

1. 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]

2(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.

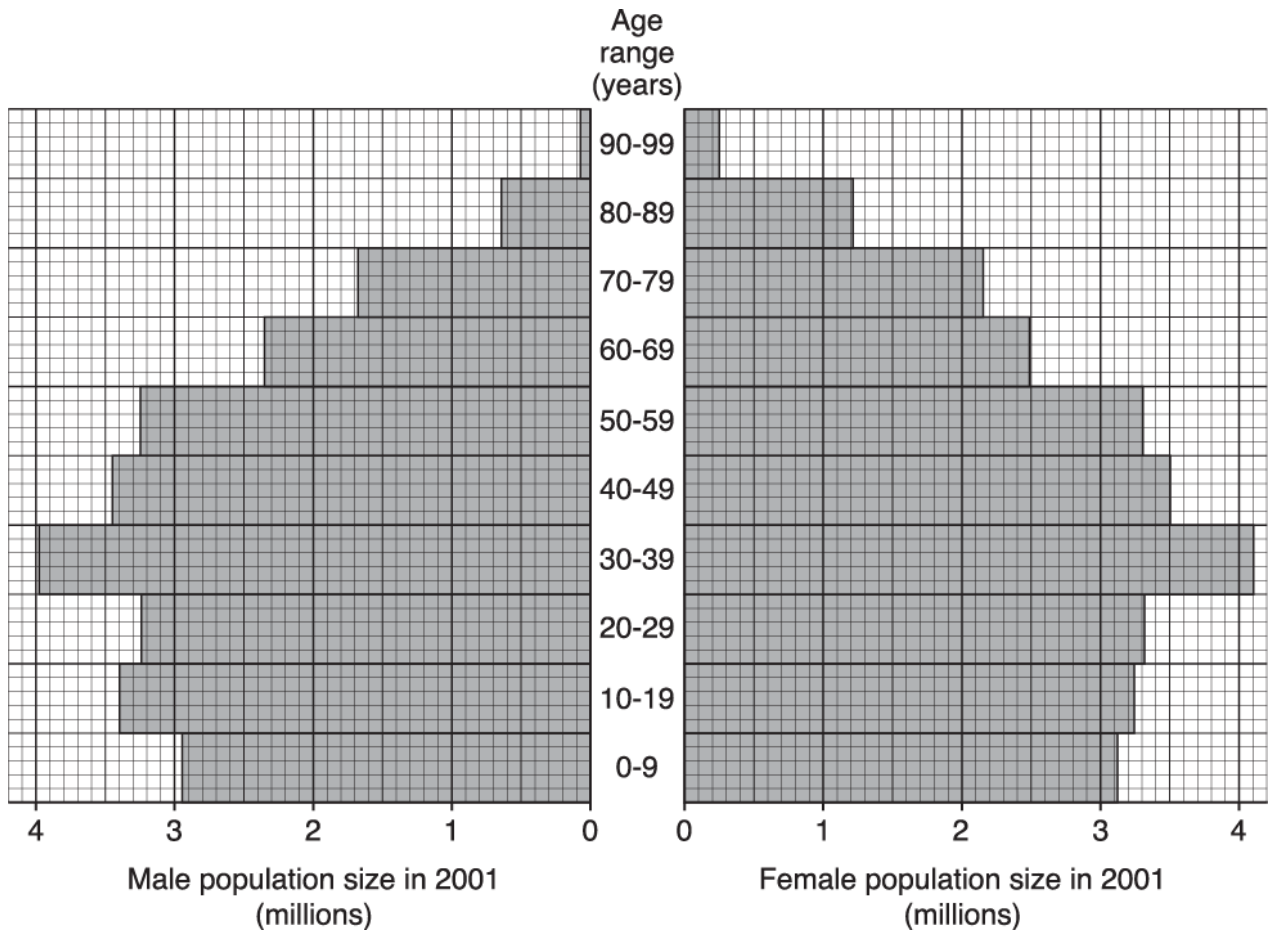


Fig. 5.1

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.

