

Sustainability and Human Impact

Mark Scheme



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1. There is a complex relationship between human demands for resources and the need to maintain biodiversity and a healthy global environment.

For each of the multiple choice questions below circle the letter of the correct answer for each.

- a) Burning fossil fuels can release sulphur dioxide gas into the atmosphere.

What is a direct consequence of this?

C – is the only correct answer.	1 mark
	Total: 1 mark

- b) The human population is increasing, putting pressure on resources and the environment.

Which human activity directly **increases** the amount of methane in the atmosphere?

D – is the only correct answer.	1 mark
	Total: 1 mark

- c) Biodiversity is the variety of all the different species of organisms on Earth.

Which of the following would lead to a **decrease** in biodiversity?

C – is the only correct answer.	1 mark
	Total: 1 mark

- d) Deforestation has a number of environmental consequences.

Why does the removal of trees lead to an increase in soil erosion?

A – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 4 marks)

2. Lough Neagh is the largest lake in Northern Ireland.

Scientists monitor the water quality in large lakes like Lough Neagh.

A rapid increase in the population of algae, known as an algal bloom, can be a sign of pollution.

- a) Name **one** type of pollutant from human activity that causes algal blooms.

Accept any one of the following:	
• Fertiliser(s). • Sewage. • Nitrates. • Phosphates.	
	Total: 1 mark

- b) An algal bloom will eventually die off. This can cause the death of fish and other aquatic animals.

Explain why the decay of a large quantity of algae leads to a decrease in the fish population.

An explanation to include the following points:	
Decomposers / bacteria / microorganisms feed on / break down the dead algae.	1 mark
These microorganisms respire aerobically / use up large amounts of oxygen.	1 mark
This reduces the concentration of dissolved oxygen in the water, so fish die / are unable to respire.	1 mark
	Total: 3 marks

- c) The amount of algae in a lake can change with the seasons.

Explain how this makes it important to measure water clarity at the same time each year.

An explanation to include the following points:	
Algal growth is affected by seasonal/abiotic factors (such as light intensity / temperature).	1 mark
Measuring at the same time each year controls this variable / allows for a valid comparison / makes it a fair test.	1 mark
	Total: 2 marks

- d) Using the data in the graph, what can you conclude about the level of pollution in Lough Neagh since 1985.

A conclusion that links the following points:	
(Trend from graph) The maximum depth the disc can be seen / water clarity has generally decreased.	1 mark
Accept a correct data quote, e.g., 'It has dropped from approx. 32m in 1985 to approx. 23m in 2015'.	
(Biological link) This indicates that there is more algae / microorganisms in the water.	1 mark
(Conclusion) Therefore, the level of pollution (from nitrates/sewage) has likely increased.	1 mark
	Total: 3 marks

(Total for Question 2 is 9 marks)

3. The graph below shows the change in the world human population from the year 1800 and includes a prediction of how it might change in the future.

- a) Describe the pattern of growth for the world human population between 1940 and 2080, as shown in the graph.

A description that includes the following two points:	
The population increases / grows rapidly / exponentially.	1 mark
Allow a data quote showing an increase, e.g., 'it goes from 2.3 billion to 9.5 billion'.	
The rate of growth slows down / it starts to level off (after 2080).	1 mark
	Total: 2 marks

- b) Use the data in the graph to calculate the predicted increase in the world human population, in billions, between the year 2000 and the year 2060.

Correct reading of values from graph: 9.2 billion AND 6.1 billion.	1 mark
Allow tolerance of ± 0.1 billion for each reading.	
Correct calculation of increase: $(9.2 - 6.1 = 3.1) = 3.1$ (billions)	1 mark
Award 2 marks for a correct final answer with no working. Allow ECF (error carried forward) if readings are incorrect but subtracted correctly.	
	Total: 2 marks

- c) The trend shown in the graph has a significant impact on global food security.

Explain how a rapid increase in the human population can threaten food security.

