Populations and Ecosystems (1.5): Eduqas A Level Biology Exam Questions by Topic

27 questions · 69 marks · about 83 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 1 · June 2024 · Q2(a)(iii) · 1 mark

(iii) Human population density is increasing exponentially.
Explain what is meant by the term **exponential growth**. [1]

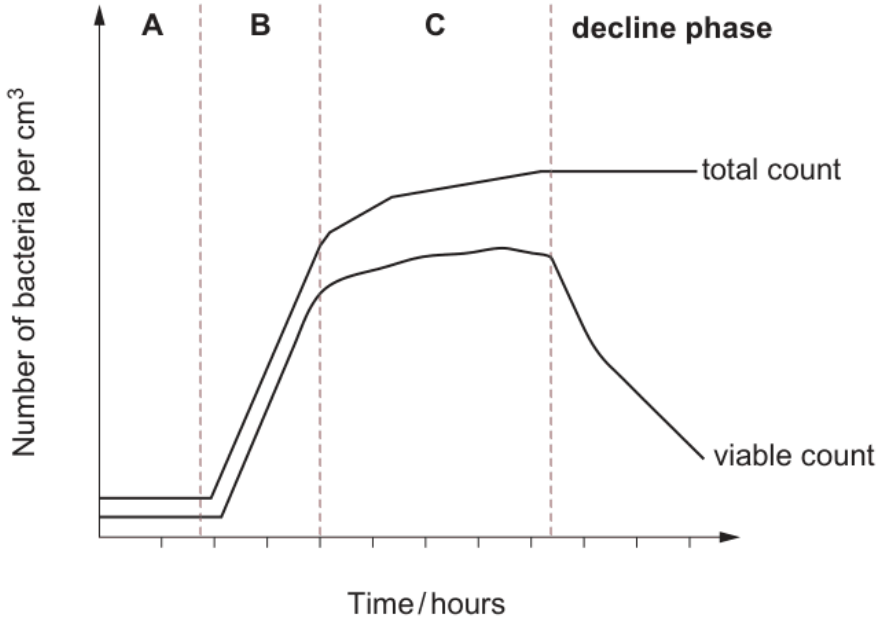
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1. A flask of sterile culture medium was inoculated with a small number of bacterial cells. The number of bacteria per cm^3 of culture medium was monitored at regular intervals using a total count and a viable count. The results were plotted as shown in **Image 1.1**.

Image 1.1



(a) (i) **Complete the table below** to name stages **A**, **B** and **C** of the population growth curve shown in **Image 1.1** and explain the shape of the growth curve in each stage. [3]

Stage	Name of Stage	Explanation of the shape of the population growth curve
A	.....	....
B	.....	....
C	.....	....

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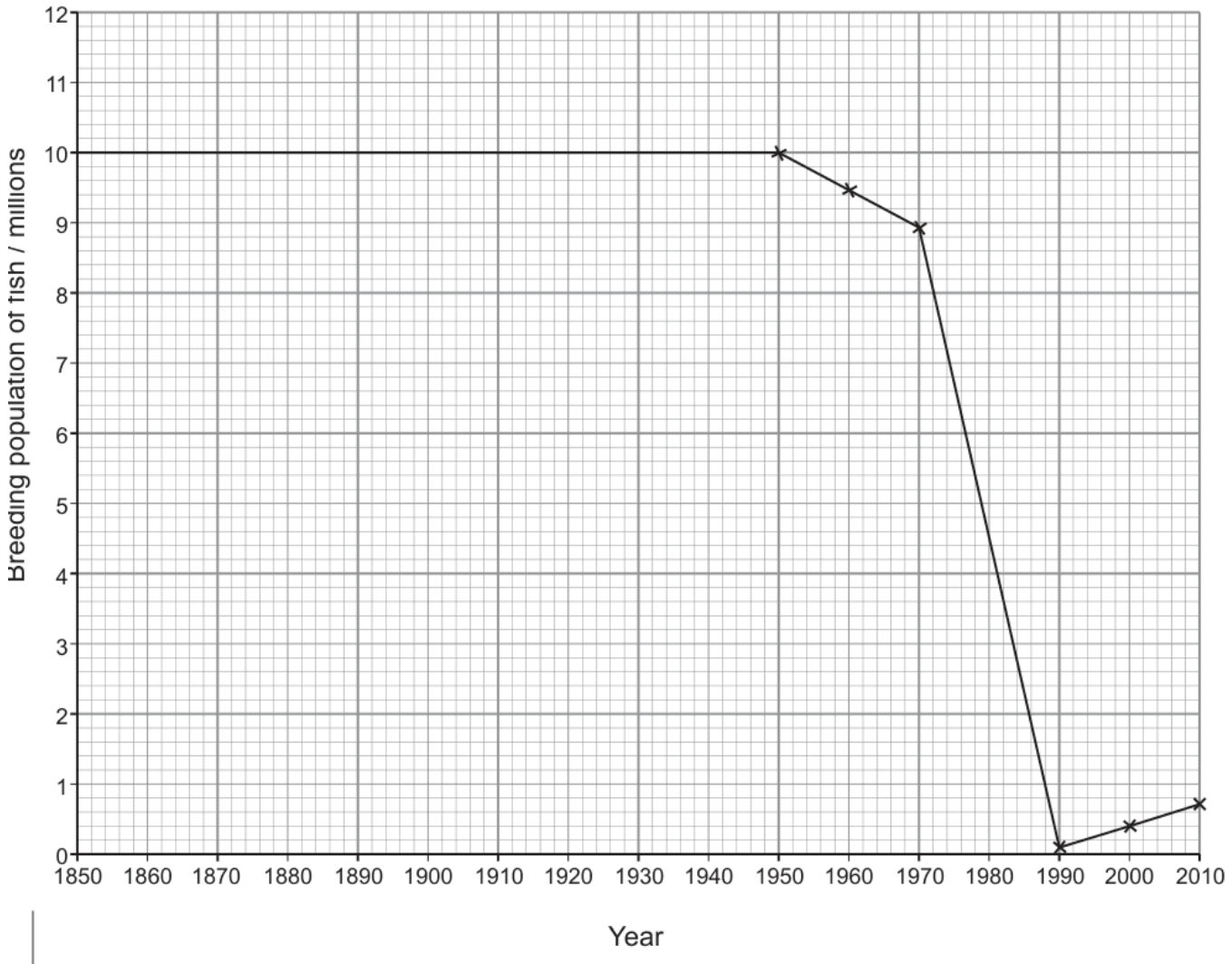
4. The Grand Banks is an area of sea off the coast of Newfoundland in Canada. Cod have been fished in the area for hundreds of years.

