

BIOLOGY



EXAM QUESTION PACK

B6.2 FEEDING THE HUMAN RACE

SCORE

/111

PERCENTAGE

%

STEMUP

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Gateway Biology A (9-1)

Feeding the human race

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 111.
- The total number of marks may take into account some 'either/or' question choices.

1 Which of these statements is an example of sustainability?

- A Harvesting selected trees from a forest and replanting.
- B Replacing forests with food crops.
- C Taking fish from the sea faster than they can reproduce.
- D Using crude oil to make plastics.

Your answer

[1]

2(a) In many countries people rely on bananas for food.

Black sigatoka is a disease of banana plants.

It is caused by a fungus.

The food security of bananas could be improved using different methods.

Draw a straight line to join each **method** to a step that it **involves**.

method	involves
biological control	putting a gene for resistance into banana plants
	growing bananas in a greenhouse
genetic engineering	choosing resistant banana plants to use for reproduction
	using hydroponics
selective breeding	introducing a virus that kills black sigatoka fungus

[3]

(b) A type of pesticide called fungicide can be used to kill the fungus.

Scientists are investigating how well the fungicide works.

They also want to see if it works better if they add a chemical called a sticking agent.

This helps the fungicide stick to the banana leaves.

The scientists grow banana plants in four blocks.

The table shows the treatments each block is given.

	treatment	
block	fungicide	sticking agent
A	✓	✓
B	✓	X
C	X	✓
D	X	X

(i) Why did the scientists include the treatments given to block C and block D?

Block C was used so the scientists could

Block D was used so the scientists could

[2]

(ii) After a few months the scientists gave the plants in each area a disease rating.

The higher the rating the more disease present.

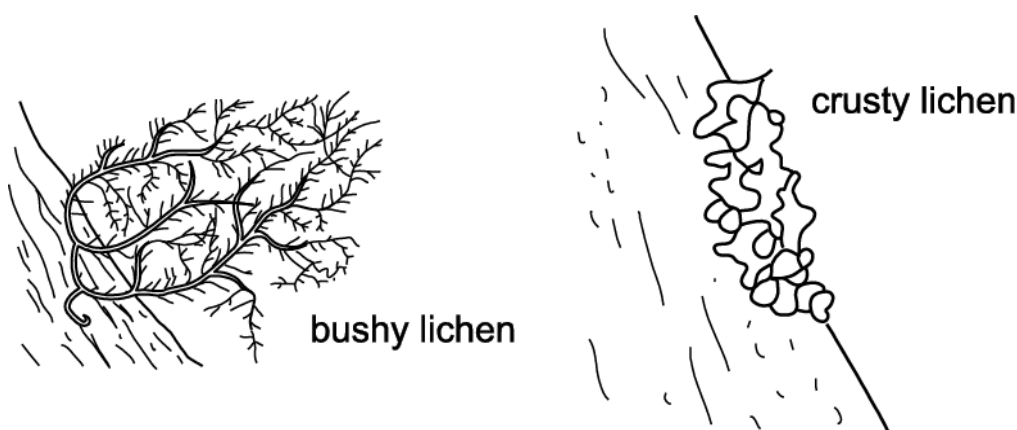
block	disease rating
A	20
B	35
C	45
D	60

What conclusions could the scientists make from this study?

[3]

- 3 Lichens are sensitive to pollution because they take up chemicals from the air.

The diagram shows a 'bushy' species of lichen and a 'crusty' species of lichen.



Bushy lichens are usually more sensitive to pollution than crusty lichens.

Students decide to use lichens to try and work out how polluted their school grounds are.

They read about a scale called the Lichen Diversity Value (LDV).

It is worked out in this way:

- choose four trees in the area
- hold a quadrat on the north side of the trunk of one tree
- count the total number of all the lichens in the quadrat
- then do this on the east, south and west side of the tree
- repeat this for each tree.

- (i) Suggest how the students could choose four trees.

(ii) The students put their results into a table.

	Number of individual lichens found in each quadrat			
Tree number	North	East	South	West
1	3	11	18	7
2	4	12	17	8
3	5	10	15	12
4	4	15	12	9
mean	4.0	12.0	15.5	

The LDV is found by adding together the four mean values.

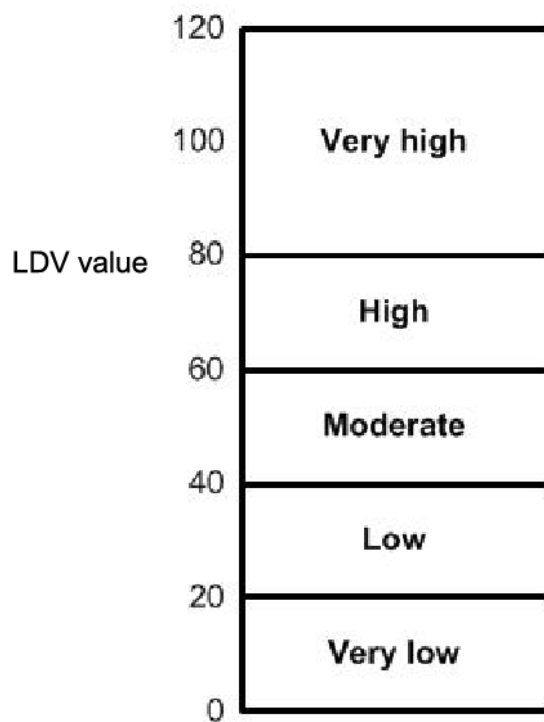
The students calculate the mean number of lichens on the north, east and south sides of the trees.

Calculate the mean for the west side and use this to calculate the LDV.

LDV = _____

[2]

(iii) This scale shows the type of diversity shown by the LDV.



What does the LDV show about the amount of diversity in the school grounds?

----- [2]

(iv) LDV is calculated by counting all the lichens present.

What else about the lichens could the students look for to make a better assessment of pollution?

----- [3]

4 Bacteria are used in genetic engineering.

A plasmid is used to transfer the required DNA into the bacterium.

