and domestic sector pollution iv) Other types: a) Radioactive pollution (contamination) b) Chemical pollution c) Invasive species pollution d) Light pollution	2

e) Noise pollution f) Visual pollution g) Thermal pollution **Pollutants classification** I. Formal approach a) Material substances b) Energy II. Medium-Based approach: a) Water pollutants b) Air pollutants c) Soil pollutants III. An Ecological Approach: a) Those that have counterpart in nature, eg. Sulphur dioxide, and the organic components of sewage b) Those that have no counterpart in nature, eg. DDT, plastics, freons and PCDs. IV. Specialized System:. a) Route of entry in body: Pollutants which are ingested, pollutants which are inhaled, and those which traverse the skin. b) Origin: Pollutants may be classified as primary or secondary. Primary pollutants are those directly emitted from the source. Secondary pollutants are those formed in atmosphere after they have been emitted from the source.	2
Q1.b) Define biodiversity. State its importance.	04
Ans: Biodiversity is the degree of variation of life forms within given ecosystem, biome, or an entire planet. Biodiversity is a measure of the health of ecosystems. Importance of Biodiversity: • The air we breathe is a product of photosynthesis by green plants. • Insects, worms, bacteria, and other tiny organisms break down wastes and aid in the decomposition of dead plants and animals to enrich soils. • More than 90 percent of the calories consumed by people worldwide are produced from 80 plant species. • Almost 30 percent of medicines are developed from plants and animals, and many more are derived from these sources. Ecosystems are the full tapestry of nature that support life and they also provide valuable services. • Wetland ecosystems filter out toxins, clean the water, and control floods. • Estuaries act as marine-life nurseries. • Forest ecosystems supply fresh water, provide oxygen, control erosion, and remove carbon from the atmosphere.	1 1 each (any 3 points)
Q1.c) what are the effects of air pollution on human health?	04
Ans: • Reduced lung functioning • Irritation of eyes, nose, mouth and throat • Asthma attacks • Respiratory symptoms such as coughing and wheezing	Any eight ½ mark each

- Increased respiratory disease such as bronchitis
- Reduced energy levels
- Headaches and dizziness
- Disruption of endocrine, reproductive and immune systems
- Neurobehavioral disorders
- Cardiovascular problems
- Cancer
- Premature death

Q1.d) define 1) turbidity2) alkalinity 3) acidity4) biological O_2 demand. — 04

Ans: **Turbidity:** Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye. Turbidity is the measure of water clarity. — 1

Alkalinity: Alkalinity is the measure of a water sample's ability to neutralize hydrogen ions (its acid neutralizing ability). — 1

Acidity: The acidity of a water sample is its capacity to neutralize hydroxide ions. — 1

Biological oxygen demand (BOD): It is the amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water at certain temperature over a specific time period. — 1

Q1.e) Explain the causes of acid rain. — 04

Ans: Sulfur dioxide (SO2) and nitrogen oxides (NOx) are the primary causes of acid rain. — 1

Most of these pollutants are from automobile and industrial exhausts'. — 1

Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. Sunlight increases the rate of most of these reactions. The result is a mild solution of sulfuric acid and nitric acid. Acid rain can occur naturally, from the volcanic eruptions also. — 2

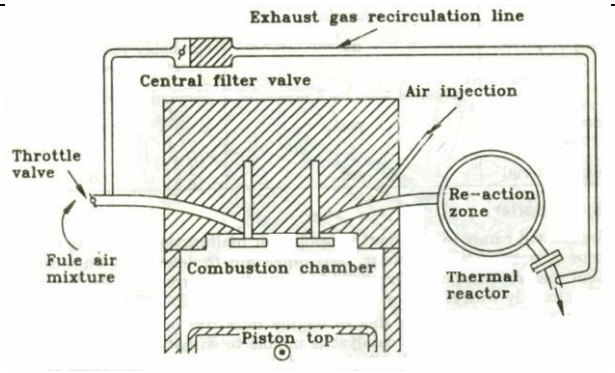
Q1.f) What are the design and operating parameters of controlling air pollution. — 04

