ICSE Class 10 Environmental Science Specimen Paper 2

Written by the Future Topper subject team on the CISCE examination pattern. Not an official CISCE paper.
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Maximum Marks: 80 | Time Allowed: Two hours | Reading Time: 15 minutes

Section A is compulsory. Attempt any four questions from Section B.

General Instructions

Write your answers on the separate answer paper provided. The first 15 minutes are for reading the paper, and you may not write during that time. Marks for each question, or part of a question, are shown in brackets. Section A is compulsory. In Section B attempt any four questions out of the six set. Answer in your own words and keep to the point, as the marks allotted are a guide to the length expected. Where a question asks for a stated number of points, write only that many, since extra points will not be marked. No diagrams, figures or sketches are required anywhere in this paper.

SECTION A (40 Marks)

Attempt all questions from this Section.

Question 1 [15]

Choose the correct answer for each part. Write only the option you choose.

(i) The three strands of the triple planetary crisis are treated as one problem chiefly because they:

(a) were named in the same decade

(b) are all studied by the same scientists

(c) share the same underlying drivers and worsen one another

(d) affect only the poorest countries

(ii) Melting glaciers in a mountain range affect biodiversity downstream mainly by:

(a) raising the salt content of the soil

(b) altering the flow of the rivers that species depend on

(c) increasing the number of invasive species carried by air

(d) reducing the oxygen content of the atmosphere

(iii) Eutrophication of a lake is caused mainly by:

(a) an excess of dissolved oxygen (b) a fall in water temperature

(c) an excess of nutrients such as nitrates and phosphates

(d) the removal of silt from the bed

(iv) Biomagnification refers to the:

(a) rise in the concentration of a persistent pollutant at each higher level of a food chain

(b) increase in the volume of waste produced by a city each year

(c) growth in the population of a species after a habitat is restored

(d) spread of a pollutant over a wider area by the wind

(v) A biodiversity hotspot is an area that has:

(a) a very high average temperature

(b) only species introduced from elsewhere

(c) a large number of endemic species and has lost much of its original habitat

(d) no human population at all

(vi) The Red List maintained by the International Union for Conservation of Nature records the:

(a) risk of extinction faced by individual species

(b) area of forest cleared in each country

(c) names of countries that have signed each treaty

(d) quantity of greenhouse gas released by each industry

(vii) Methane is released in the largest quantities from all of the following except:

(a) flooded paddy fields (b) landfill sites

(c) cattle (d) solar panels

(viii) Sea level is rising mainly because of:

(a) the dumping of solid waste in the sea

(b) a rise in rainfall over the oceans

(c) the melting of sea ice already floating on the ocean

(d) the melting of land ice together with the expansion of sea water as it warms

(ix) A carbon market allows a country or company to:

(a) buy fuel at a lower rate of tax

(b) buy and sell permits or credits representing greenhouse gas emissions or removals

(c) trade shares in coal companies

(d) obtain a loan against its forest land

(x) The expression "polluter pays" means that:

(a) the government bears the cost of cleaning up pollution

(b) the consumer alone bears the cost through higher prices

(c) the cost of preventing and repairing pollution falls on whoever causes it

(d) no industry may release any pollutant at all

(xi) Of the following, the practice that best fits the top of the waste hierarchy is:

(a) refusing a plastic carry bag and using a cloth one brought from home

(b) recycling a plastic bag after use

(c) burning plastic bags to recover energy

(d) burying plastic bags in a lined landfill

(xii) Agroforestry means:

(a) growing trees together with crops or livestock on the same land

(b) clearing forest to extend farmland

(c) growing a single crop over a very large area

(d) replacing a natural forest with one plantation species

(xiii) A green building is one that is designed to:

(a) be painted in green shades

(b) use less energy, water and material and to give healthier indoor conditions

(c) stand in a park or a garden

(d) be built entirely of timber

(xiv) Of the following, the work that is NOT normally counted as a green job is:

(a) wind turbine maintenance technician

(b) wildlife rehabilitation officer

(c) petrol pump attendant

(d) water quality analyst

(xv) A life cycle assessment of a product examines its environmental effects:

(a) only while it is being manufactured

(b) only while it is being used

(c) only after it has been thrown away

(d) from the winning of the raw material to its final disposal

Question 2 **[10]**

(i) Explain briefly how air pollution and climate change are linked through the burning of fossil fuels. **[2]**