What is the term used to describe role of the plasmid in this technology?

- A enzyme
- B host
- C transgenic
- D vector

Your answer

[1]

5 Some plants have been genetically engineered so that they grow larger.

Each cell of the plant has a new gene inserted so that it produces a different protein.

What does genetic engineering do to the plant?

- A It changes the phenotype and the genotype.
- B It changes the genotype but not the phenotype.
- C It changes the phenotype but not the genotype.
- D It changes neither the genotype nor the phenotype.

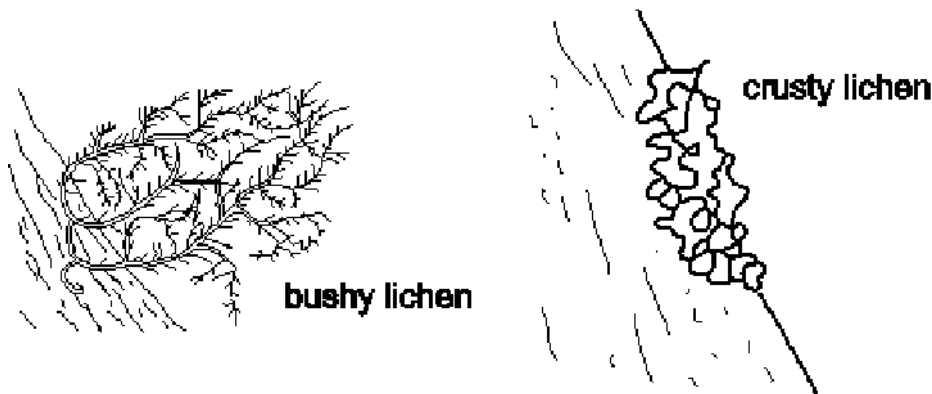
Your answer

[1]

6 Some students are investigating lichens.

Lichens are often studied because they are sensitive to pollution.

Lichens are sensitive to pollution because they take up chemicals from the air.



Students decide to use lichens to try and work out how polluted their school grounds are.

They read about a scale called the Lichen Diversity Value (LDV).

It is worked out in this way:

- choose four trees in the area
- hold a quadrat on the north side of the trunk of one tree
- count the total number of all the lichens in the quadrat
- then do this on the east, south and west side of the tree.
- repeat this for each tree.

(i) Suggest how the students could choose four trees.

[1]

(ii) The students put their results into a table.

	Number of individual lichens found in each quadrat			
Tree number	North	East	South	West
1	3	11	18	7

2	4	12	17	8
3	5	10	15	12
4	4	15	12	9
mean	4.0	12.0	15.5	

The LDV is found by adding together the four mean values.

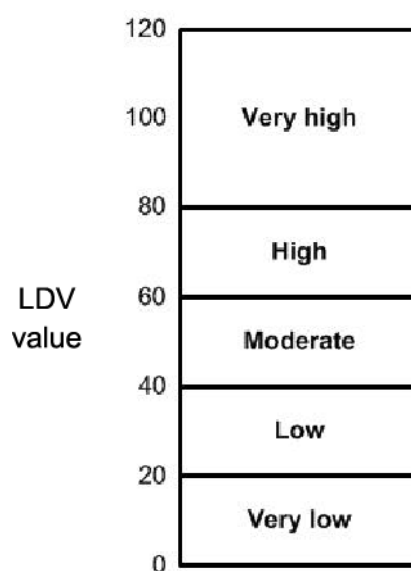
The students calculate the mean number of lichens on the north, east and south sides of the trees.

Calculate the mean for the west side and use this to calculate the LDV.

LDV = _____

[2]

(iii) This scale shows the diversity of the lichens shown by the LDV.



What does the LDV show about the diversity of lichens in the school grounds?

----- [2]

(iv) LDV is calculated by counting all the lichens present.

What else about the lichens could the students look for to make a better assessment of pollution?

----- [3]

7(a) In many countries people rely on bananas for food.

Black sigatoka is a disease of banana plants.

It is caused by a fungus.

Explain how the food security / growth of bananas could be improved:

(i) by using fungicide.

----- [1]

(ii) by using selective breeding.

----- [3]

(b) Scientists have been investigating the conditions needed for the fungus to grow.

They compiled this data.

	Conditions needed for fungus to grow	
	Temperature in °C	Percentage humidity (%)
Grows well	25–28	>90
Some growth	20–25 or 28–35	90–80
Will not grow	< 20 or >35	<70

Write in the boxes how well the fungus will grow in these conditions.

25 °C and a humidity of 85%	
27 °C and a humidity of 92%	

[2]

(c) Scientists have tried to predict the effect of climate change on the growth of the fungus.

They have used four different predictions for how the climate might change, A, B, C and D.

They then tried different ways of calculating where the fungus cannot grow.

Their results are shown in the table.

	Percentage area of the world where fungus cannot grow (%)			
Climate model	1 st calculation	2 nd calculation	3 rd calculation	4 th calculation
A	87.6	87.9	87.7	87.8
B	88.4	88.6	89.0	88.8
C	91.1	91.5	91.4	91.3
D	88.4	88.9	89.5	89.2

(i) Which climate model produces the lowest **range** of results in the four calculations? Choose from A, B, C or D.

-----[1]

(ii) At present the fungus **cannot** grow over 86.4% of the World.

What do the calculations predict about the effect of climate change on the fungus?

-----[1]

(d) Scientists are developing a genetically engineered banana plant.

This would be resistant to black sigatoka.

Look at the newspaper headline from an African newspaper.

Trouble at the genetic research station

Police have been called to a research station.

They are needed to guard the genetically modified plants.

This is because people have been trying to steal the plants to grow themselves.

In Europe, police have been used to guard genetically engineered crops from protesters.

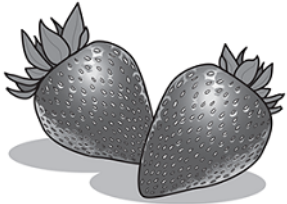
Suggest why the protesters in Europe want to destroy the crops and why the response in Africa is so different.