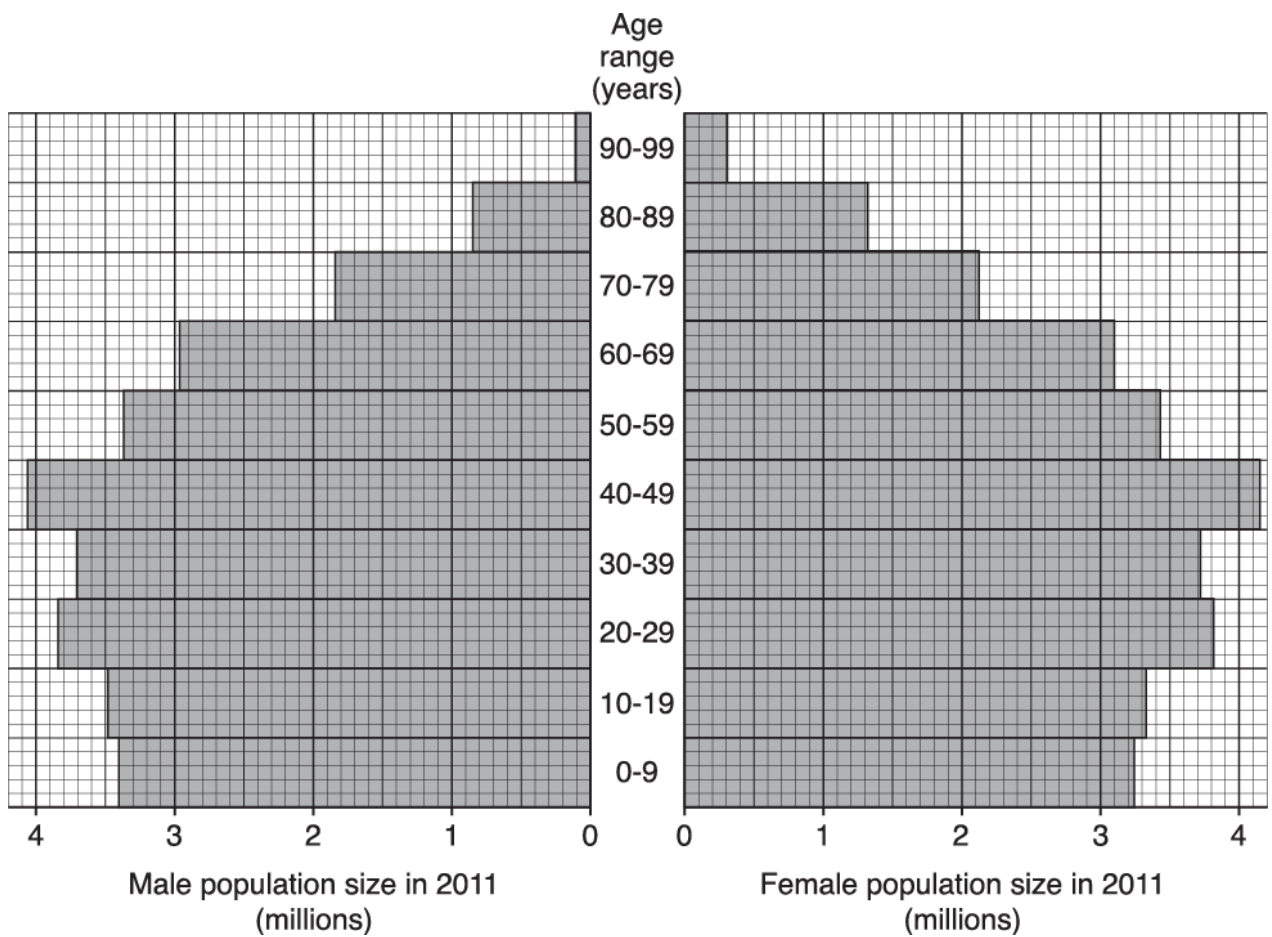


Fig. 5.2

- (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 -----

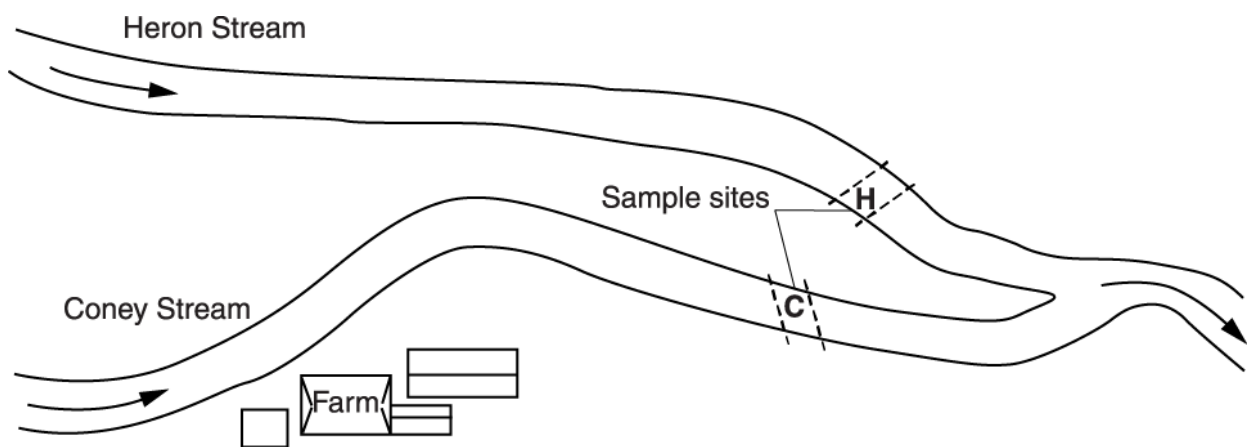
[2]

3. Biologists often judge how polluted an environment is by observing indicator species.

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]

4. 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

coniferous monoculture.

[4]

5. *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	n	n/N	$(n/N)^2$
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		
	$N =$		$\sum(n/N)^2 =$
			$1 - (\sum(n/N)^2) =$

Table 35

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

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

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]

6(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.

