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H

GCSE (9–1) Biology A (Gateway Science)

J247/04 Paper 4, B4–B6 and B7 (Higher Tier)

Monday 11 June 2018 – Morning

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator
- an HB pencil

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of the booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 Which is a **chemical** defence of plants?

A Antimicrobial substances

B Cell walls

C Leaf cuticles

D Thorns

Your answer ☐ **[1]**

2 Which is the **most** effective treatment for HIV?

A Antibiotics

B Antigens

C Antiseptics

D Antivirals

Your answer ☐ **[1]**

3 Heart disease kills thousands of people in Britain every year.

Why is it difficult to decide why a person gets heart disease?

A Heart disease is caused by the interaction of many factors.

B It is not possible to measure any of the risk factors.

C Many microorganisms cause heart disease.

D There is no genetic link to heart disease.

Your answer ☐ **[1]**

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4 Which of these processes can produce a **new** allele?

A A change in the environment

B Asexual reproduction

C Mutation

D Selective breeding

Your answer ☐ **[1]**

5 Which of these is an adaptation of white blood cells?

A The ability to make clotting enzymes.

B They can change their shape to pass out of capillaries.

C They can synthesise antibiotics.

D They lack a nucleus.

Your answer ☐ **[1]**

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6 The table shows changes in the forest cover in some continents of the world.

Continent	Total forest cover (millions of hectares)		
	1990	**2000**	**2005**
Africa	699	656	635
Asia	574	567	572
Europe	989	998	1001
South America	891	853	832

What is the approximate percentage decrease in the area of South America covered by forest between **1990** and **2005**?

A 0.9%

B 1.1%

C 6.6%

D 7.1%

Your answer ☐ **[1]**

7 A scientist is estimating the number of rabbits in a field.

He has eight different estimates, 12, 12, 13, 15, 17, 19, 22 and 26.

Which is the median value for his estimates?

A 8

B 12

C 16

D 17

Your answer ☐ **[1]**

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8 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]**

9 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]**

10 Why is the process of meiosis important in making gametes?

A The cells produced are diploid.

B The cells produced are genetically identical.

C The cells produced are much smaller in size.

D The cells produced have half the number of chromosomes.

Your answer ☐ **[1]**

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11 What is a genome?

A A description of the number of chromosomes in an organism.

B All the proteins that one organism can produce.

C A store of seeds to preserve genetic variation.

D The entire genetic material of an organism.

Your answer ☐ **[1]**

12 A harmful protein can cause pain in the joints. A new treatment is being developed to stop the protein causing pain.

What effect would this treatment have on the person's phenotype and genotype?

A Changes both the phenotype and genotype

B Changes the genotype only

C Changes the phenotype only

D No change to their phenotype or genotype

Your answer ☐ **[1]**

13 Which statement **best** describes the development of the theory of evolution by natural selection?

A Darwin and Mendel working together

B Darwin and Wallace working independently

C Darwin and Wallace working together

D Mendel working on his own

Your answer ☐ **[1]**

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14 Females aged between 12 and 13 are offered a vaccination for the human papilloma virus (HPV).

Which statement describes the reason for offering this vaccine?

A Contracting HPV greatly increases the risk of developing AIDS.

B Having the vaccination will prevent cervical cancer.

C HPV can be treated with antibiotics but cervical cancer cannot.

D HPV has been linked to about 70% of cases of cervical cancer.

Your answer ☐ **[1]**

15 Which approach would be used to classify organisms by phylogenetics?

A Compare the structure of the organisms' internal organs

B Look at DNA base sequences

C Look at the behaviour of the organisms

D Study fossils

Your answer ☐ **[1]**

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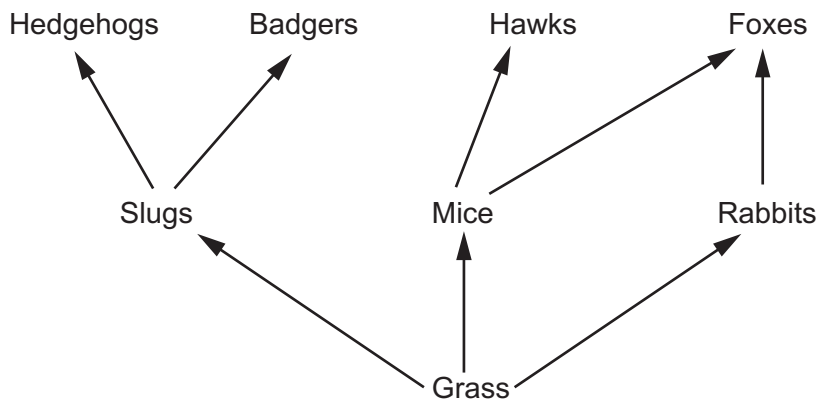
SECTION B

Answer **all** the questions.