----- [2]

8(a) A farmer is choosing which strawberry plants to grow.

He reads an advert in his farming magazine.

Buy strawberry plants from us!



We have been selectively breeding strawberry plants for many years.
This has produced a plant with very sweet tasting strawberries.
All the plants we sell are clones of this plant.
We guarantee that none of the plants we sell are genetically modified.

Why does selective breeding take many years?
Put a tick (✓) in the box next to the **correct** reason.

It takes a long time for mutations to occur.

☐

Moving genes between plants is difficult.

☐

The plants have to be selected over many generations.

☐

[1]

(b) The plant company say that none of their plants are genetically modified.

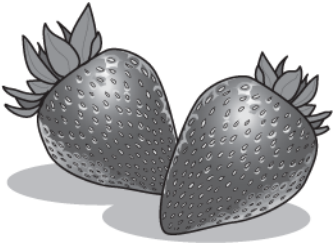
Suggest **two** reasons why the company wants to let people know this.

-----[2]

9(a) A farmer is choosing which strawberry plants to grow.

He reads an advert in his farming magazine.

Buy strawberry plants from us!



We have been selectively breeding strawberry plants for many years.

This produced a plant with very sweet tasting strawberries.

All the plants we now sell are clones of this plant.

We guarantee that none of the plants we sell are genetically modified.

The strawberry plants sold by the company are all clones.

Write about the **disadvantages** of a farmer only growing this one type of strawberry plant.

[2]

(b) The plant company say that none of their plants are genetically modified.

Suggest **two** reasons why the company wants to let people know this.

[2]

10 Some people agree with the use of pesticides and others disagree with the use.

Suggest reasons why people may have different opinions.

[2]

11(a) The picture shows crops being grown using hydroponics.

Hydroponics is a form of intensive farming where plants are grown without soil.



Hydroponics allows more crops to be grown in a limited space.

Explain **one other** advantage and **one** disadvantage of growing crops using hydroponics.

advantage

disadvantage

[2]

(b) In Africa farmers often have problems with droughts and high temperatures.

This makes growing crops in soil difficult.

Farmers in Africa often use intensive farming methods such as hydroponics.

In the UK, farmers often use organic farming methods.

Write about why the development of intensive farming methods like hydroponics maybe more important in Africa than in the UK.

[2]

12 A gardener releases spiders into a greenhouse. They eat the insects which are eating her plants.

What is this an example of?

- A Biological control
- B Gene technology
- C Homeostasis
- D Parasitism

Your answer

[1]

13 In selective breeding which organisms breed?

- A Humans choose which organisms breed.
- B Organisms that are best suited to their environment will breed.
- C Random organisms will breed.
- D The youngest organisms will breed.

Your answer

[1]

14 Plants can be grown in water.

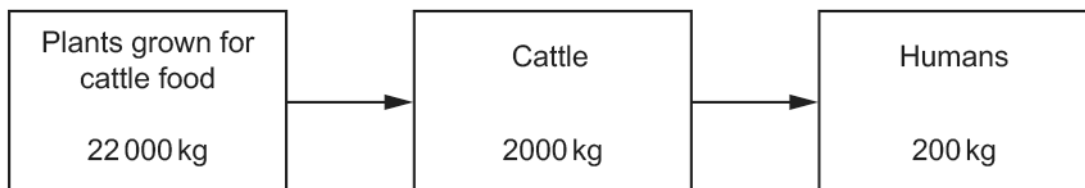
What is the name of this growth method?

- A Active transport
- B Germination
- C Hypothermia
- D Hydroponics

Your answer

[1]

15 The diagram shows the flow of biomass through an agricultural food chain.



The plants grown for cattle food often have their leaves eaten by insects.

Scientists have produced genetically modified (GM) plants that make insecticide in their leaves.

(i) Explain why these GM plants would make more biomass available to humans.

In your answer use the diagram of the agricultural food chain and ideas about photosynthesis.

[6]

(ii) Suggest **two** reasons why some people are against this type of genetic engineering.

1 -----

2 -----

[2]

16 Which of these is used to **cut DNA molecules** in genetic engineering?

- A Ligase enzymes
- B Plasmids
- C Restriction enzymes
- D Sticky ends

Your answer

[1]

17 Which is an advantage of growing crop plants by hydroponics?

- A The plants can be grown where there is poor soil.
- B The plants can support themselves more securely.
- C The plants do not require minerals.
- D The plants require less sunlight.

Your answer

[1]

18 Switching off the protection mechanism described in part (b) involves the plant making a **protein**.

Scientists have put extra copies of the gene for this protein into the plants. This makes the plant make more mRNA molecules.

(i) Explain why making more mRNA will switch off the mechanism faster.

----- [2]

(ii) Scientists have found that the genetically modified plants make 20% more biomass.

Use the agricultural food chain on page 21 to calculate the increase in biomass this would provide for humans.

Answer = -----kg [2]

(iii) Inserting extra copies of a plant's gene into a plant is a type of genetic modification (GM).

Another example of GM involves inserting a bacterial gene into a plant which makes the plant produce an insecticide.

Suggest reasons why.

----- [2]

19 The prickly pear is a cactus plant that was introduced into Australia.



The prickly pear cactus spread across the country.

To control the spread of the prickly pear cactus, a caterpillar was released to eat it.

What is the name of this type of control?

- A Biodiversity
- B Biological
- C Mutualism
- D Pesticide

Your answer

[1]

20(a) This question is about selective breeding.

The table shows the main steps in the process of selective breeding.

They are **not** in the correct order.

A	Repeat the process over many generations.
B	Decide which features are wanted.
C	Choose the individuals that have the features that are wanted.
D	Choose the offspring that have the features that are wanted.
E	Allow the individuals to mate.

Write the letters in the boxes below to give the correct order.

Two have been done for you.

C

A

[2]

(b) Cows are female and are used by farmers to produce milk.

