ICSE Class 10 Environmental Science Specimen Paper 1

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 triple planetary crisis is made up of climate change, the loss of biodiversity and nature, and:

(a) soil erosion (b) pollution and waste

(c) deforestation (d) water scarcity

(ii) Burning coal in a power station adds to the triple planetary crisis because it:

(a) releases carbon dioxide only

(b) releases air pollutants only

(c) destroys habitat only

(d) releases carbon dioxide, releases air pollutants and destroys habitat through mining

(iii) Particulate matter described as $PM_{2.5}$ consists of particles with a diameter:

(a) of 2.5 millimetres or less (b) of exactly 2.5 micrometres

(c) of 2.5 micrometres or less (d) greater than 2.5 micrometres

(iv) The pollutant released when coal containing sulphur is burnt, and which goes on to form acid rain, is:

(a) sulphur dioxide (b) methane

(c) carbon monoxide (d) nitrogen gas

(v) A species that occurs naturally in one region of the world and nowhere else is said to be:

(a) exotic (b) invasive (c) endemic (d) domesticated

(vi) Declaring a national park to protect tigers in the forest where they already live is an example of:

(a) ex situ conservation (b) in situ conservation

(c) captive breeding (d) seed banking

(vii) The greenhouse gas added to the atmosphere in the greatest quantity by the burning of fossil fuels is:

(a) methane (b) nitrous oxide (c) ozone (d) carbon dioxide

(viii) Of the following, the source that releases the least greenhouse gas for each unit of electricity generated is:

(a) coal (b) diesel (c) natural gas (d) wind

(ix) A carbon sink is:

(a) a natural or managed store that takes up more carbon dioxide than it gives out

(b) a filter fitted to a chimney to trap carbon particles

(c) a charge levied on each tonne of carbon dioxide released

(d) the total quantity of carbon held in the world's coal reserves

(x) In a circular economy a product that has reached the end of its useful life is regarded as:

(a) waste to be buried in a landfill

(b) a loss to be written off by the maker

(c) a store of materials to be recovered and used again

(d) litter to be burnt

(xi) Extended producer responsibility makes which of the following answerable for collecting and recycling a product once the buyer has finished with it:

(a) the buyer (b) the municipal corporation

(c) the shopkeeper (d) the manufacturer

(xii) Drip irrigation saves water mainly because it:

(a) delivers water slowly to the root zone, so little is lost to evaporation and runoff

(b) works without any pump or pipe

(c) raises the groundwater level under the field

(d) does away with the need for any fertiliser

(xiii) Composting of kitchen and garden waste works through:

(a) burning at a high temperature

(b) breakdown by microorganisms in the presence of air

(c) dissolving the waste in water

(d) compressing the waste under pressure

(xiv) A green job is best described as work that:

(a) is carried out in the open air

(b) is done only by government departments

(c) earns a living while helping to protect or restore the environment

(d) involves the planting of trees and nothing else

(xv) An energy auditor is employed in a factory chiefly to:

(a) find where energy is being wasted and recommend ways of cutting it

(b) sell electricity meters to the factory

(c) repair the standby generator

(d) record the monthly electricity bill

Question 2 [10]

(i) Explain briefly how the clearing of forest for farmland links climate change with the loss of biodiversity. **[2]**

(ii) Name one gaseous air pollutant released from the exhaust of motor vehicles and state one effect it has on human health. **[2]**

(iii) State what is meant by an invasive alien species and give one reason why it threatens native species. **[2]**

(iv) State what is meant by the carbon footprint of a family and give one practical way of lowering it. **[2]**

(v) State what is meant by the sharing economy and give one example of it from everyday life. **[2]**

Question 3 [15]

(i) Name the main sources of noise pollution in a city and state two effects of continued exposure to high levels of noise. **[3]**

(ii) Give three reasons why a wetland on the edge of a town should be conserved. **[3]**

(iii) Distinguish between mitigation and adaptation as responses to climate change, and give one example of each. **[3]**

(iv) Describe how a rainwater harvesting system on a school building works, stating how the water is collected, where it is stored and one use it can be put to. **[3]**

(v) Name three green jobs and state for each the skill that the work calls for. **[3]**

SECTION B (40 Marks)

Attempt any four questions from this Section.