16 The diagram shows part of a food web from a grassland.



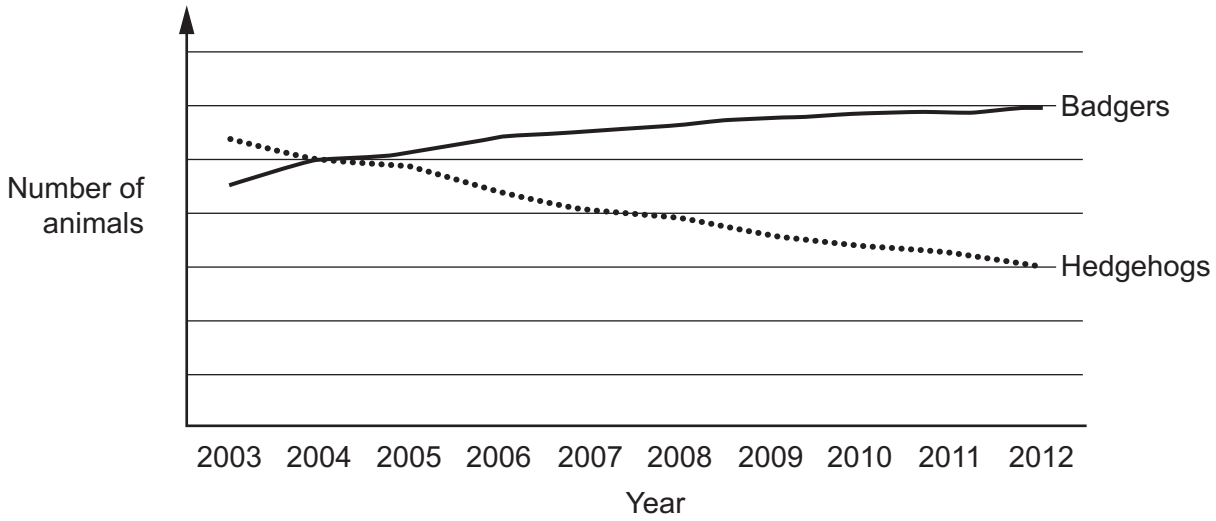
(a) How many secondary consumers are shown in this food web?

..... **[1]**

(b) A survey was set up to see if the number of badgers and hedgehogs has changed in the UK.

The number of badgers and hedgehogs were counted in different areas each year from 2003 to 2012.

The graph shows the results.



Use the food web to suggest an explanation for the change in the number of hedgehogs shown in the graph.

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..... **[2]**

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(c) Hedgehogs are covered in small spines.

When they are frightened they often roll up into a ball and keep still.

(i) In country areas, where badgers live, this is an advantage to the hedgehogs.

In cities, where there are many roads, this is a disadvantage.

Explain these two conclusions.

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(ii) Scientists have noticed that a new type of hedgehog is increasing in numbers in cities.

These hedgehogs do not roll up. They run away when frightened. The scientists think that genes control this behaviour.

Explain how this type of hedgehog may become more common in cities.

Use ideas about natural selection.

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..... **[4]**

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17 A student investigates the plants growing underneath a tree.

He lays out a tape measure on the ground, starting at the tree. He then places a quadrat on the ground.

He measures the percentage of the ground in the quadrat that is covered by plants. He repeats this every metre away from the tree.

The table shows his results.

Distance from the tree (m)	Percentage of ground covered by plants (%)
1	10
2	15
3	18
4	22
5	50
6	58
7	62
8	64

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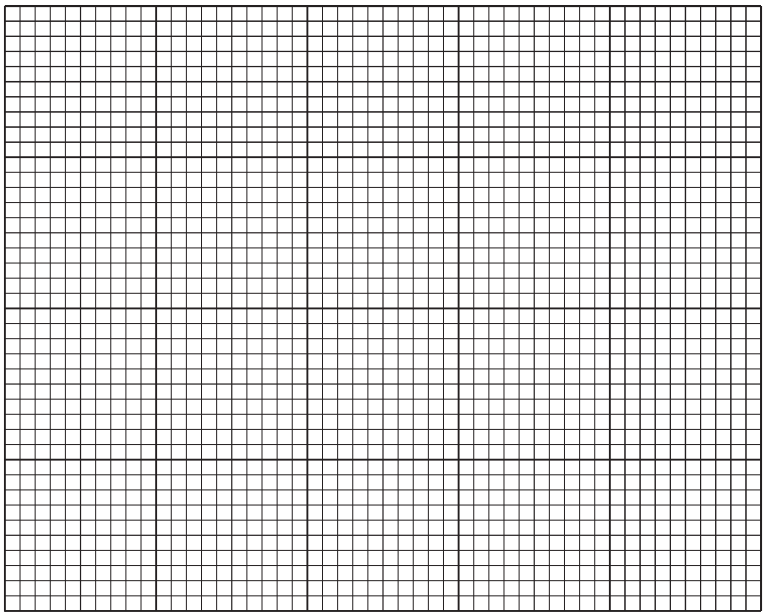
(a) Plot a graph of the student's results and draw a line of best fit.



