OCR
Oxford Cambridge and RSA

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# Friday 06 November 2020 – Morning

## GCSE (9–1) Combined Science B (Twenty First Century Science)

**J260/05** Biology (Higher Tier)

**Time allowed: 1 hour 45 minutes**



**You must have:**
- a ru er (cm/mm)

**You can use:**
- a sc ent f c or graph ca ca cu ator
- an HB penc



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 **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

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

Answer **all** the questions.

**1** Amaya feeds birds in her garden.

She wants to see if there is a relationship between the body mass of the bird and how often they are feeding.

**(a)** Amaya records how often she sees each bird species feeding and produces a dominance rank, as shown in the table.

The highest ranked species, the house sparrow, is seen feeding the most.

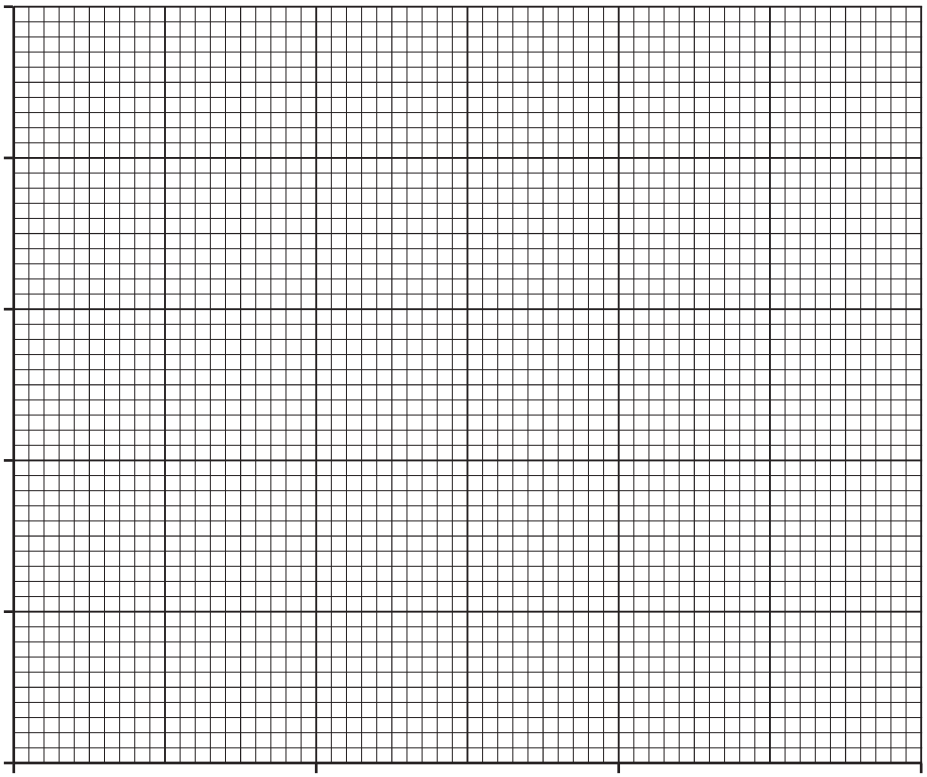
She finds out the mean body mass for each bird species from doing some research.

| **Bird species** | **Mean body mass (g)** | **Rounded body mass (g)** | **Dominance rank** |
|---|---|---|---|
| House sparrow | 27.3 | | 1 |
| Nuthatch | 21.6 | | 2 |
| Goldfinch | 15.5 | | 3 |
| Chaffinch | 21.8 | | 4 |
| Coal tit | 9.4 | | 5 |

Complete the table by rounding the mean body mass of each bird species to the **nearest whole number**. **[2]**

**(b)** **(i)** Plot a graph of dominance rank against rounded body mass, using the data in the table. **[2]**

**(ii)** Draw a line of best fit. **[1]**



**(c)** Before Amaya collected her data, she wrote the following hypothesis:

**The greater the mass of the species of bird, the more often the species will feed.**

**(i)** Do Amaya's findings **support** her hypothesis?

Use the graph to explain your answer.

.....

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

**(ii)** Explain why Amaya's findings do **not** prove her hypothesis.

.....

.....

.....

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

**(d)** The birds in Amaya's garden are part of a community that includes plants and other animal species.

The species in a community are interdependent.

Give **two** reasons why this interdependence is important for the species in the community.

1 .....