During the 1900s there were significant improvements in fishing techniques. By 1968, the number of cod caught had increased and 800 000 tons of cod were landed in that year alone. This represented 60% of the total cod population of reproductive age.

By 1992 the population had dropped to less than 1% of earlier levels and cod fishing was banned in the Grand Banks by the Canadian Government.

Image 4.1 shows the estimated breeding population of cod in the Grand Banks between 1850 and 2010.

Image 4.1



(a) With reference to **human activity**, explain the shape of the estimated population graph shown in **image 4.1** between the following dates: [3]

1850 to 1950;

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Question 4 · A level Component 1 · June 2019 · Q6(b) · 3 marks

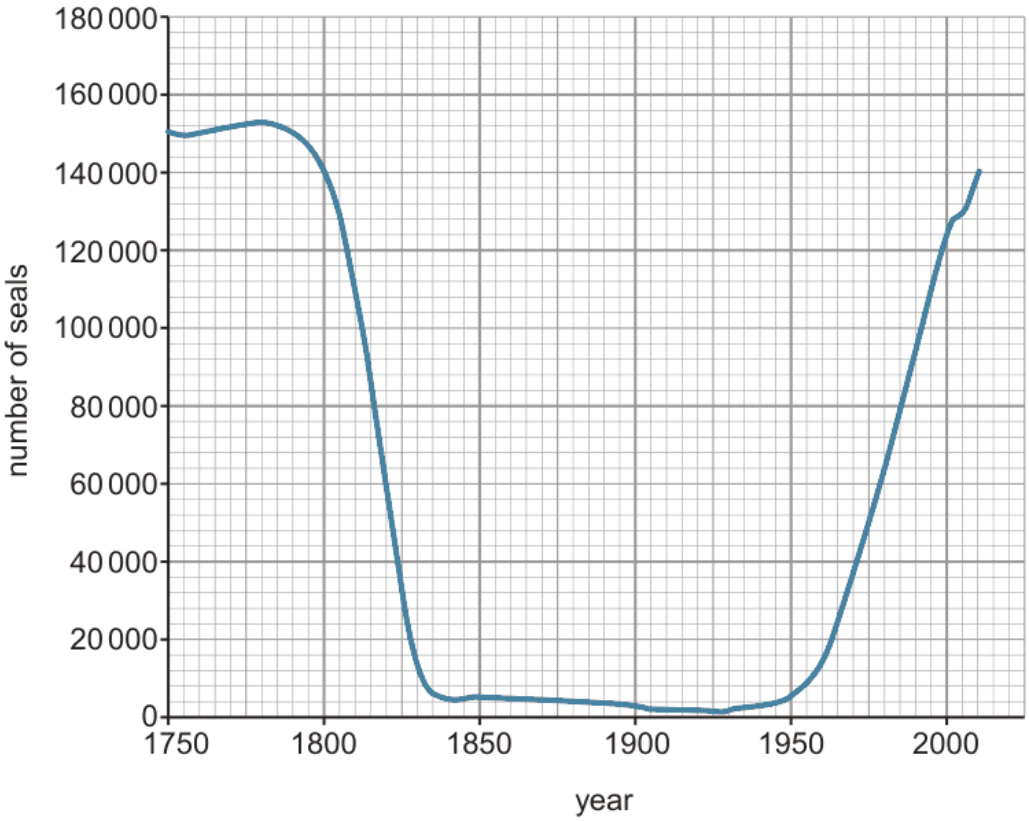
(b) In areas where Red Kites were absent and then re-introduced the numbers increased much more rapidly than in areas where they were already established. Explain the reasons for this. [3]

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5. The northern elephant seal, *Mirounga angustirostris*, is named because the male has a large nose that resembles an elephant's trunk. They feed on squid, octopus and fish. They have a thick layer of blubber which was used by humans in the nineteenth century to produce lamp oil.



The population curve below shows estimates of the population of northern elephant seals from 1750 to 2010.



(a) Factors affecting population size are described as density dependent or density independent. Use the graph to identify when density dependent and density independent factors would have been acting, between the years 1750 and 1830, and suggest what these factors may have been. [4]

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(ii) **Table 6.1** lists three factors that could affect the size of a population.

Table 6.1

Factor	Abiotic	Biotic	Density-dependent	Density-independent
Atmospheric temperature				
Disease				
Drought				

Place a tick (✓) in **two** boxes in each row in **Table 6.1** to correctly identify if these factors are **abiotic** or **biotic** and whether their effects are **density-dependent** or **density-independent**. [2]

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(d) Two species of plantain, greater plantain *(Plantago major)* and ribwort plantain *(Plantago lanceolata)* are very common in grassy areas in Britain. Both plantain species are frequently found on trampled ground.



Greater plantain *(Plantago major)*



Ribwort plantain *(Plantago lanceolata)*

The table shows some characteristics of these two species.

