

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

4.3.2 THE IMPACT OF POPULATION INCREASE

SCORE

/72

PERCENTAGE

%

STEMUP

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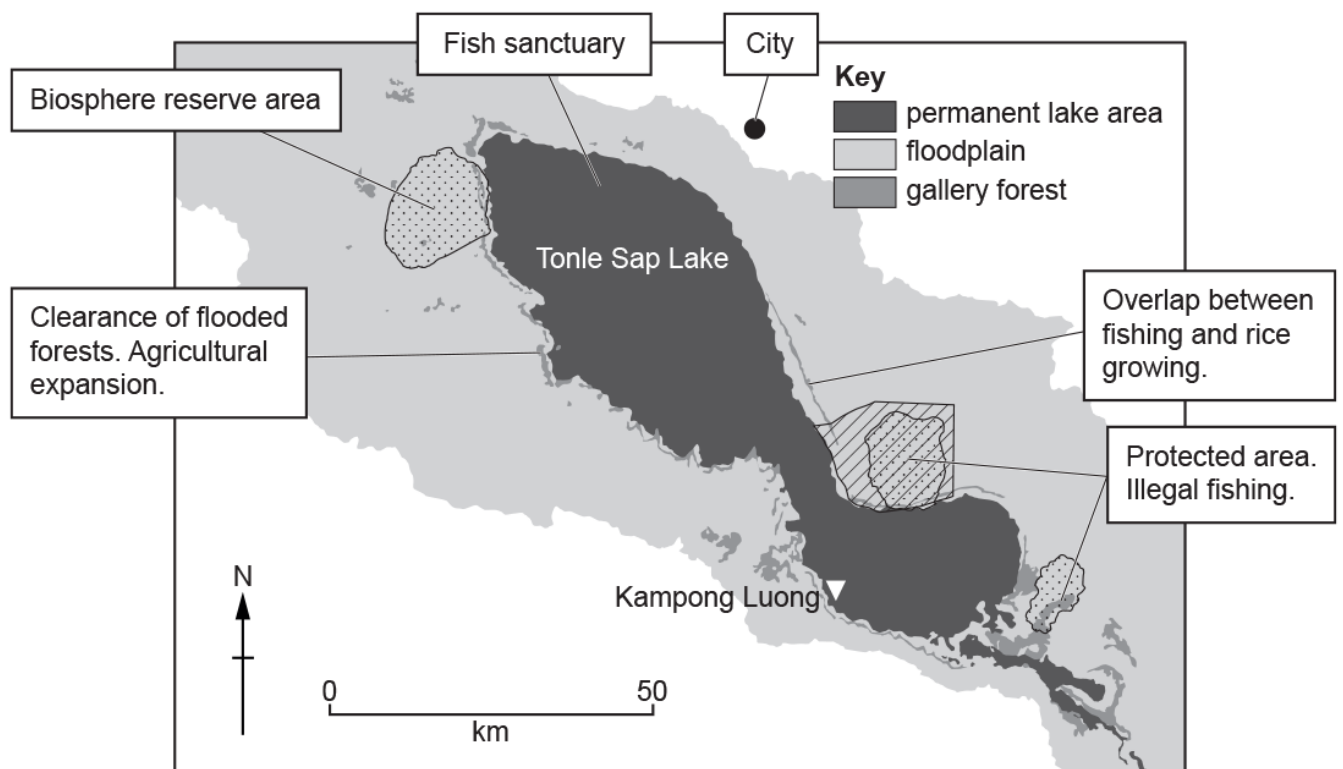
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1(a) Tonle Sap Lake in Cambodia is one of the world's most productive and biodiverse freshwater ecosystems.

The human population of the Tonle Sap Lake live on floating villages that rise and fall with the water levels and depend on the traditional ways of living from rice farming, fishing and extracting forest resources.

The location map shows the Tonle Sap Lake with some of the human activities that take place.



Using the information, evaluate the possible impact of human activities on the ecosystem of the Tonle Sap Lake.

[6]

(b) A team of ecologists recorded the number of animal species living in four different habitats provided by one region of the Tonle Sap Lake.

Their data are shown in the table below.

Habitat	Number of different animal species
Deep water	17
Abandoned rice fields	12
Floodplain shrubland and forest	92
Rice fields	4

(i) Suggest reasons for differences in the number of animal species in these habitats.

[2]

(ii) State how the team of ecologists could calculate the **biodiversity** in each of these habitats and what additional data would be needed for the calculation.

[2]

2(a)

Fig. 5.1 shows the changes in population, annual birth rate and annual death rate in Europe and Africa since 1950 and projected beyond 2080.