Bulls are male.

Look at the details of different varieties of cows and bulls.

Variety	Milk production	Aggressive
Cow A	thin and watery	no
Cow B	medium yield and creamy	no
Cow C	medium yield and creamy	yes
Bull A	mother produced high yield	yes
Bull B	mother produced high yield	no
Bull C	mother produced low yield	no

A farmer wants to produce cows that produce a high yield of creamy milk.

He does **not** want his animals to be aggressive.

Suggest which cow and bull he should choose to mate with each other.

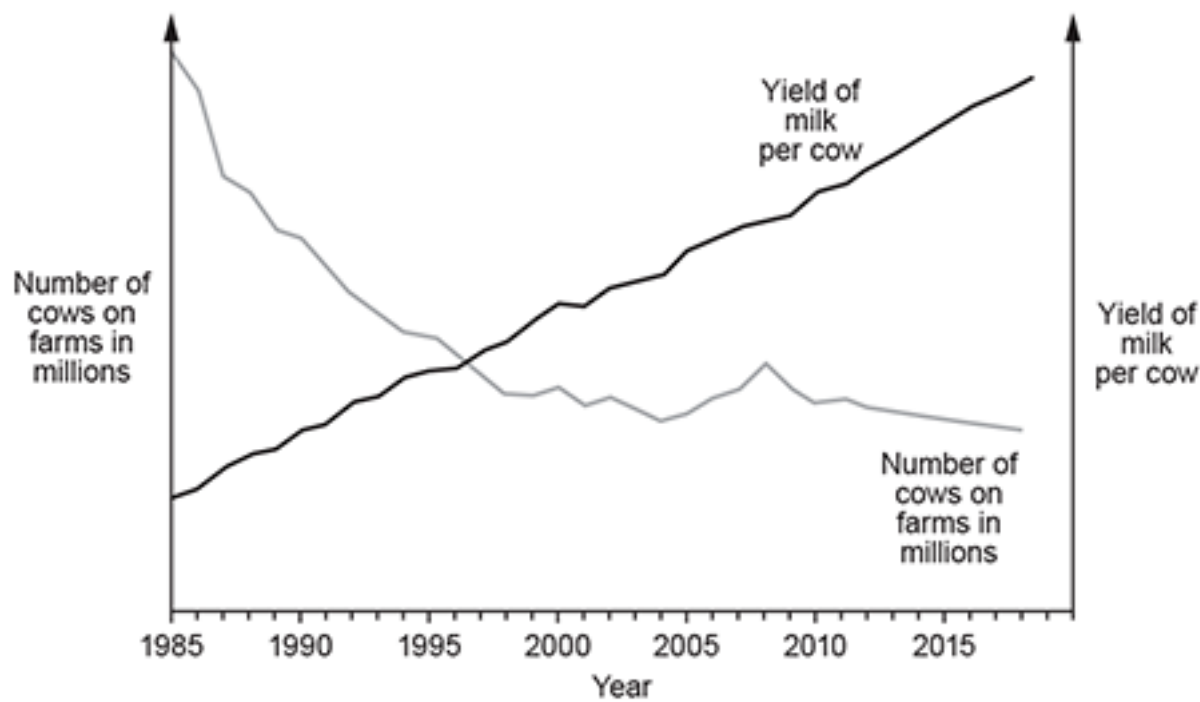
Explain your answer.

cow × bull

explanation _____

[4]

(c) The graph shows the number of cows and the yield of milk per cow on farms in the USA since 1985.



(i) Describe the relationship between number of cows and yield of milk shown in the graph.

----- [1]

(ii) Suggest **two** reasons for the relationship shown in the graph.

1 -----

2 -----

[2]

21(a) Over the whole world the demand for food to feed humans is increasing.

Describe why is there an increasing demand for food.

[1]

(b) Genetic modification (GM) is one method that humans are using to try and produce more food.

(i) What is genetic modification?

[2]

(ii) Scientists can use GM to alter the features of crops.

One feature is crop yield.

Suggest **two other** features of crops they could change.

1 -----

2 -----

[2]

(iii) In a recent survey 200 people were asked about GM crops.

The people surveyed were shown six statements. Three were negative statements and three were positive statements.

They were asked to choose **one** statement they agreed with.

These are the results.

	Statement	Number of people choosing statement
Negative	GM crops are not safe enough to use.	42
	Growing GM crops does more harm than good.	32
	Growing GM crops tampers with nature.	22
Positive	Growing GM crops can prevent people being hungry.	35
	Eating GM crops has very little risk to consumers.	35
	Growing GM crops can make food more nutritious.	34

Calculate the percentage of people in the survey that have a **negative** opinion of genetic modification.

Percentage = ... % [2]

22 In food chains, biomass is lost between different trophic levels.

One reason for this is the release of undigested food from the body.

Which term is used to describe this release?

- A Decomposition
- B Egestion
- C Excretion
- D Peristalsis

Your answer

[1]

23 Two farmers grow barley in their fields.

They both have a problem with barley powdery mildew infecting their crops.

The farmers want to prevent their crops from getting powdery mildew.

(i) Explain how burning plants after the barley has been harvested can protect the crops.

----- [1]

(ii) Explain how growing barley in the fields one year, then wheat the next year can protect the crops.

----- [2]

24 Scientists think that they might be able to reduce rat populations by using genetic engineering. They want to insert a gene into male rats that destroys all sperm that contain an X chromosome.

(i) Name the enzyme used to join two sections of DNA together in genetic engineering.