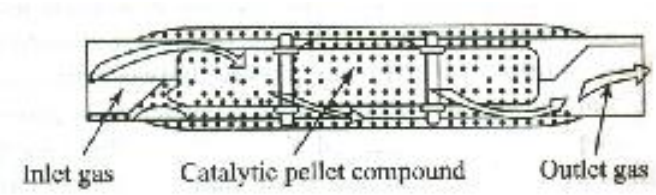
Ans: (Student should mention **Any two** design and **any two** operating parameter and write how it affects emission.) — 1 each

Design Parameter	**HC**	**CO**	**NOx**
Surface/ volume ratio	Increase	–	–
Combustion chamber Area	Increase	–	–
(L/d) Ratio	–	–	–
Displacement/cylinder	Decrease	–	–
Compression Ratio	Increase	–	-
Operating	**HC**	**CO**	**NOx**
A: F ratio	Increase	Increase	Decrease
Load	–	–	Increase
Speed	Decrease	–	Decrease
Valve overlap	Decrease	–	Decrease
Spark Retard	Decrease	–	Decrease
Exhaust back pressure	Decrease	–	Decrease
Intake manifold pressure	–	–	Increase
Combustion chamber	Increase	–	Increase

Air Injection	Decrease	Decrease	- or Increase	
Fuel Injection	Decrease	Decrease	Increase	
Coolant Temperature	- or Decrease	. - or	Increase	

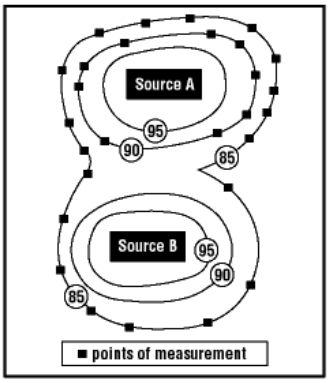
Q1.g) list the various methods of solid waste disposal. Explain any one in brief.	04
Ans: Disposal Methods: E.g. a) Land fill method, b) Land and ocean disposal, and c) Incineration **a) Land fill method:** Disposing of waste in a landfill involves burying waste to dispose it off, and this remains a common practice in most countries. Landfills were often established in abandoned or unused quarries, mining voids or borrow pits. A properly-designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. **b) Land and Ocean Disposal** Radioactive wastes from nuclear power stations are generally fused in glass containers and lowered to the ocean floor. In USA such wastes are sealed in metal drums and buried underground at great depths. But they may leak or be damaged by earthquake and release the wastes into ground water. Hazardous wastes dumped into soil/ditch have chances of leaking to the ground. This method causes is also destruction to marine ecology hence avoided. **c) Incineration** Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash. The heat energy is used for various applications.	2 2 marks for any one
Q2a)Explain the concept of 1) hydrosphere 2)lithosphere 3)atmosphere 4) biosphere and state their interrelationships	08
Ans: **Hydrosphere:** This includes all the surface and ground water resources viz., oceans, seas, rivers, streams, lakes, reservoirs, glaciers, polar ice caps, ground-water and water locked in rock crevices and mineral lying deep below the earth crust. Earth is called the blue planet, because about 80% of its surface is covered by water. **Lithosphere:** The mantle (layer) of rocks constituting the Earth's crust is called lithosphere. The soil covering the rocks is also considered to be important part of the lithosphere. The soil mainly consists of complex mixture of inorganic and organic matter and water. **Atmosphere:** The atmosphere comprises of mixture of gases (eg. N2, O2, CO2, Ar etc) and extends up to about 500 Kms above the surface of the earth. The atmosphere is mainly made up of certain gases, water vapour and dust particles. **Biosphere:** This is the region of the earth where life exists it extends from about 10,000 m below sea level to about 6000m above sea level. A constant exchange of matter takes place between atmosphere, biosphere, and hydrosphere.	1.5 1.5 1.5 1.5 2