.....

2 .....

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

**2** **(a)** Complete the sentences to describe the process of photosynthesis.

Use words from the list.

You may use the words once, more than once or not at all.

| | | | |
|---|---|---|---|
| **chlorophyll** | **carbon dioxide** | **energy** | **glucose** |
| **light** | **oxygen** | **protein** | **respiration** |
| **starch** | **transpiration** | **water** | |

Photosynthesis has two main stages. The first stage requires light and ..... to split water molecules into hydrogen and the waste product ..... . Some of the waste product is used for ..... by the plant, and the excess is released from the leaves. The hydrogen is transferred to the second stage.

In the second stage carbon dioxide and hydrogen combine to make ..... . The process of photosynthesis is endothermic, and endothermic processes require transfer of ..... from the surroundings.

**[3]**

**(b)** A student is investigating the requirements of photosynthesis.

The student sets up three test tubes,**Tube A**, **Tube B**, and **Tube C**, as shown in **Fig. 2.1**, and leaves them for 24 hours in a room with windows.

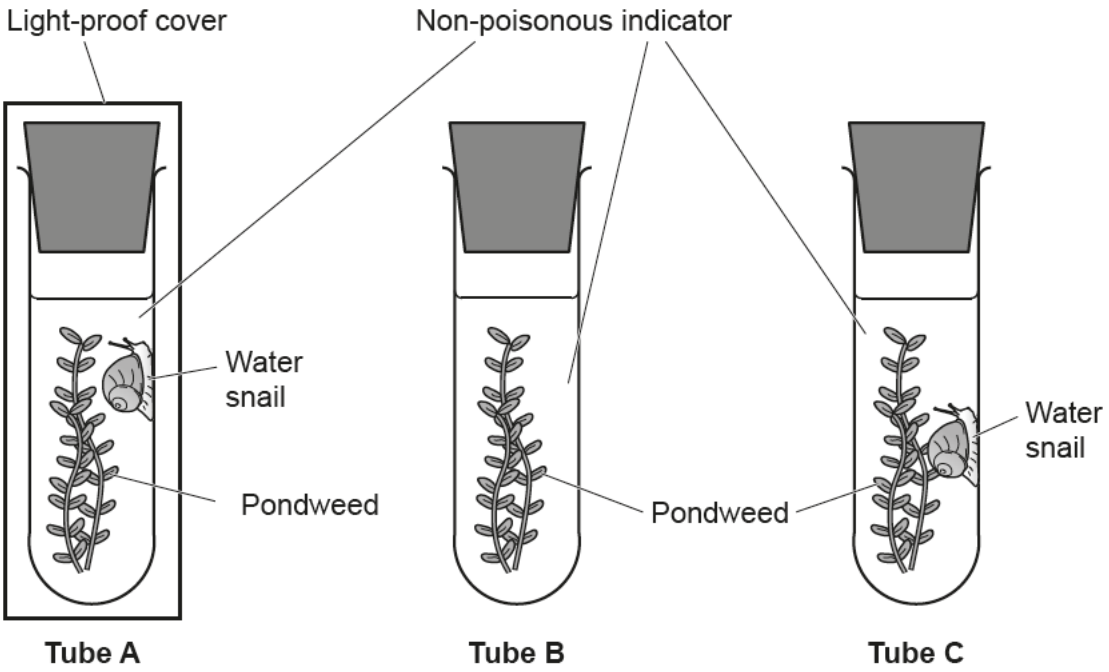



**Fig. 2.1**

**Table 2.1** shows how the indicator colour changes when the carbon dioxide level changes.

| Carbon dioxide level | Indicator colour change |
|---|---|
| Decreases | Red to purple |
| Increases | Red to yellow |

**Table 2.1**

**Table 2.2** shows the colour of the indicator at the start, and at the end after 24 hours, for each tube.

| Tube | Colour of indicator at the start | Colour of indicator at the end after 24 hours |
|---|---|---|
| **A** | Red | Yellow |
| **B** | Red | Purple |
| **C** | Red | Red |

**Table 2.2**

**(i)** Which tube, **A**, **B** or **C**, shows that carbon dioxide is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

**(ii)** Which tube, **A**, **B** or **C**, shows that light is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

**(iii)** Explain why the indicator in **Tube C** does **not** change colour.

.....

.....

.....

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

**(iv)** Identify **one** variable that should be kept the same in the student's investigation.

.....