[5]

(b) The student thinks that shade from the tree is affecting the plants.

Explain how the student's results show this.

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..... **[4]**

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18 Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

(a) Explain the meaning of these terms.

Gene .....

.....

Allele .....

..... **[2]**

(b) **(i)** Two people who are heterozygous for retinitis pigmentosa are expecting a baby.

Draw a genetic diagram to calculate the probability that the baby will have the condition.

Use R for the normal allele and r for the allele for retinitis pigmentosa.

Answer = ... **[3]**

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(ii) If the baby has retinitis pigmentosa, it will have normal colour vision but will not be able to see well in dim light.

Explain why.

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..... **[3]**

(c) **(i)** Explain why stem cells could be used as a treatment for this condition.

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..... **[2]**

(ii) Why is it an advantage to use stem cells from the patient rather than from another person?

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..... **[1]**

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19 The data in the table shows the ratio of males to females in England and Wales.

	Ratio of males to females in England and Wales
At birth	105 males : 100 females
Average over the whole population	98 males : 100 females

(a) Describe how sex is determined in humans.

You may use a genetic diagram in your answer.

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..... **[2]**

(b) In 2015 there were approximately 698 000 babies born in England and Wales.

Calculate how many of these were male.

Answer = ... **[2]**

(c) There are more females than males living in England and Wales as an average over the whole population.

Suggest **one** reason why there are more females.

.....

..... **[1]**

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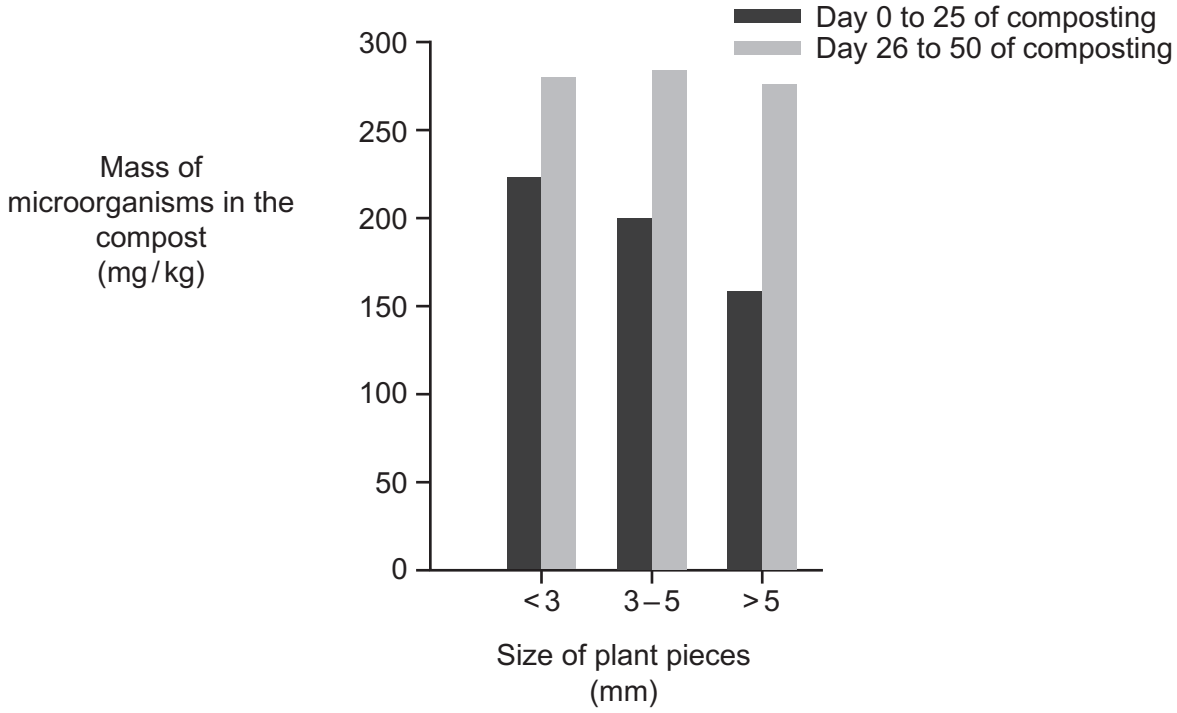
20 This machine helps shred plants for a compost heap.