An explanation that includes any two from:	
There is an increased demand for food, which may exceed the supply.	1 mark
Increased farming can lead to land becoming barren / desertification / soil erosion, reducing future crop yields.	1 mark
Increased burning of fossil fuels (for farming/transport) contributes to climate change / global warming, which can cause crop failures / droughts / floods.	1 mark
Increased demand for land for housing / infrastructure reduces the amount of land available for growing crops.	1 mark
	Total: 2 marks

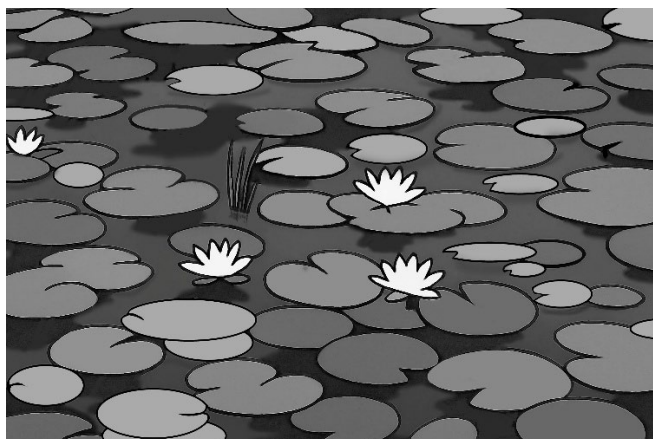
- d) Modern agricultural practices are being developed to help improve food security.

Suggest **two** ways in which large-scale farming can increase the yield of crops.

A suggestion to include any two from:	
• Use of fertilisers (to add minerals/nitrates to the soil). • Use of pesticides / insecticides / herbicides (to kill pests/weeds). • Use of greenhouses to control conditions (e.g., light/temperature/CO₂). • Hydroponics / aeroponics. • Use of biological control (to reduce pests). • Selective breeding / genetic modification (for desired traits).	
	Total: 2 marks

(Total for Question 3 is 8 marks)

4. The figure below shows a pond in Newcastle that has a large number of Japanese water lilies. A single Japanese water lily was planted in this pond 20 years ago.



- a) Explain why this invasive plant now covers the majority of the surface of the pond.

An explanation that includes any four from:	
The plant is non-native / invasive.	1 mark
There are no / few natural predators / pests / diseases to control its numbers.	1 mark
This allows the population to grow rapidly / reproduce successfully.	1 mark
It successfully outcompetes native species.	1 mark
For resources such as light / space / mineral ions.	1 mark
	Total: 4 marks

- b) Explain how this large population of Japanese water lilies could affect the population of native plant species living below them in the pond.

An explanation that links the following points:	
The water lilies on the surface block sunlight from reaching the plants below.	1 mark
This prevents / reduces photosynthesis, so the native plants die / cannot grow.	1 mark
	Total: 2 marks

(Total for Question 4 is 7 marks)

5. A farmer spreads a large amount of nitrogen fertiliser onto a field that is next to a lake.
A few weeks later, local people notice that a large number of dead fish on the surface of the lake.

Explain, in detail, the sequence of events that led to the death of the fish.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple, relevant statements are made. The answer identifies one or two key events but provides little or no detail or logical sequence (e.g., "fertiliser killed the fish").
Level 2	3 - 4	A good explanation is provided that identifies most of the key stages. The answer may lack some detail, or the sequence may not be fully logical.
Level 3	5 - 6	A detailed and coherent explanation is provided, which is logically structured and explains the full sequence of events from fertiliser to fish death. Correct scientific terminology is used throughout.

