Candidate Name	Centre Number					Candidate Number				
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GCSE

BIOLOGY

UNIT 2: VARIATION, HOMEOSTASIS AND MICRO-ORGANISMS
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**3**	
4.	**6**	
5.	**7**	
6.	**7**	
7.	**7**	
8.	**11**	
9.	**9**	
10.	**6**	
11.	**8**	
12.	**6**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **12** is a quality of extended response (QER) question where your writing skills will be assessed.

*Answer **all** questions*

1. An investigation was carried out into the effect of caffeine on the reaction time of eight people. Each person was given 2 g of instant coffee dissolved in 200 cm^3 boiling water. A computer program was used to measure the reaction times before and after drinking the coffee.

In order to measure the reaction times, each person had to press a button as soon as a signal was heard.

The results are shown in the table:

			Reaction time (s)	
Person	**Age**	**Gender**	**Before Coffee**	**After Coffee**
1	15	Male	0.17	0.16
2	17	Female	0.15	0.14
3	19	Female	0.18	0.15
4	16	Male	0.19	0.17
5	17	Male	0.14	0.12
6	20	Male	0.17	0.14
7	18	Male	0.21	0.15
8	16	Female	0.17	0.16

(a) What is the effect of caffeine on the reaction time of the people tested? [1]

.....

.....

(b) State **one** factor that has been kept constant. ..... [1]

(c) State **three** other factors which should have been controlled to make this a fair test. [3]

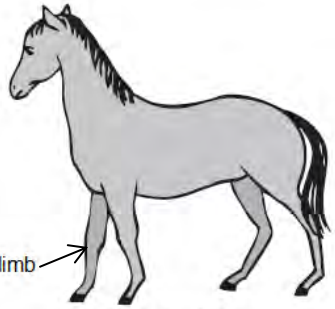
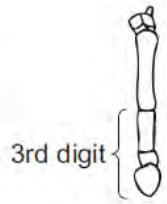
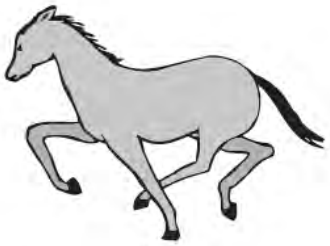
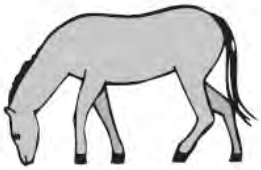
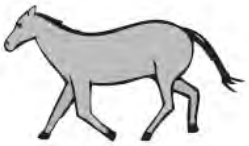
(I) .....

(II) .....

(III) .....

5

2. The diagrams show stages in the evolution of the horse.

Age of oldest fossils in millions of years	Name	Body form and size	Bones of right fore limb
1	*Equus*	 up to 1.6 m	
7	*Pilohippus*	 1.0 m	
26	*Merychippus*	 up to 1.0 m	
38	*Mesohippus*	 up to 0.6 m	
54	*Hyracotherium*	 about 0.4 m	

All the examples shown are extinct except for the modern horse. *Equus. Hyracotherium* is the earliest ancestor, it lived in swampy, marshy areas with dense vegetation.

Gradually, during evolution, the modern horse and its ancestors became adapted to living in drier areas such as firmer, open grassland.

(a) Suggest why the increase in size shown in the evolutionary stages was an advantage to the modern horse. [2]

.....

.....

.....

.....

(b) (i) Describe **two** changes that have taken place in the bones of the forelimb during evolution. [2]

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.....

(ii) Suggest an advantage to *Hyracotherium* of having several digits touching the ground. [1]

.....

.....

5

3. (a) Why are stem cells different to most cells in mature tissues of the body? [1]

