OCR
Oxford Cambridge and RSA

Tuesday 16 May 2023 – Morning

GCSE (9–1) Biology B (Twenty First Century Science)

J257/03 Breadth in biology (Higher Tier)

Time allowed: 1 hour 45 minutes

H

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

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

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

1 (a) (i) Complete the table to compare cellular aerobic and anaerobic respiration in humans.

Tick (✓) the correct boxes in each row.

Process	It requires glucose	It requires oxygen	It produces carbon dioxide	It produces water	It produces lactic acid
Aerobic respiration					
Anaerobic respiration					

[3]

(ii) Which statement about respiration is correct?

Tick (✓) **one** box.

Aerobic respiration produces more ATP than anaerobic respiration. ☐

Anaerobic respiration produces more ATP than aerobic respiration. ☐

Both aerobic and anaerobic respiration produce the same amount of ATP. ☐

Neither aerobic or anaerobic respiration produces ATP. ☐

[1]

(b) Heart muscle contains approximately 5000 mitochondria in every cell.

(i) Suggest why heart muscle cells need so many mitochondria.

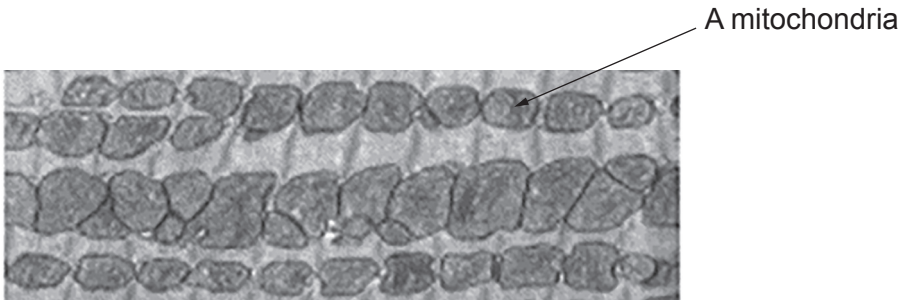
.....

.....

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

(ii) The image shows the mitochondria in a section of heart muscle. The mitochondria are different sizes.

One of the mitochondria is labelled.



Estimate the number of mitochondria in this image.

Number of mitochondria = ... **[1]**

2 The table shows the percentage of land covered in rainforest in a country.

Year	Percentage of land covered in rainforest (%)
1940	75
1950	72
1961	53
1977	31
1983	26
1987	21
1997	42
2000	45
2005	50

(a) (i) Describe the trend in the data.

.....

.....

.....

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

(ii) The government of the country started to protect areas of the rainforest and even paid people to regrow it.

Suggest when the government started to do this.

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

(iii) Predict when the rainforest will reach the percentage land coverage seen in 1940, if it increases by the same rate as shown from 1997 to 2005.

Predicted year = ... **[1]**

(b) A rainforest is one of the most biodiverse areas of the Earth.

(i) Suggest why the government wants to continue to regrow the rainforest.

.....

.....

.....

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

(ii) Suggest **two** challenges of regrowing the rainforest.

1. .....

.....

2. .....

.....

[2]

(c) Some plants in the rainforest reproduce sexually, but others reproduce asexually.

Which statements describe sexual reproduction, and which describe asexual reproduction?

Tick (✓) **one** box in each row.

	Sexual reproduction	**Asexual reproduction**
Occurs at a slower rate		
Offspring are all susceptible to the same diseases		
Only one parent is needed		
Provides offspring with genetic variation		

[3]

3 **(a)** Describe the relationship between health and disease.

.....

.....

.....

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

(b) Complete the sentences about the immune system. Use words from the list.

antibodies	**antigens**	**attack**	**digest**	**memory**
mitochondria	**pathogens**	**red**	**vaccines**	**white**

The immune system protects us against disease-causing ..... .

White blood cells from the immune system have receptors that recognise antigens on the surface of pathogens.

They act in three ways to protect us:

1. Ingest and ..... pathogens.

2. Produce ..... to disable the pathogens or tag them for attack by other white blood cells.

3. ..... cells stay in the body to make antibodies quickly upon re-infection.

[4]

(c) Cholera is a disease caused by a bacterium. Diarrhoea is a symptom of cholera. People with cholera can lose up to 1 litre of water per hour.

Why is this a concern?

.....

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

(d) Cholera is a communicable disease.

Suggest **one** way to prevent transmission of cholera between people.

.....

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

(e) Identify **three** similarities between a cholera cell and a eukaryotic cell.

1 .....