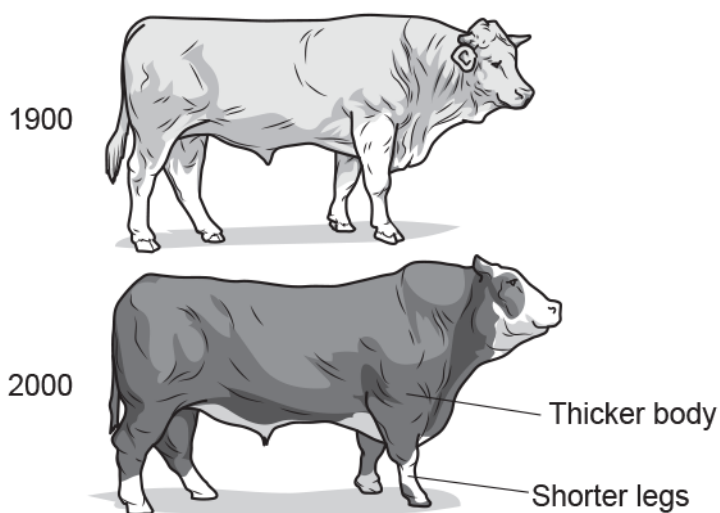
-----[1]

(ii) Explain how this method of genetic engineering would rapidly reduce the rat population.

You may use a diagram in your answer.

-----[3]

25 The drawings show typical cattle kept by farmers in 1900 and in 2000.



Which process would have been used between 1900 and 2000 to produce these changes in the cattle?

- A Artificial classification
- B Biological control
- C Natural selection
- D Selective breeding

Your answer

☐

[1]

26 Which of these is an **advantage** of using hydroponics for crop production?

- A Fertilisers are not required for crop growth.
- B The crops can be grown in areas where the soil is poor.
- C The crop plants do not need extra support.
- D The crops will not be eaten by pests.

Your answer

☐

[1]

27 Many types of cancer have been linked to certain genes.

Scientists are trying to find ways to change the genes in embryos to reduce the risks of cancer.

(i) What name is given to the process scientists use to change the genes of an organism?

----- [1]

(ii) Write down **one** reason why some people disagree with the process given in (i).

----- [1]

28 Which of these is an **advantage** of using hydroponics for crop production?

- A Fertilisers are not required for crop growth.
- B The crops can be grown in areas where the soil is poor.
- C The crop plants do not need extra support.
- D The crops will not be eaten by pests.

Your answer

☐

[1]

29 Which of these is a **similarity** between selective breeding and natural selection?

- A Cause a change in organisms' genotypes but not phenotypes.
- B Humans decide which organisms will reproduce.
- C Only some organisms reproduce.
- D Take place over many thousands of years.

Your answer

☐

[1]

These antibodies are called monoclonal antibodies.

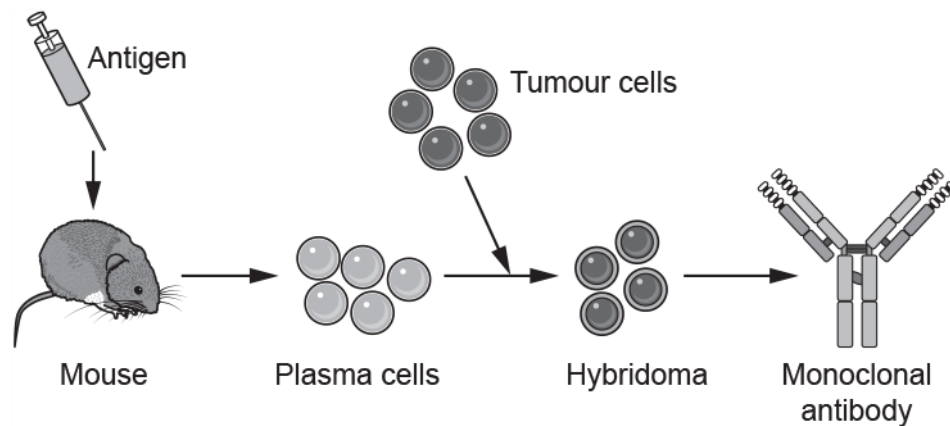


Fig. 20.2

Two scientists discovered a different method of making monoclonal antibodies.

They put genes that code for many different antibodies into viruses. The viruses then make the antibodies on their surfaces.

If an antigen attaches to an antibody, the scientists use the gene for this antibody to genetically engineer bacteria. The bacteria are then used to make large quantities of the antibody.

- (i) Describe how scientists could use the antibody gene to genetically engineer bacteria to make many copies of the antibody.

- (ii) Many people would prefer to use antibodies made using bacteria and viruses, rather than the method shown in Fig. 20.2.

Suggest an explanation for this.

- (iii) In 2018, the scientists were awarded the Nobel Prize for their work.

Explain why their work had to be peer reviewed before they were awarded the prize.

31 Fig. 16.2 shows a food web containing stevia.

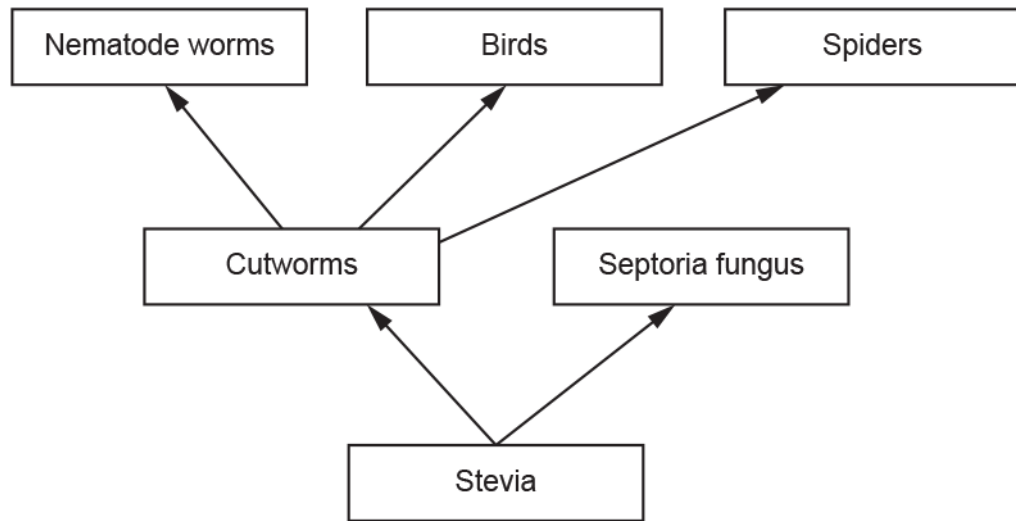


Fig. 16.2

The leaves of stevia taste very sweet. People are now trying to grow stevia as a crop.