Question 4 [10]

(a) Name the three crises that together make up the triple planetary crisis, and state one human activity that drives all three at the same time. **[3]**

(b) Explain how the warming of the sea links climate change to the loss of biodiversity, taking coral reefs as your example. **[3]**

(c) A river flowing past a town receives untreated sewage from the town and effluent from a dyeing unit. Explain how this single problem touches pollution, biodiversity and climate, and state one measure that would address all three together. **[4]**

Question 5 [10]

(a) Name three air pollutants released by the burning of crop residue in the fields and state one effect of each on human health. **[3]**

(b) Explain the difference between point source and non point source water pollution, giving one example of each, and state why the second is harder to control. **[3]**

(c) A small town has no arrangement for separating its waste. Explain what segregation at source would mean for a household, name the streams the household should keep apart, state a treatment route for each and give one benefit to the town. **[4]**

Question 6 [10]

(a) State three main causes of the loss of biodiversity and give one example of each. **[3]**

(b) Distinguish between in situ and ex situ conservation, naming one method used in each, and state when the second has to be used. **[3]**

(c) A village decides to protect a nearby grove as a community conserved area. State two benefits the village would gain, one difficulty the villagers may face, and one way the forest department could help them. **[4]**

Question 7 [10]

(a) Explain the greenhouse effect and state why an increase in greenhouse gases raises the average surface temperature of the earth. **[3]**

(b) Name three renewable sources of energy and state one limitation of each. **[3]**

(c) Explain what is meant by net zero emissions. State two ways in which a city can cut its emissions and one way in which it can take up carbon dioxide already in the air. **[4]**

Question 8 [10]

(a) State what is meant by sustainable development and name the pillars on which it rests. **[3]**

(b) Explain the difference between a linear economy and a circular economy, and give one example of a circular practice in the clothing trade. **[3]**

(c) Explain how each of the following pushes industry towards cleaner production: a tax on each tonne of carbon dioxide released, a deposit refund scheme on glass bottles, extended producer responsibility for electronic goods, an eco label on consumer products. **[4]**

Question 9 [10]

(a) Describe three features you would build into a new school block so that it uses less energy and less water. **[3]**

(b) Name one innovation in each of the following and state the environmental problem it addresses: packaging material, urban transport, farming. **[3]**

(c) A district sets up a green skills training centre for school leavers. Suggest two trades it should teach, with a reason for each, and state two steps that would help its trainees find work. **[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) (b) pollution and waste. The three strands of the crisis are climate change, the loss of biodiversity and nature, and pollution and waste, and the three are driven by the same pattern of production and consumption.

(ii) (d) releases carbon dioxide, releases air pollutants and destroys habitat through mining. One activity feeds all three strands at once, which is why the crisis is treated as a single problem.

(iii) (c) of 2.5 micrometres or less. These particles are small enough to pass the defences of the nose and throat and reach deep into the lungs.

(iv) (a) sulphur dioxide. In the air it is oxidised and dissolves in water droplets to give sulphuric acid, which falls as acid rain.

(v) (c) endemic. An endemic species has a restricted natural range, which is why it is at special risk if that one area is damaged.

(vi) (b) in situ conservation. The species is protected in its own habitat, along with the whole community of plants and animals around it.

(vii) (d) carbon dioxide. Methane and nitrous oxide trap more heat per molecule but are released in far smaller quantities.

(viii) (d) wind. A wind turbine releases nothing while it runs, and the only emissions attached to it are those from making and erecting it. Coal is the worst of the three fuels, diesel comes next and natural gas releases roughly half as much as coal for the same electricity, but all three release carbon dioxide in use.

(ix) (a) a natural or managed store that takes up more carbon dioxide than it gives out. Forests, soils, peatlands and the ocean act in this way.

(x) (c) a store of materials to be recovered and used again. The circular economy treats the end of one life as the start of another.

(xi) (d) the manufacturer. The duty of collection and recycling is placed on the one who put the product on the market.

(xii) (a) delivers water slowly to the root zone, so little is lost to evaporation and runoff.

(xiii) (b) breakdown by microorganisms in the presence of air. Composting is aerobic decay, which is why the heap has to be turned.

(xiv) (c) earns a living while helping to protect or restore the environment.

(xv) (a) find where energy is being wasted and recommend ways of cutting it.