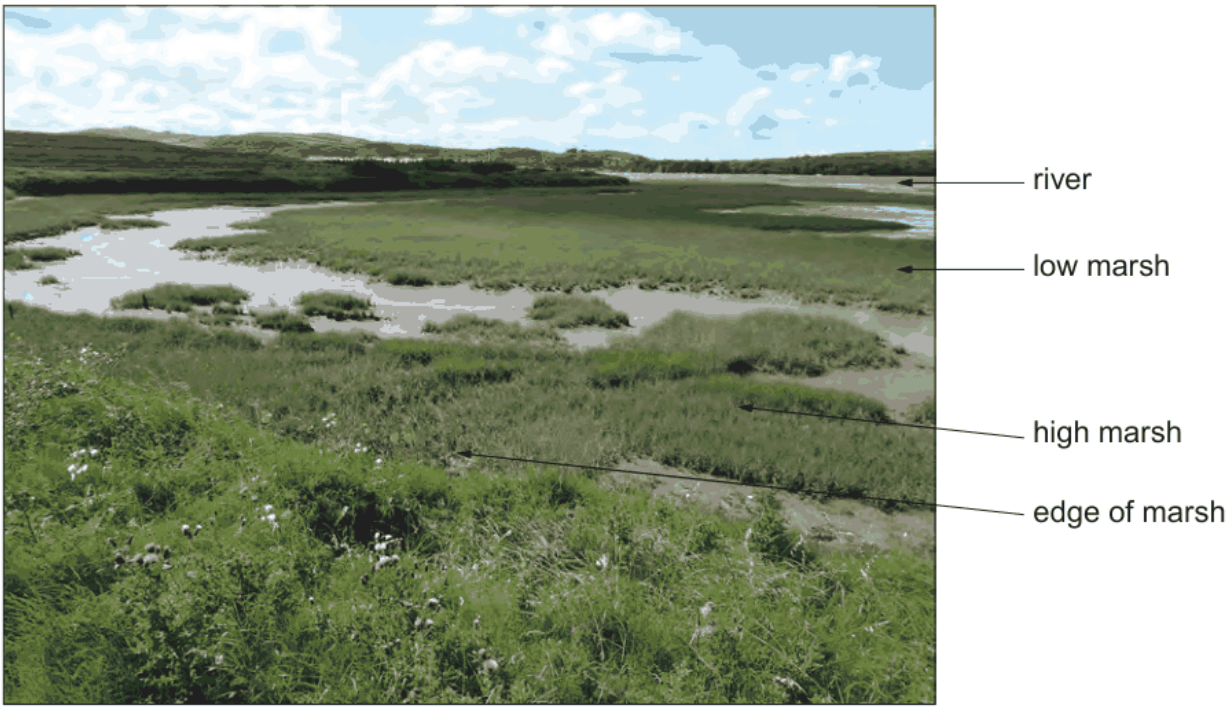
Feature	Greater plantain	Ribwort plantain
Main growth form	rosette	rosette
Drought tolerance	tolerant	not tolerant
Resistance to physical damage	very resistant	moderately resistant
Ability to vary growth form under different conditions	can vary	varies readily
Seed germination	best near soil surface on open ground	best on lightly compacted soil either in open ground or amongst vegetation
Overwintering	as small rosettes or underground	as small rosettes

(i) Describe the technique you would use to carry out an assessment of the abundance of these two species across a moderately trampled footpath. [3]

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Question 8 · information from earlier in the question

5. The sea rises and falls twice a day; this is called tidal movement. In river estuaries there is still tidal movement but little wave action. As the seawater on a rising tide moves across bare rock it brings sand, mud particles and detritus. The lack of wave action in estuaries results in this material settling out when the tide stops moving. These materials build-up and in time raise the level of mud and eventually form soil. This habitat is called a saltmarsh where rooted plants grow. Higher land, frequently used for agriculture, drains through the saltmarsh into the river.



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Question 8 · A level Component 1 · June 2019 · Q5(d) · 5 marks

(d) Describe a practical method which you could carry out on the saltmarsh to investigate the **change in vegetation over time**. [5]

Question 9 · A level Component 1 · June 2022 · Q5(c)(i) · 2 marks

To investigate whether the introduction of yellow rattle into grassland might restore biodiversity, grassland containing a single species of fast-growing grass was divided into two equal areas, area **A** and area **B**

Area **A** was seeded using a mixture of flowering plants and yellow rattle seeds

Area **B** was seeded using the same mixture of flowering plants but with no yellow rattle seeds.

The abundance and distribution of plant species in areas **A** and **B** were determined before seeding and one year after seeding.

(c) Explain why the following steps were taken when collecting data on the abundance and distribution of plant species in both areas:

(i) Each area was divided into a grid **and** a random number generator used. [2]

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(c) Moths are insects. They are pollinators for many plant species and a source of food for some predatory birds.
Image 1.3 shows a lime hawk moth, *Mimas tiliae*, a species common to Southern England with numbers increasing further north.
Due to natural selection, lime hawk moth life cycles have aligned with the seasonal cycles of lime trees. Climate change can affect the timing of the growth of leaves, which their larvae (caterpillars) feed on.

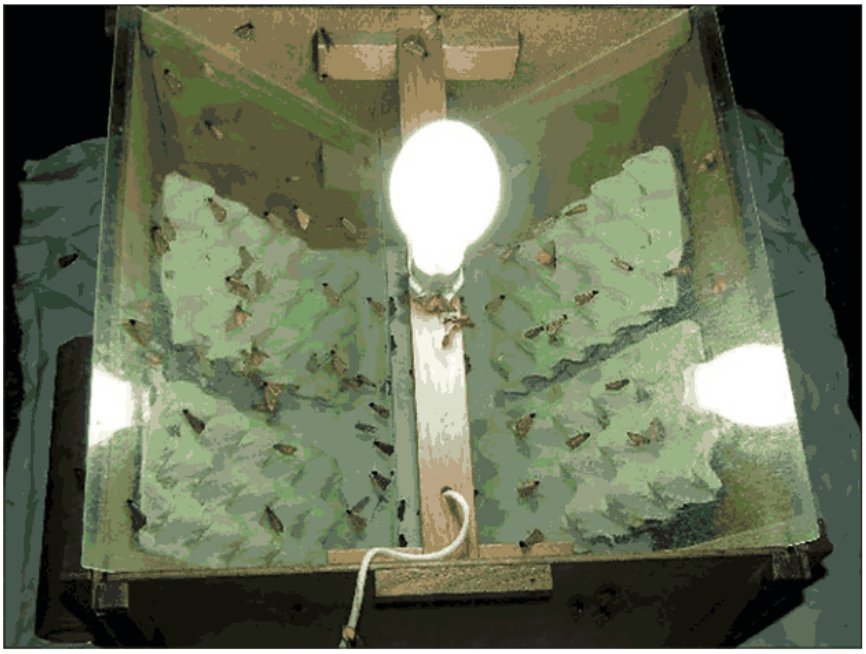
Image 1.3



Scientists monitoring the size of populations of lime hawk moths use light traps to capture moths during warm nights when they are most active.