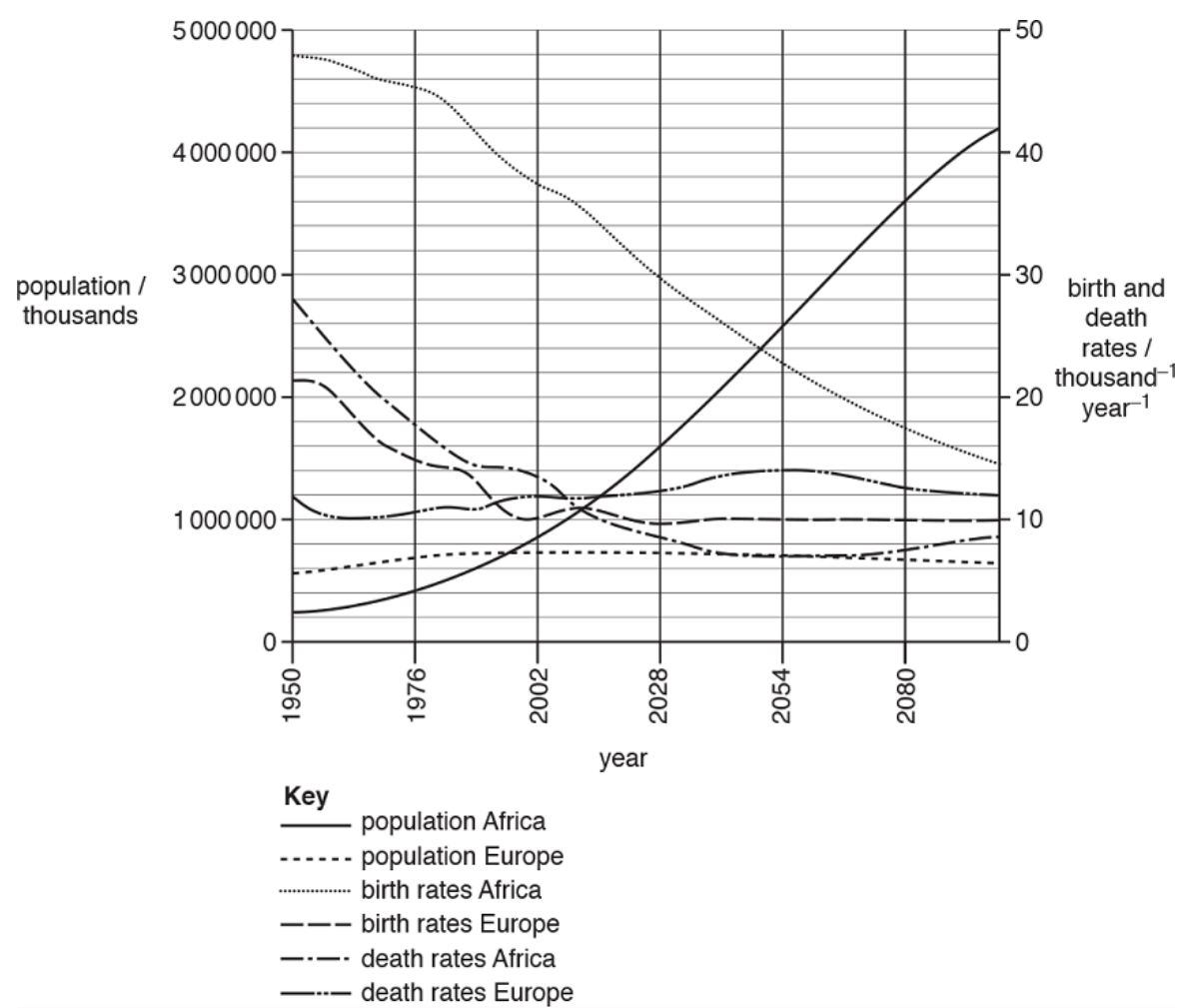


Fig. 5.1

(i) Explain why birth rates and death rates are shown in Fig. 5.1 as ‘number per thousand per year’.

----- [1]

- (ii) Use the data in Fig. 5.1 to calculate the projected rate of increase in the population of Africa between 2028 and 2080.

Show your working. Give your answer in standard form to **one** decimal place.

answer = ... thousands year⁻¹ [3]

- (iii) Use the birth rate and death rate data in Fig. 5.1 to explain the different trends in population for Africa and Europe.

----- [3]

(b) Fig. 5.2 shows the total cereal production in Africa and cereal imports into Africa in the period 1960–2010.

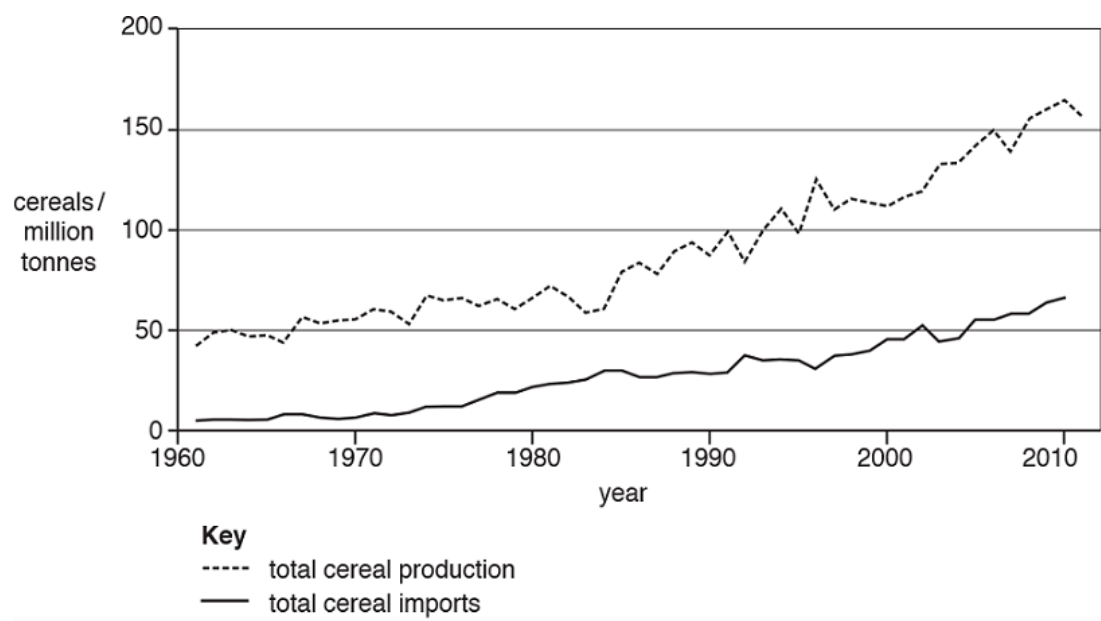


Fig. 5.2

(i) Explain why cereals are staple foods in many African countries.

[2]

(ii) Discuss to what extent the data in Fig. 5.2 explain the changes in death rates in Africa shown in Fig. 5.1.

----- [2]

- (c) Using Fig. 5.1 and Fig. 5.2, as well as your own knowledge, what can you conclude about the potential risks to food security and sustainability in Africa?

----- [5]

3(a) *Miscanthus* and reed canary grass are crops that are reported to promote species diversity.

A field trial was carried out to determine which crop promotes the greater diversity of bird species:

- two fields (**M** and **R**) were sampled
- *Miscanthus* was grown in field **M**
- reed canary grass was grown in field **R**
- the number of each bird species (*n*) was recorded for both fields
- the Simpson's Index of Diversity was calculated for both fields.

The incomplete results for field **M** are shown in Table 35.

Bird species	<i>n</i>	<i>n</i> / <i>N</i>	$(n/N)^2$
Dunnock	3	0.03	0.0009
Song thrush	40	0.40	0.1600
Reed bunting	23	0.23	0.0529
Meadow pipit	12		
Willow warbler	4		
Common redstart	18		
<i>N</i> =			$\Sigma(n/N)^2 =$
			$1 - (\Sigma(n/N)^2) =$

Table 35

- (i) Complete Table 35 and use the formula below to calculate the Simpson's Index of Diversity (*D*) for field **M**.

$$D = 1 - (\Sigma(n/N)^2)$$

Where:
n = number of individuals of each species
N = total number of individuals in all species

Simpson's Index of Diversity (*D*) = ...[3]

(ii) The Simpson's Index of Diversity for field R is 0.54.

Using this information and your answer to (b)(i), conclude which crop promotes the greater diversity of bird species. Justify your conclusion.

----- [1]

(b) Modern agricultural methods involve the use of chemical fertilisers added to the soil to increase crop yield.

However, the use of chemical fertilisers can have an impact on organisms within aquatic ecosystems such as ponds and streams.

The lifecycle of a dragonfly is shown in Fig. 35.

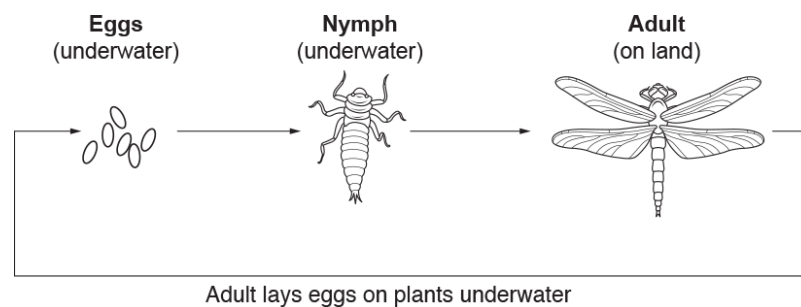


Fig. 35

Explain how the use of chemical fertilisers on agricultural land may threaten the survival of dragonflies.