Q2b) what are the sources of air pollution? Explain the effect of pollutants on environment and economy.	08
Ans: The main sources of air pollution are the • Industries, • Agriculture • Traffic • Energy generation. **Effect of pollutants on environment:** Increasing activity of agriculture, industrialization, fisheries, timber and mining has lead to: i) Rapid and excessive constructions of factories and building. ii) Increase in emissions of toxic and poisonous gases. iii) Destruction of ecosystems. And finally they lead to permanent and irreversible damage to the environment. To control and limit the effects of pollution, greater finance and grants are needed for the following purposes: i) Medical facility for humans. ii) Conservation of remaining ecosystem. iii) Rehabilitation contaminated ecosystems. iv) Cleanup of toxic waste. v) Restoration of historical landscapes. vi) Revival of biodiversity to a new ecosystem. vii) Preservation of endangered species. viii) Maintaining air quality.	2 3 3
Q2c) Explain the method of pollution like EGR and catalytic convertor.	08
Ans:  Exhaust gas recirculation: In combustion chamber at the temperature above 1370^0, nitrogen reacts with oxygen and forms oxides of nitrogen, which is very harmful for the human health, so as to reduce the peak temperature of the combustion chamber, small amount of exhaust gas recirculated back into the cylinders. This has effect of diluting the overall mixture.	2 2

Catalytic converter:  The catalytic converter is a device, placed in the exhaust pipe, which converts various emissions into less harmful. Generally, a combination of platinum, palladium and rhodium as catalysts. The purpose of catalyst is to increase the rate of reaction, it will not to take part in the chemical reaction. There are two types of catalytic convertors 1) Two-way catalytic converters: A two-way catalytic converter has two simultaneous tasks: ☐ Oxidation of carbon monoxide to carbon dioxide: $2CO + O2 \rightarrow 2CO2$ ☐ Oxidation of unburnt hydrocarbons (unburnt and partially-burnt fuel) to carbon dioxide and water: $2CxHy + (2x+y/2)O2 \rightarrow 2xCO2 + yH2O$ This type of catalytic converter is widely used on diesel engines to reduce hydrocarbon and carbon monoxide emissions. 2) three way catalytic converters: A three-way catalytic converter has three simultaneous tasks: ☐ Reduction of nitrogen oxides to nitrogen and oxygen: $2NOx \rightarrow xO2 + N2$ ☐ Oxidation of carbon monoxide to carbon dioxide: $2CO + O2 \rightarrow 2CO2$ ☐ Oxidation of unburnt hydrocarbons (HC) to carbon dioxide and water: $2CxHy + (2x+y/2)O2 \rightarrow 2xCO2 + yH2O$	1 1 1 1
Q3a) How to determine quality of water with reference to turbidity, hardness, suspended particles and dissolved pollutants?	08
Ans: (Each definition 1 mark and each permissible value 1 mark.) **i) Turbidity:** Water is said to be turbid when it contains visible material in suspension. Turbidity is measured by the resistance of water to the passage of light through it. Turbidity in water is due to the presence of suspended inorganic matter like silt, clay, etc. It is expressed in parts per million (ppm) by weight of suspended matter in water. Turbidity should not be greater than 10 ppm for public water-supply. **ii) Hardness:** Hard water does not produce lather with soap. Temporary hardness is due to the bicarbonates of calcium or magnesium. Permanent hardness is due to the presence of sulphates, chlorides and nitrates of calcium and magnesium. Hardness is expressed either in ppm of calcium carbonate or in terms of degrees. The unit of hardness is the degrees. A unit degree of hardness is given by the soap destroying power of 14-25 mg of calcium carbonate in one litre of water. For potable water the hardness should vary between 5 to 8 degrees or should not be more than 200	2 2

