Biotechnology and Genetic Engineering

Question Paper 4

Level	IGCSE
Subject	Biology
Exam Board	CIE
Topic	Biotechnology and Genetic Engineering
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 4

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

1 Dairy cattle are kept for milk production. Approximately half of all the calves born are male.

(a) Sex is determined in cattle in exactly the same way as it is in humans.

Explain why 50% of all cattle are born male.

You may draw a genetic diagram to help your explanation.

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(b) Dairy farmers only need a very small number of male calves. They limit the number by using sex selection. Sperm cells are identified and sorted before they are used in artificial insemination (AI).

Explain how artificial insemination is carried out.

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(c) Table 2.1 shows the composition of 100 g of cow's milk compared with the same quantities of commercial formula milk and human milk.

Table 2.1

nutrient	cow's milk	formula milk	human milk
carbohydrate / g	6.5	7.3	7.5
protein / g	3.3	1.3	1.3 – 1.6
fat / g	3.9	3.6	4.1
calcium / mg	120	42	34
iron / mg	0.02	0.64	0.07
vitamin D / µg	0.05	1.20	0.06
vitamin A / µg	19	66	58

Some women do not breast-feed their babies but bottle-feed them using formula milk. Health authorities advise against the use of cow's milk until babies are about 9 months old.

Use the information in Table 2.1 to explain the advantages of using formula milk rather than cow's milk.

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One of the components of human milk is the enzyme lysozyme that is present in many body fluids and is responsible for breaking down the cell walls of bacteria.

(d) Define the term *enzyme*.

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(e) The effect of human lysozyme on two common species of bacteria, **A** and **B**, was investigated at two different values of pH.

The investigation was set up as shown in Fig. 2.1.

The test-tubes were kept at 37 °C for 24 hours.

tube number	1	2	3	
species of bacteria	A	A	A	B
pH of medium	4.0	4.0	9.0	4.0
fresh lysozyme	✓		✓	✓
boiled lysozyme		✓		

Fig. 2.1

After 24 hours, samples were taken from each test-tube. Each sample was placed onto nutrient agar in Petri dishes. The dishes were incubated at 28 °C for a further 24 hours to allow any bacteria to grow.

The results are shown in Fig. 2.2.

sample from test-tube	1	2	3	
result after incubation for 24 hours				

Key:

no growth of bacteria

growth of bacteria

Fig. 2.2

Explain the results shown in Fig. 2.2 by comparing the following pairs:

1 and **3** .....

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.....[2]

1 and **4** .....

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.....[2]

1 and **2** .....

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.....[2]

(f) Human milk also contains antibodies. Explain the benefits of antibodies to a newborn child.

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[Total: 20]

2 The Food and Agriculture Organization (FAO) collects data on food supplies worldwide.

The FAO classifies the causes of severe food shortages as either by natural disasters or as the result of human action.

Natural disasters are divided into those that occur suddenly and those that take a long time to develop. Human actions are divided into those that are caused by economic factors and those that are caused by wars and other conflicts.

Fig. 6.1 shows the changes in the number of severe food shortages between 1981 and 2007.

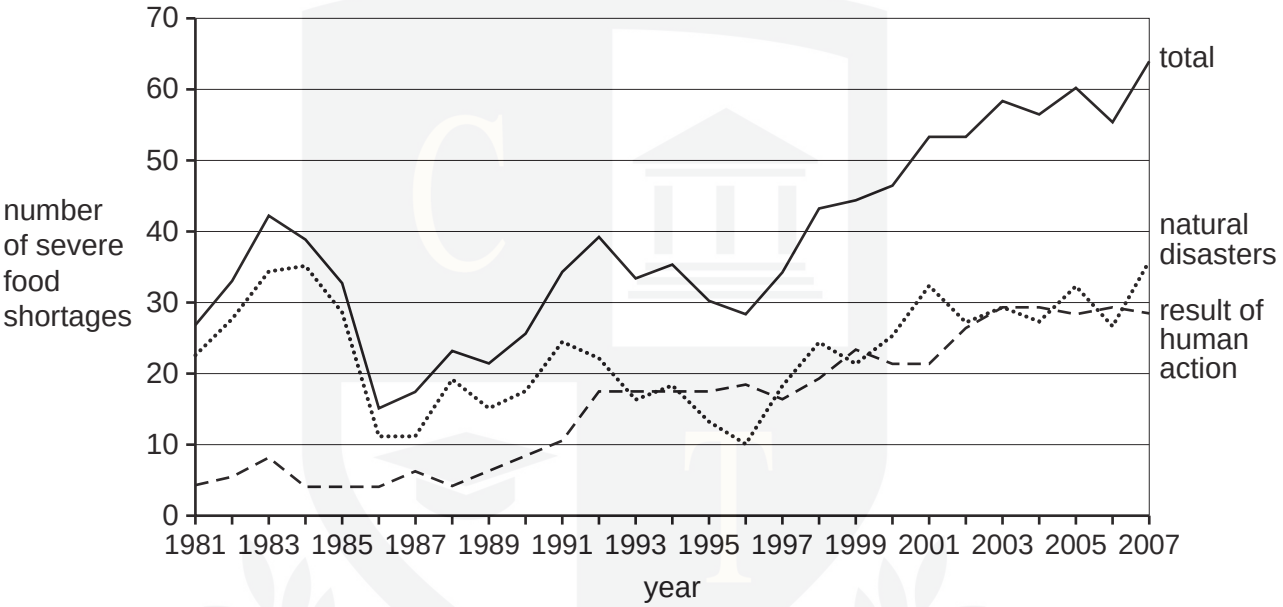

Fig. 6.1

Fig. 6.2 shows the causes of severe food shortages in the 1980s, 1990s and 2000s.