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

**3** **(a)** Chromosomes are made from DNA.

Describe the structure of DNA.

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.....

.....

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

**(b)** Chromosomes **cannot** be seen using a light microscope if a specimen is too thick.

Why should a **thin** layer of a specimen be placed on a microscope slide to see the chromosomes?

.....

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

**(c)** **(i)** A microscope slide prepared with a specimen is placed on the stage of a light microscope.

The first step is to locate the cells and focus the image.

Which combination of objective lens and focus knob should be used for the **first** step?

Tick (✓) **one** box.

| **Objective lens** | **Focus knob** | |
|---|---|---|
| ×10 | Coarse | |
| ×4 | Coarse | |
| ×10 | Fine | |
| ×4 | Fine | |

**[1]**

**(ii)** Which combination of objective lens and focus knob will allow the cells to be seen in the **greatest** detail?

Tick (✓) **one** box.

| **Objective lens** | **Focus knob** | |
|---|---|---|
| ×10 | Coarse | |
| ×4 | Coarse | |
| ×10 | Fine | |
| ×4 | Fine | |

**[1]**

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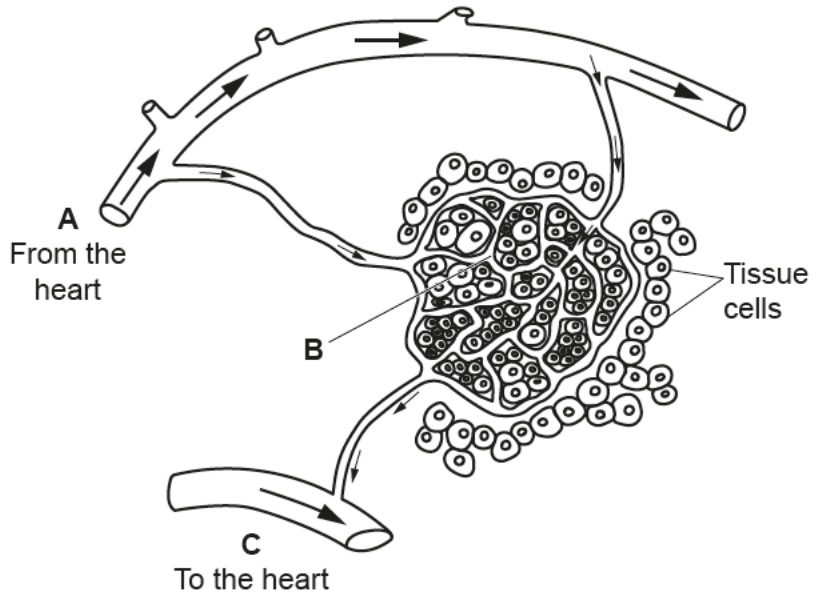
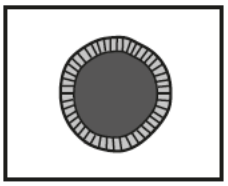
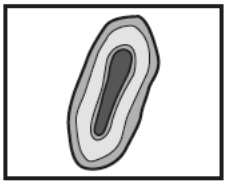
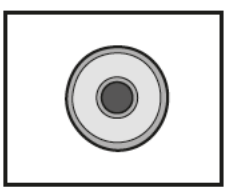
**4** The diagram shows part of the human circulatory system.

Three different types of blood vessels **A**, **B** and **C** are shown in the diagram.

The arrows on the diagram show the direction of blood flow.




**(a)** Draw lines to connect blood vessels, **A**, **B** and **C**, to their correct names and their correct drawings.

| Blood vessel | Name of blood vessel | Drawing of blood vessel |
|---|---|---|
| **A** | Artery |  |
| **B** | Capillary |  |
| **C** | Vein |  |

**[2]**

**(b)** Explain why exchange surfaces and transport systems are needed in multicellular organisms.

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.....

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

5 Coal tits are the smallest of several different species of tit that are found on mainland Sweden. They feed on insects and seeds.

The coal tits found on an isolated island are bigger than the coal tits found on mainland Sweden, as shown in **Fig. 5.1**. Coal tits are the only species of tits living on the isolated island.