(ii) Name one source of groundwater contamination in a rural area and state one disease that may follow from drinking such water. **[2]**

(iii) Give two reasons why the mangrove forest along a coast should be protected. **[2]**

(iv) State what is meant by a climate refugee and give one reason why people become climate refugees. **[2]**

(v) State what is meant by a green skill and give one example of a green skill needed in the construction trade. **[2]**

Question 3 **[15]**

(i) Explain how the use of chemical fertiliser on farmland can lead to the death of fish in a lake nearby. **[3]**

(ii) A stretch of degraded land is to be restored. State three steps that should be taken and give a reason for each. **[3]**

(iii) State three effects a rise in the average global temperature is expected to have on agriculture in a country like India. **[3]**

(iv) Explain the difference between reuse and recycling, giving one example of each, and state which of the two is to be preferred. **[3]**

(v) A school wishes to start an eco club. Suggest three activities for it and state what each would achieve. **[3]**

SECTION B (40 Marks)

Attempt any four questions from this Section.

Question 4 **[10]**

(a) Explain how the loss of forest cover in a hill district worsens all three strands of the triple planetary crisis. **[3]**

(b) Explain, with reasons, why plastic waste left on the ground is a problem for the climate as well as for wildlife. **[3]**

(c) A city of two million people grows outwards over its farmland, lakes and groves. Explain how this single pattern of growth drives pollution, biodiversity loss and climate change, and state two planning decisions that would ease all three. **[4]**

Question 5 **[10]**

(a) State three ways in which indoor air in a village home can become polluted and name one measure that would reduce it. **[3]**

(b) Explain what is meant by the term bioremediation and describe one example of its use. **[3]**

(c) Untreated electronic waste is dismantled and burnt in the open in a city locality. State two pollutants released and the harm each does, name two groups of people most at risk, and state one step that would make the trade safer. **[4]**

Question 6 **[10]**

(a) Explain what is meant by an ecosystem service and describe three services that a forest provides to the people living around it. **[3]**

(b) Explain why a monoculture plantation of a single tree species cannot replace a natural forest that has been cleared. **[3]**

(c) A coastal wetland is to be given over to a port project. State two arguments a conservationist would make against it, one argument the developer would make for it, and one way in which the two positions could be reconciled. **[4]**

Question 7 [10]

(a) State three observed or expected effects of climate change on human health, giving a reason in each case. **[3]**

(b) Explain what is meant by an early warning system for an extreme weather event and state why it counts as adaptation rather than mitigation. **[3]**

(c) Explain why coastal and low lying regions are especially exposed to climate change. State two measures a coastal district could take to protect its people and one measure to protect its farmland. **[4]**

Question 8 [10]

(a) Explain how a shift from private cars to public transport in a large city would redesign both its social and its economic arrangements for the better. **[3]**

(b) Explain what is meant by green accounting and state why it gives a truer picture of a country's progress than national income alone. **[3]**

(c) Explain how each of the following moves an economy towards sustainability: removing a subsidy on fossil fuel, lending at a lower rate of interest for clean energy projects, requiring an environmental impact assessment before a project is cleared, giving legal recognition to the rights of forest dwelling communities. **[4]**

Question 9 [10]

(a) Describe three practices a farmer could adopt to make a holding more sustainable and state what each would achieve. **[3]**

(b) Explain what is meant by a zero waste event and state three arrangements that would be needed to run a school function as one. **[3]**

(c) A state wishes to prepare its students for green jobs. Suggest one change to the school curriculum, one arrangement with industry and one measure for students who do not go on to college, giving a reason for each, and state one difficulty the plan may run into. **[4]**

ANSWER KEY AND MARKING SCHEME

A full model answer is given for every part. Marks shown in italics are the step marks an examiner would award. Accept any other correct point of equal value, and do not insist on the wording used here. Where a candidate has been asked for a stated number of points, mark only that many.

Question 1 [15]

(i) (c) share the same underlying drivers and worsen one another. The same fossil fuel use, land clearing and wasteful production feed all three, and each strand makes the other two harder to deal with.

(ii) (b) altering the flow of the rivers that species depend on. A glacier fed river first carries more water as the ice melts faster and then far less once the ice is gone, and the temperature and timing of the flow change, so the fish and the riverside vegetation that are matched to the old pattern cannot hold on.