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

Question 2 [10]

(i) When forest is cleared the trees that held carbon in their wood are felled and often burnt, and the soil is opened up and loses its carbon as well, so carbon dioxide passes into the atmosphere and the land stops working as a carbon sink. The same clearing takes away the habitat of everything that lived in that forest, so populations fall, the patch that is left is too small for large animals, and species disappear from the area. One act therefore adds to climate change and to the loss of biodiversity at the same time.

Carbon released and the sink lost 1. Habitat and species lost 1.

(ii) Nitrogen dioxide is released from the exhaust of petrol and diesel vehicles. Breathing it inflames the lining of the airways, lowers resistance to infection of the chest and makes asthma worse.

Pollutant named 1. Health effect 1.

(iii) An invasive alien species is a species carried, by accident or on purpose, into a place outside its natural range, where it establishes itself and spreads. It threatens native species because the predators, parasites and diseases that held it in check at home are absent, so it multiplies freely and takes the food, light, water

and nesting space on which the native species depend.

Definition 1. Reason 1.

(iv) The carbon footprint of a family is the total quantity of greenhouse gas, counted as carbon dioxide, released as a result of everything the family does, from cooking, lighting and travel to the goods and food it buys. It can be lowered by walking, cycling or taking a bus for short journeys instead of using a private car.

Definition 1. One way of lowering it 1.

(v) The sharing economy is an arrangement under which people obtain the use of a thing when they need it, by hiring or borrowing it, instead of each person buying one of their own, so that a single article serves many users and far fewer have to be made. Examples are a public cycle or scooter hire scheme, a tool library, a car pool to the office and a hall or set of chairs hired for a function.

Definition 1. Example 1.

Question 3 [15]

(i) The main sources are road traffic and the use of horns, construction and demolition machinery, industrial workshops, loudspeakers at functions and religious events, railway and aircraft movement, and diesel generators. Two effects of continued exposure are loss of hearing, which becomes permanent once the hair cells of the inner ear are damaged, and the broken sleep and constant irritation that follow, which show up as poor concentration, headache, raised blood pressure and, in children, slower learning.

Sources named 1. First effect 1. Second effect 1.

(ii) A wetland holds the monsoon flow and lets it go slowly, so it takes the edge off floods downstream and keeps streams and wells supplied in the dry months. It cleans the water that passes through it, since the silt settles among the plants and the roots and sediment take up nutrients and some pollutants. It is also a nursery for fish and a feeding and resting ground for resident and migratory birds, so a great deal of the local biodiversity, and the fishing that the town depends on, rests on it.

Water regulation 1. Filtering of water 1. Habitat for fish and birds 1.

(iii) Mitigation means acting on the causes of climate change, by cutting the release of greenhouse gases or by increasing the quantity taken out of the air. Adaptation means adjusting to the changes that are already under way or can no longer be avoided, so that the harm done is less. An example of mitigation is replacing coal fired electricity with solar or wind generation. An example of adaptation is sowing a flood tolerant variety of rice in a low lying field, or building a cyclone shelter in a coastal village.

Mitigation defined 1. Adaptation defined 1. One example of each 1.

(iv) Rain falling on the roof is led into gutters along its edge and down a pipe. The first few minutes of flow, which washes off the dust, leaves and bird droppings, is let out through a first flush valve, and the water that follows passes through a simple filter of gravel, coarse sand and charcoal. The filtered water is stored in a covered underground tank or sump, or it is led into a recharge pit or an old dug well so that it soaks down and raises the groundwater. Stored water is used for flushing the school toilets, for washing and for the garden, and after proper treatment it can be used for drinking.

Collection from the roof, with the first flush and the filter 1. Storage in a tank or a recharge pit 1. One use 1.

(v) Solar installation technician: must be able to read a wiring diagram, mount and align panels safely on a roof, and connect and test an inverter and its earthing. Waste management supervisor: must know the rules for segregating and handling each kind of waste, and be able to train, route and supervise a sanitation crew. Organic farming adviser: must understand composting, crop rotation and natural pest control, and be able to explain and demonstrate them to farmers in their own terms.

First job with its skill 1. Second job with its skill 1. Third job with its skill 1.