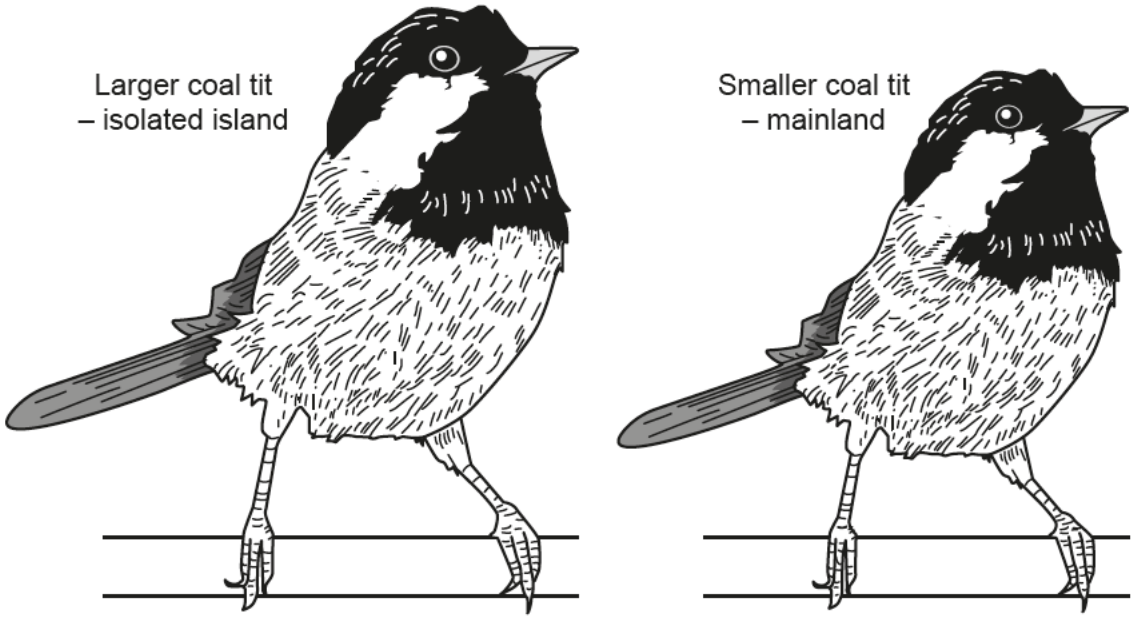


**Fig. 5.1**

**(a)** The mean length of coal tits found on the mainland is 95 mm. On the isolated island, the mean length of coal tits found is 115 mm.

Calculate the percentage increase in the mean length of coal tits that are found on the isolated island, compared to the mainland.

Give your answer to **2** significant figures.

$$\text{Percentage increase} = \frac{\text{change}}{\text{original}} \times 100$$

Percentage increase = ..... %

**[3]**

**(b)** Scientists think that the increase in size is an example of natural selection.

Explain why coal tits found on the isolated island are bigger than coal tits found on the mainland.

Use ideas about natural selection in your answer.

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.....

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

**(c)** The scientists make a hypothesis that the increase in size on the isolated island is due to a genetic change.

To test their hypothesis, they swap eggs from coal tit nests found on the island and the mainland.

**(i)** Predict the outcome of the scientist's experiment, based on their hypothesis.

.....

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

**(ii)** Explain your answer to **(c)(i)**.

.....

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

**6** **(a)** James makes a summary table of what he has been taught about communicable diseases.

Complete James's table to identify the pathogen for each communicable disease, and how the communicable disease is spread.

Tick (✓) **at least two** boxes in each column.

One has been done for you.

| | | **Athlete's foot** | **HIV/Aids** | **Influenza** | **Malaria** | ***Salmonella*** |
|---|---|---|---|---|---|---|
| **Pathogen** | **Bacterium** | | | | | ✓ |
| | **Fungus** | | | | | |
| | **Protist** | | | | | |
| | **Virus** | | | | | |
| | | | | | | |
| **Spread** | **Coughing** | | | | | |
| | **Food** | | | | | ✓ |
| | **Mosquito bite** | | | | | |
| | **Sexual contact** | | | | | |
| | **Surfaces** | | | | | |

**[4]**

**(b)** *Salmonella* bacteria can cause food poisoning.

When *Salmonella* bacteria is swallowed, it must pass through the stomach to get to the small intestine where the *Salmonella* bacteria reproduce.

Millions of other bacteria live in the small intestine.

Give **two** reasons why **large** numbers of *Salmonella* bacteria have to be swallowed for an individual to become ill.

