OCR
Oxford Cambridge and RSA

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Tuesday 17 May 2022 – Morning

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

J257/03 Breadth in biology (Higher Tier)

Time allowed: 1 hour 45 minutes

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

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

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

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

First name(s) _____

Last name _____

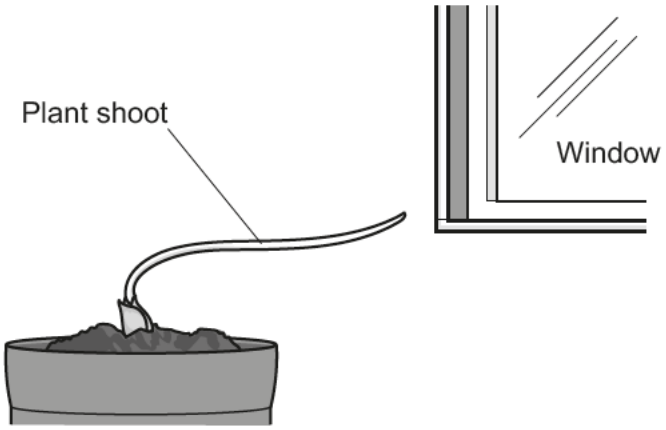
INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where 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.

Answer **all** the questions.

1 Plants respond to their environment.
One example is their response to light, as shown in the diagram.



(a) Complete each sentence to explain how the plant shoot responds to light.
Use words from the list.

auxins	**dark**	**insulin**	**less**
light	**more**	**progesterone**	**shade**

The response to light is controlled by plant hormones called ..... .

When the plant is placed in an environment where the light is coming from one direction, there is an uneven distribution of the hormone in the shoot.

..... hormone collects on the side of the shoot that is in the shade.

This causes more cell elongation on the side of the shoot that is in the

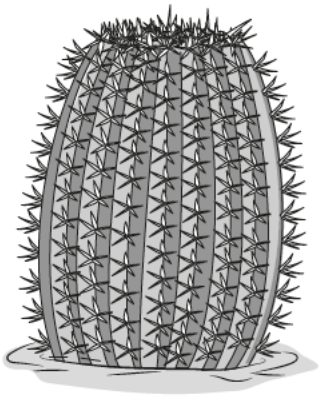
..... so the shoot grows towards the light.

[3]

(b) What word is used to describe a plant root's response to gravity?

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

2 The diagram shows a cactus. It reproduces sexually by producing flowers.



(a) There are 22 chromosomes in all of the cells in this cactus apart from the gamete cells.

Complete the table to identify how many chromosomes are present during the events that take place in the life cycle of a cactus.

Tick (✓) **one** box in each row.

Event in the cactus life cycle	**Number of chromosomes**		
	11	**22**	**44**
At the end of interphase during meiosis			
At the end of interphase during mitosis			
In the cells produced by mitosis as the cactus grows			
In the pollen produced by meiosis			

[4]

A cactus must get water from the soil.

(b) Which process reacts water with carbon dioxide in plant cells?

Tick (✓) **one** box.

Active transport ☐

Cellular respiration ☐

Photosynthesis ☐

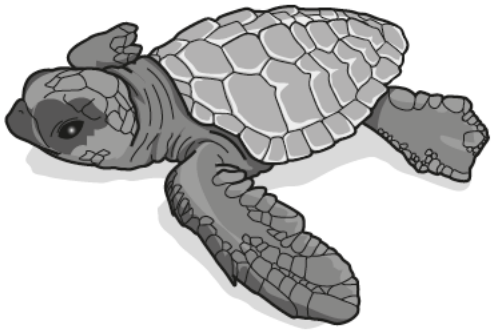
Transpiration ☐

[1]

(c) Name the vessel in a plant that transports water up the stem.

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

3 The diagram shows a Pacific sea turtle. The sex of Pacific sea turtles' offspring is determined by the temperature at which their eggs incubate.



