1(a). Limpets are molluscs that are found on rocky shores.

Limpet

A student wants to find out if there is a different population of limpets on different parts of the shore.

Describe a method that the student could use to find out which parts of the rocky shore have more limpets.

--[3]

(b). The students counted the number of limpets found on three parts of the rocky shore. The results are shown in the table below.

Part of shore	Number of limpets			Mean
	Test A	Test B	Test C	
Low shore (closest to sea)	15	16	17	
Mid shore	45	47	49	
High shore (furthest away from sea)	2	1	8	

(i) The students think one of the results is an outlier.

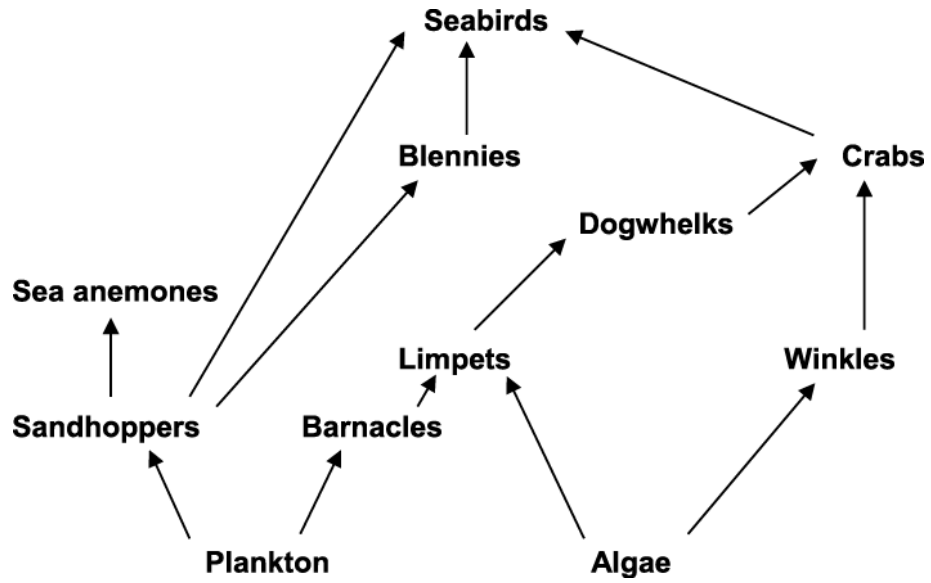Circle the outlier in the table above.

[1]

(ii) Calculate the mean number of limpets found on the mid shore.

Show your working.

Number =

_____ [2]

(c). This is a food web for the species that can live on a rocky shore.

Explain the impact of an increase in the number of **dogwhelks** on one species in this food web.

_____

_____

_____ **[2]**

(d). In some areas of the UK, dogwhelk numbers are decreasing. This reduces biodiversity.

Give **two** benefits of maintaining biodiversity.

1 _____

_____

2 _____

_____

[2]

(e). Sea anemones can reproduce asexually.

Give **one** advantage and **one** disadvantage of this method of reproduction.

Advantage ---

Disadvantage ---

----

[2]

(f).

(i) Sea anemones are mainly found in rock pools.

During the summer the water temperature in a rock pool can increase to a level which can be dangerous for a sea anemone.

Put a tick (✔) in the box that best explains why a temperature increase is a problem.

Enzyme catalysed reactions will speed up. ☐

Enzyme catalysed reactions will slow down. ☐

Enzymes will be killed. ☐

Enzymes will become denatured. ☐

[1]

(ii) When it rains, the concentration of the sea water in a rock pool decreases.

What effect will this change in concentration have on a sea anemone's cells?

Put a tick (✔) in the box next to the correct answer.

Some cells may burst. ☐

Some cells may shrink. ☐

There will be no change to the cells. ☐

Some cells will burst, others will shrink. ☐

[1]

2.   The Neanderthal species is now extinct.

Explain what could have caused the Neanderthals to become extinct.

The quality of written communication will be assessed in your answer.

--- **[6]**

3(a). A supermarket is considering how they can make their shopping bags more sustainable.

What is meant by sustainability?

---[2]

(b). What factors need to be considered when making shopping bags in a sustainable way?

Put ticks (✔) in the boxes next to the **three** best answers.

The size and shape of the bag. ☐

The cost of making the bag. ☐

The materials used to make the bag. ☐

The colour of the bag. ☐

The energy used to make the bag. ☐

The pollution created when the bag is made. ☐

[2]

(c). Biodegradable bags are more sustainable than standard plastic bags.

It is still better to reduce the use of biodegradable bags.