1 .....

.....

2 .....

.....

**[2]**

**(c)** **(i)** James eats a meal containing $1 \times 10^6$ *Salmonella* bacteria.

*Salmonella* reproduce approximately every 30 minutes.

After four hours James starts to feel ill.

How many bacteria were present to make James ill?

Assume no bacteria died.

Number of bacteria = ..... **[2]**

**(ii)** Suggest **two** reasons why doctors do not usually give antibiotics to people with *Salmonella*.

1 .....

.....

2 .....

.....

**[2]**

**(d)** Give **two** advantages of treating communicable diseases with medicines.

1 .....

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2 .....

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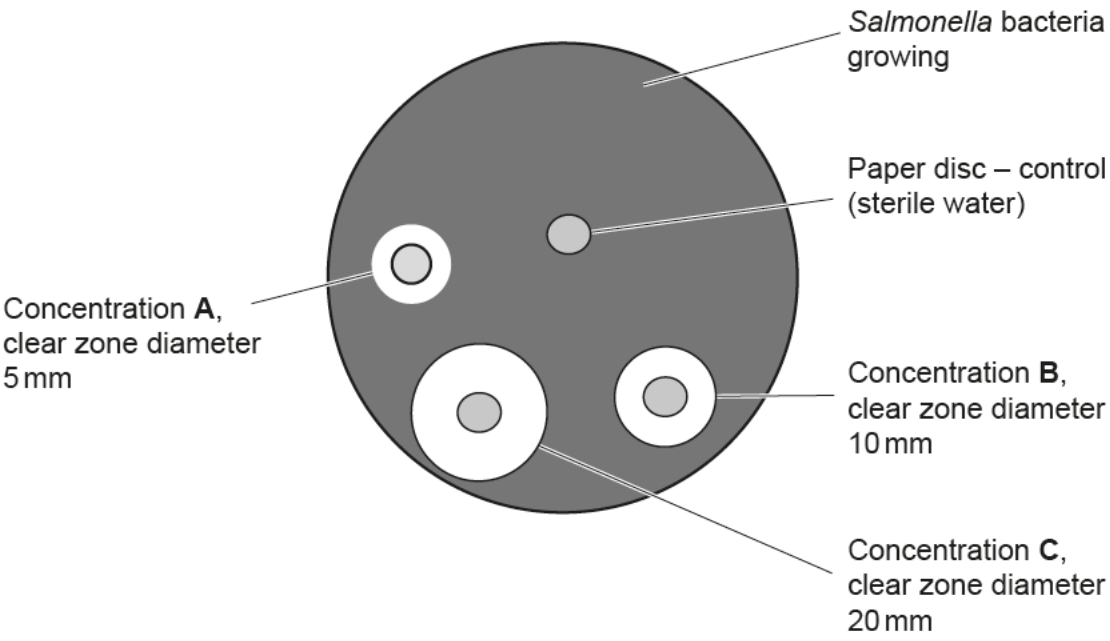
**[2]**

**(e) (i)** A researcher tested the effectiveness of **three** different concentrations of antibiotic on the growth of *Salmonella* bacteria.

Paper discs were soaked in each antibiotic and then placed on an agar plate, which was covered in the *Salmonella* bacteria. One other paper disc was soaked in sterile water as a control disc.

The clear zones are where the bacteria did not grow.

The results are shown in the diagram.




Calculate the cross-sectional area of the clear zone (including the area of the disc) for the most effective concentration of antibiotic.

Use a clear zone diameter given in the diagram.

Use the formula: $\pi r^2$

$\pi = 3.14$

Cross-sectional area = ..... $mm^2$

**[3]**

**(ii)** Why does the scientist put a control paper disc on the agar plate?

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

**(f)** Drug companies regularly develop new medicines.

Each new medicine must pass **four** stages of testing before doctors can prescribe them to patients.

Complete the table to show if each stage of testing is clinical or preclinical, and if each stage assesses safety, effectiveness, or both.

Tick (✓) **at least two** boxes in each row.

| Stage | Preclinical | Clinical | | Safety | Effectiveness |
|---|---|---|---|---|---|
| **Animal cells** | | | | | |
| **Cultured cells** | | | | | |
| **Healthy volunteers** | | | | | |
| **Humans with the disease** | | | | | |

**[4]**

**(g)** The typical size of a *Salmonella* bacterium is 4 μm.

The typical size of a virus is 100 nm.