Stevia farmers often add nematode worms to their fields.

Explain why farmers do this.

Use Fig. 16.2 in your answer.

[3]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			A	1	
			Total	1	
2	a			3	
	b	i	Block C was used so the scientists could see if the sticking agent alone killed the fungus (1)	1	
		i	Block D was used so the scientists could compare the action of the other treatments with no treatment / as a control (1)	1	
		ii	fungicide and sticking agent were the best at killing fungus (1)	1	
		ii	fungicide on its own still killed the fungus (but less than with sticking agent) (1)	1	
		ii	sticking agent does kill the fungus (but less than fungicide) (1)	1	
			Total	8	
3		i	use of random numbers (1)	1	
		ii	40.4 (2)	2	allow correct mean ie 9.0 (1)
		iii	moderate pollution (1)	1	allow ECF from (d) (ii)
		iii	only just above low / closer to low than high (1)	1	
		iv	identify the species of lichens present in their sample (1)	1	allow reference to bushy / crusty
		iv	find out how sensitive to pollution these lichens are (1)	1	
		iv	if the lichens are mostly pollution sensitive species = low pollution levels (1)	1	allow ora

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	8	
4			D	1	
			Total	1	
5			A	1	
			Total	1	
6		i	use of random numbers (1)	1	
		ii	40.4 (2)	2	allow correct mean i.e. 9.0
		iii	moderate diversity (1)	1	allow ECF from (d) (ii)
		iii	only just above low / closer to low than high (1)	1	
		iv	identify the species of lichens present in their sample (1)	1	allow reference to bushy / crusty allow ora
		iv	find out how sensitive to pollution these lichens are (1)	1	
		iv	if the lichens are mostly pollution sensitive species = low pollution levels (1)	1	
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance						
7	a	i	kills the fungus (that is killing the bananas) so protects / increases the crop / yield (1)	1							
		ii	choose the most resistant individual / banana (1)	1							
		ii	allow it to reproduce (1)	1							
		ii	repeat this process over many generations (1)	1							
	b		some growth (1) grows well (1)	1 1							
	c	i	A (1)	1							
		ii	Show that it will be able to grow in less area (all calculations greater than 86.4) (1)	1							
	d		protesters in Europe think that genetic engineering is ethically wrong / not safe (1) people in Africa need the food as less is available (1)	1 1							
			Total	10							
8	a		<table><tr><td>It takes a long time for mutations to occur.</td><td></td></tr><tr><td>Moving genes between plants is difficult.</td><td></td></tr><tr><td>The plants have to be selected over many generations.</td><td>✓</td></tr></table>	It takes a long time for mutations to occur.		Moving genes between plants is difficult.		The plants have to be selected over many generations.	✓	1	More than one answer =0
It takes a long time for mutations to occur.											
Moving genes between plants is difficult.											
The plants have to be selected over many generations.	✓										
	b		some people may not want to buy / eat GM plants (1) there are concerns about their safety / some people do not think that GM is ethically right (1)	2	allow some people are against GM allow some people prefer to buy non-GM allow environmental concerns allow may cause allergies / side effects / be harmful ignore 'playing God'						
			Total	3							

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a		the plants lack genetic variation (1) all susceptible to the same disease / any disease / environmental change might wipe them all out (1)	2	allow decreased gene pool / genetically identical allow all the strawberries will be ready at the same time (1)
	b		some people may not want to buy / eat GM plants (1) there are concerns about their safety / some people do not think that GM is ethically right (1)	2	allow some people are against GM allow some people prefer to buy non-GM allow environmental concerns allow may cause allergies / side-effects / be harmful ignore 'playing God'
			Total	4	
10			idea that they agree as provides more food / more crops / higher yield(1) idea that they disagree as pesticides maybe harmful (to humans or the environment) (1)	2	ignore references to taste / harmful to crops
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11	a		advantage (better) control of mineral levels / control of disease (1) disadvantage lack of support for plant / idea that (inorganic) fertilisers need to be added (1)	2	allow answers linked to example in question e.g. can be grown in shade away from intense heat (1) allow reduces competition (1) ignore references to increased yield ignore no soil needed ignore nutrients / fertilisers allow uses fertilisers (1) ignore minerals added ignore reference to pollution / pesticides ignore references to cost unqualified but allow expensive to buy / set up / run (1)
	b		Any two from: UK can afford to grow (more expensive) organic crops / Africa needs food grown cheaply (1) in Africa crops more likely to fail / in UK crops less likely to fail (1) high(er) demand for food in Africa (due to increased population) (1) idea that in Africa it is important to control the amount of water / UK control of water not as important(1) poor soil (conditions) in Africa / UK has better soil (condition) (1)	2	allow in UK we can afford to import food / ora (1) allow may get famines in Africa (1) ignore just 'crops grow better in UK' ignore plants in Africa die allow there is a shortage of food in Africa (1) allow more people to feed in Africa / less people to feed in UK(1) ignore just Africa has a higher population ignore just drought in Africa allow soil in UK more fertile / ora (1) allow barren soil in Africa (1) ignore dry soil
			Total	4	
12			A ✓	1 (AO1.2)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13			A ✓	1 (AO1.1)	
			Total	1	
14			D ✓	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15		i	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Provides a detailed explanation drawing conclusions why GM plants would make more biomass available to humans. Links photosynthesis to agricultural food chains and function of insecticides. <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) Provides an explanation why GM plants would make more biomass available to humans. Links photosynthesis or function of insecticides to agricultural food chains. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Provides a basic explanation why GM plants would make more biomass available to humans. This could include ideas about photosynthesis or function of insecticide or agricultural food chains. <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 No response or no response worthy of credit.	6 (AO 3 × 1.1) (AO 2 × 2.1) (AO 1 × 3.2b)	AO1.1 Demonstrates knowledge of insecticides and photosynthesis. • Insecticides will kill insect pests • Less leaves will be eaten/pests eat less leaves • Leaves are the site of photosynthesis • Less pests of the GM plant AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass • More photosynthesis • More light absorption for photosynthesis • More chlorophyll / chloroplasts for photosynthesis • More food/glucose/biomass made by photosynthesis AO3.2b Draw conclusions linking photosynthesis to food chains • More plant growth/food/biomass for cattle • More biomass passes through the agricultural food chain • Cattle receive more energy for growth • Then cattle will grow more, therefore more food for humans <u>Examiner's Comments</u> In this Level of Response question, examiners were looking for a detailed conclusion linking photosynthesis to food chains. This should link both photosynthesis and function of pesticides to agricultural food chains. This differentiated well over the whole ability range of the candidates. Exemplar 7 shows a Level 3 answer which gained 6 marks. Exemplar 7

