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GRADE 12 BLOCK TEST: Genetic Engineering

6 February 2019
minutes)

TOTAL: 50 MARKS (50

Examiner: IM Foster

Moderator: PM Gentz

Name: _____

Teacher's Initials: _____

Instructions:

- Write your name and teacher's initials in the spaces above.
- This test consists of 9 pages – make sure your test is complete.
- Answer all questions on the sheet.
- Use the mark allocation to guide you.

Question 1

Questions 1.1 to 1.4 are multiple choice questions. Choose only the letter of the correct answer and write it in the box below.

Question	1.1	1.2	1.3	1.4
Answer	B ✓✓	A✓	D✓✓	C✓

1.1 The list below gives information about stem cells.

- 1 They can develop into many different tissues
- 2 They have been used for research for the past 100 years
- 3 Body cells can be 're-programmed' to form stem cells
- 4 They are found in bone marrow and developing embryos

Which of these statements is NOT true?

- A 1 and 2 only
- B 2 only
- C 2 and 4 only
- D 4 only

(2)

1.2 Each type of human cell has a different structure and function because:

- A only some of their genes are expressed
- B they contain different genes
- C some genes are lost during cell development
- D some genes are gained during cell development

(1)

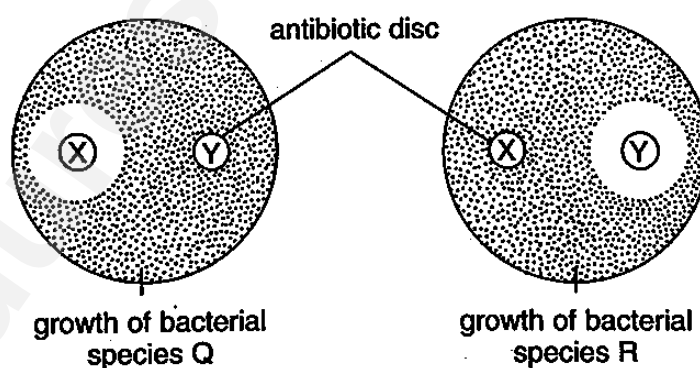
- 1.3 The table below shows optimum, maximum and minimum temperatures for the growth of some GM crop plants.

Crop	Temperature (°C)		
	Optimum	Maximum	Minimum
Maize	22–26	32–34	20–22
Wheat	20–25	36–38	5–7
Rice	30–33	37–40	18–22
Potato	15–20	28–34	12–14
Soyabean	25–28	37–40	10–14

Which of the following predictions is supported by the evidence in the table?

- A Maize will grow at lower temperatures than soyabean
 - B Rice will grow at higher temperatures than soyabean
 - C Rice will grow in a narrower range of temperatures than maize
 - D Wheat will grow in a wider range of temperatures than potato
- (2)

- 1.4 Two bacterial species Q and R were transformed with a gene for resistance to antibiotic X. The bacteria were then grown on agar plates containing discs of two antibiotics X and Y. The growth of the bacteria on the two plates is shown below. Which of the bacteria was successfully transformed?



- A both bacteria Q and bacteria R
 - B bacteria Q
 - C bacteria R
 - D neither bacteria Q nor bacteria R
- (1)

[6]

Question 2 (Adapted from IEB Paper 1 and Supp 2017)

Read the text below and answer the questions that follow:

Genetically Modified (GM) crops are now grown around the world. Since they were approved for commercial use in 1996, their production has increased dramatically. Very few products do not contain some form of GM ingredient.

A newly approved crop is this apple from a Canadian biotech company that does not brown even after it's been sliced – these are called “Arctic Apples.” It recently received FDA (Food and Drug Administration) approval. The agency said it is safe to eat, which means they may appear on supermarket shelves soon.



- 2.1 What is meant by the term “Genetically Modified crop”? (2)

A crop whose genome/DNA has been changed/modified✓ to produce a desired outcome ✓

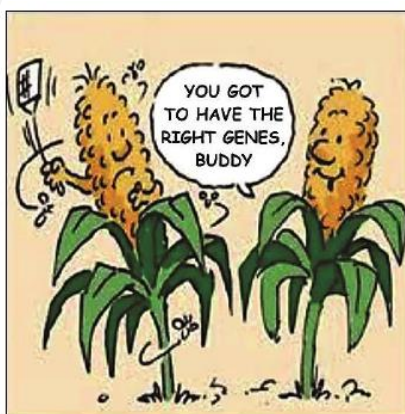
- 2.2 If you were a parent buying apples for your family, would you buy these GM apples? Justify your answer with TWO reasons. (2)

Yes, they have FDA approval so are safe✓ they don't brown so are more appetizing ✓don't brown so less waste/save money ✓

No, side effects are not known yet, e.g. allergies ✓nature shouldn't be tampered with✓

Or any reasonable answer

- 2.3 The following cartoon shows one of the advantages of certain GM crops. Explain the message in this cartoon. (3)



[Source: <<http://www.seriouswonder.com>>]

The plant on the right has been genetically manipulated to secrete pesticides/insecticides ✓so that insects/pests don't feed on it ✓. The “natural” plant on the left is still being eaten by insects ✓ The message is that GM plants are better than the “natural” ones ✓ or any other reasonable answer (max 3)

- 2.4 A scientist heard about the new GM Arctic Apples and he decided to do his own tests on the apples comparing them to “natural” apples. He took a “natural” apple and an Arctic Apple and cut each apple in half. Over the next two hours, he observed the percentage of the cut surface that turned brown and recorded it in a table every 15 minutes.