(iii) (c) an excess of nutrients such as nitrates and phosphates. These come mainly from fertiliser runoff, sewage and detergents.

(iv) (a) rise in the concentration of a persistent pollutant at each higher level of a food chain. Because the pollutant is not broken down or excreted, a predator takes in the whole load carried by everything it eats.

(v) (c) a large number of endemic species and has lost much of its original habitat. Both conditions have to be met, which is why a hotspot is treated as a conservation priority.

(vi) (a) risk of extinction faced by individual species. Species are placed in categories from least concern through vulnerable and endangered to critically endangered, extinct in the wild and extinct.

(vii) (d) solar panels. A solar panel releases no methane. Flooded paddy fields, landfill sites and cattle are all large sources, since each involves decay or digestion in the absence of air.

(viii) (d) the melting of land ice together with the expansion of sea water as it warms. Sea ice that is already floating displaces its own weight of water, so its melting adds very little to the level.

(ix) (b) buy and sell permits or credits representing greenhouse gas emissions or removals. The idea is that the cut is made wherever it costs least.

(x) (c) the cost of preventing and repairing pollution falls on whoever causes it. The principle keeps the cost from being passed silently to the public.

(xi) (a) refusing a plastic carry bag and using a cloth one brought from home. The hierarchy runs refuse, reduce, reuse, recycle, recover and dispose, so avoiding the waste altogether stands above recycling it.

(xii) (a) growing trees together with crops or livestock on the same land. The trees give shade, fodder, fruit and fuel, hold the soil and store carbon, while the land continues to produce food.

(xiii) (b) use less energy, water and material and to give healthier indoor conditions.

(xiv) (c) petrol pump attendant. The work serves the burning of fossil fuel and does nothing to protect or restore the environment.

(xv) (d) from the winning of the raw material to its final disposal. This is why it is also called a cradle to grave assessment.

1 mark for each correct option. No marks are deducted for a wrong option.

Question 2 [10]

(i) Burning coal, oil or gas releases carbon dioxide, which stays in the atmosphere for a long time and traps outgoing heat, so the climate warms. The same combustion sends out sulphur dioxide, oxides of nitrogen, carbon monoxide and fine particles, which make the air unfit to breathe near the ground. The two problems therefore have one root, and a measure that cuts the fuel burnt, such as moving a city to electric buses or a grid to solar power, improves the air and slows the warming at the same time.

Carbon dioxide and warming 1. Air pollutants from the same combustion, with the shared cause 1.

(ii) Leakage from an unlined pit latrine or an open dump sited close to a hand pump contaminates the groundwater with faecal bacteria. Drinking such water causes diarrhoea, and typhoid and cholera are spread in the same way. Fertiliser and pesticide leaching from the fields is another source, and nitrate in the water causes methaemoglobinaemia in infants.

Source named 1. Disease named 1.

(iii) Mangroves stand between the sea and the land and break the force of storm waves, cyclonic surge and high tides, so the villages, fields and roads behind them are shielded and the shoreline is not cut away. They are also a nursery: a very large part of the coastal fish and prawn catch breeds and spends its young life among the mangrove roots, so the fishing the coast lives on depends on them. They hold a great deal of carbon in their waterlogged soil as well, far more for their area than most forests on dry land.

First reason 1. Second reason 1.

(iv) A climate refugee is a person who has had to leave home, either within the country or across a border, because changes in the climate have made the place unfit to live in or to earn a living in. People are forced out when repeated flooding or a cyclonic surge destroys the house and the land, when the sea moves in and the soil and the wells turn salty, or when a drought that returns year after year leaves farming and grazing impossible.

Definition 1. One reason 1.

(v) A green skill is the practical knowledge and ability a worker needs in order to do a job in a way that protects or restores the environment, or in order to do a job that exists only because of environmental work. In the construction trade an example is the ability to install rainwater harvesting and greywater reuse plumbing in a building, or the ability to fit roof and wall insulation and glazing correctly so that the building needs far less cooling.

Definition 1. Example from construction 1.