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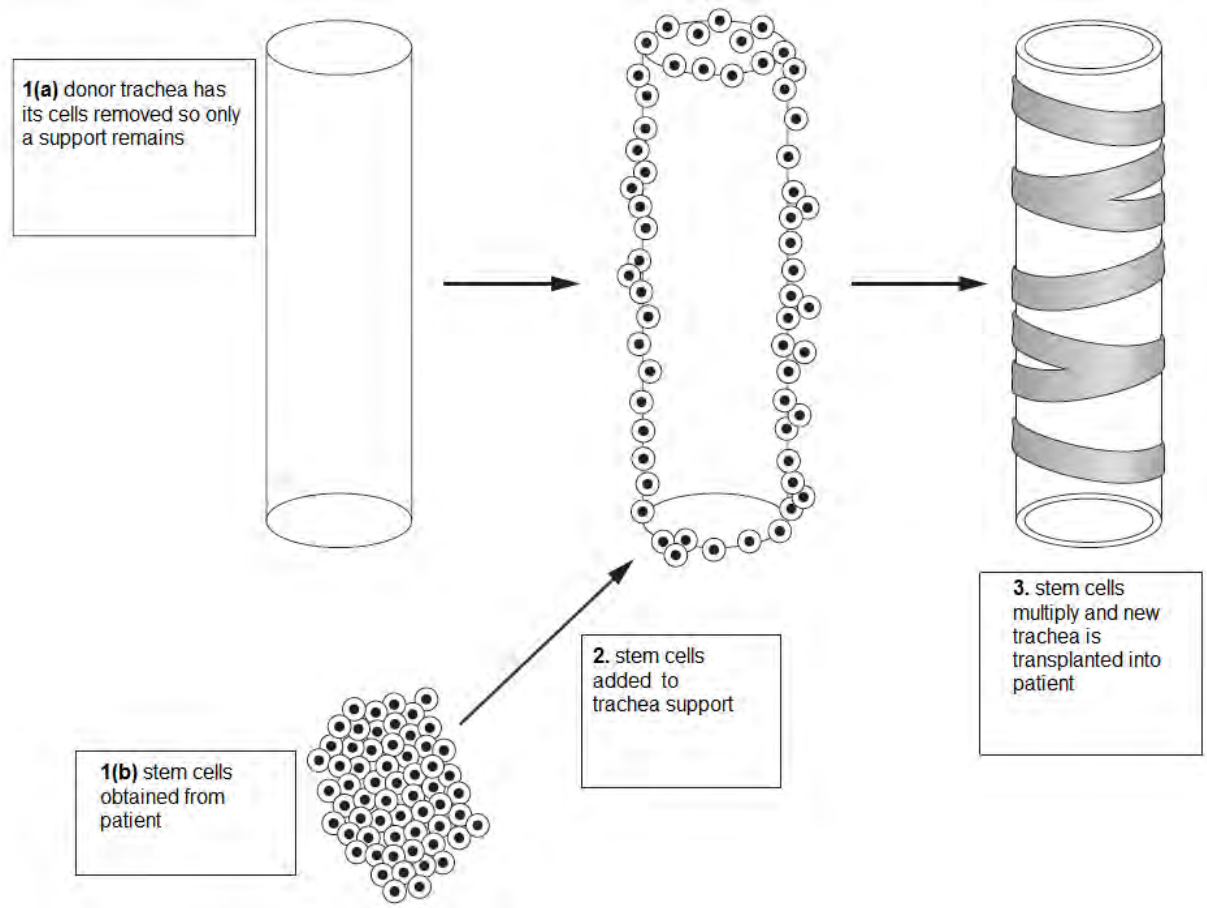
.....

The trachea supplies the lungs with air. If the trachea becomes damaged it can now be replaced by one that is made using the person's own stem cells. The process is summarised in the following diagram.



(b) State **two** advantages to the patient of using their own stem cells rather than using embryonic stem cells from another source. [2]

.....

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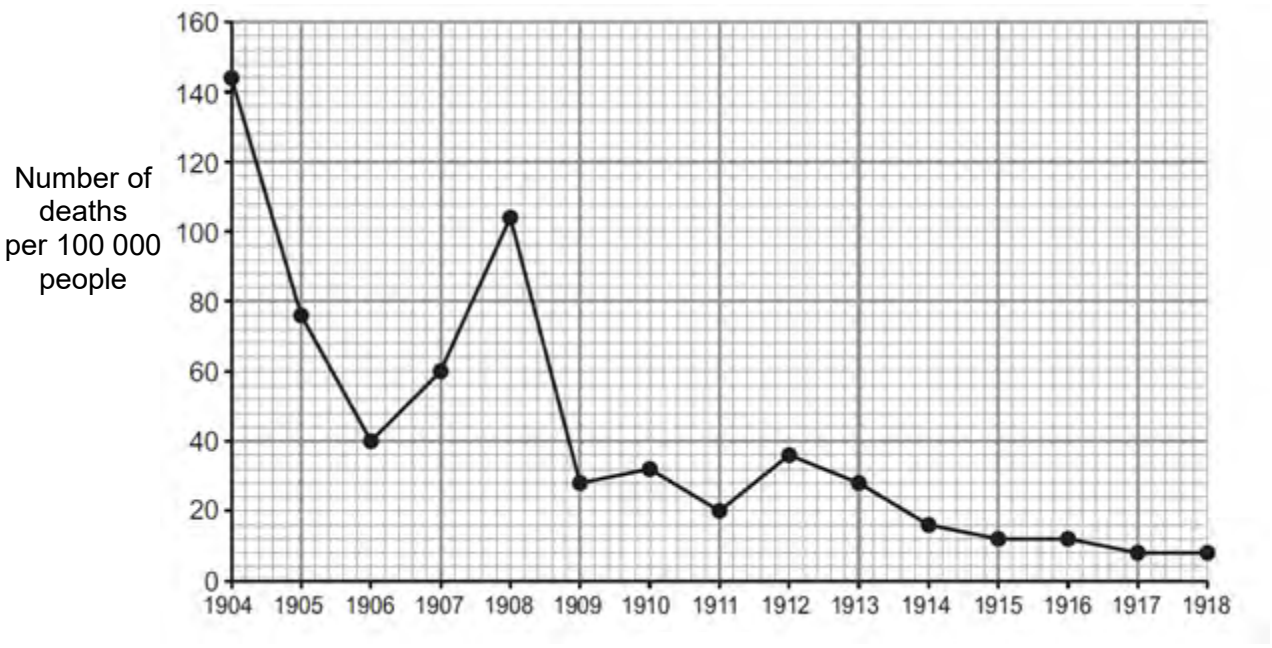
3

4. The graph shows the death rate from the disease, typhoid, over a period of fourteen years in Mexico. The disease is caused by the bacterium *Salmonella typhi*. In 1908, chlorine was added to Mexico's drinking water for the first time.