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					13 Genetically modified plants that make insecticide are resistant to insects and repel them. This prevents biomass being lost this way and results in more biomass being available for cattle consumption which means more food for them which means more cattle are reared resulting in more food being available for humans in the form of meat or dairy. If less leaves are eaten by insects then there are more leaves available for photosynthesis as there is more surface area. A greater rate in photosynthesis means that the plants will grow stronger and faster which is more efficient for the farmer which means more food for the cattle at a lower cost.
		ii	any two from: concern that they may be harmful to humans if eaten ✓ plants may escape into the wild ✓ useful /pollinating insects might be harmed ✓ disrupt food chains ✓ ethically wrong ✓	2 (AO 2 × 2.1)	ALLOW harmful effects not discovered to humans IGNORE dangerous ALLOW resistance / resistance gene could get into other plants IGNORE harmful to insects/pests ALLOW harm the environment /reduce biodiversity ALLOW morally / religiously wrong IGNORE playing God / not natural / disrupt nature IGNORE may not taste good IGNORE reduced gene pool / genetic variation / susceptible to the same disease Examiner's Comments The most common credited mark was that it was ethically wrong. A lot of responses focused on it not being natural, which was a non-credit worthy answer.
			Total	8	
16			C ✓	1 (AO1.2)	
			Total	1	
17			A ✓	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18		i	mRNA carries the code for proteins ✓ more protein will be made ✓	2 (AO 2 × 2.1)	ALLOW protein will be made faster <u>Examiner's Comments</u> This question assessed AO2.1. Many candidates were able to link mRNA to either more or faster protein synthesis, but very few referred to the term 'code' to link mRNA and protein synthesis.
		ii	First check answer on answer line If answer = 40 award 2 marks $\frac{20 \times 200}{100}$ ✓ = 40 ✓	2 (AO 2 × 2.2)	<u>Examiner's Comments</u> Candidates found this AO2.2 mathematics skills question quite challenging. 240 was a common incorrect response. Candidates need to have more practice at similar questions using percentages to develop their mathematical skills in this area.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	new method uses the plants own genes ✓ concern that plants with the insecticide/gene might be harmful to humans / might impact on food chains / might kill useful insects ✓	2 (AO 2.2) (AO3.2a)	ALLOW might have side-effects IGNORE ideas about cultural or religious or ethical objections or that it is playing God <u>Examiner's Comments</u> This question assesses both AO2 and AO3. Candidates were most likely to score a mark for the AO3 marking point, but it was rare for them to gain the AO2 mark. Many candidates described the effect of the gene on the plant, not consumers, or did not pick up on the possible problems of the insecticide itself. There were several responses written about the concern about genetic modification not being a natural process. This is an idea that mark schemes are unlikely to credit, preferring instead to focus on the effects of GM food on all consumers. Candidates also frequently missed out writing about the plants own genes and just focused on the AO3 marking point of the bacterial gene so missed the AO2 marking point. It was common for candidates to write about general dangers of bacteria and infections and not specifically the gene.
			Total	6	
19			B	1 (AO 1.2)	<u>Examiner's Comments</u> This question assessed knowledge and understanding of biological control. Main incorrect response chosen by the majority of candidates was D, confusing pesticide with biological control in stopping the spread of the prickly pear cactus.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
20	a		B, (C), E, D, (A) ✓✓	2 (AO 1.1)	ALLOW 1 mark for B selected in first box <u>Examiner's Comments</u> The question required the candidates to have knowledge and understanding of the process of selective breeding. The majority of lower ability candidates did gain at least one mark here.
	b		cow B x bull B ✓ cow makes creamy milk ✓ bull's mother produced high yield of milk ✓ Cow B / Bull B not aggressive ✓	4 (AO 3.2a) (AO 3.1b x3)	If wrong cow or bull chosen = No marks IGNORE cow C has creamy milk IGNORE bull A's mother produced high yield <u>Examiner's Comments</u> The question required the candidates to analyse information from the table to evaluate and make judgements. The majority of candidates gained full marks here, with a select few identifying the wrong cow and bull to selectively breed.
	c	i	yield of milk has gone up and number of cows has decreased ✓	1 (AO 3.1a)	IGNORE negative correlation <u>Examiner's Comments</u> Many candidates could successfully analyse the graph and describe the relationship between number of cows and yield of milk. Lower ability candidates described the wrong relationship by incorrectly identifying that as the yield of milk increases so does the number of cows.