Question 3 [15]

(i) Fertiliser spread on a field is never taken up entirely by the crop, and the nitrate and phosphate left in the soil are carried off by rain and irrigation water into the drains and streams that lead to the lake. Once in the lake these nutrients feed a heavy growth of algae and water weed, which covers the surface as a bloom and shuts out the light from the plants below. The algae then die in large quantities and bacteria set about decomposing them, and this decay uses up the dissolved oxygen in the water. With the oxygen gone the fish suffocate and die in numbers, and the process is called eutrophication.

Nutrients washed into the lake 1. Algal bloom 1. Decay removes the oxygen and the fish die 1.

(ii) Stop whatever is degrading the land first, by fencing or by agreement with the users, so that grazing, cutting and quarrying stop. Nothing planted will survive while the damage continues. Treat the slope so that the soil and water stay on it, with contour trenches, bunds, check dams and gully plugs, because degraded land loses its topsoil and its rain before anything can establish. Plant and sow native species suited to the place, grasses and shrubs first and then trees, because they take root with less tending, feed the local insects, birds and animals and leave a community that can look after itself.

First step with its reason 1. Second step with its reason 1. Third step with its reason 1.

(iii) Yields of the main cereals fall where the temperature in the growing season crosses what the crop can stand, since heat during flowering and grain filling leaves the grain small and poorly filled. The monsoon becomes less dependable, with the rain arriving late and falling in fewer and heavier spells, so sowing dates slip, fields are waterlogged at one time and short of water at another. Pests, weeds and crop diseases spread into districts that were formerly too cool for them and breed through more generations in a season, so losses rise and more has to be spent on control.

Effect on yields 1. Effect through the monsoon 1. Effect through pests and diseases 1.

(iv) Reuse means using an article again as it is, for the same purpose or for another, without breaking it down, as when a glass jar is washed and filled again or a bottle is returned to the filler. Recycling means breaking the article down to its material and making something new from it, as when waste paper is pulped and made into fresh paper or old aluminium is melted and cast again. Reuse is to be preferred, because the article keeps its shape and its value and almost no energy, water or fresh material is needed, whereas recycling costs energy to collect, sort and reprocess the material, and most materials lose some quality each time they go round.

Reuse defined with an example 1. Recycling defined with an example 1. Reuse preferred with a reason 1.

(v) A waste audit and a segregation drive: the club weighs and sorts what the school throws out for a week, then sets up labelled bins, a compost pit for the canteen and garden waste and a tie up with a recycler. The school

sees its own figures, the waste going out falls and the garden gets manure. A water and energy watch: the club reads the meters each week, puts up the readings, reports dripping taps and lights left burning and checks that the rainwater harvesting pit is clear. Consumption falls, the bills come down and the students learn to measure before they argue. A campus biodiversity register: the club lists and labels the trees, birds, butterflies and insects on the grounds over a year and plants native species to fill the gaps. The students learn to identify what lives around them and the grounds become better habitat.

First activity with what it achieves 1. Second activity with what it achieves 1. Third activity with what it achieves 1.

Question 4 [10]

(a) Climate change: the felled trees stop taking carbon dioxide out of the air, the carbon held in the wood is returned to the atmosphere when the timber is burnt or decays, and the exposed soil loses its carbon as well, so the district turns from a carbon sink into a source. Biodiversity: the habitat on which the forest species depended goes with the trees, and what is left is cut into small patches too small to hold large animals or to let populations mix, so species are lost locally and the invasive weeds that thrive on disturbed ground move in. Pollution and waste: with no roots to hold it the topsoil is washed off the slope in the monsoon, so the streams run thick with silt, the tanks and reservoirs below fill up, the springs that the villages drink from fail, and landslides follow.

Climate effect 1. Biodiversity effect 1. Pollution and soil effect 1.

(b) For wildlife: an animal cannot tell plastic from food. Cattle swallow carry bags along with the waste they eat and the plastic blocks the gut, a turtle takes a floating bag for a jellyfish, and birds feed fragments to their young, so the animal starves with a full stomach. Plastic in a drain also chokes it, so water stands and breeds mosquitoes, and in the sea it breaks down into fragments that enter the food chain at every level. For the climate: almost all plastic is made from oil and gas, so the carbon is released at the refinery and the factory before the article is even sold, and burning the waste in the open, which is how much of it is got rid of, releases that carbon directly along with soot and toxic fumes. Plastic lying in sunlight also gives off small quantities of greenhouse gas as it degrades, and litter that smothers soil and vegetation reduces the capacity of the land to take up carbon.