----- [3]

4(a) The National Census is carried out every 10 years and the data can be analysed to compare changes in the size and composition of the UK population over time.

Fig. 5.1, shows the structure of the population of England and Wales in 2001.

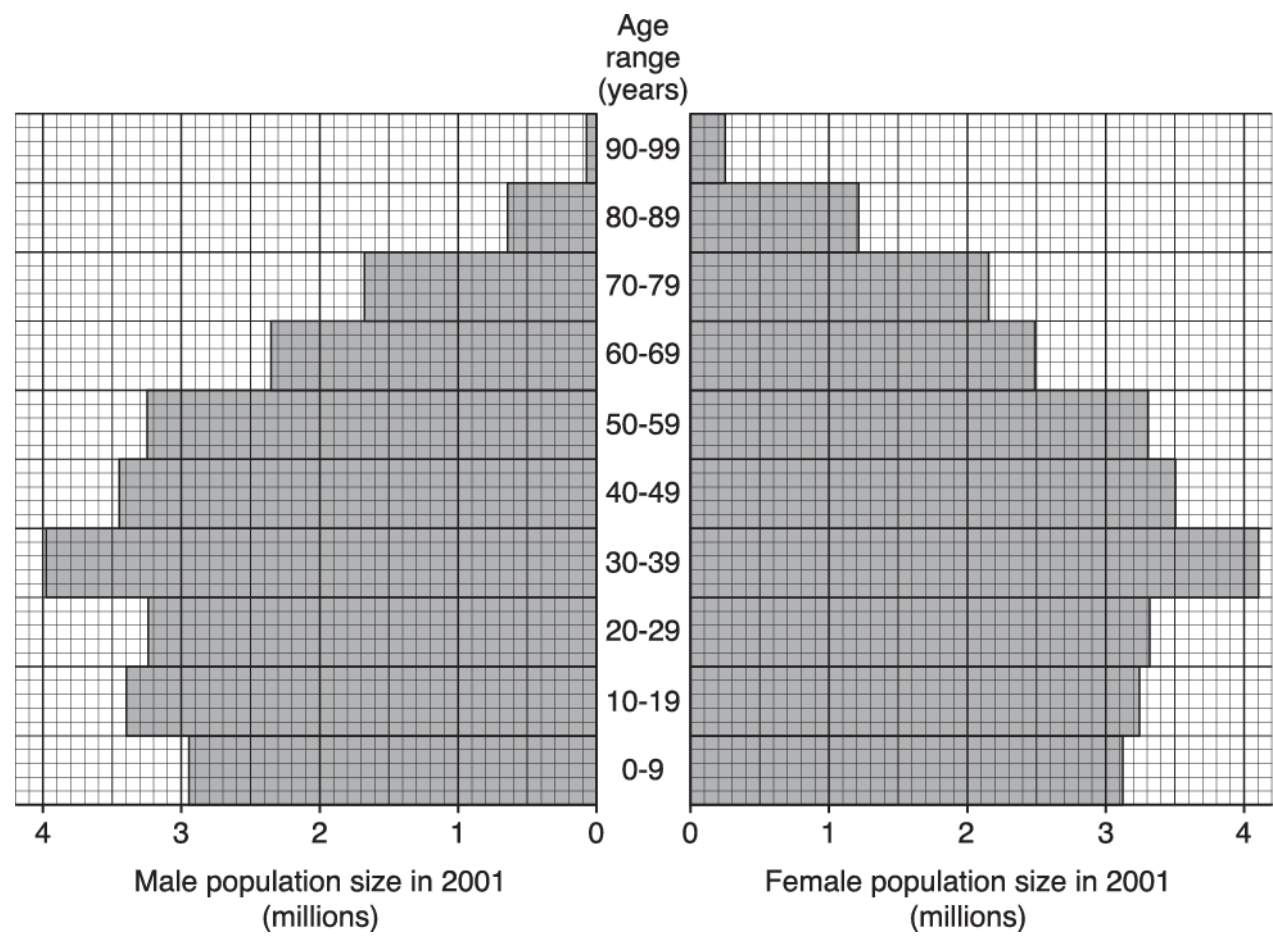


Fig. 5.1

The 1960s was a period which experienced a ‘baby boom’ when the birth rate increased significantly.

Describe the evidence from Fig. 5.1 that shows that this decade experienced a ‘baby boom’.

[2]

(b) The number of births each year depends on two factors. One of these factors is the fertility rate of the female population. The fertility rate is measured by the mean number of children born to a woman over her lifetime.

(i) Suggest the second factor which will affect the number of births each year in a population.

----- [1]

- (ii) • In 1911 the fertility rate was 2.8 and the population size was 36.1 million.
- In 2001 the fertility rate was 1.6 and the population size was 52.0 million.

Outline why the population increased in size dramatically despite a fall in the fertility rate.

----- [2]

(c) Fig. 5.2, shows the population graph produced from the census data in 2011.