(a) Use the data given to answer the following:

(i) What can be concluded about how *Salmonella typhi* can enter the body? [1]

.....

(ii) Suggest a reason why the death rate in 1910 was lower than in 1905. [1]

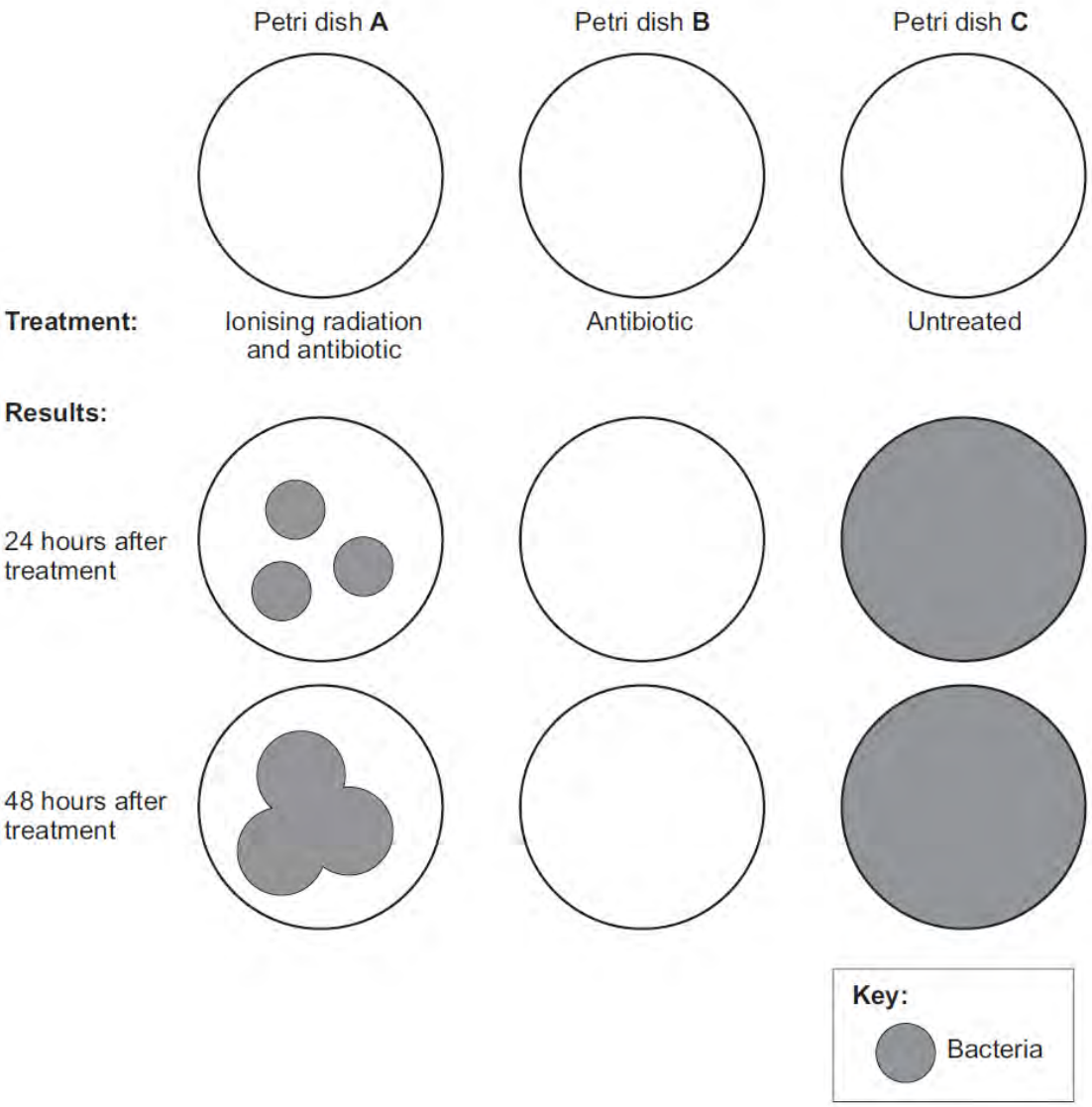
.....

(b) In 1979, fourteen thousand people in Mexico died during an outbreak of typhoid. The antibiotic, chloramphenicol, proved to be ineffective during the outbreak. In order to find out why chloramphenicol failed to cure patients, scientists cultured *Salmonella typhi* in Petri dishes and treated them as follows:

Petri dish **A**: this was subjected to ionising radiation followed immediately with a dose of chloramphenicol.