Harm to animals 1. Harm through drains or the sea 1. Link to the climate through manufacture and burning 1.

(c) Pollution: the new distance between homes and workplaces puts far more vehicles on the roads, so exhaust emissions and dust rise, and the sewage and solid waste of a far larger population is produced faster than the treatment plants and the dump can take it, so untreated sewage reaches the drains and the waste reaches the land. Biodiversity: the farmland, groves, tanks and grassland built over were themselves habitat, and the creatures that lived there lose it. The lakes are filled or cut off from the channels that fed them, the trees that lined the roads and fields go, and what survives is a few adaptable species. Climate: the city now spreads over a wider area, so every trip is longer and emissions per person rise. Concrete, tar and metal replace soil and leaf, so the surface absorbs heat instead of cooling by evaporation and the built up area becomes several degrees hotter than the land around it, which pushes up the demand for cooling and so for power. The soil and vegetation that were taking up carbon dioxide are gone, and making the cement and steel for the new building releases a great deal more. Planning decisions that ease all three: build densely along a mass transit corridor instead of spreading outwards, with homes, shops, schools and workplaces mixed together so that most daily journeys can be made on foot, by cycle or by bus. Protect the city's lakes, drainage channels, groves and farmland in the master plan as a permanent green and blue network, with construction kept out of them, so that the city keeps its habitat, its flood storage and its cooling.

Pollution 1. Biodiversity 1. Climate, including the heat island 1. Two planning decisions 1.

Question 5 [10]

(a) Smoke from a cooking fire of wood, dung cake or crop residue burnt in an open chulha in a room with little ventilation, which fills the kitchen with fine particles and carbon monoxide. Smoke from a kerosene lamp or wick stove used where the power supply is poor, and from tobacco smoked indoors. Fumes from mosquito coils, from a kerosene or diesel pump kept near the house, and from pesticide and whitewash stored inside, together with the damp and mould of a room that is never opened. Measures that reduce it: replace the open

chulha with a gas or electric connection, or at least with an improved stove fitted with a chimney that takes the smoke out of the room, and give the kitchen a window and a ventilator so that air can cross it and a roof opening for the smoke.

First source 1. Second source 1. Third source with the measure 1.

(b) Bioremediation is the use of living organisms, chiefly bacteria, fungi and plants, to break down or take up pollutants in soil or water and so make a contaminated site fit for use again. The organisms use the pollutant as food or lock it away in their tissues, and the method is cheaper and gentler than digging the site out, though it is slower. An example is the treatment of an oil spill, where bacteria that feed on hydrocarbons are applied to the oiled soil or water, along with nitrogen and phosphorus to help them multiply, and they break the oil down to carbon dioxide and water. Another example is phytoremediation, in which plants are grown on soil carrying heavy metals and draw the metal up into their shoots, and the crop is then harvested and disposed of safely, taking the metal with it. Constructed wetlands, in which reeds and the bacteria on their roots clean sewage as it passes through, work on the same principle.

Definition 1. How it works 1. One worked example 1.

(c) Pollutants and their harm: burning the plastic casing and insulation gives off dioxins and furans, which are highly toxic, persist in the environment, build up in body fat and cause cancer and damage to the immune and reproductive systems. Lead, which comes from solder and from the glass of old picture tubes, escapes as fume and dust and settles in the soil, and it damages the developing brain and the nervous system, with children worst affected. Mercury from switches and backlights, cadmium from batteries, and the fine soot of the fire itself add to the load. Groups most at risk: the workers who break the goods up and burn them, almost always without gloves, masks or any training, and the children of the locality, who are often working alongside them and whose growing bodies take up lead and mercury readily. Pregnant women and the families living nearest the yards follow close behind. One step to make the trade safer: bring the work inside the law and into authorised facilities, by registering the existing workers into formal collection and dismantling centres with extraction hoods, protective equipment, training and a fair price for the material, while holding the manufacturers answerable under extended producer responsibility for taking their goods back and funding that recycling. Open burning then loses its purpose, because the worker earns more by dismantling the article properly.

First pollutant with its harm 1. Second pollutant with its harm 1. Two groups at risk 1. One step 1.