Explain why bacteria and viruses are not the same order of magnitude.

1 μm = 1 000 nm

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.....

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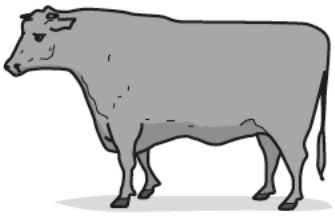
..... **[2]**

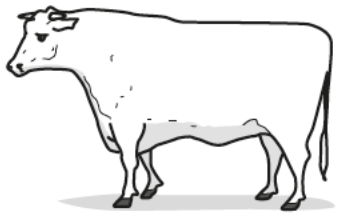
7 Coat colour in shorthorn cattle (bulls and cows) is controlled by two alleles, red, R, and white, W.

The alleles that control coat colour are codominant. This means that cattle with both alleles express **both** colours in their phenotype, as shown in the diagram.

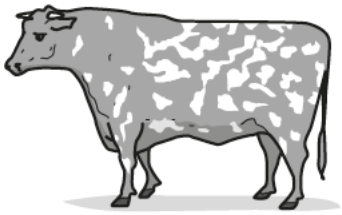
Pure red – genotype RR



Pure white – genotype WW



Roan – genotype RW



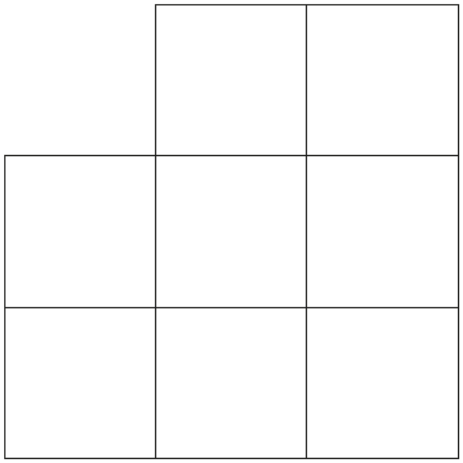
**(a)** When a **roan** shorthorn cow and a **roan** shorthorn bull are mated a mixture of white, red and roan offspring are produced.

The farmer counts 23 white, 28 red and 52 roan offspring, in one year.

The farmer thinks these numbers show that **roan** cattle are heterozygous.

Is the farmer correct?

Use the Punnett square to explain your answer.



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

**(b)*** Modern shorthorn cattle have been produced by selective breeding for over 200 years.

Describe how farmers have used selective breeding to produce shorthorn cattle that produce more beef per animal, and explain how selective breeding is different to natural selection.

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..... **[6]**

8 **(a)** Complete the sentences to describe how the genome affects the phenotype in eukaryotic organisms.

Use words from the list.

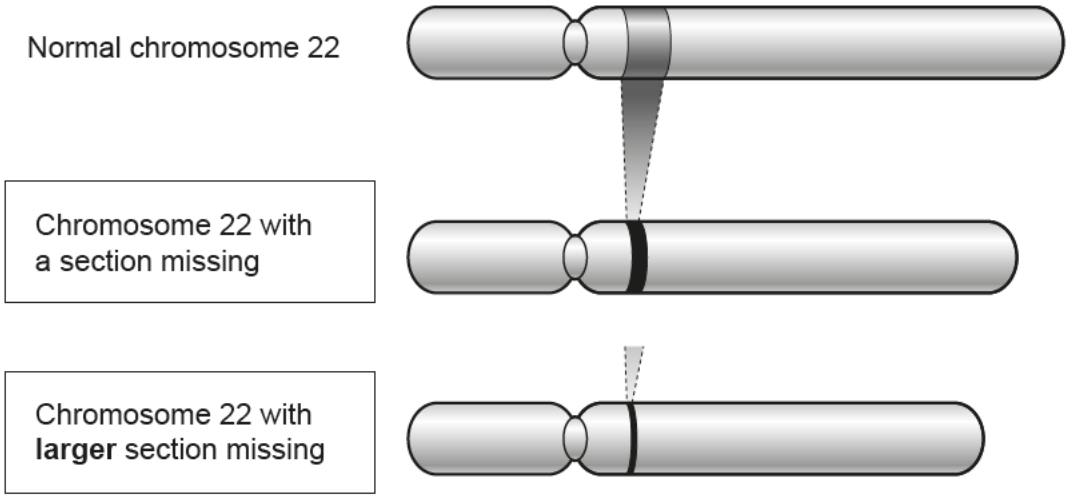
You can use each word once, more than once, or not at all.