ppm. **iii) Total Solids:** The total solids in water are due to • Suspended particles • Dissolved particles These are determined separately and then added together. The suspended solids are found by filtering the water through a fine filter. The material retained on the filter is weighed. The filtered water is then evaporated and the residue is weighed. This gives the dissolved particles. The total solids in potable water should not exceed 500 ppm and never more than 1000 ppm.	4
Q3b) What are the parameters to be considered while measuring noise level at factory location?	08
Ans: The first step is to determine whether or not noise is a potential problem in factory location. A walk-through survey helps in making this decision. The indicators of potentially hazardous noise level include: • Noise is louder than busy city traffic, • People have to raise their voice to talk to someone at one metre (3 feet) away, • At the end of work shift people have to increase the volume of their radio or TV to a level too loud for others, and • After working for a few years at that workplace, employees find it difficult to communicate in a crowd or party situation where there are other sounds or many voices. Noise measurement data from studies in similar situations are very helpful in assessing the potential noise problem. Before taking field measurements, it is important to determine the type of information required. The person making the measurement must understand: • The purpose of measurement: compliance with noise regulations, hearing loss prevention, noise control, community annoyance etc., • The sources of noise, and times when the sources are operating, • The temporal pattern of noise - continuous, variable, intermittent, impulse, and • Locations of exposed persons. The initial measurements are noise surveys to determine if noise problem exists and further measurements are needed. The second step is to determine personal noise exposure levels; that is, the amount of noise to which individual employee is exposed. If the workplace noise remains steady, noise survey data can be used to determine employee exposures. However, noise dosimetry is necessary if the workplace noise levels vary throughout the day or if the workers are fairly mobile.	4 4
Q3c) Explain the following i) Green house effect ii) Ozone depletion problem	08
Ans: i) Green house effect The "greenhouse effect" is the heating of the Earth. Certain gases in the atmosphere	

like water vapor, carbon dioxide, nitrous oxide, and methane, trap energy from the sun. Without these gases, heat would escape back into space and Earth's average temperature would be about 60ºF colder. Because of how they warm our world, these gases are referred to as greenhouse gases.	1
The greenhouse effect is important. Without the greenhouse effect, the Earth would not be warm enough for humans to live. But if the greenhouse effect becomes stronger, it could make the Earth warmer than usual. Even a little extra warming may cause problems for humans, plants, and animals.	1
The activities that are responsible for producing green house gases are burning of fuels, deforestation and some agriculture practices.	1
Generating more green-house gases will result in global warming causing problems like flooding of coastal areas, Increase in number and severity of tropical storms and cyclones, more extreme weather, more contagious diseases etc.	1
ii) Ozone Layer depletion	
Ozone layer is a protective layer in our atmosphere (O3, three oxygen atoms). It's about 19 to 30 km in distance from the Earth surface. It plays an important role of blocking ultraviolet (UV) rays that come from the sun.	1
CFC molecule, consisting of one atom for each fluorine and carbon and 3 chlorine atoms, is hit by the UV rays. One chlorine atom breaks apart. It will hit an ozone (O3) and takes one oxygen atom away to create chlorine monoxide, thus leaving one oxygen molecule (O2). Another oxygen atom breaks the chlorine monoxide and takes the oxygen atom away, leaving one chlorine atom, leaving no ozone molecule. Process repeats.	1
In today's trends there is a noticeable depletion of the ozone layer. It's popularly known since 1970 that a substance called CFC (chlorofluorocarbon) is threatening the layer. This substance is usually contained in refrigerators, coolants, and aerosol sprays. When we use much of those things (which contain CFC), we are continually depleting our Earth's ozone layer.	1
If more ultraviolet rays come to Earth (this could make the Earth just like a cooking oven) cancer would dominate and even no life would be in this world. More heat, thus increasing the risk of global warming	1
Q4a) Write the steps involved in water treatment.	08
Ans: Generally eight-steps are used for purification process:	
i. Screening (Pre-Treatment):	
Pumps bring "raw" or untreated water, often from lakes or rivers, into the purification plant through screens that exclude fish, weeds, branches and large pieces of debris. Screening may not be necessary for groundwater.	1
ii. Pre-Treatment (aeration):	
The plant may aerate the water at this point to increase the oxygen content and thus help remove problematic odors and tastes by exchange of gases between water and atmosphere. Aeration is done by bringing water in contact with atmospheric air.	1
iii. Coagulation & Flocculation:	
The purpose of these two steps is to clear water of the small particles that cause it to be	