Image 1.4

A light trap



Moths can fly in through gaps under the glass.

The glass prevents them flying back upwards.

An investigation was carried out in a southern and northern region of England using the following method.

- Five light traps, 10 metres apart, were left with the light on for four hours at night.
- After this time, captured moths were counted and marked with a small dot placed on the abdomen before releasing them.
- The procedure was repeated the following night without marking the moths after

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Question 10 · AS Component 2 · June 2023 · Q1(c)(ii) · 2 marks

(ii) During the time period between the 1st and 2nd samples, several events might occur that could lead to an inaccurate estimate of population size. Suggest **two** of these possible events. [2]

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Question 11 · A level Component 1 · June 2024 · Q2(a)(ii) · 2 marks

(ii) Plant productivity can be expressed as GPP or NPP.
Explain why only NPP is available to consumers. [2]

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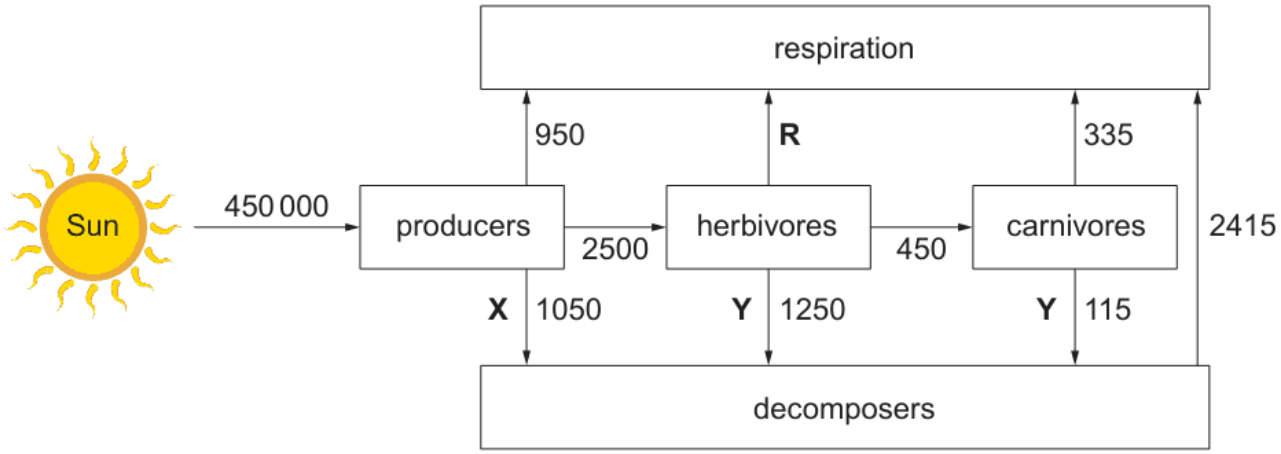
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Question 12 · A level Component 1 · June 2022 · Q3(a)(i) · 1 mark

3. In terrestrial ecosystems the Sun is the ultimate source of energy. The flow of energy through one ecosystem is shown in **Image 3.1** where **R** = respiration. The figures are given in $kJ\,m^{-2}\,year^{-1}$.

Image 3.1



(a) The productivity of the producers can be represented as:

GPP = NPP + R

(i) State what is represented by the following abbreviations: [1]

GPP .....

NPP .....

Question 13 · A level Component 1 · June 2022 · Q3(a)(ii)I · 1 mark

(ii) Using figures from **Image 3.1**, calculate the following:

I. The **GPP** of the producers. [1]

GPP = ... $kJ\,m^{-2}\,year^{-1}$

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Question 14 · A level Component 1 · June 2022 · Q3(a)(ii)II · 1 mark

II. The **NPP** of the producers. [1]

NPP = ... $kJ\,m^{-2}\,year^{-1}$

Question 15 · A level Component 1 · June 2022 · Q3(b)(i) · 2 marks

(b) The energy transferred from plants and animals to the decomposers is represented in **Image 3.1** by **X** and **Y** respectively. For plants, the energy transferred at **X** is in the form of dead tissue.

(i) Apart from dead tissue, name **two** other processes carried out by herbivores and carnivores that would also transfer energy to decomposers at **Y**. [2]

I. .....

II. .....

Question 16 · A level Component 1 · June 2022 · Q3(b)(ii) · 2 marks

(ii) Using figures from **Image 3.1**, calculate the secondary productivity of the herbivores and use this to calculate **R** for this trophic level. [2]