Petri dish **B**: a dose of chloramphenicol, equal to the dose given in Petri dish **A**, was added.

Petri dish **C**: this was given neither ionising radiation, nor chloramphenicol.



(i) What was the purpose of Petri dish **C**? [1]

.....

(ii) Explain the effect of ionising radiation on *Salmonella typhi* and why scientists must continue to discover new antibiotics. [3]

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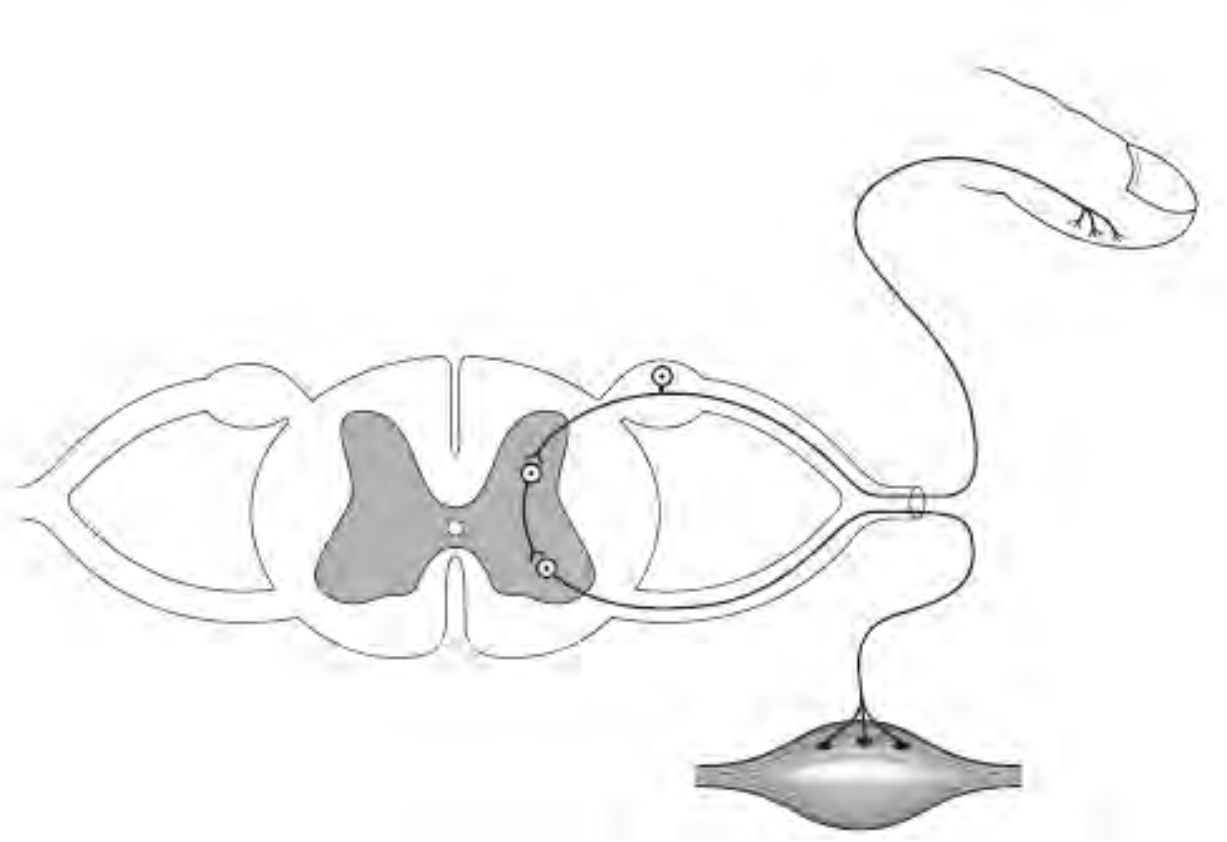
6

5. The diagram shows part of the nervous system involved in a withdrawal reflex action.



(a) **On the diagram** above, **label**: [4]

(i) the motor neurone;

(ii) the co-ordinator;

(iii) the synapse;

(iv) the sensory neurone.

(b) (i) Name the path taken by a nerve impulse in the reflex action shown in the diagram. [1]

.....

(ii) **Draw an arrow** on **each** neurone to show the direction of the nerve impulse. [1]

(iii) What stimulus affects receptors in your skin when your finger touches a flame? [1]

.....

7

6. In 1905, the French scientist, Lucien Cuenot, discovered that a combination of certain dominant alleles in mice resulted in their death at birth. This principle is also shown in Manx cats.

Manx cats have short tails. Their **genotype** is **Nn**, where **N** represents the allele for short tail and **n** represents the allele for long tail. Manx cats with the genotype **NN** die shortly after birth.

(a) (i) Complete the following Punnet square to show the possible genotypes of the kittens produced from a cross between two short tailed cats. Use the letters **N** and **n**. [2]

short tail x

short tail

(ii) What fraction of a total litter of 8 would be expected to survive? [1]

.....