turbid or cloudy. The water is rapidly agitated to disperse coagulant chemicals throughout it. The small particles, including many bacteria, begin to form large clumps called flocs or floccules. In flocculation, the water is mixed gently so that these clumps combine and precipitate out further.	1
iv. Sedimentation: The water and flocs are pumped into sedimentation basins. Here, the flocs settle beneath the water so that they can be removed.	1
v. Filtration: In filtration, the water flows through a multilayer medium such as quartz sand, activated carbon or anthracite coal in order to remove up to 99.5 percent of the solid materials remaining in it,	1
vi. Disinfection: Disinfection kills off disease-bearing organisms in the water. Most water treatment plants use chemicals, generally chlorine compounds, as disinfectants, ultraviolet radiation and ozone gas are becoming more widespread.	1
vii. Corrosion & Scale Control: The pH of the water is adjusted so that it neither corrodes nor deposits too much scale in pipes.	1
viii. Taste & Odor Control Water purification plants often remove tastes and odors through additional chemical treatment, ozonation or filtration.	1
Q4b) What is meant by noise mapping? State and explain ambient noise standards in day and night time.	08
Ans: Noise mapping  Fig · Noise Survey map	2
A Noise Map is a map of an area which is colored according to the noise levels in the area. Sometimes, the noise levels may be shown by contour lines which show the boundaries between different noise levels in an area. Noise survey maps, as shown in figure provide very useful information by clearly identifying areas where there are noise hazards.	1
Noise map can be drawn for particular area, region or location. A further benefit of having a noise model is that it can be used to assess the effects of transportation and other plans. Thus the effect of a proposed new road can be assessed and suitable noise	1

mitigation can be designed to minimize its impact. This is particularly important in noise action planning, where a cost benefit analysis of various options can be tested before a decision is made.

Ambient noise standard for day and night

The Central Pollution Control Board constituted a Committee on Noise Pollution Control. The Committee recommended noise standards for ambient air which were later notified in Environment(Protection) Rules,1986 as given below

Sl No	Area+	Leq dB(A)	
		Day Time*	Night Time**
1.	Industrial Area	75	70
2.	Commercial Area	65	55
3.	Residential Area	55	45
4.	Silence Zone***	50	40

2

* Day time - 06.00 am to 10.00 pm

** Night time - 10.00 pm to 06.00 am

*** Areas up to 100 meters around certain premises like Hospitals, Educational Institutions, courts, religious places may be declared as Silence Zones by the Competent Authority. Honking of vehicle horns, use of loudspeakers, bursting of crackers and hawkers' noise should be banned in these zones. 2

+ Mixed area should be declared as one of four aforesaid areas by the Competent Authority and the corresponding limit is applied.

Q4c) List the sources of radiation pollution. What are the effects of radiation? Explain treatment and disposal method of radiation waste. 08

Ans: Sources of radiation

i) Natural source: 1

Radon gas that is trapped within buildings. Granite found in home furnishings such as counter tops and furniture tends to emit radon.

ii) Anthropogenic source:

a) Accidents: Nuclear reactor accidents, medical radiation therapy accidents or errors in treatment dose, accidents during the transportation of radioactive material. 1

b) Terrorist Use of Nuclear Materials: The use of radioactive materials in an RDD or a nuclear weapon by a terrorist is a remote but probable threat.

c) Mining: mining and refining of uranium and thorium are also causes of nuclear waste.

Effects of radiation

1) Hair: The losing of hair quickly and in clumps occurs with radiation exposure at 200 rems or higher.

2) Brain: Since brain cells do not reproduce, radiation kills nerve cells and small blood vessels, and can cause seizures and immediate death.