Secondary productivity = ... $kJ\,m^{-2}\,year^{-1}$

R = ... $kJ\,m^{-2}\,year^{-1}$

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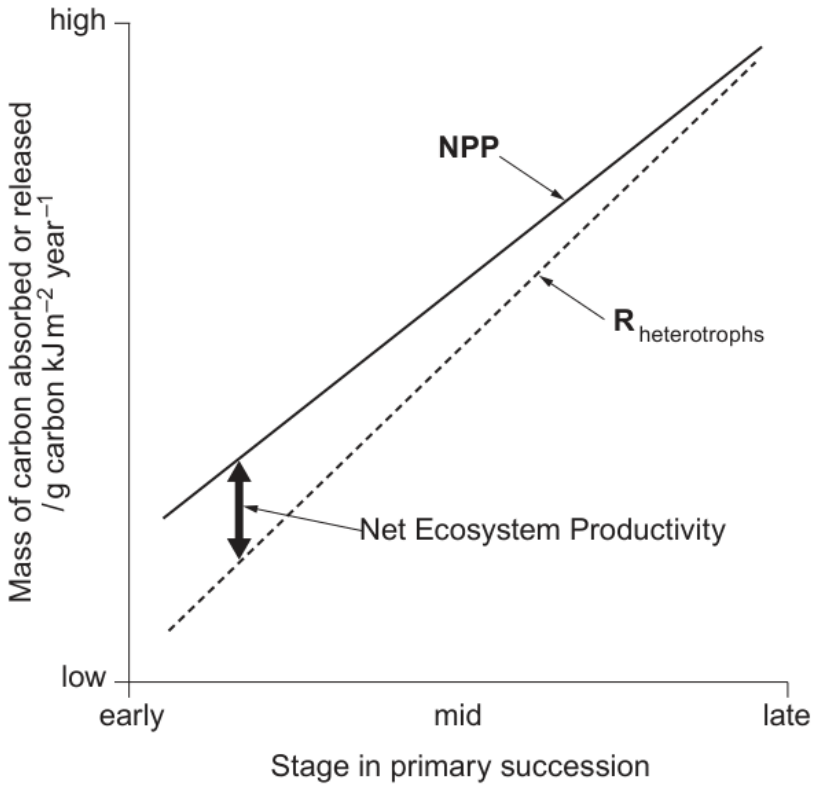
Question 17 · information from earlier in the question

(c) Net Ecosystem Productivity (NEP) is defined as the rate of accumulation of organic matter in an ecosystem. It can be calculated as:

$$\mathbf{NEP = NPP - R_{heterotrophs}}$$

Image 3.2 summarises the relationship between **NPP** and the rate of respiration by heterotrophs during the development of a forest ecosystem.

Image 3.2



Question 17 · A level Component 1 · June 2022 · Q3(c)(iii) · 3 marks

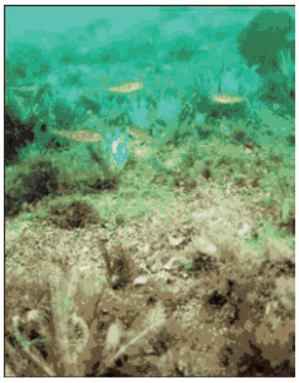
(iii) With reference to the information provided and your knowledge of succession, conclude why Net Ecosystem Productivity eventually approaches zero. [3]

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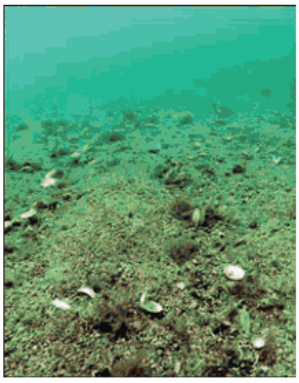
(d) Bottom trawling involves dragging very large weighted nets along the sea bed. The heavy equipment used in bottom trawling destroys the seabed, as shown in **image 4.5**.

Image 4.5

Before bottom trawling



Same area 2 days after bottom trawling



Following bottom trawling, organisms repopulate the area. Identify the type of succession that results in the repopulation **and** give **two** reasons for your answer. [3]

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Question 19 · A level Component 1 · June 2023 · Q6(a)(i) · 2 marks

6. The first UK motorway opened in 1958 and was just over 13 km long. By 2017 there were 3800 km of motorway in the UK. Despite the high pollution levels on motorways, they have become havens for wildlife, especially plants, mainly because pedestrians are not allowed on motorways.

In some areas, the verges have been used to establish colonies of endangered species as part of local conservation efforts and some verges have been planted or seeded with wildflowers to increase biodiversity. Natural colonisation has also taken place with native species. Many wildflowers are adapted to growing in soils with low fertility. The soil at the edge of motorways is often of poor quality and provides ideal habitats for these plants.

(a) (i) During motorway construction the verges are usually left as bare soil. Explain why subsequent colonisation of these verges can be described as secondary succession. [2]

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Question 20 · A level Component 1 · Autumn 2021 · Q4(a) · 1 mark

4. Carbon dioxide and atmospheric nitrogen can be fixed by living organisms.

(a) State the meaning of the word *fixed* as used in this context. [1]

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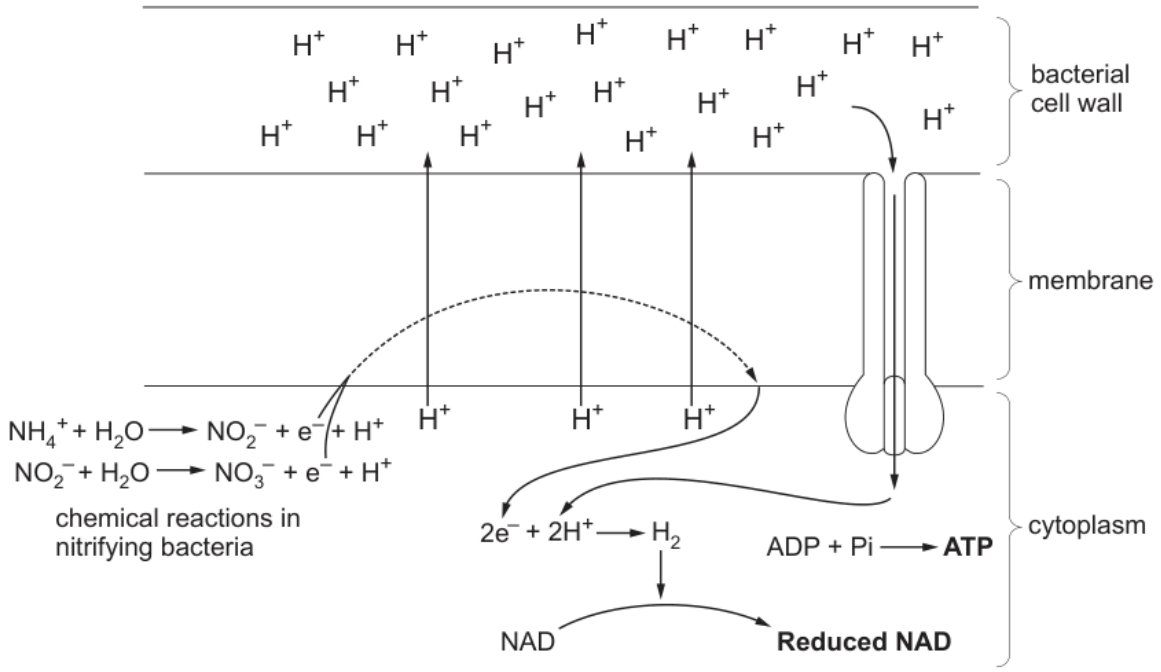
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Question 21 · A level Component 1 · Autumn 2021 · Q4(b)(i) · 3 marks