2 .....

3 .....

[3]

4 **(a)** Which statements about cell division are **true**, and which are **false**?

Tick (✓) **one** box in each row.

Statement	True	False
During interphase the number of chromosomes double.		
Gametes are produced by mitosis.		
In meiosis there are two cell divisions.		
Interphase occurs in both mitosis and meiosis.		

[2]

(b) Why is it important that the number of chromosomes halves when gametes are formed?

.....

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

(c) Describe how a cancer tumour forms.

.....

.....

.....

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

5 **(a)** The components of the nervous system work together allowing it to function.

Draw lines to connect each **component** with its correct **role in nervous system functioning**.

Component	Role in nervous system functioning
Effector	Detects stimuli and initiates an electrical impulse in the sensory neuron
Motor neuron	Is a gland or a muscle that produces the desired response
Sensory neuron	Transmits the electrical impulse to the central nervous system
Sensory receptor	Transmits the electrical impulse from the central nervous system to the effector

[3]

(b) Wobblers disease in dogs is a condition that affects the spinal cord.
- It can be caused by compression of the spinal cord.
- It causes problems with the functioning of the motor neurons.

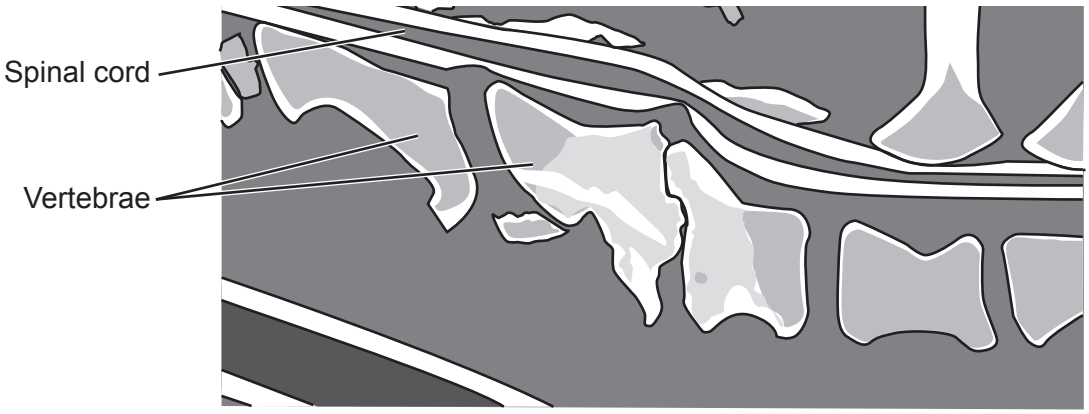
Suggest **one** symptom that a vet may look for in dogs with wobblers disease.

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

(c) When diagnosing wobblers disease vets use imaging techniques. They look for areas where the spinal cord appears to be squeezed by the vertebrae of the spine (backbone).

Fig. 5.1 shows an image a vet would look at where the spinal cord is squeezed by the vertebrae.

Fig. 5.1



Draw an arrow on **Fig. 5.1** to an area where you think there is evidence of wobblers disease in this dog. **[1]**

(d) Surgery is the only treatment option for dogs with wobblers disease.

Suggest **one** factor that would need to be considered when deciding whether to operate.

.....

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

(e) Some dog owners train their dogs in dog agility. The dogs are trained to react rapidly to certain commands.

Explain why this rapid response is not classed as a reflex response.

.....

.....

.....

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

6 Horses can develop a condition called laminitis.

Excess carbohydrate in a horse's diet is one risk factor.

(a) Explain why horses that are at risk of laminitis should spend less time in fields eating grass.

.....

.....

.....

.....