Which statement best explains why?

Put a tick (✔) in the box next to the best answer.

Biodegradable bags need energy to be transported to the shops. ☐

Biodegradable bags don't look as good as standard plastic bags. ☐

Biodegradable bags need oxygen to break down. ☐

Biodegradable bags are not expensive to make. ☐

[1]

4(a). Species that no longer exist are said to be extinct.

The graph shows the estimated total number of extinctions worldwide since 1800.
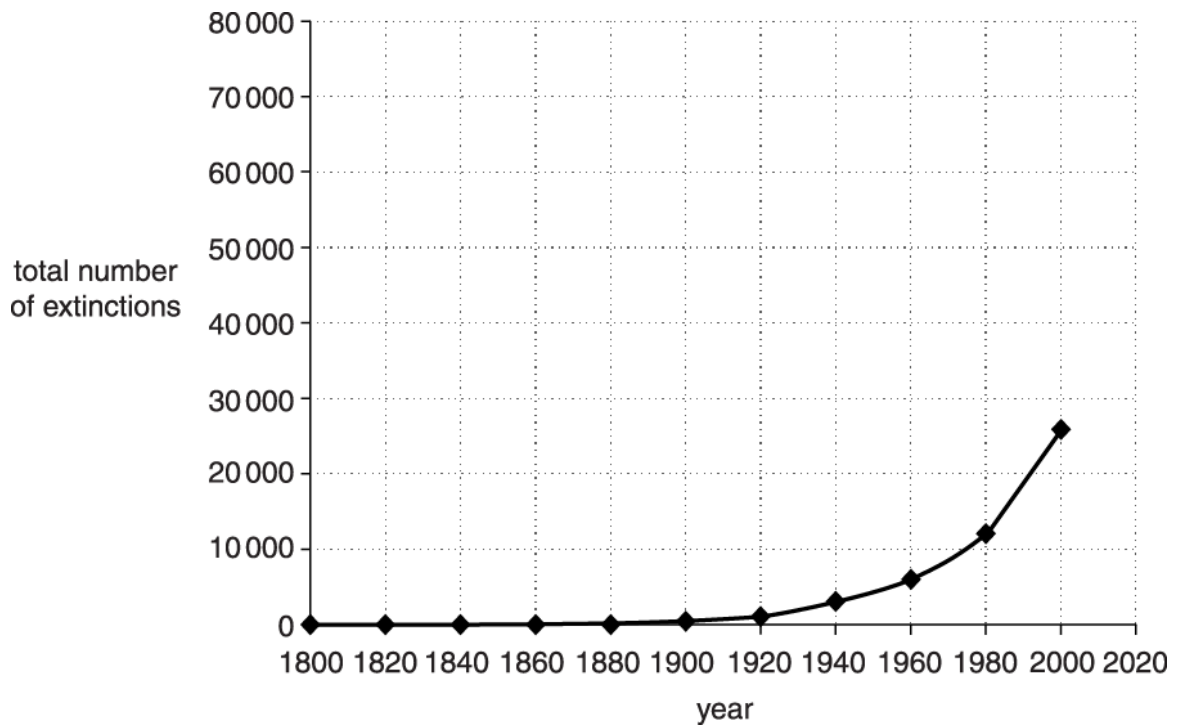
(i) The graph suggests that very few, if any, species became extinct between 1800 and 1900.

Which of the statements are the most likely reasons for this?

Put ticks (✔) in the boxes next to the **two** most likely answers.

Between 1800 and 1900 …

… there were fewer species so there were fewer to become extinct.

… human activity was less damaging to plants and animals.

… humans were eating all the plants and animals.

… life on Earth began.

… there is not much evidence written down about the plants and animals.

[2]

    (ii) Continue the line on the graph to predict how many species are likely to have become extinct by 2020.

number of extinct species by 2020 = _ **[1]**

   (iii) Describe the trend shown on the graph after 1900 and give a possible explanation for this.

--**[1]**

(b). Scientists work hard to prevent species becoming extinct.

 (i) Suggest **one** way in which scientists can help to prevent species becoming extinct.

--**[1]**

  (ii) Suggest why preventing extinctions is an important part of using the environment in a sustainable way.

--**[2]**

5(a). People with haemophilia lack the gene to make the protein Factor 8 (Factor VIII).
As a result their blood cannot clot if they cut themselves.

Suggest how the process of genetic modification could be carried out to treat people with haemophilia.

The quality of written communication will be assessed in your answer.