(b) **Image 4.1** represents the production of ATP and reduced NAD by nitrifying bacteria.

Image 4.1



Use the information in **image 4.1** and your own knowledge to answer the following.

(i) Name the nitrifying bacteria **and** describe how they produce a source of electrons and protons (H^+). [3]

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Question 22 · information from earlier in the question

3. Natural, species rich, seasonally-flooded grasslands are one of the rarest forms of flower-rich meadows with rare plants such as orchids. These rare plants survive on flooded meadows where levels of nitrates are low.
Many such meadows have been lost through ploughing and the application of fertilisers to increase yields of hay.
Many species-rich meadows in floodplains next to streams and rivers function as seasonal washlands, by temporarily storing flood water during periods of high water flow.

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Question 22 · A level Component 1 · June 2018 · Q3(b) · 3 marks

(b) Explain fully how the change in agricultural practices has led to the loss of this type of meadow. [3]

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Question 23 · information from earlier in the question

4. Instructions for setting up a new freshwater aquarium are given below.

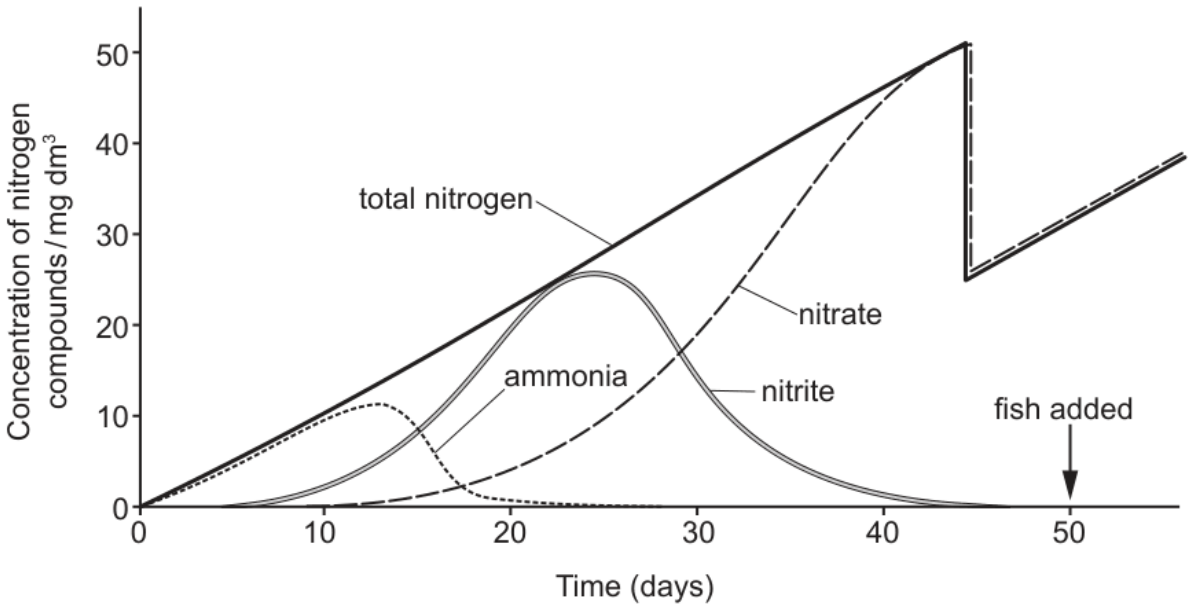
- Fill the aquarium with water.
- Use an air pump to aerate the water and use an aquarium heater to reach a constant temperature of 28°C.
- Add a small amount of fish food every three days for at least 45 days (the fish food is added as a source of nitrogen compounds and bacteria which decay the food).
- Before each addition of food, test the water in the aquarium for the presence and concentration of ammonia, nitrite and nitrate.

IMPORTANT: Do not add fish until ammonia and nitrite are not detected in the water of the aquarium.

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Graph 4 shows the concentration of three nitrogen-containing compounds found in the water samples from the aquarium.

Graph 4



(ii) Use your knowledge of the nitrogen cycle to explain the sequence of the appearance of ammonia, nitrite and nitrate as shown in **Graph 4**. [4]

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Question 24 · A level Component 1 · June 2023 · Q4(b)(ii) · 3 marks

(ii) Suggest why the concentration of nitrogen containing compounds may increase if too many fish are introduced into an aquarium. [3]

Question 25 · A level Component 1 · June 2023 · Q4(c) · 3 marks

(c) The aquarium was kept on a windowsill in bright sunlight. Two weeks after the introduction of fish to the aquarium the water turned green and the fish died. Suggest why the fish died and explain your answer. [3]