Question 6 [10]

(a) An ecosystem service is a benefit that people obtain from a natural ecosystem without having to pay for it or build it, and these are grouped as provisioning, regulating, supporting and cultural services. A forest provides water regulation: the canopy and the litter break the fall of the rain, the soil takes it in instead of letting it run off, and it is released slowly, so the streams and springs run through the dry season and the flooding and siltation below are less. It provides climate regulation and clean air: the trees take up carbon dioxide and store it in wood and soil, trap dust and release moisture, so the district is cooler and the air is cleaner. It provides the material the households around it live on, in the shape of fuelwood, fodder, timber, bamboo, fruit, honey, gum, resin and medicinal plants, and it pollinates the crops in the fields nearby. Its cultural value, as the site of sacred groves, festivals and recreation, counts as well.

Definition 1. First and second services 1. Third service 1.

(b) A natural forest is a community that has assembled over a very long time, with trees of many species and many ages, an understorey of shrubs, climbers, herbs and grasses, dead and hollow trees, a deep litter layer and a soil full of fungi and small animals. The animals, birds, insects and plants of that forest are matched to that structure, and each depends on others for food, pollination, seed dispersal and shelter. A plantation of one species, all of one age and set in rows, offers almost none of this. There is no understorey, little litter of mixed kinds, no dead wood and no variety of flowering and fruiting times, so most of the species of the original forest find nothing to eat and nowhere to nest, and the soil life does not return. Being one species of one age it is also fragile: a single pest or disease can take the whole stand, and a fire runs through it unchecked, whereas a mixed forest absorbs such shocks. If the species planted is an exotic that uses a great deal of water or whose litter suppresses other plants, the ground beneath it is poorer still. A plantation may grow

timber and lock up some carbon, and it may be a reasonable use of already degraded land, but it does not restore the ecosystem that was cleared.

Structure and variety of the natural forest 1. What the plantation fails to provide for the species 1. Fragility of a single species stand, or the point that it stores carbon but does not restore the ecosystem 1.

(c) Against the project: the wetland is the nursery and feeding ground of the coastal fishery and a staging point for migratory birds, so filling it would take away the breeding grounds on which thousands of fishing families depend and break a link in a flyway that cannot be replaced elsewhere. It is also the district's defence against the sea, absorbing storm surge and tidal flooding and holding the shoreline in place, and the carbon locked in its waterlogged soil would be released once it is drained. For the project: a port brings trade, with construction work, loading and transport work, servicing industry and a market for local produce, and it brings revenue to a district with few other prospects, so people who have little may not have to leave to find work. A way of reconciling the two: carry out a full environmental and social impact assessment first and consider other sites and a smaller design, then, if the port goes ahead, shift it to the least sensitive part of the coast, keep the most productive stretch of wetland and the bird roosts out of the project area as a protected zone with a buffer, and require the developer to restore and plant mangrove of at least the area lost, to treat all discharge and ballast before release, and to fund the fishing families through the years when their catch is disturbed, with trained jobs at the port reserved for them. Monitoring by a committee that includes the fishing community keeps the conditions real rather than on paper.

First argument against 1. Second argument against 1. Argument for 1. Way of reconciling the two 1.

Question 7 [10]

(a) Heat illness becomes commoner and more severe, because longer and hotter heatwaves push the body past the point at which it can shed heat by sweating, and that brings on heat exhaustion and heat stroke and worsens existing heart and kidney disease, with outdoor workers, the elderly and the very young at greatest risk. Vector borne disease spreads into new areas and lasts longer in the year, because warmer and wetter conditions let the mosquitoes that carry malaria and dengue breed faster and survive at altitudes and in seasons that were formerly too cool for them. Water borne disease rises after extreme weather, because floods carry sewage into the drinking water supply while droughts force people to use whatever water is left, and diarrhoea, cholera and typhoid follow. Undernutrition is a fourth, since poorer harvests mean a poorer diet.

First effect with its reason 1. Second effect with its reason 1. Third effect with its reason 1.

(b) An early warning system is an arrangement that watches for a coming hazard, such as a cyclone, a flood, a heatwave or a landslide, works out who is in its path and how much time is left, and gets a clear warning to those people quickly enough and in plain enough terms for them to act. It has four parts: knowing which areas and groups are at risk, monitoring and forecasting the hazard, communicating the warning through channels people actually attend to, and a prepared plan so that the warning turns into action, with shelters, routes, transport and drills already in place. It counts as adaptation because it does nothing about the causes of climate change. It does not reduce the greenhouse gas in the atmosphere, and the cyclone or the heatwave still arrives with its full force. What it reduces is the harm done when it arrives, by giving people the time to reach shelter and to move their animals, boats and papers. Mitigation would mean cutting emissions so that such events become less frequent or less severe in the first place.