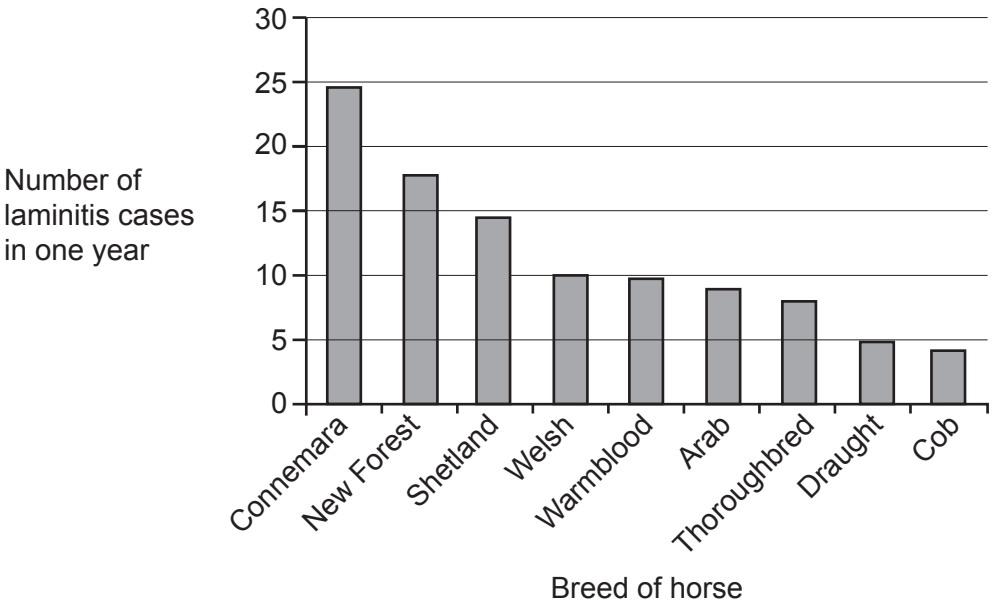
.....

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

(b) There are other factors that increase the risk of a horse developing laminitis:

- the breed of horse
- if the horse has a medical condition called equine metabolic syndrome (EMS)
- if the horse is overweight.

The graph shows data about the number of laminitis cases in one year for different breeds of horse.



The table provides some information about four horses.

Horse	Breed	Body condition
A	Arab	Normal weight and has EMS
B	Connemara	Normal weight
C	New Forest	Overweight and has EMS
D	Thoroughbred	Slightly overweight

Which horse is most at risk of developing laminitis?

Explain your answer.

Horse .....

Explanation .....

.....

.....

[2]

(c) Blood glucose concentration is controlled by the same hormones in horses and humans.

Name a hormone that controls the blood glucose concentration of the horses' blood.

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

(d) When a horse eats grass, not all of the biomass that makes up the grass becomes part of the horse's biomass.

Explain this statement.

.....

.....

.....

.....

.....

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

7 A student reads an article that states one way to measure a person's fitness is to measure their recovery rate after exercise.

(a) Describe a method the student could use to work out a person's recovery rate.

.....

.....

.....

.....

.....

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

(b) Suggest the number of people the student should use in their investigation to determine if recovery rates are different for different people.

Justify your answer.

.....

.....

.....

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

8 A new contraceptive pill called Lovima is now available in the UK.

It can be purchased online without a prescription from a doctor.

Before the pill is sent to the consumer, the online pharmacy asks several questions.

(a) (i) Suggest **one** health-based question the pharmacy may ask the consumer before they agree to send them this contraceptive pill.

.....

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

(ii) Identify **one** risk and **one** benefit of being able to buy Lovima **without** seeing a doctor.

Risk .....

.....

Benefit .....

.....

[2]

(b) Lovima is a progesterone-only contraceptive pill.

Explain how this contraceptive pill prevents pregnancy.

.....

.....

.....

.....

.....

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

(c) Progesterone is a hormone.

Which **three** describe the principles of hormonal communication?

Tick (✓) **three** boxes.

Hormones are always fast-acting. ☐

Hormones are always slow-acting. ☐

Hormones bind to receptors on effectors. ☐

Hormones provide slower, longer-lasting responses. ☐

Hormones are secreted by glands. ☐

Hormones are transported by neurons. ☐

[2]

(d) Some hormones are made from proteins, others are made from lipids.

Complete the sentences to describe how to test for the presence of proteins, and for lipids.

Put a (ring) around each correct option.

To test for the presence of proteins we use **benedicts / biuret / ethanol**. If protein is present, the sample will turn **blue / cloudy / purple**.

To test for the presence of lipids we use **benedicts / biuret / ethanol**. If lipid is present, the sample will turn **blue / cloudy / purple**.