Time (min)	"Natural" Apple (% brown)	Arctic Apple (% brown)
0	0	0
15	4	0
30	10	0
45	15	0
60	15	0
75	25	5
90	40	5
105	50	5
120	50	5

[Hypothetical data]

- 2.4.1 State the independent variable in this experiment. (2)

Apple✓ type✓ or time✓ (mins) ✓

- 2.4.2 State the dependent variable in this experiment. (2)

% / amount of ✓browning ✓

- 2.4.3 Did his observations support the claims made by the producers of the Arctic Apple? Explain. (2)

Yes, because the % browning was much less in Arctic apples ✓✓ or

No, they said it does not brown but there was some browning ✓✓

- 2.4.4 Identify TWO fixed variables. (2)

Same size apple pieces✓, same length of time exposed✓ environmental conditions✓

- 2.4.5 How could the scientist have made sure his results were more reliable? (1)

Repeat the experiment and take average result ✓ or perform on a number of apples ✓

- 2.5 Read the text below and then answer the question that follows:

According to an article by *Food Democracy Now!*, the same company that created the “Arctic Apples” are working on developing new varieties of peaches, pears, cherries and bananas. The company is using a “gene-silencing” technique to produce the GM fruit.

- 2.5.1 In terms of the enzyme-catalysed browning process that happens when fruit is cut and exposed to air, explain how a “gene-silencing” technique could be used to develop the new variety of pear that does not brown when cut. (2)

The gene coding for the enzyme that catalyses the browning reaction in the pear is inactivated ✓ through genetic modification therefore the enzyme is no longer produced ✓
[18]

Question 3

Read the text below which describes the development of a herbicide-resistant crop plant.

Plant scientists in Belgium have grown genetically engineered sugar beet that survives the action of weedkiller. It is the first time that researchers have managed to grow sugar beet plants from single cells carrying a foreign gene for herbicide resistance. The researchers aim to produce a variety of sugar beet that survives when sprayed with a herbicide that kills weeds. They have inserted into cultured cells of sugar beet a gene taken from the bacterium, *Streptomyces*. The gene orchestrates the production of an enzyme that deactivates the herbicide. The company used standard techniques for inserting the foreign bacterial gene into sugar beet cells. The *Streptomyces* gene was first spliced into a plasmid of another bacterium, *Agrobacterium tumefaciens*. When *A. tumefaciens* is co-cultured with cells of the sugar beet plant, the plasmid moves from the bacterial cells to the plant cells, carrying the *Streptomyces* gene with it.

- 3.1 Describe how the transferred gene allows this variety of sugar beet to be resistant to herbicide. (2)

The GM sugar beet produces an enzyme ✓ that deactivates the herbicide ✓

- 3.2 Identify examples for each of the terms given below *from the text* above:

transformed cell ***A. tumefaciens* / sugar beet cell ✓**

donor cell/organism ***Streptomyces* (bacterium) ✓ / sugar beet cell/plant ✓**

vector **plasmid ✓**

transgenic organism **genetically engineered (GM) sugar beet ✓** (4)

- 3.3 Explain fully the advantage of this type of genetic engineering to the farmer. (3)

Less damage/crop losses due to weeds out-competing the crop ✓ therefore higher yield ✓
therefore more income generated from the crop ✓

3.4 Name ONE disadvantage of growing herbicide-resistant plants. (1)

**The plants are expensive to produce✓ consumers may not want to buy them ✓
Farmers may overuse herbicides ✓, leading to water pollution / environmental disturbance ✓**

3.5 Apart from having the herbicide-resistance gene, the GM sugar beet plants are identical to the herbicide-susceptible sugar beet plants. Explain why this is the case. (2)

Tissue culture✓ is used to produce the GM sugar beet so the plants are clones of the parent plant containing the added single gene in all cells ✓

3.6 Many people are opposed to the growing of herbicide-resistant crops produced in this way. Give TWO well-explained arguments against the growing of these crops. (4)

Spread of antibiotic resistance to bacteria in environment has potential for antibiotic resistance in bacteria to spread ✓✓