Definition, including the parts 1. Point that it does not act on the causes 1. Point that it reduces the harm from an unavoidable effect, hence adaptation 1.

(c) Why they are exposed: these are the places where the sea is rising, so the land is slowly lost and salt water pushes into the soil, the creeks and the groundwater, which spoils drinking water and ruins paddy land. They take the full force of cyclones and of the surge that comes with them, and because the ground is barely above the sea the water that comes in over it does not drain away. A great many people live there, often crowded into informal settlements with weak housing, and their work, in fishing, salt making, farming and tourism, depends directly on the coast. The natural defences, the mangrove, the dunes and the reef, have in many places been cleared or built over, so nothing now breaks the waves. Measures to protect the people: restore and plant mangrove belts, dunes and shelter plantations along the shore, since a living barrier absorbs the

surge, holds the land and repairs itself, which a wall does not. Put in place a cyclone warning system with built shelters on high ground, marked evacuation routes, drills and trained volunteers, and enforce a coastal regulation zone so that no new housing goes up on the most exposed ground. Measure to protect farmland: sow salt tolerant varieties of paddy and other crops, and keep the salt water out with sluice gates, bunds and tidal regulators on the creeks, so that the fresh water is held in and the sea cannot reach the fields.

Reason why coastal regions are exposed 1. First measure for people 1. Second measure for people 1. Measure for farmland 1.

Question 8 [10]

(a) Socially, a bus or metro system is open to everyone who can pay a modest fare, so the student, the domestic worker, the elderly person and the office goer all reach work, school and hospital, whereas a city built around the private car serves only those who own one and leaves everyone else stranded at the edge of it. Road space, which the car takes up out of all proportion to the people it carries, is freed for footpaths, cycle tracks and trees, so streets become usable and safer, road accidents fall and the air that everyone breathes improves. Economically, the city stops losing the hours and the fuel that its workers burn in traffic, so productivity rises and households spend far less on travel than they would on buying, fuelling, insuring and parking a car, which leaves money for other things. The city also avoids the cost of building and widening roads and flyovers for ever, and the money saved on imported fuel and on treating the illnesses caused by bad air stays in the economy. The system itself employs drivers, conductors, mechanics, signal and track staff and planners.

Social gain in access and in the use of street space 1. Economic gain to households and to the city 1. Avoided cost in infrastructure, fuel or health, or employment created 1.

(b) Green accounting means keeping the national accounts in a way that also records what happens to the country's natural wealth, its forests, soil, water, fisheries, minerals and clean air, so that the depletion of those assets and the cost of pollution are set against the income earned, and the services nature provides free are counted as well. Figures of this kind are published as natural capital accounts alongside the usual national income. National income alone gives a false picture because it counts only what is bought and sold, and it counts it all as a gain. Felling a forest and selling the timber appears as income, while the loss of the forest itself appears nowhere, so a country can run down the assets it lives on and show growth all the while. Pollution is counted twice over in the wrong direction, since the output of the polluting factory is added and so is the money spent treating the illness and cleaning the river, while the harm itself is not subtracted. Work that nature does for nothing, such as a wetland holding a flood or bees pollinating a crop, is valued at zero until it stops, at which point the substitute has to be built and paid for. Green accounting corrects this, and makes it possible to see whether growth is being earned or merely borrowed from the future.

Definition 1. Depletion of natural assets not shown in national income 1. Pollution and unpriced services counted wrongly 1.