-- **[6]**

(b). One example of genetic modification is the production of golden rice.
Golden rice has a gene inserted that produces vitamin A.
White rice does not contain vitamin A.
Countries with people who eat mainly white rice have high levels of blindness due to a lack of vitamin A.

Suggest why people in these countries may be more in favour of the genetic modification of organisms than people who live in the United Kingdom.

-- **[2]**

(c). This question is about genetic modification.

There are many examples of genetic modification.
Which of the following can be achieved by genetic modification?
Put ticks (✓) in the boxes next to the **two** correct answers.

sexual reproduction in plants	☐
bacterial synthesis of medicines	☐
testing for genetic disorders	☐
selective breeding	☐
asexual reproduction in animals	☐
herbicide resistance in crop plants	☐

[2]

6(a). It is very important that the use of natural resources by humans is sustainable.

What is meant by the sustainable use of natural resources?
Put a tick (?) in the box next to the correct description.

Resources are not taken from the environment. ☐

Resources are used faster than they are replaced. ☐

Resources are only used if they are urgently needed. ☐

Resources are used at the rate at which they are replaced. ☐

Resources are looked for in new areas. ☐

[1]

(b). Suggest **two** ways that North Sea fish stocks could be managed in a sustainable way.

---[2]

(c). Tensions sometimes exist between conserving a natural ecosystem and the needs of local people.
Suggest why this tension may exist.

---[1]

7(a). Sunita studies biodiversity in four different habitats, **A**, **B**, **C** and **D**.

She measures the number of different species and the relative size of the population of the most common species in each habitat.

These are her results.

	Habitat **A**	Habitat **B**	Habitat **C**	Habitat **D**
number of different species	20	106	10	255
relative size of populations	large	medium	small	large

(i) Which habitat, **A**, **B**, **C** or **D** shows the greatest biodiversity?

Explain your answer.

_____

_____ [2]

(ii) Look at the following table of data.

Habitat	Features
part of a desert	medium number of species, but small populations
part of the Antarctic	large populations, but a small number of species
part of a tropical rain forest	large populations and a large number of species
part of a woodland	medium population size and medium number of species

Which habitat, **A**, **B**, **C** or **D**, is likely to be part of Antarctica?

_____ [1]

(iii) Describe **one** criteria other than number of species or population size that Sunita could use to measure biodiversity.

_____ [1]

(b). Which of the following are good examples of why biodiversity should be maintained?

Put ticks (?) in the boxes next to the **three** correct answers.

The ultimate source of energy for food webs is the Sun. ☐

A new antibiotic is discovered in a rare species of plant. ☐

A gene is identified that could make crops grow in a drier climate. ☐

Classification is used to make it easier to identify different organisms. ☐

Mutations are required for the development of a new species. ☐

Evidence for evolution comes from the fossil record and from DNA. ☐

Darwin's theory of natural selection. ☐

All living organisms are dependent on other organisms for their survival. ☐

[3]

(c). Human activity can have an unintended direct impact on the environment.

Describe **one** example.

---[1]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		**Any three from** Use a line transect **AND** quadrat ✔ Running from the sea up the shore ✔ To take many samples ✔ Repeat at different parts of the shore ✔	3	
	b	i	8 ✔	1	
		ii	**FIRST CHECK THE ANSWER ON THE ANSWER LINE IF** answer = 47 award 2 marks (45 + 47 + 49) / 3 ✔ 47 ✔	2	
	c		limpets will decrease in numbers ✔ as more are eaten ✔ **OR** crabs will increase ✔ as more food ✔	2	**ALLOW** any correct species with correct explanation
	d		**Any two from** idea of interdependence ✔ example of interdependence e.g. food / shelter / reproduction ✔ maintaining genetic diversity ✔ may be required in the future for medicines ✔ maintains the stability of the food web ✔	2	
	e		Advantage: (can be) fast / no need to find a mate ✔ Disadvantage: lack of genetic diversity / are all genetically identical ✔	2	MP2 **ALLOW** are clones **DO NOT ALLOW** are all identical
	f	i	✔ Enzymes will become denatured	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked
		ii	✔ Some cells may burst	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked
			Total	14	

Question	Answer/Indicative content	Marks	Guidance
2	**[Level 3]** Answer includes causes AND explanations including a level 3 adaptation explanation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Answer includes several causes and a level 2 explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Answer includes only causes OR explanations. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points may include: **Causes** *environmental conditions:* • environmental conditions changed / natural disaster • example of environmental change (e.g. change in temperature) • example of consequences of environmental change (e.g. different vegetation, affecting diet) • idea that the change was long-term (i.e. not just seasonal / temporary) *introduction of:* • a new competitor of the Neanderthals / example • a new predator of the Neanderthals / example • a new pathogen / disease / example **accept** increase in number of competitors / predators / pathogens *disappearance of another species:* • another species disappeared / died out / declined • idea that the Neanderthals ate / depended upon this species **Explanations:** Level 1/2 • the Neanderthals could not reproduce (successfully) • not enough food • conditions too cold / too hot for them Level 3