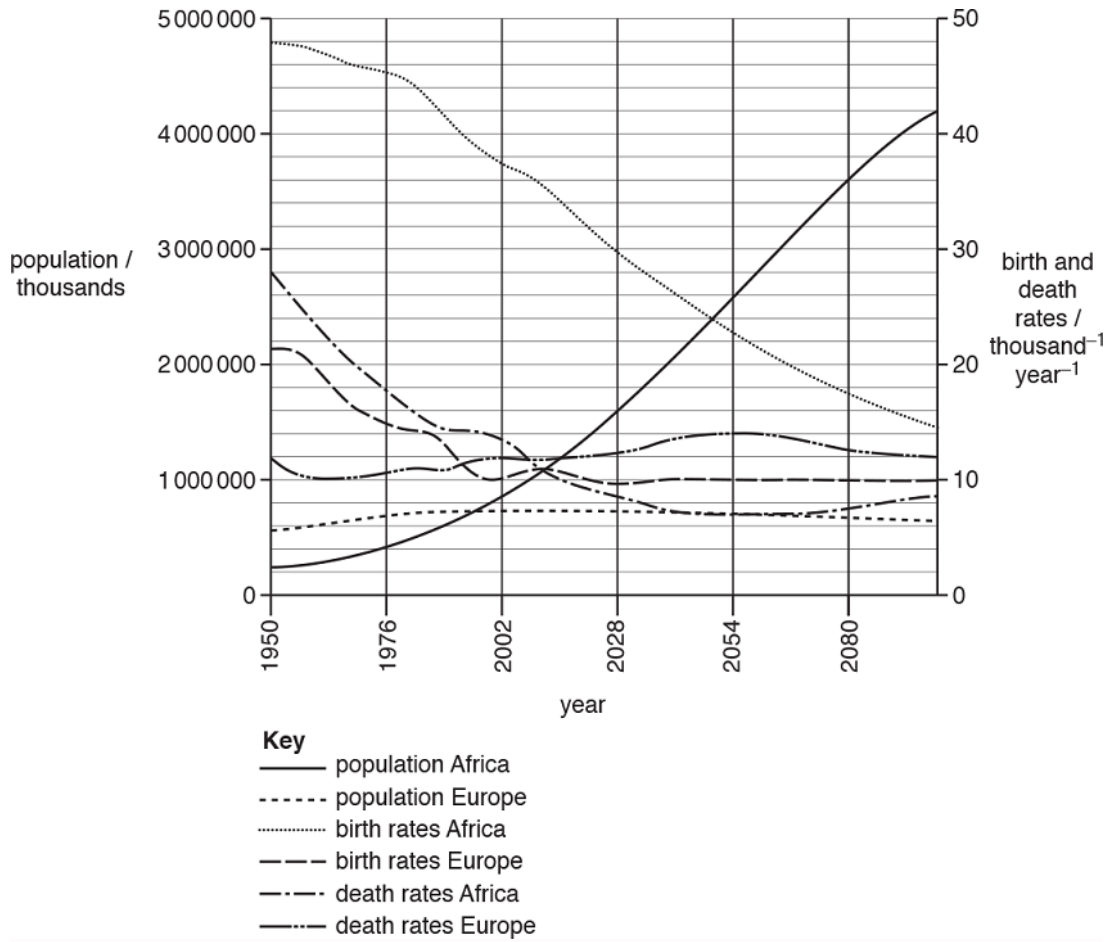


Fig. 5.1

(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.

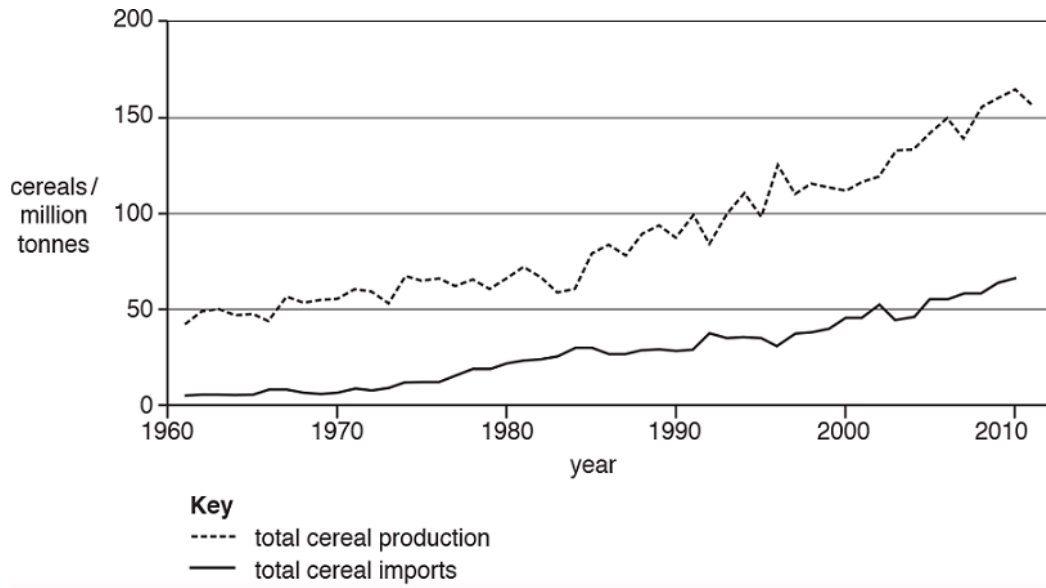


Fig. 5.2

(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]