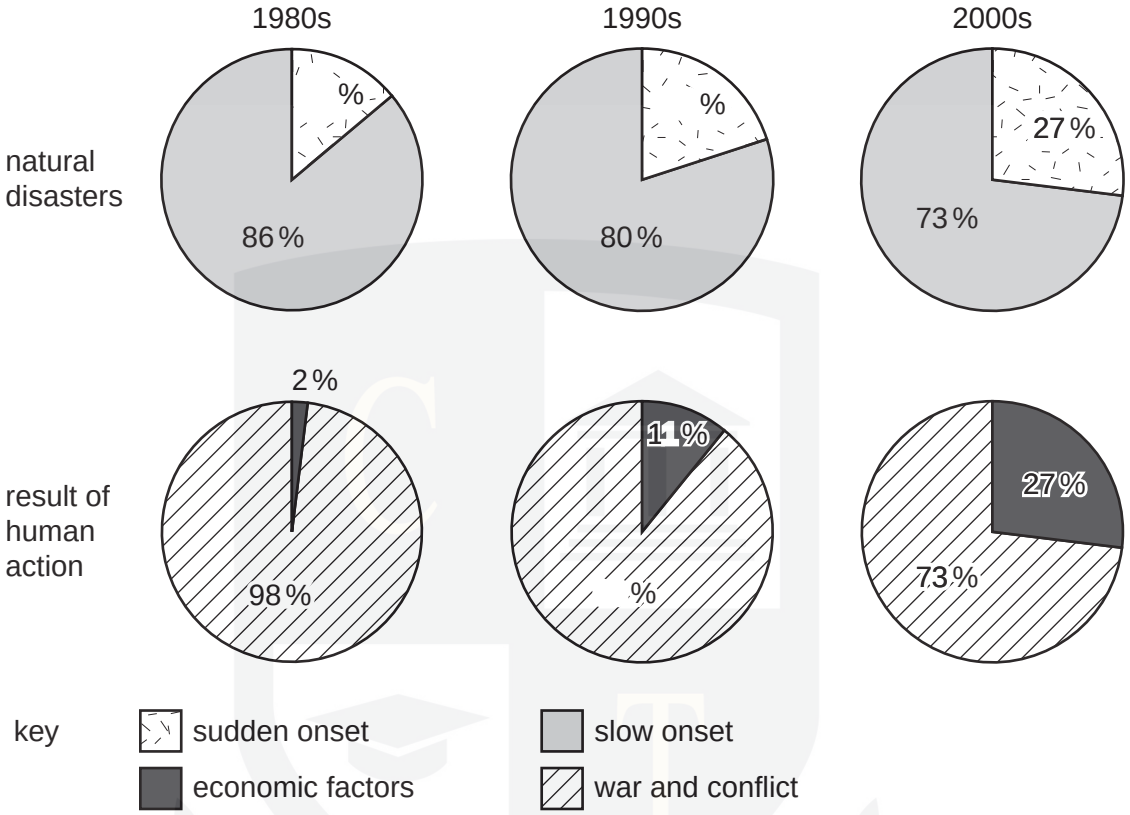

Fig. 6.2

(a) State two types of natural disaster that occur suddenly and may lead to severe food shortages.

1. .....

2. ..... [2]

(ii) State **one** type of natural disaster that may take several years to develop.

..... [1]

(b) Use the information in Fig. 6.1 and Fig. 6.2 to **describe** the changes in food shortages between 1981 and 2007.

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(c) Explain how the increase in the human population may contribute to severe food shortages.

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The quality and quantity of food available worldwide has been improved by artificial selection (selective breeding) and genetic engineering.

(d) Use a **named** example to outline how artificial selection is used to improve the quantity or quality of food.

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(e) Define the term *genetic engineering*.

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[Total: 16]

3 Scientists are considering the use of a genetically engineered virus to kill a population of the cane toad, *Bufo marinus*, which is growing out of control in Australia.

This virus will introduce a modified form of genetic material, responsible for hormone production. The normal hormone causes the toads to mature in a similar way to hormones causing puberty in mammals. The modified genetic material will prevent toads maturing, leading to their death.

The toad was introduced into Australia because it eats scarab beetles, a pest of sugar cane plants. Sugar cane is an important crop plant.

Animals such as crocodiles and dingos are predators of the toad, but the toad can kill them by squirting a powerful toxin.

(a) Define the term *genetic engineering*.

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..... [2]

(b) State which part of the virus would carry the modified genetic material.

..... [1]

(c) **(i)** Name the hormone that causes puberty in male mammals.

..... [1]

(ii) State two characteristics that develop in a boy when this hormone is produced.

1 .....

2 ..... [2]

The toad population is increasing out of control. In terms of a sigmoid growth curve, it is in the exponential phase.

(d) (i) 1. Sketch a sigmoid growth curve using the axes below.
2. Label the axes (units ar **not** needed).
3. Label the exponential phase of the curv

[4]

(ii) Suggest **one** limiting factor, other than viruses or predators, that could stop the toad population rising.

..... [1]

(e) (i) Construct a **food web** for the organisms named in this question.

[2]

(ii) Complete the table by writing each of the organisms you used in the food web in the correct column.

carnivore		producer

[3]

[Total : 16]