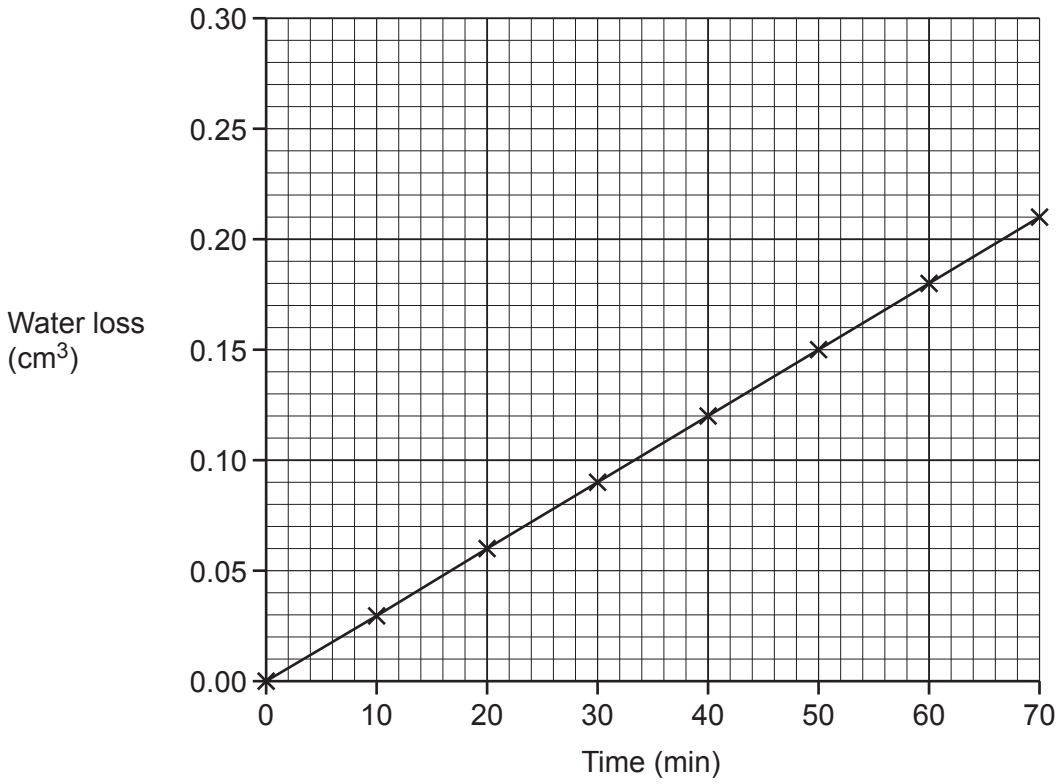
[2]

9 A student investigates the rate of transpiration in **two** different species of plant, plant **A** and plant **B**.

The student uses a potometer to collect the data in the table.

Time from the start of the investigation (min)	Plant A water loss (cm^3)	Plant B water loss (cm^3)
0	0.00	0.00
10	0.03	0.04
20	0.06	0.09
30	0.09	0.13
40	0.12	0.16
50	0.15	0.20
60	0.18	0.24
70	0.21	0.28

The student plots the data for plant **A** on the graph.



(a) Plot the data for plant **B** on the graph. **[2]**

(b) Calculate the rate of water loss for plant **A**.

Rate of water loss ..... cm^3 / min **[2]**

(c) What conclusion can be made from the data?

.....

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

(d) Explain why an increase in temperature will increase the transpiration rate for both species of plant.

.....

.....

.....

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

10 Haemochromatosis is a recessive hereditary disease. It causes iron to build up in the body over many years.

People with this disease begin to show symptoms between the ages of 30 and 60.

(a) Jane is 31, and she has started to develop symptoms of the condition.

Neither of her parents has the disease.

Calculate the probability that Jane has haemochromatosis.

Use a Punnett square.

Probability = ... **[3]**

(b) If detected early those with the condition are less likely to have serious health problems.

Jane's sister is 24.

Explain why she decides to have a genetic test.

.....

.....

.....

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

(c) There are three common variations that cause this condition.

The table shows the number of people with each of the three common variations.

Variation	Number of people with this variation
C282y / C282y	9 in 10
C282y / H63d	5 in 100
H63d / H63d	5 in 100

It is estimated that 1 in 150 people in England have haemochromatosis.