END OF QUESTION PAPER

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
1		<p><i>idea that</i> rising population requires more, housing / buildings qualified</p> <p>OR</p> <p>less controversial than building on green field sites</p> <p>OR</p> <p>more likely to obtain planning permission;</p> <p>(losing land to building results in) loss of, biodiversity / species / habitat;AVP</p>	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	
2	a	<p><i>idea that</i> number of 30 – 39 year olds is, significantly greater / AW, than decades either side;</p> <p>data quote in support;</p>	2	<p>Candidates must compare this decade with the decades either side for this mark. ACCEPT 'number is largest' or 'numbers peak'</p> <p>LOOK FOR numbers of males and numbers of females plus units males 4 million, females 4.1 million(+ 1– 0.2 million)</p> <p>Examiner's Comments</p> <p>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.</p>

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	<p>the number of women of reproductive age / AW</p> <p>OR</p> <p><i>idea of</i> number of fertile women in the population;</p>	1	<p>ACCEPT a reference to a specific fertile age to e.g.20 year olds, 20 – 30 year olds</p> <p>ACCEPT reference to number of women using contraception</p> <p>Examiner's Comments</p> <p>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.</p>
		ii	<p><i>idea of</i> lower infant mortality;</p> <p><i>idea of</i> longer life expectancy;</p> <p><i>reason</i></p> <p>improvements in health care / suitable example. (vaccination / antenatal care / antibiotics / surgery);</p> <p>improvements in food production / intensive farming;</p> <p>reference to immigration;</p>	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c	i	<i>idea of immigration (of people this age);</i>	1	<p>Examiner's Comments</p> <p>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.</p>
		ii	<p><i>effect</i> increase in number of children aged 0 – 9; <i>reason</i> 20 – 29 year olds are having children;</p> <p>OR</p> <p><i>effect</i> increase in number of older people aged, 40 – 49 / 50 – 59 / 60–69 / 70 – 79;</p> <p><i>reason</i> immigrants bring older family members with them</p> <p>OR immigrants / (20 – 29 year old) people, in health profession improving health of elderly people;</p>	2	
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																																				
3		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> </tbody> </table> <p>Correct answer = 4 marks</p> <p>If answer is incorrect or missing then CREDIT correct working in table columns as follows:</p> <p>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.</p> <p>Examiner's Comments</p> <p>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.</p>	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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Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	ii	<p>calculated value / χ^2 / 10.48 / 10.5, is (much) larger than, critical value / 7.81; ORA</p> <p><i>idea that</i> probability that these results are due to chance is (much) less than, 5% / 0.05; ORA</p> <p>conclusion is justified / result not due to chance / significant difference between observed and expected results (at the 0.05 level);</p>	2	<p>ALLOW ecf for a correct explanation that corresponds to the candidate's incorrect calculation for (a)(i)</p> <p>ACCEPT probability lies between, 5%/0.05, and 1%/0.01 confidence limits</p> <p>IGNORE ref to null hypothesis</p> <p>Examiner's Comments</p> <p>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?).</p>
		Total	6	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
4	i	<p>loss of, (natural/original) biodiversity / species richness;</p> <p>planting/felling, in one go / not continuous; disruption to food chains/webs; prevents a climax community (from being reached);</p> <p>destruction of habitats;</p> <p>soil erosion;</p>	2 max	<p>ACCEPT prevent other species, growing (in conifer monoculture)</p> <p>ACCEPT pressure on, rare / endangered, species</p> <p>ACCEPT deflected succession, plagioclimax</p> <p>IGNORE disrupts / disturbs, habitats</p> <p>Examiner's Comments</p> <p>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.</p>