Question 4 [10]

(a) The triple planetary crisis is made up of climate change, the loss of biodiversity and nature, and pollution and waste. The burning of fossil fuels drives all three at once. It releases carbon dioxide, which warms the climate. The same flue gas carries sulphur dioxide, oxides of nitrogen and fine particles, which pollute the air and return to the land and water as acid deposition. The mining and drilling that supply the fuel strip forest, farmland and seabed, so habitat is destroyed and species are lost.

Three crises named 1. Activity named 1. Explanation of how it drives all three 1.

(b) A coral animal lives in partnership with tiny algae inside its tissues, and those algae make most of the food the coral needs. When the water around it stays warmer than usual for several weeks the coral expels the algae and turns white, which is called bleaching. A bleached coral is starving, and if the warm spell lasts it dies. The reef that the corals built is the habitat of a very large share of all marine species, so when the reef dies the fish, molluscs and other animals that shelter, breed and feed there go with it, and the fishing and tourism that people drew from the reef go too. Warming also makes the problem worse in two other ways. Warmer water holds less dissolved oxygen, and the extra carbon dioxide dissolving in the sea makes it more acidic, so corals and shellfish find it harder to build their skeletons and shells.

Bleaching explained 1. Death of the reef 1. Loss of the species and the services that depend on it 1.

(c) Pollution: the sewage and the effluent add organic matter, nutrients, pathogens, dye and often heavy metals to the water, so the river becomes unfit to drink from, unsafe to bathe in and unusable for irrigation. Biodiversity: bacteria decomposing the organic load use up the dissolved oxygen, so fish and other oxygen dependent animals suffocate or move away, and the nutrients set off an algal bloom that shuts out the light from the plants below. A long stretch of the river ends up with only a few tolerant species. Climate: once the water has lost its oxygen the decay turns anaerobic and gives off methane, which is a strong greenhouse gas, and the extra pumping and treatment needed to make such water fit for use downstream burns more energy. One measure that works on all three is to treat the sewage and the effluent before they are discharged, in a sewage treatment plant or a constructed wetland, and to digest the sludge in a closed tank so that the methane is captured and burnt as fuel instead of escaping.

Pollution effect 1. Effect on aquatic life 1. Link to climate 1. One measure covering all three 1.

Question 5 [10]

(a) Fine particulate matter, $PM_{2.5}$, which travels deep into the lungs and causes coughing, falling lung function and a worsening of asthma and heart disease. Carbon monoxide, which binds to the haemoglobin of the blood in place of oxygen, so the tissues are starved of oxygen and the person suffers headache, giddiness and breathlessness. Oxides of nitrogen, which irritate the airways directly and in sunlight help to form ground level ozone, which inflames the lungs and the eyes.

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

(b) A point source is one from which the pollution enters the water at a single identifiable place, such as the outfall pipe of a factory or the discharge channel of a sewage works. It can be sampled at that point, measured against a standard and controlled by requiring treatment there. A non point source is spread over a wide area and has no single outlet, so the pollution arrives with runoff from many places at once. Examples are the fertiliser and pesticide washed off farmland by rain, and the oil, rubber and dust washed off city roads. Non point pollution is harder to control because there is no pipe on which to fit a plant and nobody in particular to hold answerable, so it has to be tackled by changing practice across the whole catchment, which takes persuasion, incentives and time.

Point source defined with an example 1. Non point source defined with an example 1. Reason why it is harder to control 1.

(c) Segregation at source means that the waste is separated by the household at the moment it is produced, in the kitchen itself, instead of being mixed in one bin and sorted later. Each house keeps wet biodegradable waste, which is kitchen and garden waste, apart from dry recyclable waste, which is paper, plastic, glass, metal and cloth, and keeps domestic hazardous waste such as batteries, tube lights and old medicine in a third small container. The wet waste is composted in a pit or a bin, or digested in a biogas plant, and gives manure and gas. The dry waste goes to the recyclers, who return paper, plastic, glass and metal to industry as raw material, and the hazardous fraction goes to an authorised handler. The town gains because far less waste reaches the dump, so the dump lasts many more years, gives off less methane and less leachate, breeds fewer flies and rats, and the recyclable material fetches a price instead of being spoilt by having wet waste mixed into it.

Meaning of segregation at source 1. Streams named 1. A treatment route for each stream 1. One benefit to the town 1.