3) Thyroid: The thyroid gland is susceptible to radioactive iodine. In sufficient amounts, radioactive iodine can destroy all or part of the thyroid. 2

4) Heart: Intense exposure to radioactive material at 1,000 to 5,000 rems would do immediate damage to small blood vessels and probably cause heart failure and death directly. **Treatment & disposal of radiation waste** Radioactive nuclear wastes cannot be treated by conventional chemical methods and must be stored in heavily shielded containers in areas remote from biological habitats. The safest of storage sites currently used are impervious deep caves or abandoned salt mines. **Low-level Waste**: Low-level Waste is generated from hospitals, laboratories and industry, as well as the nuclear fuel cycle. It comprises paper, rags, tools, clothing, filters etc. Usually it is buried in shallow landfill sites. To reduce its volume, it is often compacted or incinerated (in a closed container) before disposal. **Intermediate-level Waste:** Intermediate-level Waste contains higher amounts of radioactivity and may require special shielding. It typically comprises resins, chemical sludge's and reactor components, as well as contaminated materials from reactor decommissioning. It may be solidified in concrete or bitumen for disposal. **High-level Waste:** High-level Waste may be the used fuel itself, or the principal waste from reprocessing this. It generates a considerable amount of heat and requires cooling, as well as special shielding during handling and transport. If the used fuel is reprocessed, the separated waste is vitrified by incorporating it into borosilicate (Pyrex) glass which is sealed inside stainless steel canisters for eventual disposal deep underground.	1 1 1 1
Q5a) Explain i) ISO 14000 standards ii) Kyoto treaty/protocol	08
Ans: **ISO 14000** is a series of standards being prepared by the International Standards Organization (ISO), for Environment Management System. ISO 14000 group of standards cover the following areas: i) Environmental Management Systems (14001, 14002, 14004) ii) Environmental Auditing (14010, 14011, 14012) iii) Environmental Labeling (14020, 14021, 14022, 14023, 14024, 14025) iv) Evaluation of Environmental Performance (14031) v) Life-Cycle Assessment (14040, 14041, 14042, 14043) **Important characteristics of ISO 14001 are:** i) It is **comprehensive**: all members of the organization participate in environmental protection, the EMS considers all stakeholders, and there are processes to identify all environmental impacts. ii) It is **proactive**: it focuses on forward thinking and action instead of reacting to command and control policies. iii) It is a **systems** approach: it stresses improving environmental protection by using a single environmental management system across all functions of the organization. **Kyoto Treaty / Protocol:**	1 1 2

The Kyoto Protocol is an **agreement under which industrialized countries will reduce their collective emissions of greenhouse gases** by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this limitation represents a 29% cut). The goal is to lower overall emissions of six greenhouse gases: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons averaged over the period of 2008-2012.	2
National limitations range from 8% reductions for the European Union and some others to 7% for the US, 6% for Japan, 0% for Russia, and permitted increases of 8% for Australia and 10% for Iceland.	1
It was adopted for use on 11 December 1997 by the 3rd Conference of the Parties, which was meeting in **Kyoto - Japan**, and it entered into force on 16 February 2005. As of May 2008, 182 parties have ratified the protocol. Of these, 36 developed countries are required to reduce greenhouse gas emissions to the levels specified for each of them in the treaty (representing over 61.6% of emissions from Annex I [developed] countries), with three more countries intending to participate. One hundred thirty-seven (137) developing countries have ratified the protocol, including Brazil, China and India, but have no obligation beyond monitoring and reporting emissions. The United States is the only developed country that has not ratified the treaty and is one of the significant greenhouse gas emitters.	1
Q5b) State emission standards used in India and Europe. Also state the reasons of causing pollutions in Indian metro cities	08
Ans: Emission norms are the limits prescribed under Rule 115 of the Central Motor Vehicle Rules 1989 for various types of emissions coming out of the vehicles, with a view to controlling environment pollution.	1
Emission norms are prescribed maximum, CO (Carbon Monoxide), HC (Hydrocarbons) NOX (Nitrous oxide) and PM (Particulate matter), levels set by the government which a vehicle would emit when running on roads. All the manufacturers need to implement the same for vehicles being manufactured from the date of implementation.	1
In India emission standards used are Bharat Stage-I, Bharat Stage-II, Bharat Stage-III, and Bharat Stage-IV	1
In Europe emission standards used are Euro-I, Euro-II, Euro-III, Euro-IV	1
Air pollution in Indian metro cities:	
There are four reasons of air pollution: emissions from vehicles, thermal power plants, industries and refineries. Air quality is worst in the big cities like **Kolkata, Delhi, Mumbai,** Chennai, etc	1
India's environmental problems are increased by its heavy reliance on coal for power generation. This energy source has led to a nine-fold jump in carbon emissions over the past forty years. The government estimates the cost of environmental degradation has been running at 4.5% of GDP in recent years. The low energy efficiency of power plants that burn coal is a contributing factor. The government has taken steps to address its environmental problems. As of now the use of washed coal is required for all power	1