Question			Answer/Indicative content	Marks	Guidance
					• the Neanderthals were not well **adapted** to the new conditions • the Neanderthals (species) did not **adapt** quickly enough **ignore** 'suited' for adapted **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** **Examiner's Comments** It was encouraging to see very detailed descriptions about the possible causes of extinction of the Neanderthals.
			Total	6	
3	a		meeting the needs of the people today (1) without damaging the Earth for future generations (1)	2	<u>Examiner's Comments</u> The best responses could define sustainability clearly and succinctly.
	b		<table><tr><td>The size and shape of the bag.</td><td></td></tr><tr><td>The cost of making the bag</td><td></td></tr><tr><td>The materials used to make the bag.</td><td>✓</td></tr><tr><td>The colour of the bag.</td><td></td></tr><tr><td>The energy used to make the bag.</td><td>✓</td></tr><tr><td>The pollution created when the bag is made.</td><td>✓</td></tr></table>	2	all 3 correct = two marks 2 correct = one mark More than 3 boxes ticked, negate 1 mark for each additional tick. <u>Examiner's Comments</u> Most candidates could give the three best factors which need consideration when producing shopping bags sustainably.
	c		<table><tr><td>Biodegradable bags need energy to be transported to the shops.</td><td>✓</td></tr><tr><td>Biodegradable bags don't look as good as standard plastic bags.</td><td></td></tr><tr><td>Biodegradable bags need oxygen to break down.</td><td></td></tr><tr><td>Biodegradable bags are not expensive to make.</td><td></td></tr></table>	1	If more than 1 box is ticked, no mark awarded. <u>Examiner's Comments</u> Many Candidates were not secure in selecting the best explanation for why we should reduce the use of biodegradable bags.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
4	a	i		......there were fewer species so there were fewer to become extinct.		2	deduct 1 mark for each additional incorrect answer
				......human activity was less damaging to plants and animals.	✓		**Examiner's Comments**
				......humans were eating all the plants and animals.			Most candidates were able to give the 2 correct responses required.
				......life on Earth began.			
				......there is not much evidence written down about the plants and animals.	✓		
		ii	40000 and above		1	**Examiner's Comments** It was encouraging to see that most candidates could interpret the graph correctly.
		iii	extinctions are (rapidly) increasing (exponentially) **and** are due to human activities / increasing human population		1	allow positive correlation for the trend For second half allow examples of human activity, e.g. pollution, deforestation, habitat destruction, industrialisation **Examiner's Comments** The best responses were able to describe the correct tend and explain it in relation to human activities.
	b	i	captive breeding programmes / protected areas / tracking animals / seed or gene banks / zoos / cloning		1	allow prevent introduction of new species into environment / elimination of alien species **Examiner's Comments** Most candidates were able to identify a relevant method to prevent extinction of species.
		ii	**Any 2 from:** maintains (bio) diversity / food webs or chains / maintains ecosystems (1) provide us with valuable resources (1) (we need to try to conserve these species) so that the resources are there for future generations (1)		2	Ignore references to crops **Examiner's Comments** The best responses were able to produce two reasons why preventing extinctions is important to the environment.

Question			Answer/Indicative content	Marks	Guidance
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
5	a		**Level 3 (5–6 marks)** Includes reference to **getting** the gene AND **transferring** the gene AND **expressing** the gene. Quality of written communication does not impede communication of science at this level. **Level 2 (3–4 marks)** Includes reference to **getting** the gene AND **transferring** the gene OR **getting** the gene AND **expressing** the gene. OR **transferring** the gene AND **expressing** the gene. Quality of written communication partly impedes the communication of science at this level. **Level 1 (1–2 marks)** Includes reference to **getting** the gene OR **transferring** the gene OR **expressing** the gene. Quality of written communication impedes the communication of science at this level. **Level 0** Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted at grades D to C Relevant points include: **Getting the gene** - identify gene - isolate gene - replicate gene **Transferring the gene** - put gene into vector - example of vector eg virus, aerosol / plasmid / phage - explanation of how insertion occurs **Expressing the gene** - idea that DNA is common in all organisms *in humans* - transferred gene makes Factor 8 *in bacteria* - transferred gene makes Factor 8 - bacteria reproduce - isolate / purify F8 / give people F8 - If they inject bacteria into human, then max L2 Use the L1, L2, L3 annotations in Scoris; do not use ticks. **Examiner's Comments** This six-mark extended-writing question was common with the Foundation Tier.. Examiners were looking for how the gene was obtained, how the gene was transferred and how the gene was expressed. Some candidates went down the route of transferring the gene to a viral vector that could administer the gene to a