Question 6 [10]

(a) Habitat loss and fragmentation, for example the clearing of forest for a mine, a highway or farmland, which also leaves the animals that remain in small isolated patches. Overexploitation, for example fishing a stock faster than it can breed, or collecting a medicinal plant from the wild until it disappears. The introduction of invasive alien species, for example a floating weed that covers a tank and crowds out the native plants and the fish below. Pollution and climate change act on top of these three and make each of them worse.

First cause with its example 1. Second cause with its example 1. Third cause with its example 1.

(b) In situ conservation protects a species in the place where it naturally lives, by protecting the whole habitat and the community of species in it. The methods used are national parks, wildlife sanctuaries, biosphere reserves, conservation reserves and sacred groves. Ex situ conservation protects a species away from its natural home, in conditions arranged and maintained by people. The methods used are zoos, botanical gardens, captive breeding centres, seed banks, gene banks and tissue culture. Ex situ conservation has to be used when the wild population has fallen so low that it cannot recover on its own, or when its habitat has already gone, and it is treated as a holding measure until the animals or plants can be returned to the wild.

In situ defined with a method 1. Ex situ defined with a method 1. When ex situ has to be used 1.

(c) Benefits: the village keeps a steady supply of fuelwood, fodder, fruit, honey, gum and medicinal plants, taken at a rate the grove can stand, instead of losing the grove altogether in a few years of unrestricted cutting. The grove also holds the soil on the slope and lets the rain soak in, so the wells and the fields below it do better and the village is less exposed to flash flooding. Difficulty: once grazing and cutting are restricted the households that leaned most heavily on the grove lose part of their income at once, while the benefit comes slowly, and quarrels start over who may take what and over outsiders who ignore the rules. The forest department can help by providing alternatives and backing: fuel efficient stoves or a gas connection, fodder plots raised outside the grove, and training and seed money for beekeeping, nursery raising or tourism work, together with legal recognition of the village committee so that it can keep outsiders out and settle disputes.

First benefit 1. Second benefit 1. Difficulty 1. One form of help 1.

Question 7 [10]

(a) Short wave radiation from the sun passes through the atmosphere with little hindrance and warms the surface of the earth. The warmed surface gives the energy back as long wave infrared radiation. Gases such as carbon dioxide, methane, nitrous oxide and water vapour absorb part of this outgoing infrared radiation and radiate it again in all directions, including downwards, so the surface and the lower atmosphere stay far warmer than they would be if the heat passed straight out to space. This is the greenhouse effect, and without it the earth would be too cold for most life. When human activity adds more of these gases, a larger share of the outgoing radiation is held back while the incoming radiation is unchanged, so more energy enters the system than leaves it. The average surface temperature then rises until the warmer surface radiates enough to restore the balance.

Incoming short wave and outgoing infrared radiation 1. Absorption and re radiation by the greenhouse gases 1. More gas holds back more heat, so the temperature rises to a new balance 1.

(b) Solar: it generates only in daylight and much less under cloud, so it needs storage or a backup supply if it is to be relied on, and a large area of roof or land is required for a given output. Wind: the output rises and falls with the wind and cannot be ordered up when needed, the best sites are often far from the places that use the power, so transmission has to be built, and the turbines kill birds and bats if they are badly sited. Hydroelectric: a large reservoir floods land and forest and displaces the people living there, the dam blocks the movement of fish and of silt down the river, and the output falls in a poor monsoon.

First source with its limitation 1. Second source with its limitation 1. Third source with its limitation 1.

(c) Net zero emissions means that over a given period the quantity of greenhouse gas a country, city or company puts into the atmosphere is balanced by the quantity it takes out of the atmosphere, so that its net addition is nil. It does not mean that nothing at all is released, but that whatever is still released is matched by removals. A city can cut its emissions by shifting its electricity supply from coal to solar, wind and hydro generation, and by moving its passengers off private vehicles onto electric buses, a metro, cycle tracks and footpaths. It can take up carbon dioxide already in the air by planting and protecting trees, parks, avenues and urban wetlands,

which lock carbon into wood and soil, and by restoring the land around it so that the soil regains the carbon it has lost.

Net zero defined 1. First way of cutting emissions 1. Second way of cutting emissions 1. One way of taking up carbon dioxide 1.