(b) (i) Complete the following Punnet square to show the possible genotypes of the kittens produced from a cross between a short tailed cat and a long tailed cat. Use the letters **N** and **n**. [2]

short tail x

long tail

(ii) What percentage of the litter would be expected to survive? [1]

.....

(c) Name the type of genetic variation shown in the tail length of cats. [1]

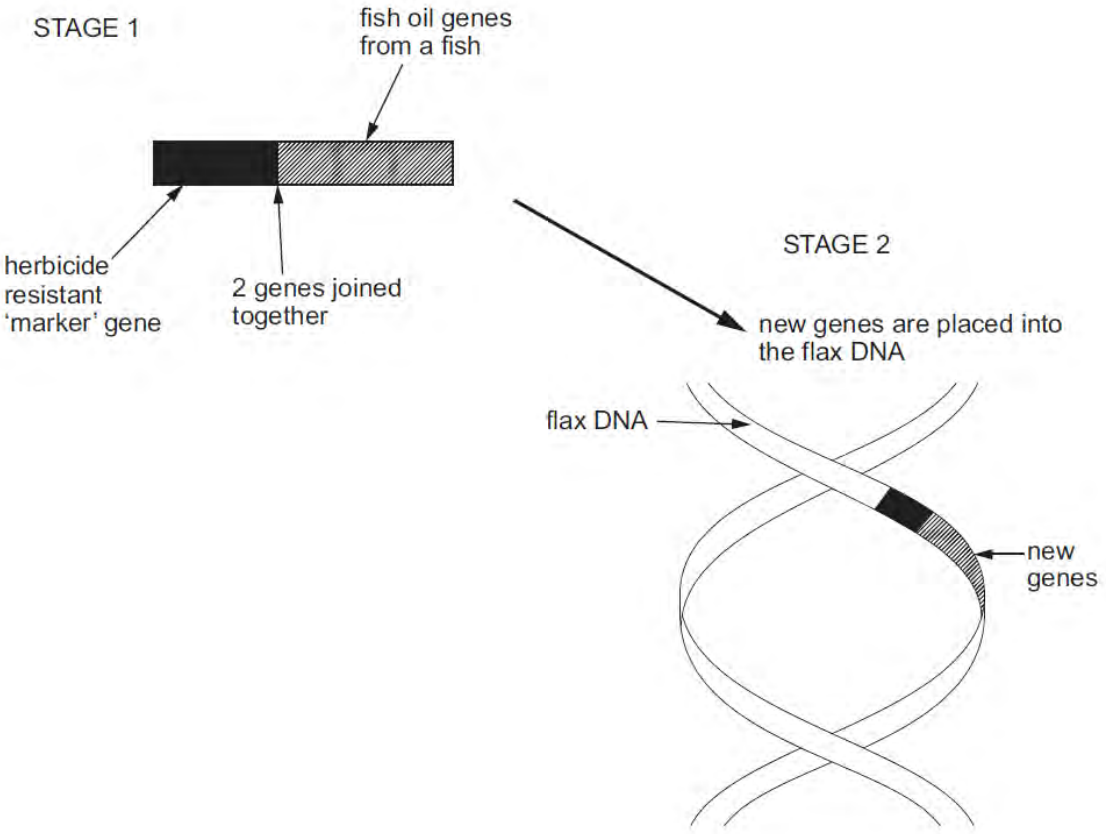
.....

7

7. The following report appeared in a scientific journal in 2015:

FISH OIL FROM FLAX SEEDS

The production of fish oils is controlled by genes. Scientists have artificially transferred these genes to the DNA of flax plants. During this transfer, a herbicide-resistant 'marker' gene is joined to the fish oil genes and is also transferred to the DNA of the flax plant. The plant is now able to produce fish oil in its seeds.



(a) The scientists needed to know if the genes for fish oil production were successfully added to the DNA of the flax plant. Suggest how the 'marker' gene helps them to find out. [2]

.....

.....

.....

(b) Fish oils are recommended as part of a healthy diet to protect against heart disease. The world market for them is very large. Suggest **two** advantages of obtaining fish oils from GM flax seeds rather than from fish. [2]

(I) .....

(II) .....

(c) The cultivation of the four main GM crops in 2002 and 2006 is shown in the table for the USA.

	Area of land for growing crops (Thousands of Hectares)			
	2002		2006	
Crop	**Non GM**	**GM**	**Non GM**	**GM**
soya bean	72	37	50	45
cotton	34	7	29	13
rapeseed	25	3	24	4
maize	140	12	116	36

(i) What does the data in the table suggest about a possible change of attitude of Americans to growing GM crops between 2002 and 2006? [1]

.....

.....