| | | | |
|---|---|---|---|
| **alleles** | **amino acids** | **chromosomes** | **environment** |
| **gene** | **genome** | **genotype** | **mutation** |
| **nucleus** | **phenotype** | **proteins** | **recessive** |

In eukaryotic organisms the ..... is packaged into long molecules of DNA called ..... . Genes are sections of the DNA. Each gene codes for a particular sequence of ..... , which are synthesised into ..... . The ..... is the characteristic that results from the combination of ..... and the interaction with the ..... .

**[3]**

**(b)** DiGeorge syndrome is a genetic disorder caused by the deletion of a small part of chromosome 22. The size of the missing section of chromosome 22 varies, as shown in the diagram.



**(i)** Diagnosing the genetic disorder is difficult as there are many different symptoms but once it is diagnosed, the symptoms can be treated.

Suggest **two** reasons why DiGeorge syndrome can cause so many different symptoms.

Use information from the diagram to support your answer.

1 .....

.....

2 .....

.....

**[2]**

**(ii)** Scientists want new born babies to be tested for DiGeorge syndrome.

Give **one** benefit and **one** risk or ethical issue of testing newborn babies for DiGeorge Syndrome.

Benefit .....

.....

Risk/Ethical issue .....

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

**(iii)** At least one in 2000 UK babies is affected by this disorder each year.

679 106 babies were born in the UK in 2017.

Assume 1 in 2000 of these babies were born with DiGeorge syndrome.

Calculate the expected number of babies born in 2017 with DiGeorge syndrome.

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

Number of babies = ..... **[2]**

**(iv)** The article on DiGeorge syndrome is from a newspaper.

Scientists report their work to other scientists in peer-reviewed journals.

Why is it important that science is reported in both **peer-reviewed journals** and **newspapers**?

Peer-reviewed journals .....

.....

Newspapers .....

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

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**9** The oesophagus is an organ that carries food and liquid from the mouth to the stomach.

Scientists have made an artificial oesophagus. To make the artificial oesophagus the scientists used:

- stem muscle cells from adult mice
- stem connective tissue cells from adult humans
- stem skin cells from adult rats.

**(a)** Explain why scientists used **adult** stem cells.

.....

.....

.....

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

**(b)** The scientists used stem cells from mice, humans and rats.

How was this an advantage when analysing the tissues in the artificial oesophagus?

Tick (✓) **one** box.

The scientists could check only one type of tissue was produced. ☐

The scientists could confirm the source of each tissue in the artificial oesophagus. ☐

The scientists could justify using three types of stem cell. ☐

The scientists could make sure that the artificial oesophagus worked. ☐

**[1]**

**(c)** An artificial oesophagus may benefit people in the future but there are **risks** and **ethical** issues.

**(i)** Suggest **one** risk associated with this research.

.....

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

**(ii)** Suggest **one** ethical issue associated with this research.

.....

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

**(d)** Adult humans cannot regrow lost or damaged organs, but most plants can.

Explain why most plants can regrow organs.

.....

.....

.....

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

**10** *Homo sapiens*, modern humans, evolved from *homo erectus*, upright humans.

**Fig. 10.1** shows two models, **Model A** and **Model B** from a 2008 scientific paper, to try and explain the evolution of modern humans from upright man.

The curved arrows in **Fig. 10.1** represent human migration from Africa, to Europe, and Asia.