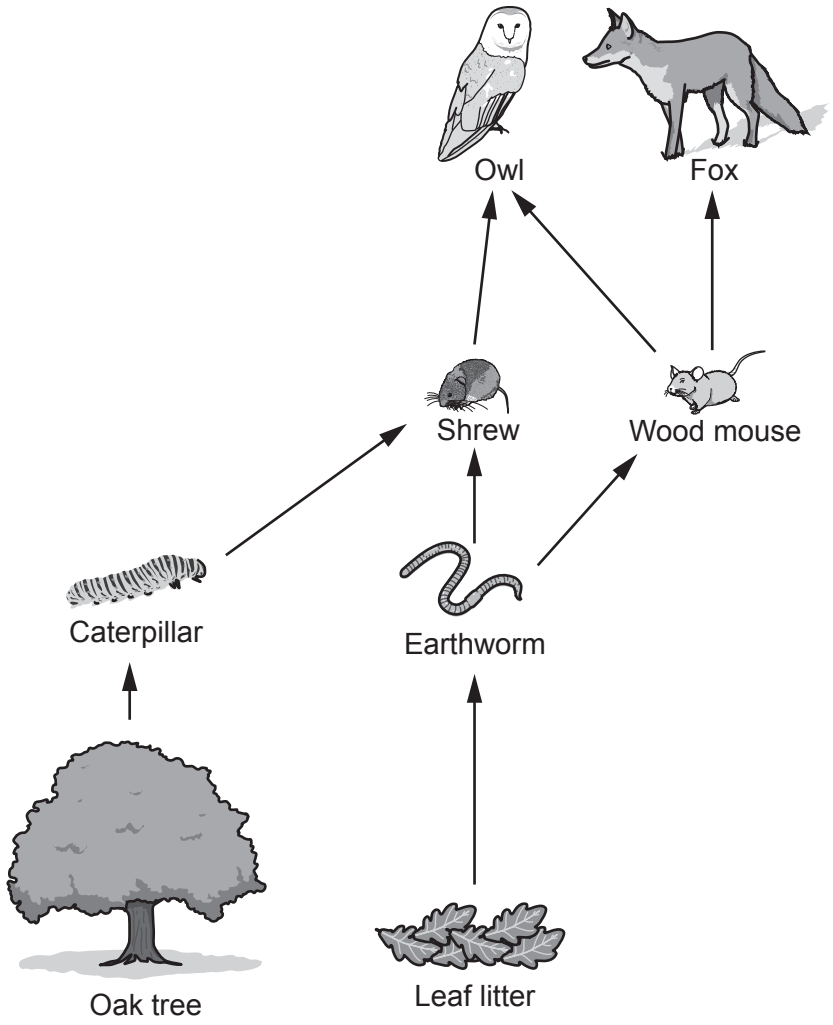
The population in England is 56 500 000.

Calculate the number of people in England that are likely to have the H63d / H63d variation.

Give your answer to the nearest **whole** number.

Number of people = ... **[4]**

11 A food web is shown for a woodland ecosystem.



(a) Describe the differences between the organisms found at trophic level 2 and trophic level 3 in the food web.

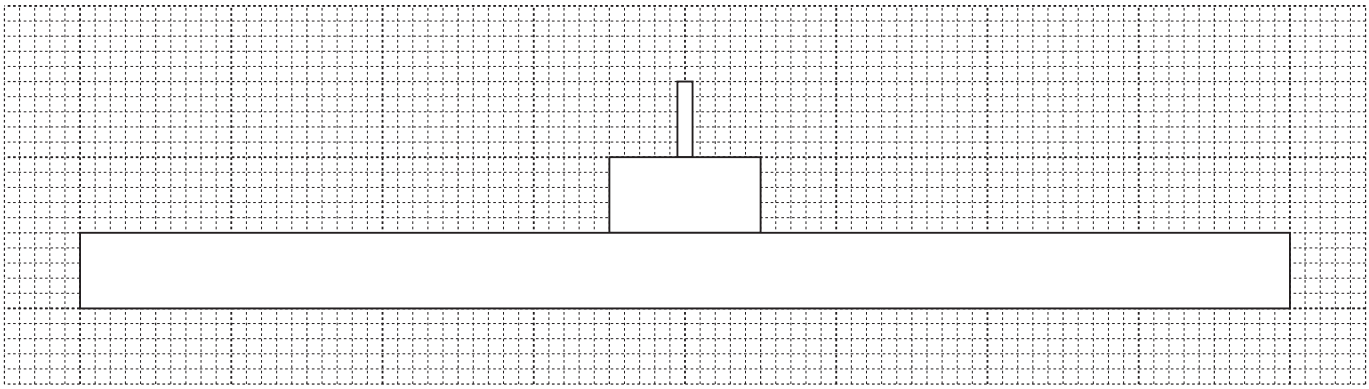
.....

.....

.....

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

(b) A pyramid of biomass is shown.
The bars are drawn to the same scale.



Calculate the percentage efficiency of biomass transfer between primary consumers and secondary consumers.

Percentage efficiency of biomass transfer = ... % **[3]**

(c) Explain why photosynthetic organisms are the source of all biomass on Earth.

.....

.....

.....

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

(d) Name **two** substances that cycle through the biotic and abiotic components of an ecosystem.

1 .....

2 .....

[1]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).