plants.
Vehicle emissions are responsible for 70% of the country's air pollution. The major problem with government efforts to safeguard the environment has been enforcement at the local level. Air pollution from vehicle exhaust and industry is a worsening problem for India. — 1

Exhaust from vehicles has increased eight-fold over levels of twenty years ago; industrial pollution has risen four times over the same period. The economy has grown two and a half times over the past two decades but pollution control and civil services have not kept pace. — 1

Q5c) Classify air pollution and Explain how fertilizer industry produce air pollution. — 08

Ans: Air pollution is classified in different ways as follows:

i) On basis of Source:

a) Natural pollution: e.g. pollution due to Volcano, storm, forest fire, etc

b) Anthropogenic (Human cause) pollution: Pollution due to burning of fuels in furnaces or engines etc. — 2

ii) On basis of pollutant:

a) Biological air pollution, such as pollens, small insects and microrganisms (bacteria fungi, yeasts and algae)

b) Physical air pollution, such as sound, smell, thermal pollution and radioactive radiation

c) Chemical air pollution, such as ozone, aerosols and ammonia. — 2

Due to raw material and various processes in manufacturing of fertilizer following pollutants are emitted from this industry which causes pollution. The agricultural sector is known for its extensive use of pesticides. This application causes emissions of many toxic chemicals. — 1

Source	**Typical pollutant emission**
Fertilizer industry	Sox, NOx, CO, Particulate matter, smoke Hydrogen fluoride, ammonia, fluorides, fertilizer dust and Sulphuric acid mist.

— 3

Q6a)How does cement industry produces air pollution — 04

Ans:

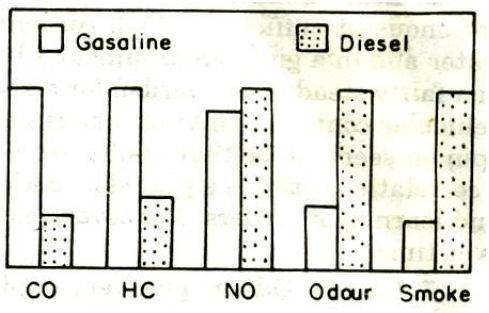
Due to raw material and various processes in manufacturing of cement following pollutants are emitted from this industry which causes pollution. — 1

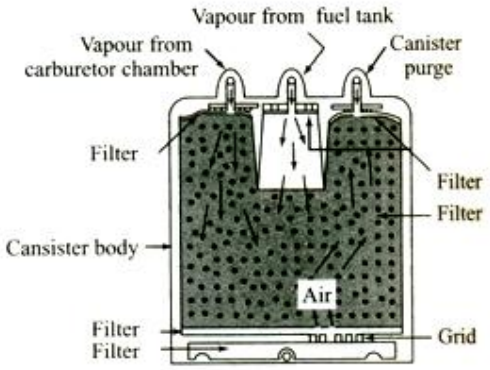
Source	**Typical pollutant emission**
Cement industry	Sox, NOx, CO, Particulate matter, smoke Cement and lime dust.