Question			Answer/Indicative content	Marks	Guidance
					human being, others went down the route of transferring the gene to a bacterium that could copy and express the gene such that factor 8 could be isolated and injected into a human being. Both types of answers were credit worthy. However those candidates that confused and mixed up both routes were restricted to Level 2 marks by the Examiners.
	b		idea of need or benefit (1) relevant comparison to UK (1)	2	**Examiner's Comments** Candidates needed to give both points of view to gain the two marks for this question. Good answers referred to countries with high levels of blindness being more inclined to accept the genetically engineered rice, whereas, in the UK we had alternative sources of vitamin A and would be more likely to be concerned with the ethics and dangers of genetically modified food.
	c		sexual reproduction in plants ☐ bacterial synthesis of medicines ✓ testing for genetic disorders ☐ selective breeding ☐ asexual reproduction in animals ☐ herbicide resistance in crop plants ✓	2	3 ticks = 1 mark max. 4 or more ticks = 0 marks **Examiner's Comments** Most candidates scored at least one of the two marks available for this question. Incorrect answers were randomly distributed across the remaining distractors. Candidates who gave an additional incorrect response were restricted to one mark.
			Total	10	

Question			Answer/Indicative content	Marks	Guidance
6	a		Resources are not taken from the environment. ☐ Resources are used faster than they are replaced. ☐ Resources are only used if they are urgently needed. ☐ Resources are used at a rate at which they are replaced. ✓ Resources are looked for in new areas. ☐	1	2 or more ticks = 0 marks **Examiner's Comments** This question was extremely well answered with almost all candidates being awarded the single mark.
	b		**any two from:** *idea of restrictions on:* number of fish taken / idea of quotas; size / age / species taken; fishing at certain times / at certain places	2	**ignore** fish farming **ignore** reference to need **accept** bans **Examiner's Comments** Most candidates scored at least one mark on this question. Credit was given for the idea of restrictions on the number of fish taken, the size, age or species of fish taken, or restricting fishing at certain times or places. References to fish breeding were not credited.
	c		idea that local people need the resources	1	**ignore** want **Examiner's Comments** Most candidates were awarded this mark for the idea that local people needed certain resources from the environment to survive.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
7	a	i	**D**; has both largest population **and** greatest number of different species	2	mark as independent points **Examiner's Comments** Most candidates recognised Habitat D as having the greatest diversity but related this only to the number of species and not the size of the populations.
		ii	**A**	1	**Examiner's Comments** This was generally well answered.
		iii	genetic variation / variation within a species	1	**accept** DNA differences **Examiner's Comments** That genetic variation plays a role in biodiversity was only known by a few of the best candidates.
	b		<table><tr><td>The ultimate source of energy for food webs is the Sun.</td><td></td></tr><tr><td>A new antibiotic is discovered in a rare species of plant.</td><td>✓</td></tr><tr><td>A gene is identified that could make crops grow in a drier climate.</td><td>✓</td></tr><tr><td>Classification is used to make it easier to identify different organisms.</td><td></td></tr><tr><td>Mutations are required for the development of a new species.</td><td></td></tr><tr><td>Evidence for evolution comes from the fossil record and from DNA.</td><td></td></tr><tr><td>Darwin's theory of natural selection.</td><td></td></tr><tr><td>All living organisms are dependent on other organisms for their survival.</td><td>✓</td></tr></table>	3	**Examiner's Comments** The majority of candidates knew that "all living things are dependent on other organisms for their survival" and most also correctly identified that finding new antibiotics or new useful genes may depend on maintaining biodiversity and so scored two or three marks.

Question			Answer/Indicative content	Marks	Guidance
	c		any correct example but must include **cause** and linked **effect**	1	Eg deforestation causes habitat destruction; burning fossil fuels leads to global warming

ignore unqualified reference to "pollution"

Examiner's Comments

There were many good answers often describing deforestation or monoculture and how they destroy habitats and reduce biodiversity. Weaker candidates tended to give only an example of human activity without explaining its consequences. |
| | | | Total | 8 | |