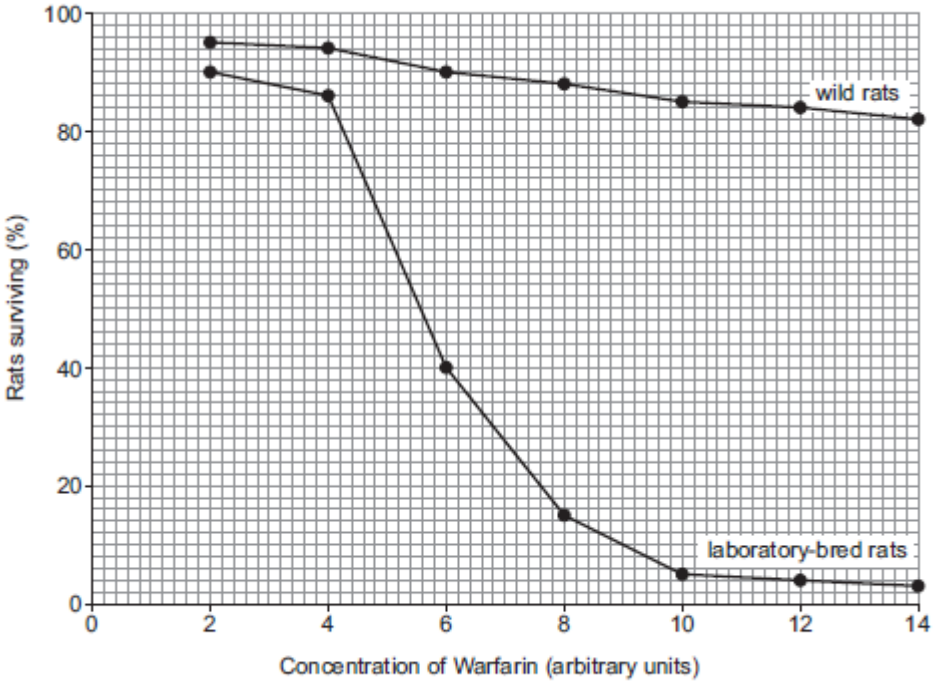
(ii) Calculate the percentage increase in GM maize production in 2006 compared to 2002. Show your working. [2]

percentage increase in GM maize production = ... %

7

8. In the 1960s, some wild rats in Wales were found to be resistant to the concentrations of Warfarin that normally killed them. Scientists investigated the effect of Warfarin on resistant and non-resistant rats.

They used samples captured from the population in the wild together with non-resistant rats which had been bred in the laboratory. They noted the percentage that survived various concentrations of Warfarin. The results are shown in the graph below.



(a) What basic assumption is being made by the scientists regarding the wild rats used in this investigation? [1]

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.....

.....

(b) How would you modify the procedure in order to increase confidence in the conclusion? [2]

.....

.....

.....

(c) Compare the effect of increasing the concentration of Warfarin on the wild rats and the laboratory-bred rats. [2]

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.....

.....

(d) Calculate the percentage difference in survival between the wild rats and the laboratory-bred rats at a Warfarin concentration of ten arbitrary units. [1]

percentage difference = ... %

(e) Today, most rats in Britain have developed resistance to Warfarin. Explain how resistance to Warfarin has evolved and spread throughout populations of rats since the 1960s. [4]

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(f) State **one** advantage of using laboratory-bred rats in this investigation. [1]