— 3

Q6b) Write note on photochemical air pollution — 04

Ans: Photochemical air pollution means formation of summer **smog.** Smog is a

combination of the words smoke and fog. We can distinguish two separate types of smog, summer smog and winter smog. A photochemical smog is the chemical reaction of sunlight, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the atmosphere, which leaves airborne particles (called particulate matter) and ground-level ozone. Ozone is formed according to the following chemical reactions: **NO_2 + uv --> NO + O** **O + O_2 --> O_3** **The reverse reaction is:** **NO + O_3 --> NO_2 + O_2** Nitrogen oxides are released by nitrogen and oxygen in the air reacting together under high temperature such as in the exhaust of **fossil fuel**-burning engines in **cars**, trucks, **coal power plants**, and industrial manufacturing factories. VOCs are released from man-made sources such as **gasoline** (petrol), **paints**, **solvents**, **pesticides**, and biogenic sources, such as pine and citrus tree emissions. **Effects of smog:** Smog is a problem in a number of cities and harms human health. **Ground-level ozone, sulfur dioxide, nitrogen dioxide** and **carbon monoxide** are especially harmful for senior citizens, children, and people with heart and lung conditions such as **emphysema, bronchitis**, and **asthma**.	1 1 1 1
Q6c) Compare pollution due to SI and CI engines	04
Ans: The emissions of HC, CO, NOx, smoke and odour in the exhaust gases for petrol and diesel engines are shown in Fig  **Fig** Comparision of emissions and odour from petrol and diesel engine. Although, the exhaust emission is the result of incomplete combustion in both the engines, but the type of fuel used, nature of combustion and design of combustion chamber in both cases are totally different. All the petrol engines show the same pattern of emission irrespective of combustion chamber design and fuel control system but there is wide variations in emission pattern as they are very much affected by operating variables and design of combustion chambers. Therefore, diesel engines have different emission characteristics. This is because, combustion in diesel engine occurs over a wide range of A : F ratio, ranging from very	 2 1

lean (35 : 1) to very rich mixture (10 : 1). In addition to this, the diesel engines have large amount of excess air at all loads as it is controlled by qualitative governing method.	1
Q6d) Explain method of pollution control like canister	04
Ans: Charcoal canister  **Fig:** Charcoal canister A charcoal canister used for trapping gasoline vapours is shown in Fig. This type of charcoal canister is used in the evaporative emission control system of a petrol engine. Fuel vapours from the float· chamber of the carburettor enter into the canister though the left end passage. Fuel vapours from the fuel tank enter through the mid passage into the canister. The flow of these vapours is shown by the arrows pointing downwards. When the engine is not running, the fuel vapours flow in this manner. The fuel vapours are absorbed by the charcoal particles present in the canister. When the engine runs, air reaches the charcoal, canister due to the suction provided by the engine. This air carries away the hydrocarbons (HC) in the fuel vapours to the engine manifold. This purging action is shown at the right end of the charcoal canister by the arrows pointing upwards. As charcoal is a form of carbon, the charcoal canister is also called the carbon canister.	2 2
Q6e) Write steps to determine total suspended solids in given water sample	04
Ans: Total Solids: The total solids in water are due to • Suspended matter • Dissolved matter These are determined separately and then added together. i.The suspended solids are found by filtering the water through a fine filter. ii. The material retained on the filter is weighed. iii. The filtered water is then evaporated and the residue is weighed. iv. This gives the dissolved matter. The total solids in potable water should not exceed 500 ppm and never more than 1000.	 01 01 01 01
Q6f) Prepare a brief report of recycling and recovery of material is done from refuse	04

e.g. agricultural waste.	
Ans: **Recycle** means to process old, used items in order that the material can be used to make new products. Examples of things that are often recycled are glass, plastic, newspapers, aluminum cans, used motor oil, and batteries. The process of extracting resources or value from waste is generally referred to as recycling, meaning to recover or reuse the material. There are a number of different methods by which waste material is recycled: the raw materials may be extracted and reprocessed, or the calorific content of the waste may be converted to electricity. New methods of recycling are being developed continuously, and are described briefly below. i) Physical reprocessing. ii) Biological reprocessing: e.g. composting and anaerobic digestion iii) Energy recovery. **Any one agricultural waste product should be explained on above basis.**	1 1 2