Indicative content:	
- Fertilisers / nitrates / minerals are washed / leached from the soil into the lake. - The high concentration of minerals causes rapid growth of algae / aquatic plants (an algal bloom). - The layer of algae on the surface blocks light from reaching plants at the bottom of the lake. - These submerged plants die because they cannot photosynthesise. - The algae also die (due to competition for light/minerals). - Decomposers / bacteria break down the dead plants / algae. - The decomposers respire aerobically. - This uses up a large amount of the dissolved oxygen in the water. - The concentration of oxygen becomes too low for fish to survive / respire. - Therefore, the fish die.	
	Total: 6 marks

(Total for Question 5 is 6 marks)

6. Peat bogs are areas of land that are waterlogged and acidic. Plants, such as moss, grow in these bogs. When the plants die, they do not fully decompose. Over thousands of years, a thick layer of partially rotted plant material, known as peat, builds up.

- a. The conditions in a peat bog slow down the rate of decomposition.

Describe **two** conditions in a peat bog that cause the rate of decomposition to be slow.

A description to include any two from:	
Waterlogged conditions / lack of oxygen.	1 mark
Acidic conditions / low pH.	1 mark
(For a second mark) which denatures the enzymes (of the decomposers).	1 mark
	Total: 2 marks

- b. Peat bogs are a very important carbon store.

Explain why the destruction of peat bogs for use as garden compost contributes to an increase in atmospheric carbon dioxide.

An explanation that links the following points:	
When peat is dug up / drained, it is exposed to air / oxygen.	1 mark
This allows decomposers / microorganisms to break it down / decompose the organic matter.	1 mark
The decomposers respire, releasing carbon dioxide.	1 mark
Allow peat being burned, which releases carbon dioxide, for all 3 marks.	
	Total: 3 marks

- c. Peat bogs are also considered important for conservation.

Other than the release of carbon dioxide, state one reason why the large-scale destruction of peat bogs is a problem.

It reduces biodiversity / destroys habitats.	1 mark
	Total: 1 mark

- d. To reduce the environmental impact of gardening, people are encouraged to use '**peat free**' compost. This alternative compost is often made by local councils from household garden and food waste.

Suggest **two** advantages of using compost made from household waste instead of peat based compost.

A suggestion to include any two of the following:	
Reduces the amount of household waste going to landfill.	1 mark
Conserves peat bogs / protects habitats / protects biodiversity.	1 mark
Reduces the release of carbon dioxide (from destroying peat bogs).	1 mark
It recycles / returns minerals/nutrients from waste material back to the soil.	1 mark
	Total: 2 marks

(Total for Question 6 is 8 marks)

7. This question is about fish farming.

Salmon are carnivorous fish that are grown in large numbers on fish farms. They are fed pellets made from small fish. Humans then eat the farmed salmon.

The food chain is shown below.

Algae → Small fish → Farmed salmon → Humans

a. Name the trophic level of the humans in this food chain.

Fourth trophic level or Trophic level 4	1 mark
	Total: 1 mark

b. In one fish farm, 10000 kg of pellets made from small fish were fed to the salmon. This resulted in a total mass increase of 1500 kg in the salmon.

The 1500 kg of salmon were then harvested and eaten by humans, resulting in 180 kg of new human biomass.

Calculate the percentage efficiency of biomass transfer from the salmon to the humans.

Correct substitution into formula: $(180 \div 1500) \times 100$	1 mark
Correct final answer = 12 (%)	1 mark
	Total: 2 marks

The table below shows information about the mass of fish caught in the UK between 2020 and 2024.

Year	Mass of fish caught by UK fishing vessels (Thousand tonnes)	Mass of fish caught from UK fish farms (Thousand tonnes)	Percentage of fish caught from UK fish farms (%)
2020	720	399.6	55.5
2021	680	409.7	60.3
2022	650	422.5	65.0
2023	610	454.5	74.5
2024	630	507.2	

c. Calculate the percentage of the total fish supply that came from fish farms in 2024.

The total fish supply is the mass from vessels plus the mass from farms.

Correct substitution into formula: $(507.2 \div 630) \times 100$	1 mark
Correct final answer rounded to one decimal place = 80.5 (%)	1 mark
	Total: 2 marks

d. The figure below shows a UK fish farm.