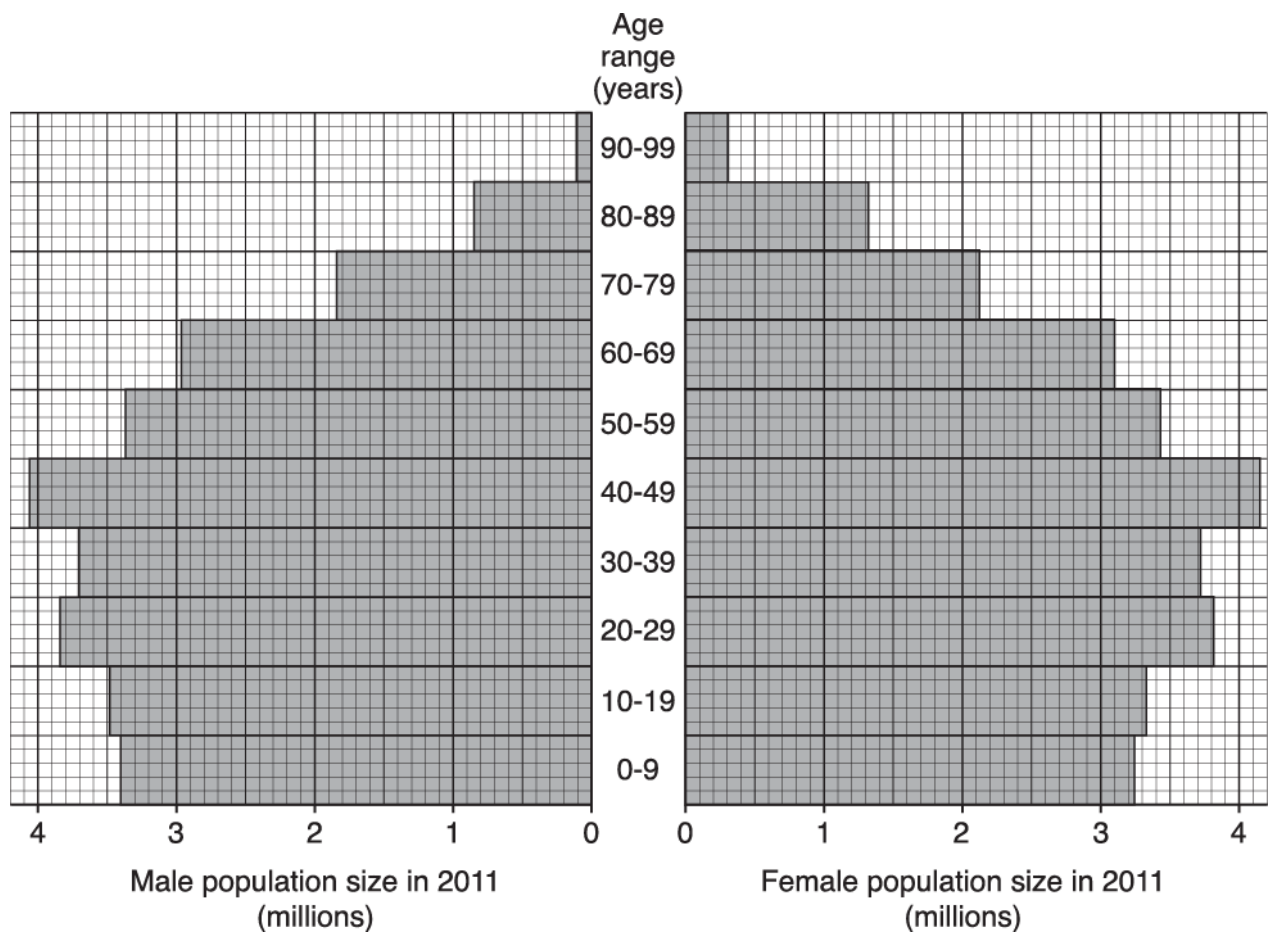


Fig. 5.2

- (i) Suggest why there is a significant increase in the population of 20 to 29 year olds on the 2011 graph compared with that of the 10 to 19 year olds on the 2001 graph.

----- [1]

- (ii) Comparing the data from 2001 with the data from 2011, identify **one** effect that the increasing number of 20 to 29 year olds may have had on the size of any other age group **and** explain why this might have occurred.

Effect -----

Explanation -----

[2]

- 5 Some brownfield sites in large cities have become urban wildlife parks. One such example is Gillespie Park in Islington, London.

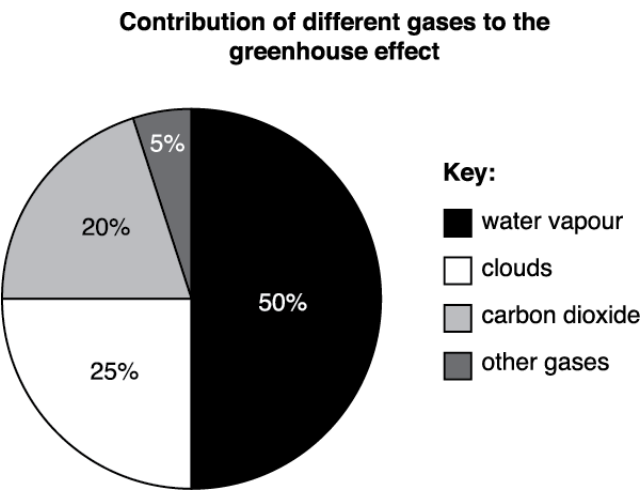
Many other brownfield sites are at increasing risk of being acquired by developers for building.

Suggest why more brownfield sites are at risk of being lost due to development **and** suggest **one** consequence of this loss to the urban ecosystem.

[2]

6(a) The greenhouse effect is caused by particular gases in the atmosphere including water vapour. These gases absorb infrared radiation from the Earth's surface and re-emit it. This process ensures that the surface of the Earth is 20 °C to 30 °C warmer than it would be otherwise.

A simplified summary of the contribution of different gases to the greenhouse effect is shown in the figure.



Suggest why water vapour is **not** considered a cause of global warming.

[1]

(b) Greenhouse gases vary in their contribution to global warming. Each greenhouse gas lasts for a different length of time in the atmosphere.

Carbon dioxide equivalents (CO_2e) are used to express the relative global warming potentials of different greenhouse gases.

(i) Suggest the advantage of converting greenhouse gas emissions into carbon dioxide equivalents.

----- [1]

(ii) Carbon dioxide has a global warming potential (GWP) of 1.

Methane has a GWP of 25, meaning that 1 kg of methane emitted is equivalent to 25 kg of carbon dioxide being emitted.

The following table shows the GWP of some greenhouse gases.

Greenhouse gas	GWP
Carbon dioxide	1
Methane	25
Nitrous oxide	298
Hydrofluorocarbon-23	22 800

Using the information in the table, calculate the mass of carbon dioxide that is equivalent to 0.5 kg of nitrous oxide.

Answer = _____ kg [2]

(c) Hydrofluorocarbons are used as coolants in refrigeration and air conditioning units.

Hydrofluorocarbons were introduced to replace ozone-destroying chlorofluorocarbons (CFCs).

Explain, using information from The table, why even a small increase in the use of hydrofluorocarbons could act against the benefits gained from the reduction of other greenhouse gases.

[2]

- (d) A large supermarket chain has started to use eCO_2 as the coolant in their refrigeration systems.

This eCO₂ refrigerant is obtained during the production of bioethanol from waste sugar beet.

Other CO₂ based refrigerants are produced from hydrocarbons derived from fossil fuels.

- (i) How is carbon dioxide converted to organic molecules in the palisade mesophyll cells of sugar beet plants?



In your answer, you should use appropriate technical terms, spelled correctly.

[4]

- (ii) Suggest why using eCO₂ is more efficient in reducing the carbon footprint of the supermarket chain than using CO₂ based refrigerants produced from fossil fuels.

[2]