(a) Explain how sex determination in **humans** is different to sex determination in turtles.

.....

.....

.....

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

(b) The effect of temperature on the sex of the offspring is shown in the table.

Egg incubation temperature (°C)	**Sex of offspring**
Below 27.7	male
Between 27.7 and 31.0	mix of male and female
Over 31.0	female

(i) In some locations in 2020 the female turtles outnumbered male turtles in a ratio of 116 : 1.

Calculate the number of female turtles in a sample of 18 000 turtles.

Give your answer to the nearest whole number.

Number of female turtles = ... **[3]**

(ii) In the 1970s the ratio of female to male turtles was 6 : 1.

What effect could the change in the ratios from 1970 to 2020 have on the population of sea turtles?

Explain your answer.

.....

.....

.....

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

(iii) Suggest how scientists could help return the sex ratio in the next generation of turtles to that seen in the 1970s.

.....

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

4 Diseases can be described as communicable or non-communicable.

(a) Explain what is meant by communicable diseases **and** non-communicable diseases.

Give examples of **both** types of disease in your answer.

Communicable diseases .....

.....

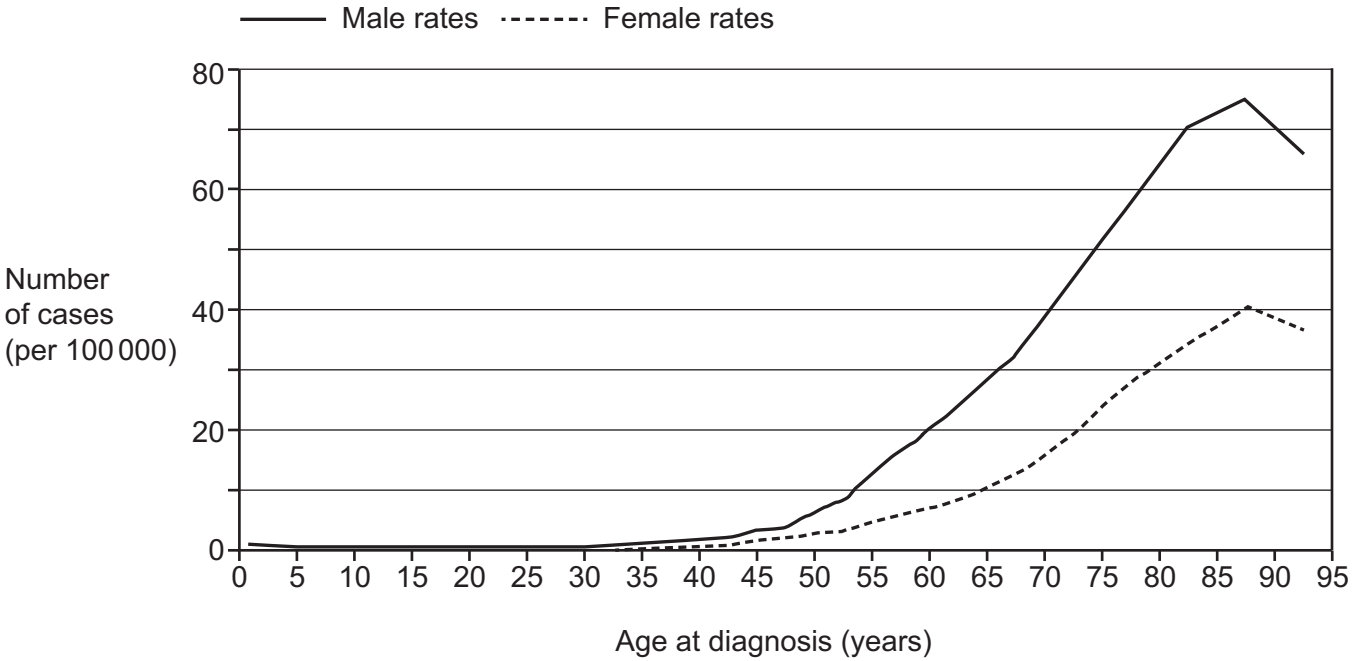
.....