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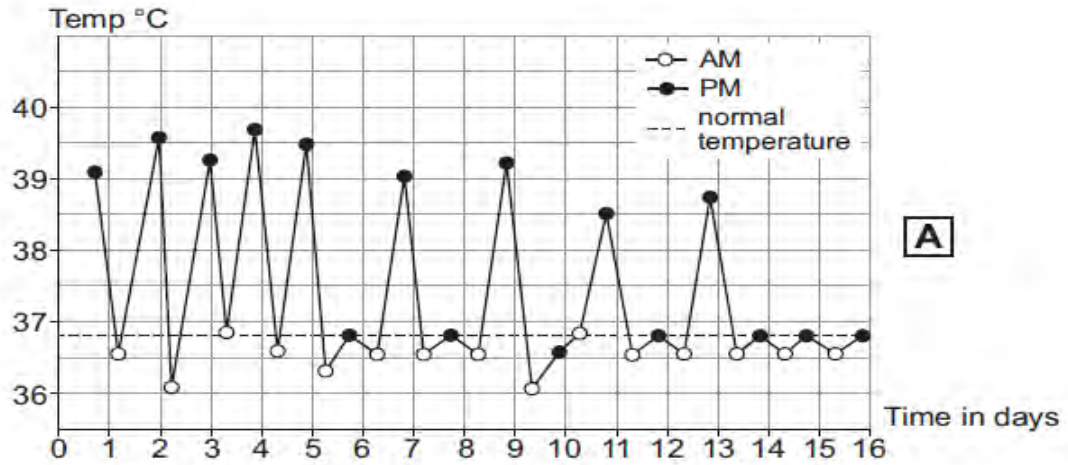
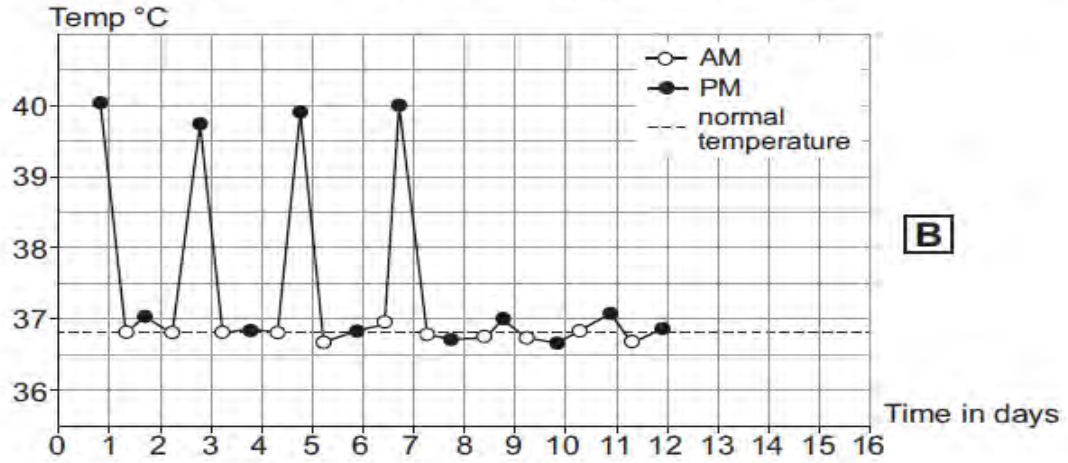
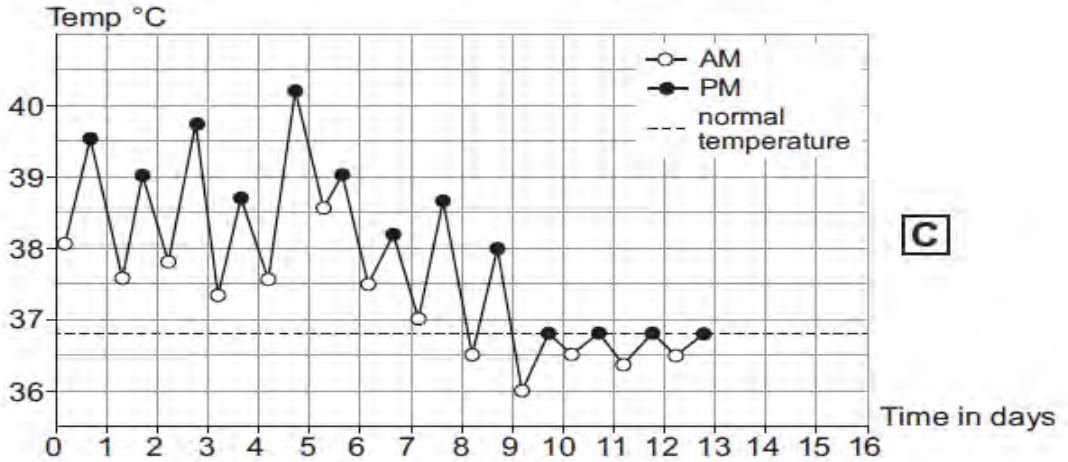
11

9. Malaria can occur in three forms, each caused by a different species of single-celled organism. The charts below show temperature charts of patients suffering from each of the three types of malaria, **A**, **B** and **C**. The charts record the changes in body temperature over sixteen days. A person suffers fever when the body temperature rises **above normal body temperature**.







(a) Use the information given, to state which chart shows: [6]

(i) the most regular pattern of fever every three days;

.....

(ii) the most irregular pattern of fever;

.....

(iii) the highest body temperature;

.....

(iv) the most frequent temperatures below normal;

.....

(v) the patient recovering quickest from an attack of malaria;

.....

(vi) the greatest range of difference in temperature.

.....

(b) Fever occurs when the causative malarial organism bursts out of red blood cells. How many times does this occur in type **B**? [1]

.....

(c) Name:

(i) the causative agent of malaria; [1]

.....

(ii) the organism which spreads malaria from one human to another. [1]

.....

9

10. The hepatitis B virus causes a life-threatening disease. Vaccines used against this virus are very expensive. Scientists have genetically engineered bananas to produce an antigen, found on the hepatitis B virus. The banana 'vaccine' produced in this way costs just a few pence per dose.

The hepatitis antigen has also been produced by genetically engineering potatoes. It has produced an immune response in rats which eat the genetically engineered raw potatoes.