Question 26 · A level Component 1 · June 2017 · Q3(c) · 3 marks

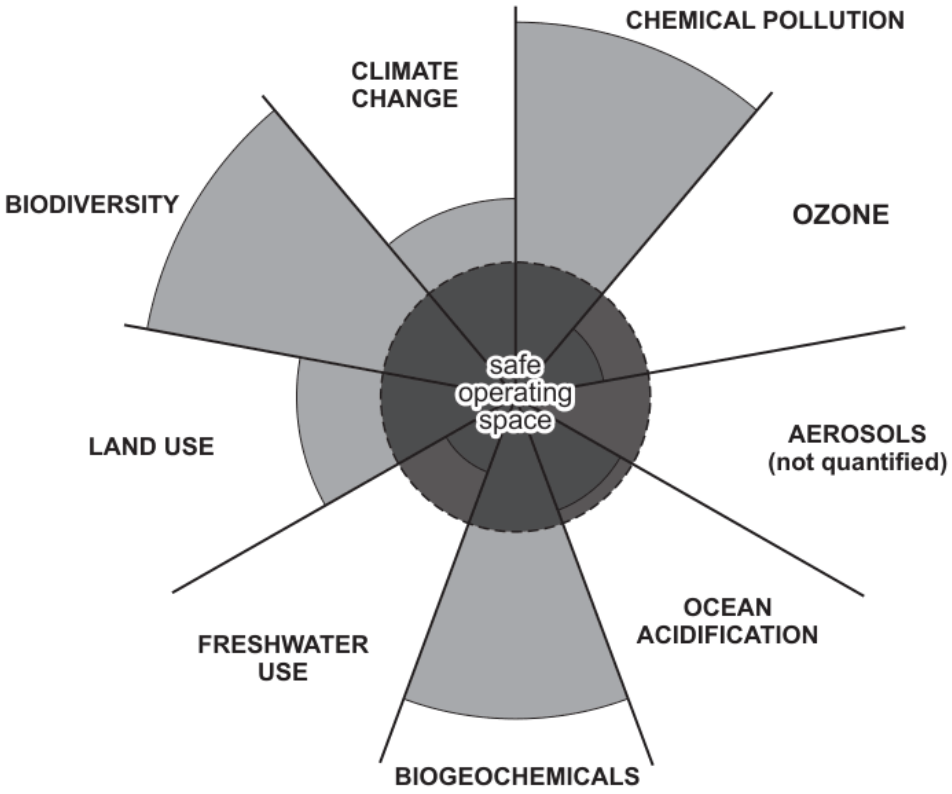
(c) Explain how deforestation can directly affect the planetary boundary for climate change. [3]

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Question 27 · information from earlier in the question

4. (a) Planetary boundaries represent the central concept in an Earth system framework proposed by scientists. **Image 4.1** shows the status of the nine planetary boundaries in 2022.

Image 4.1



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Question 27 · A level Component 1 · June 2025 · Q4(a)(ii) · 4 marks

(ii) The threshold for climate change has been crossed. This has been linked to human activities, including deforestation.
With reference to the role of **photoautotrophs** and **saprotrophs** in the carbon cycle, explain how deforestation could account for the status of the climate change planetary boundary shown in **Image 4.1**. [4]

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Mark schemes

Question 1 · A level Component 1 · June 2024 · Q2(a)(iii) · 1 mark

		(iii)	{Growth rate / population density} keeps on increasing **over time** / owtte		1	1	

Question 2 · A level Component 1 · June 2022 · Q1(a)(i) · 3 marks

1	(a)	(i)	**Stage**			3	3
			A	Lag	Synthesis of {enzymes / proteins /RNA/ amino acids/ DNA} /absorption of nutrients / cell growth (1) Ignore acclimatise/ adapt		
			B	Log phase/ exponential	{Rapid/ owtte} cell division/ doubling in a unit time/ exponential growth (1)		
			C	Stationary phase	Cell death = cell production / {nutrients/ specified nutrients} reduced / accumulation {waste products/ named}/ carrying capacity reached/ increased environmental resistance/ there are limiting factors (1)		
			Reject ref to birth rate once in either B or C				

Question 3 · A level Component 1 · Autumn 2020 · Q4(a) · 3 marks

4	*(a)*	1850-1950. stationary phase/ Carrying capacity/ or description of **and** sustainable fishing/ owtte (1) 1970 – 1990 rapid population decline/ population crash **and** overfishing (1) 1990 – 2010. Population recovery **and** due to banning of cod fishing (1)	3	3

Question 4 · A level Component 1 · June 2019 · Q6(b) · 3 marks

	(b)	A. Fewer predators (1) B. Less intraspecific competition (1) C. for food/ nest sites/habitat (1) NOT space/ resources D. Less likely to pass on disease as fewer numbers (initially) (1)	3	3

Question 5 · A level Component 2 · June 2018 · Q5(a) · 4 marks

5	(a)	{within range of 1750- 1800/at the beginning} population was regulated by density dependent factors (1) e.g. {competition for/limited availability of} {food/mating sites/mates}/disease/predation (1) within range1780-1830 population was subject to density independent factors (1) Eg. hunting (1)	2	2	4

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Question 6 · A level Component 1 · June 2025 · Q6(a)(ii) · 2 marks

(ii)

Factor	Abiotic	Biotic	Density-dependent	Density-independent
Atmospheric temperature	✓			✓
Disease		✓	✓	
Drought	✓			✓

Abiotic + biotic correct = 1 mark
Density and density independent correct = 1 mark

2 2

Question 7 · A level Component 1 · June 2018 · Q3(d)(i) · 3 marks

(d) (i)

Use of transect **and** use of quadrats(1)
Estimate of %cover/number/ frequency of each species (1)
NOT count abundance
Repeat at {points/ intervals} along footpath (1)

3 3 3

Question 8 · A level Component 1 · June 2019 · Q5(d) · 5 marks

(d)

Any five (×1) from:

A. Mark out a permanent/ same area each time (1)
B. 10m × 10m / other sensible area/ transect (1)
C. Method of sampling - use of quadrats (1)
D. Reviewed periodically (1)
E. All species {identified/ counted/ percentage cover/abundance/frequency}/ measure species diversity (1)
F. Ref to H & S issues re tide/ minimising damage to area (1)

	5	5		5

Question 9 · A level Component 1 · June 2022 · Q5(c)(i) · 2 marks

(c) (i)

Any two (x1) from:
Identify co-ordinates/ or description of (1)
{samples could be selected/ quadrats placed/ or description of} at random (1)
to reduce bias (1)