Non-communicable diseases .....

.....

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

(b) The graph shows the number of cases of liver disease in people in the UK.



Give **two** conclusions that can be made from the graph.

Conclusion 1 .....

.....

Conclusion 2 .....

.....

[2]

(c) There are several causes of liver disease.
These causes include obesity, alcohol consumption and some viral diseases.

(i) Which of these causes can be prevented by vaccination?

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

(ii) Different types of disease can interact.
Explain what this statement means.

.....

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

5 **(a)** Complete the sentences to explain how individuals in the same family can have different phenotypes.

Use words from the list.

alleles	**chromosomes**	**DNA**	**gene**	**genomics**
genotype	**mutations**	**phenotype**	**protein**	**variants**

..... are long molecules of DNA that store genetic information.

A ..... is a small section of this DNA.

You inherit two copies of a gene, one from your father and one from your mother. These different copies are called ..... .

There can be many different versions of a gene, which are referred to as genetic ..... .

A ..... is the collection of alleles that an individual has.

An individual's ..... is the result of their genotype interacting with the environment.

[5]

(b) Genes code for proteins that are made by cells.

Put sentences **A–D** in the correct order to describe protein synthesis.

A mRNA leaves the nucleus.

B mRNA enters the cytoplasm and joins to a ribosome.

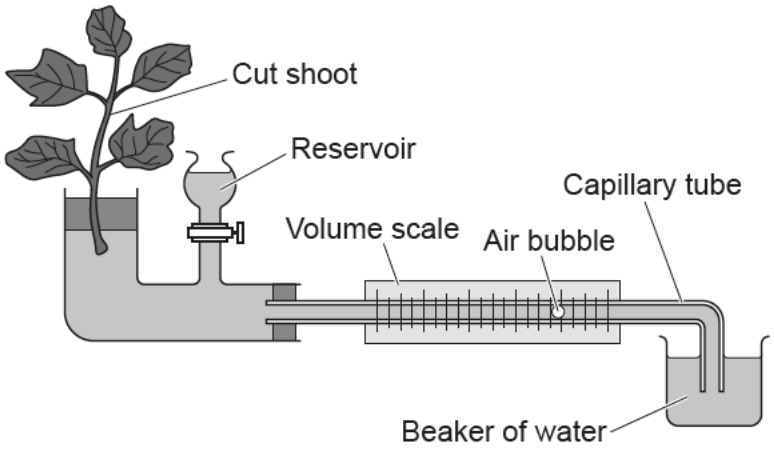
C The ribosome 'reads' the mRNA and joins the amino acids together in the right order.

D The gene is copied and mRNA is formed.

[2]

6 Kai is investigating transpiration in plants. He sets up a potometer, as shown in the diagram.

Kai fills the potometer with water, then inserts a cut shoot and checks that none of the apparatus is leaking.



(a) Describe how Kai can use the potometer he has set up to investigate the rate of transpiration in a plant.

.....

.....

.....

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

(b) Kai wants to compare the rate of transpiration in cut shoots from **two** species of plant.

He uses the potometer to investigate one of the species, and then repeats the experiment with the other.

State **three** variables that Kai should control with the plant shoots so that he can compare the results from the two species.

Variable 1 .....

.....

Variable 2 .....

.....

Variable 3 .....

.....

[3]

(c) Kai finds that the rate of transpiration is different for the two species.

He thinks this could be due to a difference in the number of stomata on the leaves of the two species. He prepares two slides to investigate this.

Describe how Kai can use a microscope to work out the number of stomata per cm^2 on the leaves of the two plant species.

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

7 (a) **Fig. 7.1** shows the structure of the brain.
Three areas of the brain have been labelled **A**, **B** and **C**.