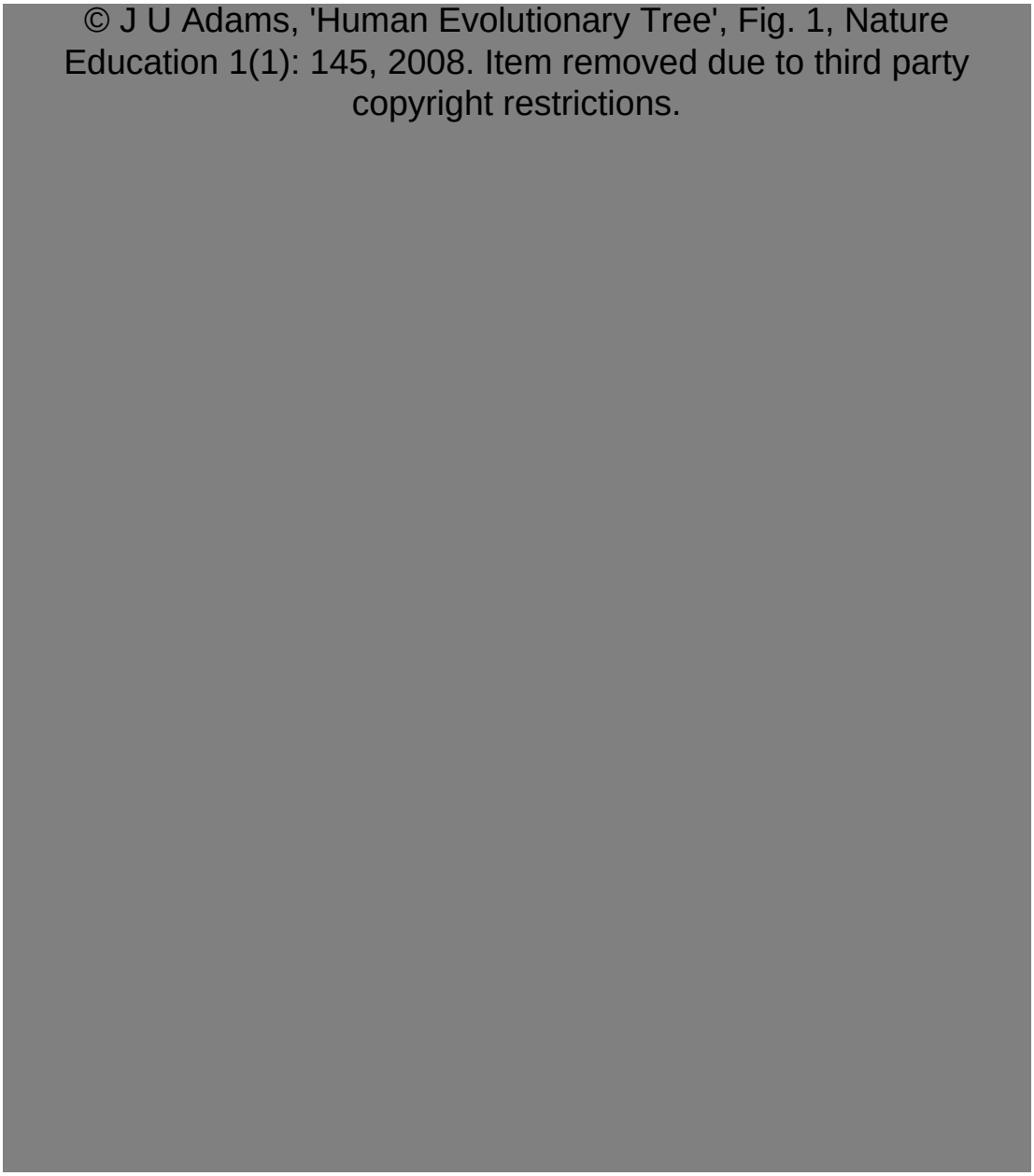


**Fig. 10.1**

**(a)** Complete **Table 10.1** to identify what is shown by each model.

Tick (✓) **at least one** box in each row.

| Statement | Model A | Model B |
|---|---|---|
| Upright humans and modern humans both evolved in Africa. | | |
| Modern humans evolved separately and continuously in three continents. | | |
| Modern humans migrated out of Africa 100 000 years ago. | | |

**Table 10.1**

**[3]**

**(b)** Since 2008, more human fossils have been found and advances in technology have provided DNA evidence.

Complete **Table 10.2** by deciding if each new piece of evidence is supported by each model.

Use **Fig. 10.1** to help you.

Tick (✓) **at least one** box in each row.

| New evidence | Model A | Model B |
|---|---|---|
| A modern human fossil dated as 200 000 years old has been found outside of Africa. | | |
| About 2% of the DNA found in modern humans living in Europe is from modern humans who lived in Europe more than 100 000 years ago. | | |
| Mitochondrial DNA suggests that all modern humans share a single African female common ancestor who lived 200 000 years ago. | | |

**Table 10.2**

**[3]**

**(c)** In 2008 most scientists accepted **Model A**.

Suggest why many scientists today still accept **Model A**.

.....

..... **[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).