Question 8 [10]

(a) Sustainable development is development that meets the needs of the present generation without destroying the ability of future generations to meet their own needs. It rests on three pillars, the environmental, the social and the economic, which are often called the three pillars of sustainability. A plan counts as sustainable only when it holds up on all three together, since a project that is profitable but ruins a river, or clean but leaves people without a livelihood, will not last.

Definition 1. Three pillars named 1. The point that all three must hold together 1.

(b) A linear economy runs in a straight line. Raw material is taken from the earth, made into a product, used for a time and then thrown away, so fresh material has to be won for every new product and the waste piles up at the end. A circular economy runs in loops. Products are designed to last, to be repaired and to be taken apart, they are kept in use through reuse, repair, refurbishment and sharing, and when at last they cannot be used the materials are recovered and go back into making something else. Both the demand for new material and the quantity of waste therefore fall. A circular practice in the clothing trade is a take back scheme, in which the shop collects worn garments from its customers, passes the sound ones on for resale or repair and sends the rest to be pulled back into fibre and spun into new yarn. Hiring clothes that are needed only for an occasion is another.

Linear economy explained 1. Circular economy explained 1. Example from the clothing trade 1.

(c) A tax on each tonne of carbon dioxide released puts a price on the emission itself, so the dirtier a process is the more it costs to run. The firm now saves money by burning less fuel, recovering waste heat or switching to a cleaner fuel, and the cleaner competitor is no longer undercut by the dirtier one. A deposit refund scheme adds a small sum to the price of a bottle which the buyer gets back on returning it, so bottles come back to the filler in sound condition instead of being broken or dumped, and the firm washes and refills them rather than buying new glass. Extended producer responsibility makes the maker of an electronic good answerable for collecting and recycling it at the end of its life. Since the firm now pays for the disposal, it pays the firm to design goods that are easy to take apart, that use fewer hazardous materials and that last longer. An eco label tells the buyer at a glance which product has met an agreed environmental standard, so firms compete to earn and keep the label, and to keep it they have to clean up the process behind the product.

Carbon tax 1. Deposit refund scheme 1. Extended producer responsibility 1. Eco label 1.

Question 9 [10]

(a) Orientation and shading: set the block so that the classrooms face north and south, keep the window area on the east and west walls small, and fit sunshades and verandahs, so the rooms get plenty of daylight without the sun beating on them. That cuts the lighting load and the cooling load together. Ventilation and a cool roof: put windows and ventilators on opposite walls so that air crosses the room, add a stair or a shaft that lets hot air out at the top, and finish the roof with a light reflective coating or a layer of plants, so the block stays comfortable through most of the year without air conditioning. Water fittings and reuse: fit dual flush cisterns, aerated taps and waterless urinals, lead the roof rainwater to a storage sump and a recharge pit, and treat the wash basin water in a small plant so that it can be used on the garden and the playing field.

Daylight, orientation and shading 1. Ventilation and the roof 1. Water saving and reuse 1.

(b) Packaging material: mouldings grown from fungal mycelium, or pressed from sugarcane bagasse or straw, in place of expanded polystyrene. The problem addressed is a packing material that cannot be recycled in practice and lasts for centuries, whereas these can be composted after use. Urban transport: the electric bus, together with public cycle hire and a metro feeder service. The problem addressed is the exhaust emissions and the congestion caused by very large numbers of private vehicles, each carrying one or two people. Farming: drip and sprinkler irrigation controlled by soil moisture sensors. The problem addressed is the water wasted in flood irrigation, together with the waterlogging and the build up of salt in the soil that follows it.

Packaging innovation with the problem it addresses 1. Transport innovation with the problem it addresses 1. Farming innovation with the problem it addresses 1.

(c) Trades: a solar installation and servicing course, because rooftop systems, pump sets and street lighting are being put up faster than there are trained hands to fit, test and maintain them, so a certified technician finds work locally and does not have to migrate. A natural and organic farming course, because the farmers of the district are looking for ways to bring down their fertiliser and pesticide bills and need advisers who can set up composting, soil testing and biological pest control and show the results on a field. Steps to help trainees find work: run each course jointly with the firms, contractors and farmer producer organisations that actually hire, so that the syllabus matches the work and the employer has seen the trainee before the course ends. Finish with a recognised certificate and either a paid apprenticeship or, for those who mean to work on their own, a starter tool kit, a small loan and help with the first few contracts.

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