The global demand for fish as a source of protein is increasing. One way to meet this demand is by farming fish in large pens in the sea.

Evaluate the use of fish farming as a method of producing food for the growing human population.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple, relevant statements are made, identifying at least one advantage or disadvantage. The answer may be a list with little or no explanation.
Level 2	3 - 4	A good explanation is provided that identifies both advantages and disadvantages. The answer may lack detail, or the links between points may be unclear. A limited conclusion may be present.
Level 3	5 - 6	A detailed and coherent evaluation is provided, considering both advantages and disadvantages. A concluding judgement is made based on the evidence presented. Correct scientific terminology is used throughout.

Indicative content:	
Advantages: - Reduces overfishing of wild stocks, helping to conserve wild fish populations. - Provides a reliable and high-yield source of protein to feed the growing human population. - Fish are kept in controlled conditions / protected from predators, increasing survival rates. - Growth can be optimised by controlling diet / water quality / temperature. - Creates jobs in coastal / rural areas. Disadvantages: - Dense populations of fish can lead to a rapid spread of diseases and parasites (e.g., sea lice). - Waste products (faeces, uneaten food) can pollute the surrounding water, causing eutrophication. - Antibiotics and pesticides used to manage disease can harm other marine organisms. - Escaped farmed fish can outcompete or interbreed with wild populations, affecting the native gene pool. - Often, large quantities of wild-caught fish are used to make the feed pellets, which still puts pressure on wild stocks.	
	Total: 6 marks

(Total for Question 7 is 11 marks)

8. In the modern world human activities have huge effects on our ecosystem.

a. Describe the trends shown in the figure above.

A description that includes the following two points:	
The volume of peat compost used has generally decreased (between 2010 and 2015). Allow a data quote showing the trend, e.g., 'It fell from approx. 3400 to 2900'.	1 mark
The volume of peat-free compost used has increased (between 2010 and 2015).	1 mark
	Total: 2 marks

- b. Peat bogs are areas of land that are waterlogged and acidic. These conditions prevent the complete decay of dead plant material.

Explain how the large scale removal of peat could contribute to an increase in global warming.

An explanation that links the following points:	
Peat is decomposed (by microorganisms) OR peat is burned.	1 mark
This releases carbon dioxide, which is a greenhouse gas / contributes to global warming.	1 mark
	Total: 2 marks

- c. Human activities are leading to deforestation on a global scale. This is causing significant environmental change.

Explain how deforestation is causing the change in the amounts of different gases in the atmosphere.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple, relevant statements are made. A reason for deforestation is stated, OR a simple statement is made about the effect on gases (e.g., 'burning trees releases CO ₂ '). The answer may be a list with little or no linkage.
Level 2	3 - 4	A good explanation is provided. A reason for deforestation is given and there is a linked explanation of the effect on atmospheric gases (e.g., explains either increased CO ₂ release or reduced CO ₂ uptake).
Level 3	5 - 6	A detailed and coherent explanation is provided. At least one reason for deforestation is given, and a clear explanation of the effect on atmospheric gases, including both increased CO ₂ release and reduced CO ₂ uptake, is given.

Indicative content:	
Reasons for deforestation (any one needed for higher levels): - To provide land for farming / agriculture (e.g., cattle ranching, palm oil plantations). - To grow crops for biofuels. - To build houses / roads / infrastructure. - To extract wood for timber / paper. - To mine for resources. Effects on atmospheric gases: - Carbon Dioxide (CO₂) levels increase: - Fewer trees means less carbon dioxide is removed from the atmosphere by photosynthesis. - Trees are often burned to clear land (combustion), which releases the large amounts of carbon stored in the wood as carbon dioxide. - Dead/decaying vegetation is broken down by microorganisms which respire and release carbon dioxide. Oxygen (O₂) levels decrease: - Fewer trees means less oxygen is released into the atmosphere from photosynthesis.	
	Total: 6 marks

(Total for Question 8 is 10 marks)