7 Important crops within the UK include potatoes, sugar beet, oilseed rape, wheat and fresh fruits.

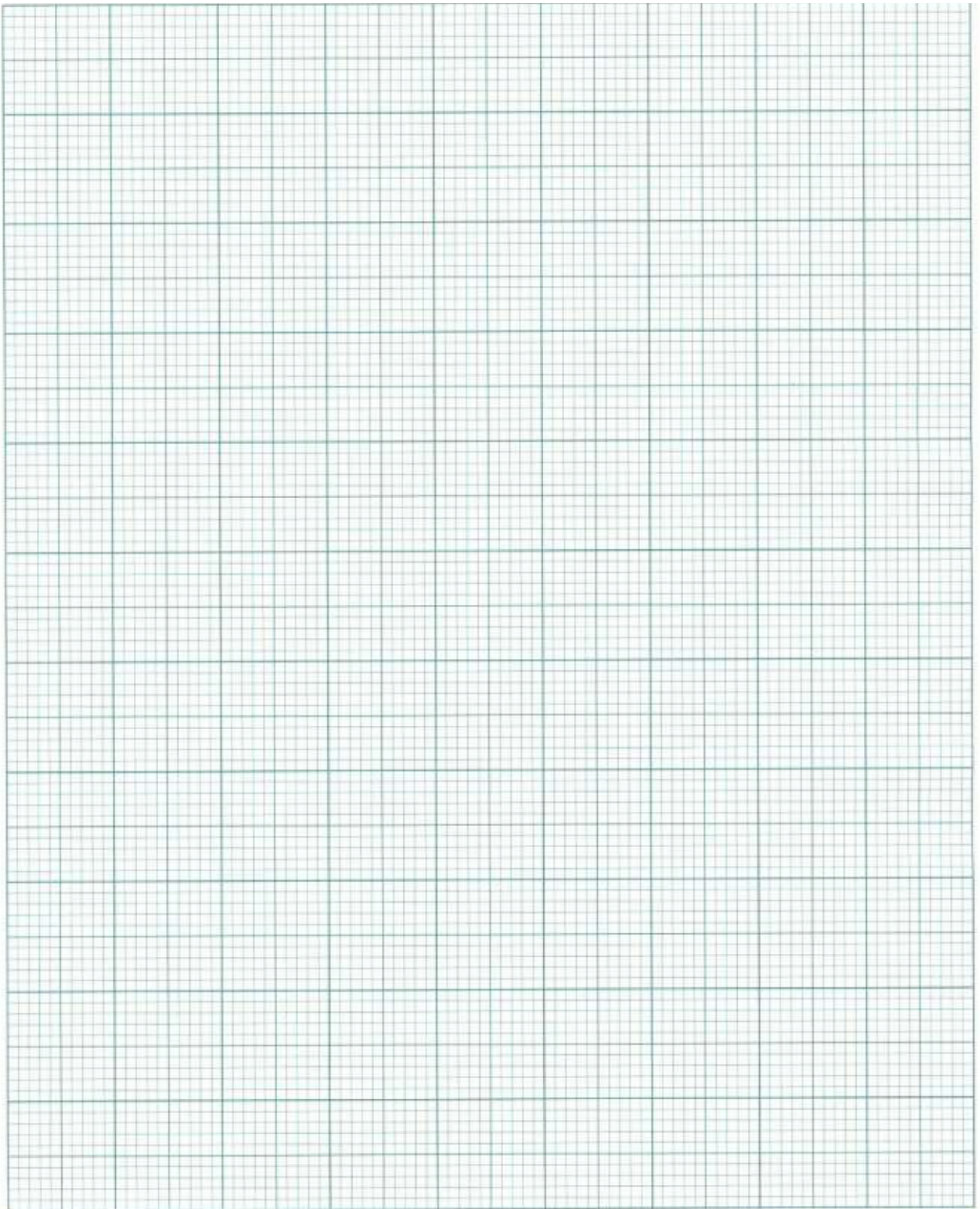
Table 4.1 below shows the UK production in tonnes per hectare for each of these crops in 2012.

Crop	Total production (thousand tonnes per hectare)
Potatoes	4553
Sugar beet	1144
Oilseed rape	2557
Wheat	13261
Fresh fruits	358

Table 4.1

Plot a graph on the grid provided to show this data in the most appropriate way.

[4]



- 8 It is very important that meat products are stored at the correct temperature.

A student was investigating the growth of a bacterial culture at 20°C in a liquid containing meat extract. The following results were obtained:

Time (hrs)	<i>E. coli</i> ($\log_{10}$ of numbers per cm^3)
0	2.0
4	2.0
8	3.0
12	4.0
16	5.0
20	5.5
24	6.0

Table 16.1

Which of the following conclusions is correct?

- A The number of bacteria doubles between 4 hours and 12 hours.
- B There is a 25% increase in the number of bacteria between 12 and 16 hours.
- C There are 550 000 bacteria per cm^3 after 20 hours.
- D There are a million bacteria per cm^3 after 24 hours.

Your answer

[1]

- 9 In the last century, large areas of natural woodland on the Scottish mainland were removed by the Forestry Commission. The large areas of land were replanted with closely-spaced conifer trees.

As the young conifers grew, they reduced the light reaching the ground. Other plant species died.

When mature, the conifers were felled for industries like paper and chipboard. The area was left covered with unwanted conifer branches.

- (i) This method of producing timber is now regarded as **ecologically** undesirable.

Suggest why.

----- [2]

The figure is a photograph of a woodland that is managed differently.



- (ii) The woodland in the figure can supply timber continuously, sustainably and economically.

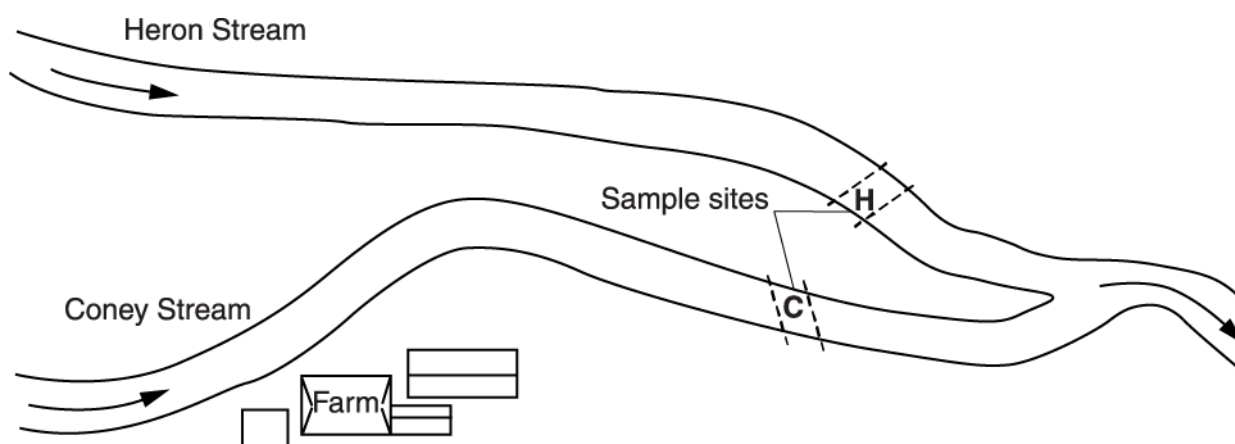
Discuss some social, aesthetic and ethical benefits of managing woodland in this way compared to

[4]

The table lists some freshwater invertebrates, the presence of which indicates the level of water pollution.

Freshwater invertebrate	Water quality indicated
Stonefly nymph	Clean water
Freshwater shrimp	Slightly polluted water
Water louse	Badly polluted water
Sludge worm	Very badly polluted water

The figure below shows two streams draining the same piece of moorland. They are close together and the water in them should be of identical quality.



The farm beside Coney Stream was suspected of occasionally discharging polluting manure from the cattle sheds into the stream.

The indicator species living in a stream are a record of the level of pollution in the stream over time.

A Water Board biologist collected samples of invertebrates from Coney Stream and Heron Stream at the sites (H and C) indicated in the figure. The processed data from the samples collected are shown in the table.