Superweeds with resistance to herbicides could emerge ✓✓

People could develop allergies to the foreign proteins in the plants ✓✓

Farmers could use too much weed killer and damage environment/waterways ✓✓

Any two

[16]

Question 4

Supply terms for the following descriptions:

4.1 Technology involving the transfer of genes from one species to another **recombinant DNA technology✓ or genetic engineering/modification ✓**

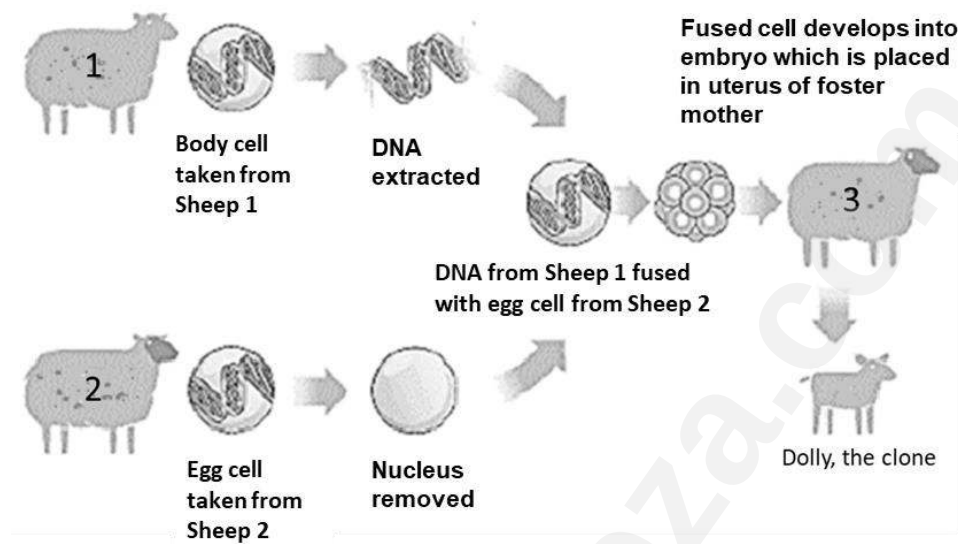
4.2 Enzyme used to join a foreign gene to a plasmid (DNA) **ligase ✓**

4.3 Injection at microscopic level **micro-injection ✓**

4.4 Enzyme used to cut DNA **(Restriction) Endonuclease ✓ or restriction enzyme✓** [4]

Question 5

In 1996, researchers from the Roslin Institute in Edinburgh successfully produced the first cloned mammal from an adult cell, using a technique called adult cell cloning. They called the clone Dolly. The diagram below shows the stages by which Dolly was created.



For 5.1 and 5.2, complete each statement by ticking the box next to the most correct answer:

5.1 An empty egg cell was joined with the nucleus from the Sheep 1 body cell because... (1)

it would make the surrogate mother pregnant.	
it is the only type of cell with which the nucleus could fuse	✓
it ensured that Dolly would be born a female.	
it had the potential to divide to produce any type of cell in the clone.	

5.2 Dolly was a clone of which sheep in the diagram? (1)

Sheep 1 from which a body cell was taken.	✓
Sheep 2 from which an egg was taken.	
Sheep 3 that was used as a mother for the embryo to develop in.	
A combination of all three sheep used in the process.	

5.3 Give TWO reasons why the cloning of animals might be considered unethical. (2)

Many attempts result in deformed animals that suffer ✓ animals have a shortened life span ✓
life should not be tampered with but be respected ✓ or any other valid answer max 2

Question 6

Read the text and answer the questions that follow:

China Has Already Gene-Edited 86 People With CRISPR

Kristen V. Brown, Jan 23, 2018, 2:30pm

In the US, the first planned clinical trials of CRISPR gene editing in people are about to kick off. China, meanwhile, has been racing ahead, having already used the gene-altering tool to change the DNA of dozens of people in several clinical trials. So far in China, at least 86 people have had their genes edited. China's rapid advancement is the result of more relaxed regulations, and a willingness to forge ahead with cutting-edge research despite potential unknowns and safety concerns, which are significant. In China, 36 patients with cancers of the kidney, lung, liver and throat had cells removed from their bodies, altered with the gene editing tool called CRISPR-Cas9, and then infused back into their bodies to fight the cancer. The first human CRISPR trial in the US will enrol just 18 people and is designed primarily to test whether CRISPR is safe. *Adapted from <https://www.chemistryworld.com/news>*

Which of the statements regarding CRISPR-Cas9 are correct? Circle your choice/s.

- (a) The CRISPR-Cas9 system is only effective in bacteria.
- (b) CRISPR-Cas9 can cut out sections of DNA in a host cell. ✓
- (c) There are many ethical concerns with regard to gene editing in human embryos. ✓
- (d) CRISPR-Cas9 has been used to remove mutated genes in human embryos only. [2]

Total: 50 marks