2 2 2

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Question 10 · AS Component 2 · June 2023 · Q1(c)(ii) · 2 marks

(ii)	**Any two (×1) from** • Moths might be predated/die (between the 1st& 2nd night) (1) • The mark may be removed (1) • Moths might migrate away (from the sampling area) (accept migrate into the sampling area) (1) Reject migration from N to S of England • Marked/captured moths may not have integrated randomly into the population/moths captured previously may have a greater chance of becoming captured a second time (1) • More moths may have emerged. accept hatched (1) Reject 'given birth'/reproduced.	2	2		2

Question 11 · A level Component 1 · June 2024 · Q2(a)(ii) · 2 marks

(ii)	• (NPP is the) energy {stored in new growth / in biomass } (1) • Energy lost from GPP through respiration is not available / NPP = GPP – R so some energy lost / owtte (1)	1	1	2

Question 12 · A level Component 1 · June 2022 · Q3(a)(i) · 1 mark

3	(a)	(i)	GPP = gross primary {productivity / production} NPP = net primary {productivity/ production} Both needed for 1 mark	1	1

Question 13 · A level Component 1 · June 2022 · Q3(a)(ii)I · 1 mark

	(ii)	I	(950 + 1050 + 2500 =) 4500	1	1	1

Question 14 · A level Component 1 · June 2022 · Q3(a)(ii)II · 1 mark

		II	(1050 + 2500=) 3550	1	1	1

Question 15 · A level Component 1 · June 2022 · Q3(b)(i) · 2 marks

(b)	(i)	I II	Egestion (1) Excretion / urination (1)	2	2

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Question 16 · A level Component 1 · June 2022 · Q3(b)(ii) · 2 marks

(ii)	(Secondary productivity = 450 + 1250 =) 1 700 (1) **(R** = 2500-1700) = 800 (1)	2	2	2	

Question 17 · A level Component 1 · June 2022 · Q3(c)(iii) · 3 marks

(iii)	**Any three (x1) from:** A. {Biodiversity / biomass} increases during (primary) succession (1) B. (R) heterotroph respiration increases (1) C. More energy lost from {ecosystem/ trophic levels} (1) D. Until NPP = $R_{heterotrophs}$ / owtte(1)	3	3	

Question 18 · A level Component 1 · Autumn 2020 · Q4(d) · 3 marks

(d)	Secondary succession (1) sediment/ organic matter still present (1) Larval stages/ seeds/ roots still present/ owtte (1)	1	2	3

Question 19 · A level Component 1 · June 2023 · Q6(a)(i) · 2 marks

6	(a)	(i)	Soil already present (1) Seeds / roots already present (1)	2	2	

Question 20 · A level Component 1 · Autumn 2021 · Q4(a) · 1 mark

4	(a)	Conversion into {a form which can be used by living organisms / organic compound/ name organic compounds}	1	1	

Question 21 · A level Component 1 · Autumn 2021 · Q4(b)(i) · 3 marks

(b)	(i)	**Any three (×1) from:** Nitrosomonas + Nitrobacter (1`) (Nitrosomonas +) NH_4^+/ ammonium ions to nitrites (1) (Nitrobacter +) NO_2 / nitrite ions to nitrates (1) Reference to release e^- and H^+ from water (1)	3	3	

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Question 22 · A level Component 1 · June 2018 · Q3(b) · 3 marks

	(b)		**Any three (x1) from** 1. Use of fertilisers (1) 2. Ploughing increasing aeration/increasing aerobic/decreasing anaerobic conditions (1) 3. Nitrification increases (1) 4. More nutrients in flood water increasing nitrate levels (1)		3	3	

Question 23 · A level Component 1 · June 2023 · Q4(a)(ii) · 4 marks

(ii)		**Any four (x1) from** A. {ammonia / ammonium} produced by {decomposers/ bacteria}/ ref to ammonification (1) B. {NH_4^+ / NH_3} converted to {nitrite (ions) / NO_2^-} (1) C. By *Nitrosomonas* (1) D. {nitrite/ NO_2^-} to {nitrate / NO_3^-} (1) E. By *Nitrobacter* (1) F. Ref to Nitrification / by nitrifying bacteria (1)	2	2	4	

Question 24 · A level Component 1 · June 2023 · Q4(b)(ii) · 3 marks

(ii)		{urine / faeces / food / dead fish/ egesta / excreta}/ ref to {excretion/ egestion} (1) contain N-containing compounds/named N-containing compounds (1) (N-containing compounds) released during decay of {dead fish / food / faeces / egesta} (1)	3	3	

Question 25 · A level Component 1 · June 2023 · Q4(c) · 3 marks

(c)		**Any three (x1) from** Algal bloom/ growth of algae (1) Bacteria / saprotrophs / decomposers decay {dead algae / dead plants / food / faeces} (1) Ignore fungi use oxygen from water/ respire aerobically (1) (fish die) as they cannot respire (due to lack of oxygen) (1)	2	1	3	

Question 26 · A level Component 1 · June 2017 · Q3(c) · 3 marks

(c)	• Deforestation reduces carbon dioxide uptake (1) • {Burning of felled trees/ transport of felled trees/ use of fuels in processing trees} puts carbon dioxide into the atmosphere/ (1) • Decay of waste tree material (1)	3	3		

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Question 27 · A level Component 1 · June 2025 · Q4(a)(ii) · 4 marks

(ii)	**Any four (x1) from:** (deforestation) A. Less {photoautotrophs / plants / trees} to carry out photosynthesis / removal of {photoautotrophs / plants / trees} results in less photosynthesis (1) B. reduces (natural) removal of CO_2 from the atmosphere / ORA (1) C. (more) dead organic matter decayed / (more) saprotrophs causing decay (1) D. (More) respiration (of saprotrophs) releases (more) CO_2 (1) E. (Decay of more dead trees from deforestation) releases more CO_2 than that removed by photosynthesis / owtte (1) F. Increased carbon dioxide linked to climate change / greenhouse gas (1)	2	2	4

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