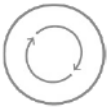
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Any two from: (cows' milk yield has increased) due to selective breeding ✓ (cows' milk yield has increased) due to intensive farming ✓ need less cows to produce the same amount of milk ✓	2 (AO 3.2)	ALLOW improved medications / hormone injections / better quality food supply ✓ <u>Examiner's Comments</u> The question required candidates to analyse the relationship in the graph and draw conclusions, which challenged candidates. Few gained full marks here and didn't appreciate the impact of intensive farming on the increase yield of milk. The most common marking point given was due to selective breeding.
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21	a		the population is increasing ✓	1 (AO 1.1)	ALLOW more births than deaths <u>Examiner's Comments</u> This question which tested the candidate's knowledge and understanding was well answered with the majority of candidates gaining the mark.
	b	i	move genes ✓ from one organism to another ✓	2 (AO 1.1)	ALLOW modifying/alter the genome IGNORE alter genes <u>Examiner's Comments</u> Candidates found this question which tested their knowledge and understanding challenging. Most candidates just repeated the question that genetics/genes are modified and did not score.
		ii	Any two from: disease resistance ✓ frost resistance ✓ pest resistance ✓ taste ✓ drought resistance ✓ vaccines ✓ colour ✓ flavour ✓	2 (AO 1.2)	IGNORE yield /size of fruit✓ <u>Examiner's Comments</u> A lot of candidates did not read this question properly. They referred to features which were linked to yield, which was already stated in the stem of the question, such as crop size or repeated crop yield. The most common awarded marking points were colour/taste/disease resistance.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	FIRST CHECK ANSWER ON THE ANSWER LINE If answer = 48 (%) award 2 marks 96? or 0.48 ✓ =48 (%) ✓	2 (AO 2.2) (AO 1.2)	ALLOW correct conversion of the fraction of the people with a negative opinion into a percentage <u>Examiner's Comments</u> The majority of higher ability candidates and over half of all candidates could correctly calculate the percentage in the survey that had a negative opinion. A small number of candidates picked up the error carried forward mark for the mathematical element to correctly calculate a percentage, even if the response was wrong.  AfL It is important for all candidates to show full working out, as a significant number displayed no working out. Showing full working out gives candidates a chance of scoring the error carried forward mark, even if the final answer is incorrect.
			Total	7	
22			B	1 (AO 1.1)	<u>Examiner's Comments</u> This AO1.1 question testing recall of mechanisms of energy losses in food chains, showed a clear area of misconception. In general, candidates chose either B or a significant number frequently put C and did not score.  Misconception Many candidates are unaware of the distinction between egestion and excretion.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23		i	kills the spores / fungus ✓	1 (AO 2.1)	ALLOW kills/burns/eradicates the (barley) powdery mildew <u>Examiner's Comments</u> Many candidates did not score on this AO2.1 question because of the lack of reference to the specific organisms in the question. A common mistake is to give generic responses using terms like disease and infection. Rather unexpected, but throughout this question about a fungus a lot of candidates referred to bacteria and viruses.
		ii	the spores left by the fungus growing on the barley cannot infect wheat / the fungus does not grow on wheat / wheat is not a host for the fungus✓ (after two years) there will be less spores/fungus population / the spores/fungus will die✓	2 (AO 2.1)	AW barley powdery mildew for fungus AW pathogen for fungus ALLOW wheat resistant to barley powdery mildew <u>Examiner's Comments</u> This AO2.1 question was approached more like a recall question by many candidates. A substantial number described crop rotation ideas about depletion/replacement of nutrients. Again, many candidates wrote about killing infections or diseases rather than spores or fungi.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
24		i	(DNA) ligase ✓	1 (AO 1.1)	Examiner's Comments Although many candidates did score on this AO1.1 question, the most common error was to refer to restriction enzymes. A significant minority gave lipase as their answer.
		ii	males are XY ✓ so only male rats will be born / ORA ✓ the population will contain an imbalance of sexes / (too many males and) not enough females/no females to mate/reproduce with ✓	3 (AO 1.1) (AO 2.1 x2)	ALLOW female is XX DO NOT ALLOW males are YY ALLOW genetic diagram for 2 marks male X Y female X -- XY X -- XY Male only Examiner's Comments Higher ability candidates scored well on this AO1.1 and AO2.1 question. Several candidates thought the space for a diagram required them to illustrate how genetic engineering was carried out, rather than showing what would happen in a cross without an X sperm. Many candidates unfortunately replaced the X sperm with a Y, saying males were now YY. Also, there was evidence of a few candidates still mixing up the chromosomes and incorrectly recalling the male as XX and female as XY and others who had correctly done a Punnett square but did not annotate the genotypes. Lower ability candidates showed little understanding about sex-determination or the difference between a gene and a chromosome.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25			D ✓	1 (AO2.1)	
			Total	1	
26			B ✓	1 (AO1.1)	
			Total	1	
27		i	genetic engineering / genetic modification ✓	1 (AO1.1)	ALLOW GM / Gene Therapy
		ii	worried about possible side effects / ethically / morally / religiously wrong ✓	1 (AO3.2a)	IGNORE playing God / not natural
			Total	2	
28			B ✓	1 (AO1.1)	
			Total	1	
29			C ✓	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30		i	Any four from: plasmid used to insert the gene ✓ restriction enzyme to cut open the plasmid / for removing the gene ✓ ligase enzyme to insert the gene / join ends of gene and plasmid ✓ correct reference to sticky ends ✓ correct reference to selection using antibiotic markers ✓	4 (AO4 x 1.1)	enzyme and role must be correct link
		ii	idea (this method) does not use mice / ORA ✓ people may think original method is cruel / unethical / killing mice ✓	2 (AO2.1)	ALLOW does not use animals IGNORE references to religion/playing god etc.
		iii	to repeat the work / make sure it is reproducible ✓ to make sure it worked / was safe ✓	2 (AO2 x 1.1)	ALLOW make sure work was valid ALLOW check for errors/mistakes ALLOW was correct ALLOW was reliable ALLOW was ethical ALLOW make sure work was original / authentic ALLOW recognise significance of work ALLOW to improve quality of report/published work
			Total	8	
31			Any three from: biological control ✓ nematodes will eat cutworms ✓ less cutworms ✓ less stevia eaten ✓ increase the yield ✓	3 (AO3 x 2.1)	ALLOW predators of the cutworms added ALLOW more crop
			Total	3	