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	ii	<p><i>social</i> amenity / recreation / (eco)tourism; educational benefit (to visitors / children); improve (mental) well-being;</p> <p><i>aesthetic</i> landscape more attractive / AW (for local people / visitors);</p> <p><i>ethical</i> (continuous management) better for local employment; duty of care for, habitat / environment / biodiversity / food webs /ecosystems;</p>	4 max	<p><i>Mark as continuous proso</i> IGNORE commercial / economic reasons</p> <p>ACCEPT landscape aesthetically pleasing e.g. greater variety of species to look at / deciduous leaf changes / more flowers to see</p> <p>ACCEPT prevents soil erosion IGNORE vague refs to “playing God” / species have the right to live</p> <p>Examiner's Comments</p> <p>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.</p>
		Total	6	

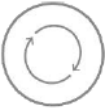
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance										
5		i	<p>$N = 100$ AND</p> <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> <p>✓</p> <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> <p>✓</p> <table border="1"> <tr><td>$\sum(n / N)^2 = 0.2622$</td></tr> <tr><td>$1 - (\sum(n / N)^2) = 0.7378$</td></tr> </table> <p>✓</p>	n / N	0.12	0.04	0.18	$(n/N)^2$	0.0144	0.0016	0.0324	$\sum(n / N)^2 = 0.2622$	$1 - (\sum(n / N)^2) = 0.7378$	3	<p>ECF</p> <p>ECF</p> <p>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.</p>
n / N															
0.12															
0.04															
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$(n/N)^2$															
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$\sum(n / N)^2 = 0.2622$															
$1 - (\sum(n / N)^2) = 0.7378$															
		ii	<p>M AND greater value of, D / Simpson's Index of Diversity ✓</p>	1	<p>ECF (i.e. R AND lower value of, D / Simpson's Index of Diversity, if D calculated as < 0.54)</p> <p>ALLOW M AND 0.738 is greater than 0.54 Examiner's Comments (b)(ii) was also highly scoring.</p>										
Total				4											

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a	i	allows comparison between (areas with) different population sizes ✓	1	<p>ALLOW can compare as population size doesn't have to be taken into account</p> <p>Examiner's Comments</p> <p>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.</p>
		ii	<p>(population increase) 2 100 000 ✓</p> <p>(divided by 52 years =) 40 385 thousand year⁻¹ ✓</p> <p>= 4.0×10^4 (thousand year⁻¹) ✓</p>	3	<p>ALLOW figure in the range 1 900 000 – 2 200 000</p> <p>ECF any value divided by 52</p> <p>ECF value from previous mark in standard form and 1 dp</p> <p>Examiner's Comments</p> <p>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.</p>

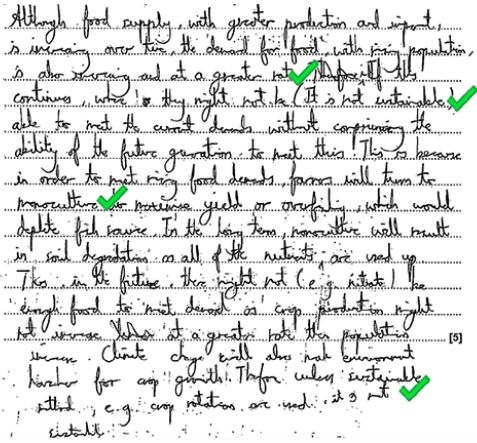
Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
iii	<p><i>population in Africa increase because</i></p> <p>more births than deaths ✓</p> <p>birth rate (always) higher in Africa compared to Europe ✓</p> <p><i>population in Europe decreases because</i></p> <p>more deaths than births ✓</p> <p>death rate (now) higher in Europe compared to Africa ✓</p>	3 max	<p><u>Examiner's Comments</u></p> <p>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.</p>  <p>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.</p>
b i	<p>(cereals endosperm is), rich in starch / a good source of carbohydrate ✓</p> <p>(endosperm from some) cereals be used to make bread ✓</p> <p>cereals can grow in hot climates ✓</p>	2max	<p><u>Examiner's Comments</u></p> <p>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.</p>

Mark Scheme

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

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
			<p>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.</p> <p>Exemplar 3</p>  <p>The 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.</p>
	Total	16	