The machine can shred plants into three different sizes.

This graph is in the instruction booklet for the machine.



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(a) Which size of plant pieces is best for making compost?

Explain your answer.

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..... **[3]**

(b) The size of the plant pieces has an effect on the number of microorganisms in the compost.

Suggest why.

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..... **[2]**

(c) The decomposition of dead plants and animals is an important process for ecosystems.

Explain why.

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..... **[3]**

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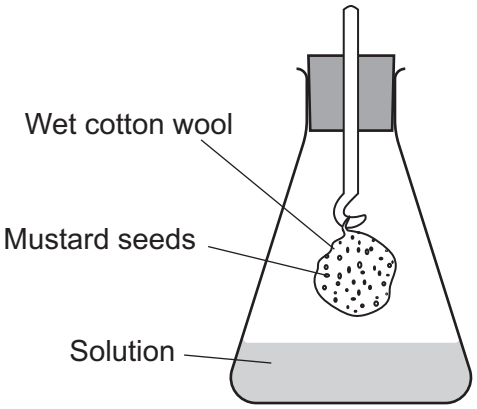
21 A student investigates the effect of acid rain on seed growth.

She dips some cotton wool in 20 cm^3 of water. She then puts 20 mustard seeds onto the cotton wool and places it inside a flask. The student puts the remaining water into the flask with the cotton wool.

She repeats this four more times, each time using different solutions of water and dilute sulfuric acid.

One of the flasks is shown in the diagram.



After **8 days** she counts how many of the seeds have germinated.

The table shows her results.

Volume of water in flask (cm^3)	**Volume of dilute sulfuric acid in flask (cm^3)**	**Number of seeds that germinated**
20	0	18
16	4	15
8	12	13
4	16	6
0	20	2

(a) What is the dependent variable in this investigation?

..... **[1]**

(b) State why the student changed the volume of water in each flask.

..... **[1]**

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(c) The student kept each flask at the same temperature during the experiment to make it a fair test.

Explain **one** other reason why she kept each flask at the same temperature.

..... **[1]**

(d) Explain what this experiment shows about the effect of acid rain on seed germination.

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..... **[2]**

(e) The student used a formula to describe the germination of seeds called the viability index (**VI**).

(i) For the seeds in 20 cm^3 of sulfuric acid, the mean root length was 5 mm and the mean shoot length was 2 mm.

Calculate **VI** for these seeds.

Use the equation:
VI = mean root length × mean shoot length × percentage of seeds that germinated

Answer = ... **[2]**

(ii) Using **VI** is a better way of comparing the effects of acid rain than just using the number of seeds germinated.

Explain why.

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..... **[2]**

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22 Methamphetamine is a drug.

Scientists are investigating the use of antibodies as a treatment to control the negative effects of the drug.

(a) What is an antibody?

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..... **[2]**

(b) As the human body does not naturally make antibodies against methamphetamine, scientists are using mice to make antibodies.

Describe how large amounts of the antibodies can be made using monoclonal antibody techniques.

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(c) These antibodies would **not** work against other drugs.

Explain why.

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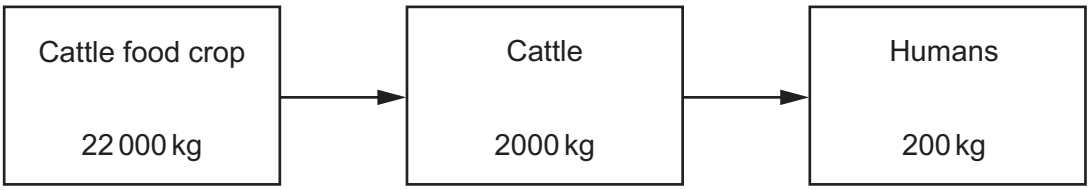
23 The diagram shows the flow of biomass through an agricultural food chain.



(a) **(i)** Calculate the percentage efficiency of transfer of biomass between the cattle food crop and humans.

Answer = ... % **[2]**

(ii) Write down **two** ways that biomass is lost from the food chain.

1 .....

2 .....
[2]

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(b)* High levels of light intensity can damage plants. To prevent damage, plants have a protection mechanism.

When light intensity levels get **too high**, the protection mechanism switches on. This stops the plant absorbing too much light.

When the light intensity drops to safe levels, the protection mechanism switches off **slowly**.

Explain why this mechanism would **reduce** the biomass available to humans.

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(c) 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.

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..... **[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.

People are more likely to support genetic modification involving extra copies of the plant gene, rather than inserting the bacterial gene.

Suggest reasons why.

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..... **[2]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

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