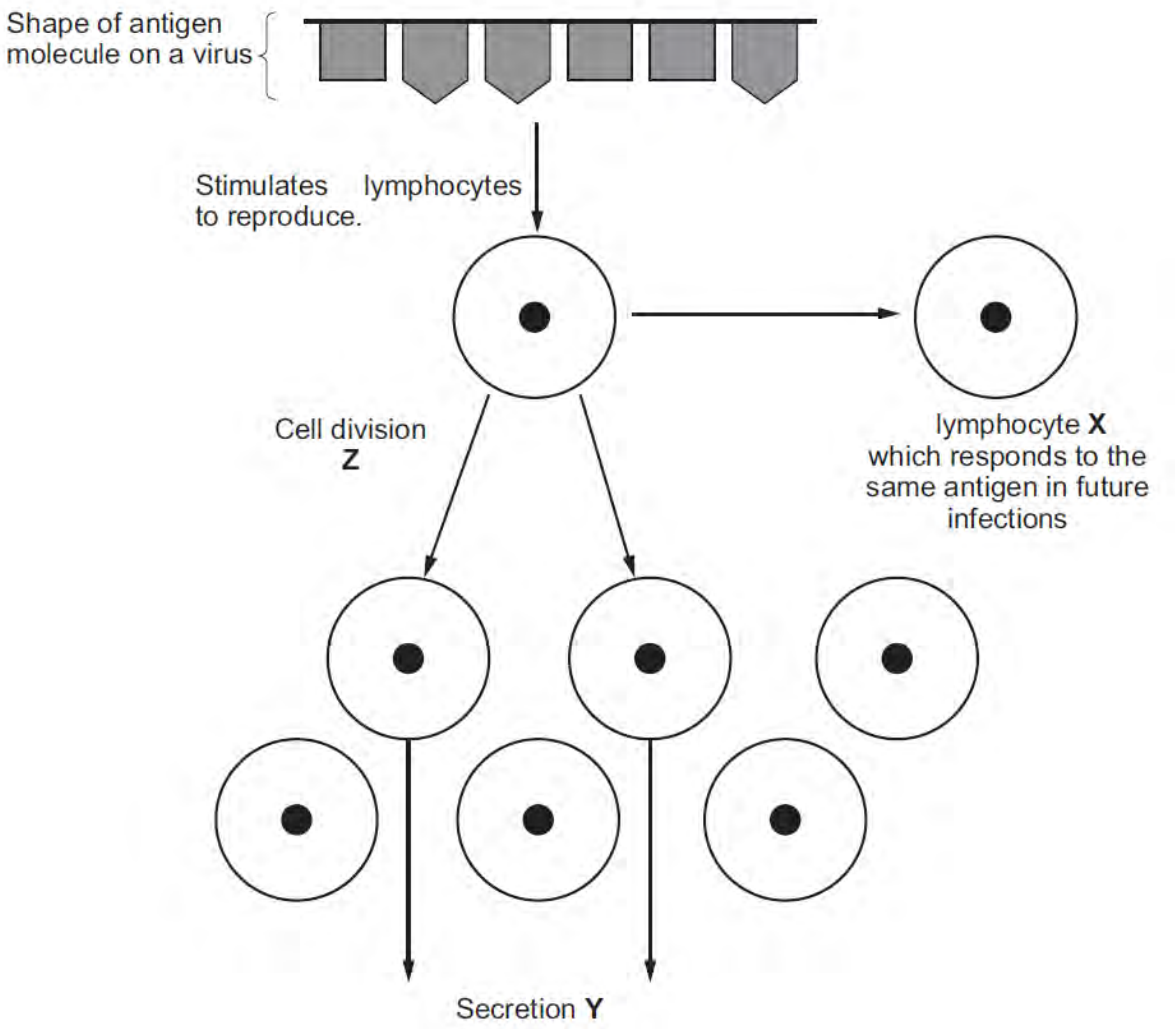
(a) Antigens are proteins. State why boiled genetically engineered potatoes would be of no use in giving immunity to humans. [1]

.....

(b) Suggest **one** advantage of using genetically engineered bananas rather than normal vaccines in developing countries. [1]

.....

(c) The following diagram shows how the immune response is stimulated by antigens.



Name: [3]

(i) the type of lymphocyte **X** .....

(ii) the secretion **Y** .....

(iii) the type of cell division **Z** .....

(d) In some countries, vaccination is compulsory for all people. Suggest **one** reason why some people object to this legislation. [1]

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.....

6

11. Chinese mitten crabs (*Eriocher sinensis)*, were accidently introduced to the river Thames in England in 1935. By 2014 they had spread as far as Scotland. Chinese mitten crabs eat invertebrates and decaying plants and animals. They compete with native species of crayfish. The result of the invasion has been a reduction in biodiversity.

(a) (i) Why is the Chinese mitten crab regarded as an alien species? [1]

.....

.....

(ii) What is meant by the term, *biodiversity*? [2]

.....

.....

(b) When the Chinese mitten crabs were recorded in a river near a crayfish farm, the owner of the farm wanted to know how many were there.

Scientists estimated the population size as follows:

- Cages were baited and placed in the river and left for two days.
- After two days, the scientists found 45 crabs in the cages, these were marked with water-proof paint and released back into the river.
- The cages were re-baited, placed in the river and visited two days later.
- At this time 47 crabs were counted and found to include 29 that had been marked two days before.

If **Q** is the number of crabs in the first sample, **R** the number in the second sample and **S** the number of marked crabs in the second sample, the following equation could be used to estimate the population size:

$$\frac{\mathbf{Q} \times \mathbf{R}}{\mathbf{S}}$$

(i) Use the equation to estimate the population of crabs in the river. [2]

population size = ……

(ii) Give **three** sources of error in this method of estimating the population size. [3]

I .....

II .....

III .....

8

12. Describe the function of Antidiuretic Hormone (ADH) in the maintenance of a constant volume of water in the body. [6 QER]

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END OF PAPER