Indicator species	Percentage of catch in Heron Stream sample (%)	Percentage of catch in Coney Stream sample (%)
Stonefly nymph	58	44
Freshwater shrimp	33	43
Water louse	7	12
Sludge worm	2	1

If no serious pollution was coming from the farm, there would be no significant difference in the percentages of each type of invertebrate collected from Coney Stream and Heron Stream. The percentages would be similar.

- (i) Use the formula and the table below to calculate the χ^2 value for the invertebrate samples from the two streams.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Indicator species	E	O	(O - E)	(O - E) ²	$\frac{(O - E)^2}{E}$
Stonefly nymph	58	44			
Freshwater shrimp	33	43			
Water louse	7	12			
Sludge worm	2	1			

$\chi^2 =$ _____ [4]

- (ii) Look on table to find the probability that the difference between Coney Stream and Heron Stream is due to chance and is not due to pollution from the farm.

Degrees of freedom	Probability of a larger value of χ^2							
	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09

The Water Board biologist concluded that the farm beside Coney Stream had been causing water pollution.

Use your calculated value for χ^2 (on page 21) and the information in Table 6.3 to justify whether the biologist's conclusion can be supported or not.

[2]

END OF QUESTION PAPER

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
1	a	<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> <i>In summary:</i> <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> <i>award the higher mark where the Communication Statement has been met.</i> <i>award the lower mark where aspects of the Communication Statement have been missed.</i> The science content determines the level. The Communication Statement determines the mark within a level. Level 3 (5–6 marks) Evaluation with both positive and negative impact statements using examples. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Evaluation with either positive or negative impact statements using examples. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1–2 marks) Little evaluation with basic descriptive	6(AO3.2)	Indicative scientific points may include Must be about impact on biodiversity / ecosystem <i>Positive impacts:</i> • bioreserve area will maintain biodiversity and habitats • protected areas and fish sanctuary could limit decline in fish stocks • city could provide ecotourism to encourage maintaining biodiversity • traditional ways of living in floating villages more sustainable • human waste from floating villages could provide nutrients for fish increase in certain species (could also be negative impact) <i>Negative impacts:</i> • clearance of flooded forests could lead to loss of tree-dwelling species • clearance of flooded forests could lead to change extent of flood plain area leading to change in biodiversity • possible conflicts between fishermen and rice growers / over-fishing or over-planting could cause decline or loss of certain species • agricultural expansion leading to loss of habitats • illegal fishing causes decline of some species

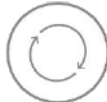
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			statement that may not include reference. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		
	b	i	least species in rice growing areas due to , disturbance / clearance of habitats , for , planting / harvesting ✓ most species in shrubland and forest due to more different types of habitat available ✓ abandoned rice fields more than existing rice fields due to repopulation of areas ✓	2 max(AO2.1)	ALLOW <i>idea of</i> lack of different habitats / monoculture ALLOW <i>idea that</i> secondary succession is occurring
		ii	Simpson's Diversity Index ✓ number of individuals in <u>each</u> species ✓	2(AO1.1)	ALLOW species abundance
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2	a	i	allows comparison between (areas with) different population sizes ✓	1	ALLOW can compare as population size doesn't have to be taken into account <u>Examiner's Comments</u> Most candidates discussed this terminology in terms of producing smaller numbers for ease of comparison or not being able to count every member of a population.
		ii	(population increase) 2 100 000 ✓ (divided by 52 years =) 40 385 thousand year⁻¹ ✓ = 4.0×10^4 (thousand year⁻¹) ✓	3	ALLOW figure in the range 1 900 000 – 2 200 000 ECF any value divided by 52 ECF value from previous mark in standard form and 1 dp <u>Examiner's Comments</u> This was well answered with most candidates using a population increase of 2000 000. As seen previously, candidates struggled to express their correct answers in standard form.

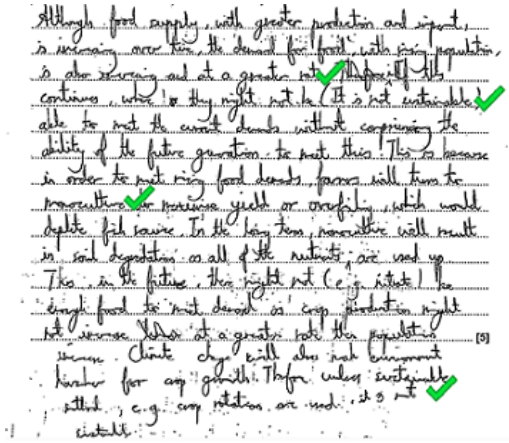
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	<i>population in Africa increase because</i> more births than deaths ✓ birth rate (always) higher in Africa compared to Europe ✓ <i>population in Europe decreases because</i> more deaths than births ✓ death rate (now) higher in Europe compared to Africa ✓	3 max	<u>Examiner's Comments</u> Although candidates discussed birth and death rates, few appreciated the relevance of these to the overall trend in the populations of the two continents. Thus candidates did not gain marks as they did not connect their detailed description of e.g. death rates over time, to the overall population growth.  The use of acetates can help with building up graphical information. Students can place an acetate over the detailed graph and sketch one line only and describe (and explain) that line. Each candidate can sketch a different line and then work in groups and add the lines together by placing the acetates on top of each other. This will eventually build up to the original graph, but having interpreted and described each line first.
	b	i	(cereals endosperm is), rich in starch / a good source of carbohydrate ✓ (endosperm from some) cereals be used to make bread ✓ cereals can grow in hot climates ✓	2max	<u>Examiner's Comments</u> Few candidates appreciated that cereals are a good source of carbohydrates and could be used to make other foods. Most candidates stated cereals cope well with the climate but did not appreciate it would be their growth in a hot climate.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	increase in cereal (imports and production) correlates with decrease in death rate ✓ death rate due to malnutrition decreases ✓ (however) other factors / named example, will reduce death rate ✓	2max	ALLOW negative correlation between cereal (imports and production) and death rate ALLOW more people live as they have plenty of food ALLOW improved sanitation / healthcare <u>Examiner's Comments</u> The majority of candidates correctly related the increase in cereals to the decrease in death rates to gain mark points 1 and 2.
	c		food security ensures access to safe & nutritious foods ✓ (rising population) greater demand for food ✓ Increased risk to food security ✓ (rising population) makes sustainable farming practices less likely (to be maintained) ✓ (increased cereal production) reduces biodiversity ✓ (as) increased use of monoculture ✓ (increased use of) pesticides will kill other insects / herbicides will kill other plants ✓ (increase in) imported foods may not be safe ✓	5 max	ALLOW (rising population) is major threat to food security ALLOW description of food security being at risk (e.g. 'less likely to be able to supply food to everyone') ALLOW genetic diversity is low ALLOW imported cereals may have decreased food security <u>Examiner's Comments</u> Candidates struggled to answer this question with some clearly not understanding the meaning of food security, whilst others did not relate their knowledge of food security to the figures and the increase in the population. Very