(c) Removing a subsidy on fossil fuel takes away the artificial cheapness that has been encouraging people to burn more of it, so the price finally reflects something nearer the real cost, demand falls, efficient equipment and clean alternatives become worth buying, and the public money released can be spent on public transport or on direct help to the poor households that the higher price would otherwise hurt. Lending at a lower rate of interest for clean energy works on the other side of the same problem. A solar plant or an efficient boiler costs a great deal to put up and then saves money for years, so the obstacle is the first payment, and cheap long term credit makes such a project pay back within reach for a firm, a farmer or a household, which draws investment towards clean capacity. An environmental impact assessment requires a project to be examined before it is cleared, so the damage to water, air, forest and people is identified, the public is heard, alternatives and a smaller design are considered and conditions are attached while changes are still possible, instead of the cost being discovered once the project is built and nothing can be undone. Recognising the rights of forest dwelling communities gives the people who live in a forest a secure legal claim to it and a say in what happens to it. Because their living depends on the forest standing, they have every reason to protect it from felling, encroachment and fire, and their knowledge of the place makes them better guardians than a distant office, so protection and livelihood pull in the same direction instead of against each other.

Removal of fossil fuel subsidy 1. Concessional lending for clean energy 1. Environmental impact assessment 1. Recognition of community rights 1.

Question 9 [10]

(a) Crop rotation with a legume, in place of growing the same crop season after season: the legume fixes nitrogen in the soil, so less fertiliser is needed, and the rotation breaks the life cycle of the pests and diseases that build up under one crop. Composting and the use of farmyard manure and green manure in place of chemical fertiliser alone: this returns organic matter to the soil, so the soil holds water better, its structure improves and the nutrients are released slowly instead of being washed off into the streams. Drip or sprinkler irrigation with mulching, in place of flooding the field: the water goes to the root zone and little is lost to evaporation and seepage, so far less water and pumping energy are used and the waterlogging and salinity that follow flood irrigation are avoided. Integrated pest management, agroforestry on the bunds and zero tillage are other acceptable answers.

First practice with what it achieves 1. Second practice with what it achieves 1. Third practice with what it achieves 1.

(b) A zero waste event is one planned so that as little as possible of what it uses ends up in a landfill or an incinerator. Everything brought to it is either avoided in the first place, reused afterwards, composted or recycled, and the organisers aim to send almost nothing to the dump. Arrangements needed for a school function: avoid the disposables altogether, by serving in steel plates, tumblers and bowls hired or borrowed for the day and washed afterwards, by putting out water in jugs and refillable bottles rather than packaged bottles, and by printing no single use banners, flyers or bottled water labels, using a reusable cloth backdrop and a notice on the school's website instead. Set up clearly labelled collection points with students posted at each to guide people, one for food waste and soiled paper, one for clean paper, plastic and metal, and one small one for anything else, since a bin without a person beside it fills up with everything. Arrange for each stream before the day, with the food waste going to the school compost pit or a nearby biogas unit, the dry recyclables going to a known recycler, and the food itself ordered against a count of those attending so that little is left over, with any surplus arranged in advance to go to a hostel or a shelter the same evening.

Definition 1. First arrangement 1. Second and third arrangements 1.

(c) Curriculum: make environmental science a subject with practical fieldwork rather than reading alone, with a project on the school's own waste, water, energy and biodiversity, and add an elective in the senior school on renewable energy, waste management or sustainable agriculture. The reason is that green work is hands on, and a student who has measured a meter, tested water and built a compost pit leaves school with something an employer can use, and with a reason to choose the field. Arrangement with industry: sign up solar installers, water treatment firms, waste management companies, electric vehicle workshops and farmer producer organisations as partners, so that teachers are trained with them, their engineers teach a part of the course, students visit and work on site, and the syllabus is revised against what the firms are actually hiring for. The reason is that a course designed inside a school drifts away from the work very quickly, and a student the employer has already met is far easier to place. For students who do not go on to college: run short certified skill courses after Class 10 and Class 12 at the local industrial training institute or skill centre, in solar installation, electrical and plumbing work for green buildings, water testing, waste handling and organic farming, each ending in an apprenticeship with a stipend and a recognised certificate. The reason is that these are the trades that are short of hands, they pay reasonably, they can be learnt in months rather than years and they keep the young person from having to migrate. Difficulty the plan may run into: the schools do not have the teachers or the equipment for it. Practical work needs trained instructors, a workshop and a budget for consumables, and the few teachers who can teach it are drawn away by better paid work in the industry itself, so unless teacher training, laboratory funding and pay are settled first the subject is taught from the textbook and the scheme exists only on paper. Student and parent reluctance, as long as a trade is thought less respectable than a degree, is another acceptable answer.

Curriculum change with its reason 1. Industry arrangement with its reason 1. Measure for school leavers with its reason 1. One difficulty 1.