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					few candidates quoted the meaning of food security to gain a mark. Many candidates discussed an increased risk to food security in terms of climate change and natural disasters. Exemplar 3  This exemplar shows recognition of relevance to increasing population at the start and a clear understanding of risk to food security, and relating reliance on crops to monoculture and lack of biodiversity.
			Total	16	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance										
3	a	i	$N = 100$ AND <table border="1"><tr><td>n / N</td></tr><tr><td>0.12</td></tr><tr><td>0.04</td></tr><tr><td>0.18</td></tr></table> ✓ <table border="1"><tr><td>$(n/N)^2$</td></tr><tr><td>0.0144</td></tr><tr><td>0.0016</td></tr><tr><td>0.0324</td></tr></table> ✓ <table border="1"><tr><td>$\Sigma(n / N)^2 = 0.2622$</td></tr><tr><td>$1-(\Sigma(n / N)^2) = 0.7378$</td></tr></table> ✓	n / N	0.12	0.04	0.18	$(n/N)^2$	0.0144	0.0016	0.0324	$\Sigma(n / N)^2 = 0.2622$	$1-(\Sigma(n / N)^2) = 0.7378$	3	ECF ECF ALLOW 0.26 or 0.262 ALLOW 0.74 or 0.738 Examiner's Comments (b)(i) was correctly answered by over 90% of the candidates. It required a straightforward substitution of figures into the formulae.
n / N															
0.12															
0.04															
0.18															
$(n/N)^2$															
0.0144															
0.0016															
0.0324															
$\Sigma(n / N)^2 = 0.2622$															
$1-(\Sigma(n / N)^2) = 0.7378$															
		ii	M AND greater value of, D / Simpson's Index of Diversity ✓	1	ECF (i.e. R AND lower value of, D / Simpson's Index of Diversity, if D calculated as < 0.54) ALLOW M AND 0.738 is greater than 0.54 Examiner's Comments (b)(ii) was also highly scoring.										
	b		fertiliser moves (from soil) into lake / stream / aquatic ecosystem ✓ algae bloom / rapid growth of algae ✓ plants (underneath), cannot photosynthesise / die ✓ bacteria / microorganisms, break down / decompose, dead matter ✓ bacteria / microorganisms consume all oxygen / decrease in oxygen concentration ✓ at least 1 from: (adult) dragonflies may not be able to lay eggs (because of lack of plants) ✓ eggs / nymph die from lack of oxygen ✓	max 3	Must link idea of eutrophication to interruption of dragonfly life cycle for 3 marks Examiner's Comments Most candidates scored at least 1 mark for (c). To gain all three marks, the candidates had to link the process of eutrophication to the survival of dragonflies. The most common misconception here was that the fertilisers were poisoning the dragonflies.										

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4	a		<i>idea that</i> number of 30 – 39 year olds is, significantly greater / AW, than decades either side; data quote in support;	2	Candidates must compare this decade with the decades either side for this mark. ACCEPT 'number is largest' or 'numbers peak' LOOK FOR numbers of males and numbers of females plus units males 4 million, females 4.1 million(+ 1– 0.2 million) Examiner's Comments The majority of candidates recognised that the number of 30 – 39 year olds was the largest group in this part and gave correct data quotes regarding males and females. Marks were lost in relevant answers for not giving suitable data. Some candidates missed out on the data quote by giving the total for males and females, or by comparing one gender with the other age ranges.
	b	i	the number of women of reproductive age / AW OR <i>idea of</i> number of fertile women in the population;	1	ACCEPT a reference to a specific fertile age to e.g.20 year olds, 20 – 30 year olds ACCEPT reference to number of women using contraception Examiner's Comments Very few candidates answered (i) correctly, the fertility rate of males being the most popular incorrect answer. Most candidates got two marks for (ii) showing a good understanding that people are living longer due to advances in medicine and health care. Lower infant mortality was also a fairly common answer, but little reference was made to improvements in agriculture. Increases were also attributed to immigration in a noticeable number of answers.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	<i>idea of</i> lower infant mortality; <i>idea of</i> longer life expectancy; <i>reason</i> improvements in health care / suitable example. (vaccination / antenatal care / antibiotics / surgery); improvements in food production / intensive farming; reference to immigration;	2	
	c	i	<i>idea of</i> immigration (of people this age);	1	Examiner's Comments Immigration was stated by the majority of candidates in answer to (i), the usual reason for lost marks was where candidates referred to emigration without specifying it was to the UK. Most answers in (ii) were based on an increase in 0 – 9 year olds explained by the fact that 20 – 29 year olds were at childbearing age and having children. A few referred to an older population group with the 20 – 29 year old group in a helping or caring capacity.
		ii	<i>effect</i> increase in number of children aged 0 – 9; <i>reason</i> 20 – 29 year olds are having children; OR <i>effect</i> increase in number of older people aged, 40 – 49 / 50 – 59 / 60–69 / 70 – 79; <i>reason</i> immigrants bring older family members with them OR immigrants / (20 – 29 year old) people, in health profession improving health of elderly people;	2	
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5			<i>idea that</i> rising population requires more, housing / buildings qualified OR less controversial than building on green field sites OR more likely to obtain planning permission; (losing land to building results in) loss of, biodiversity / species / habitat;AVP	2	Needs both the idea of increase in population and need for more housing CREDIT reasons such as 'cheaper' if this is qualified
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a		<i>idea that</i> (water vapour) does not accumulate / increase over time;	Max 1	IGNORE ref. to other greenhouse gases Examiner's Comments Apart from relatively few candidates who were aware that water vapour does not accumulate or increase over time, answers were too vague and based loosely on the fact water does not absorb or emit infrared radiation or that it has always been here and is not affected by man's activities.
	b	i	<i>idea that</i> it allows comparison between different gases;	1	CREDIT CO₂ sets a baseline for comparing other gases Examiner's Comments The idea that carbon dioxide equivalents allowed an easy comparison between different gases or that CO₂ sets a baseline for comparison was largely appreciated by the majority of candidates and most gained this marking point. Some candidates thought that eCO₂ was a real gas, rather than a measurement unit, and wrote about them being used in photosynthesis and being less harmful than other greenhouse gases
		ii	149;;	1	Max 1 for 298 / 2 OR 298 x 0.5 Examiner's Comments The majority of candidates correctly calculated the mass of carbon dioxide that is equivalent to 0.5kg of nitrous oxide.

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	c		(hydrofluorocarbons) have very high GWP; <i>idea that</i> small quantity of hydrofluorocarbons affect global warming to same degree as large quantity of other greenhouse gases; data quoted correctly in support;	Max 2	IGNORE high / -er / -est / large / -er / -est CREDIT idea that a small quantity of HFC can offset a large reduction in CO₂ production / emissions must be a comparison between GWP values Examiner's Comments There were some very good answers where many candidates had clearly linked the very high GWP value of hydrofluorocarbons to the fact that the release of a small quantity of it would offset a large reduction in CO₂ emissions. Although some candidates didn't make clear comparisons, stating that the GWP value of hydrofluorocarbons was higher than the others without emphasising that it had a very high value and simply quoting figures.
	d	i	carbon fixation / carbon dioxide combines with, ribulose biphosphate / RuBP; formation of, glycerophosphate / glycerate-3-phosphate / GP, from six carbon intermediate; formation of, triose phosphate / TP, from, glycerophosphate / GP, using ATP and reduced NADP; organic molecules formed from, triose phosphate / TP;	Max 3	ACCEPT NADPH ACCEPT named organic molecules (carbohydrates, lipids, aminoacids)

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		i		1	QWC awarded for correct use of three emboldened terms carbon fixation ribulose biphosphate glycerophosphate / glycerate 3- phosphate triose phosphate Examiner's Comments A lot of candidates gained two to four marks for (i) mainly for the combining of CO₂ with ribulose biphosphate and for the formation of organic molecules from triose phosphate. Marks gained for the intermediate stages varied. The marking point for the first stage which was the formation of glycerate-3-phosphate from a six carbon intermediate was gained by more candidates than for the second stage which was the formation of triose phosphate from glycerate-3-phosphate with the use of ATP and reduced NADPH. The QWC mark for this question was not obtained to the same extent as question 3 due to the misspelling of ribulose biphosphate and the fact that carbon fixation was rarely given in the answer.
		ii	(eCO₂) produced using, sugar beet / plants; renewable; fossil fuels not renewable;	Max 2	IGNORE recyclable / biodegradable Examiner's Comments A lot of candidates didn't link the greater efficiency of using eCO₂ to its production from a plant and that it was a renewable source compared to fossil fuels which weren't renewable in (ii). A lot of candidates gave vague refs to eCO₂ releasing less CO₂ to the atmosphere than burning fossil fuels.
			Total	12	

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7			bar chart drawn with equal width size bars, not touching (1) X axis labelled as "Crop" AND Y-axis labelled as "Total production / thousand tonnes per hectare" (1) equidistant vertical scale used so that plot area covers at least 50% of the y axis space (1) all data plotted accurately (1)	4	ALLOW +/- 1 mm
			Total	4	
8			D	1	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
9		i	loss of, (natural/original) biodiversity / species richness; planting/felling, in one go / not continuous; disruption to food chains/webs; prevents a climax community (from being reached); destruction of habitats; soil erosion;	2 max	ACCEPT prevent other species, growing (in conifer monoculture) ACCEPT pressure on, rare / endangered, species ACCEPT deflected succession, plagioclimax IGNORE disrupts / disturbs, habitats Examiner's Comments Candidates often failed to appreciate that a two mark question needs two answers. Most got at least one mark, usually for reduced biodiversity or the alternatives. Habitat destruction was also commonly seen, and by linking the two together, candidates could achieve both marks. Other acceptable answers such as disruption to food chains and soil erosion were more rarely seen.

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		ii	<i>social</i> amenity / recreation / (eco)tourism; educational benefit (to visitors / children); improve (mental) well-being; <i>aesthetic</i> landscape more attractive / AW (for local people / visitors); <i>ethical</i> (continuous management) better for local employment; duty of care for, habitat / environment / biodiversity / food webs /ecosystems;	4 max	<i>Mark as continuous prose</i> IGNORE commercial / economic reasons ACCEPT landscape aesthetically pleasing e.g. greater variety of species to look at / deciduous leaf changes / more flowers to see ACCEPT prevents soil erosion IGNORE vague refs to “playing God” / species have the right to live Examiner's Comments This was answered well by those candidates who had read the question carefully enough to give social, aesthetic and ethical reasons. The specification and textbooks give clear indications of mark-worthy responses for this type of question but many candidates still answered with a vague, though often lengthy, response, often focusing on biodiversity which was not creditworthy. Despite instructions to the contrary, economic benefits were also often mentioned which also gained no credit. Candidates who scored well on this question often got the idea of improving the aesthetic value of the woodland. Other common correct answers were improved recreational use - usually walkers, tourism, and bird watching. All other marking points were seen occasionally.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																																										
10		i	$\chi^2 = 10.48 / 10.480 / 10.5; ; ; ;$	4	<table border="1"> <thead> <tr> <th>Indicator species</th><th>E</th><th>O</th><th>O - E</th><th>(O - E)²</th><th>$\frac{(O - E)^2}{E}$</th></tr> </thead> <tbody> <tr> <td>Stonefly nymph</td><td>58</td><td>44</td><td>-14</td><td>196</td><td>3.38</td></tr> <tr> <td>Freshwater shrimp</td><td>33</td><td>43</td><td>10</td><td>100</td><td>3.03</td></tr> <tr> <td>Water louse</td><td>7</td><td>12</td><td>5</td><td>25</td><td>3.57</td></tr> <tr> <td>Sludge worm</td><td>2</td><td>1</td><td>-1</td><td>1</td><td>0.50</td></tr> <tr> <td></td><td></td><td></td><td>;</td><td>;</td><td>;</td></tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> Correct answer = 4 marks If answer is incorrect or missing then CREDIT correct working in table columns as follows: All figures in one column correct = 1 mark to 3 max DO NOT CREDIT column mark if minus signs on figs missing or incorrect IGNORE number of d.p.in table CREDIT fractions for last column ALLOW ecf from any incorrect column to the next and for χ^2. Examiner's Comments Most candidates gave the correct answer. Candidates usually gave their answer to 2dp although this was not a required marking point. The main problems were incorrect rounding and not knowing that squaring a negative produces a positive.	Indicator species	E	O	O - E	(O - E) ²	$\frac{(O - E)^2}{E}$	Stonefly nymph	58	44	-14	196	3.38	Freshwater shrimp	33	43	10	100	3.03	Water louse	7	12	5	25	3.57	Sludge worm	2	1	-1	1	0.50				;	;	;						
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Question			Answer/Indicative content	Marks	Guidance
		ii	calculated value / χ^2 / 10.48 / 10.5, is (much) larger than, critical value / 7.81; ORA <i>idea that</i> probability that these results are due to chance is (much) less than, 5% / 0.05; ORA conclusion is justified / result not due to chance / significant difference between observed and expected results (at the 0.05 level);	2	ALLOW ecf for a correct explanation that corresponds to the candidate's incorrect calculation for (a)(i) ACCEPT probability lies between, 5%/0.05, and 1%/0.01 confidence limits IGNORE ref to null hypothesis Examiner's Comments Most candidates correctly concluded that the biologist's conclusion 'could be supported'. However many chose the wrong critical value by using either the wrong degrees of freedom or using $p=0.01$ to find the critical value. Candidates generally knew they were deriving a probability, but were unclear about what exactly this meant. Many believed they were determining the probability of getting a bigger X^2 value. A few candidates did not understand the difference between the null hypothesis and the biologist's hypothesis/conclusion. They therefore correctly rejected the null hypothesis but also erroneously stated that the biologist's conclusion was false. It is helpful to give candidates opportunities to calculate chi-squared values for real-life examples where they will have a clear sense of whether the differences seen are due to chance or to some other reason. For example the colour distribution of sweets in a packet (equally distributed or not?) and woodlice distribution in a choice chamber (more woodlice in the dark and wet area?).
			Total	6	