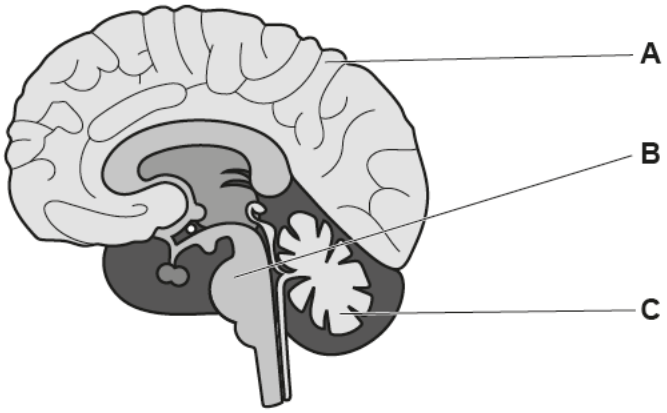

Fig. 7.1

(i) Draw lines to connect each **labelled** part of the brain to its **name** and **function**.

Label	Name	Function
A	Cerebellum	Conscious movement
B	Brain stem	Intelligence, memory, and language
C	Cerebral cortex	Regulation of heart and breathing rate

[3]

(ii) Name **two** additional parts of the brain **and** state their functions.

1 .....

.....

2 .....

.....

[2]

Dementia is a term used to describe a decline in mental ability.

Fig. 7.2 shows the number of people diagnosed with dementia in the UK.

Link to material: www.dementiastatistics.org/statistics/diagnoses-in-the-ukItem removed due to third party copyright restrictions.

Fig. 7.2

(b) State **two** conclusions that can be drawn from the data in **Fig. 7.2**.

1 .....

.....

2 .....

.....

[2]

(c) Alzheimer's is a form of dementia. Alzheimer's is caused by a build-up of proteins around the cells in the brain.

(i) What name is given to the cells found in the brain?

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

The build-up of these proteins reduces the amount of transmitter substance produced in the brain.

(ii) What is the role of a transmitter substance?

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

(iii) The level of transmitter substance released by brain cells is lower in people with Alzheimer's.

Suggest how this could affect the person with Alzheimer's.

.....

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

(iv) Scientists are investigating the use of stem cells to treat Alzheimer's disease.

They implanted human stem cells into the brains of mice.

They observed changes in the mice 4 weeks after transplant and 16 weeks after transplant. They found that the mice had improved brain function.

Suggest what the scientists should do next in this research.
Explain your suggestions.

.....

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.....

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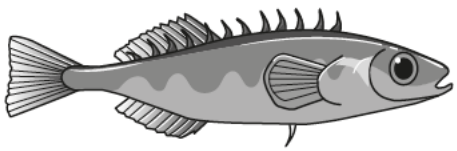
..... **[3]**

8 The diagram shows a stickleback fish. At the end of the last ice age, stickleback fish were trapped in a lake in Iceland.



The environment in different parts of the lake varies. Some areas are deep and have a lot of vegetation, other areas are shallow and there are cracks in the rocks.

Over time this species of fish has evolved to become two different subspecies.

A subspecies is a smaller group within a species. A subspecies has small differences from other members of the same species.

(a) (i) What caused the fish in the lake to evolve into two different subspecies?

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.....

.....

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

(ii) Describe how evolution occurs.

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

(iii) How could scientists show that the stickleback fish are subspecies and not different species?

.....

.....

.....

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

(b) Fish form a large part of the diet of Icelandic people.
Some fish contain high levels of oils. Oils are fats.

What are the **two** components that make up a fat?

1 .....

2 .....

[1]

9 Elephants live in a habitat where temperatures can get extremely high.

(a) Which statement explains why elephants find it difficult to regulate their body temperature?

Tick (✓) **one** box.

Elephants have a fast heart rate. ☐

Elephants have a large surface area to volume ratio. ☐

Elephants have a small surface area to volume ratio. ☐

Elephants move slowly. ☐

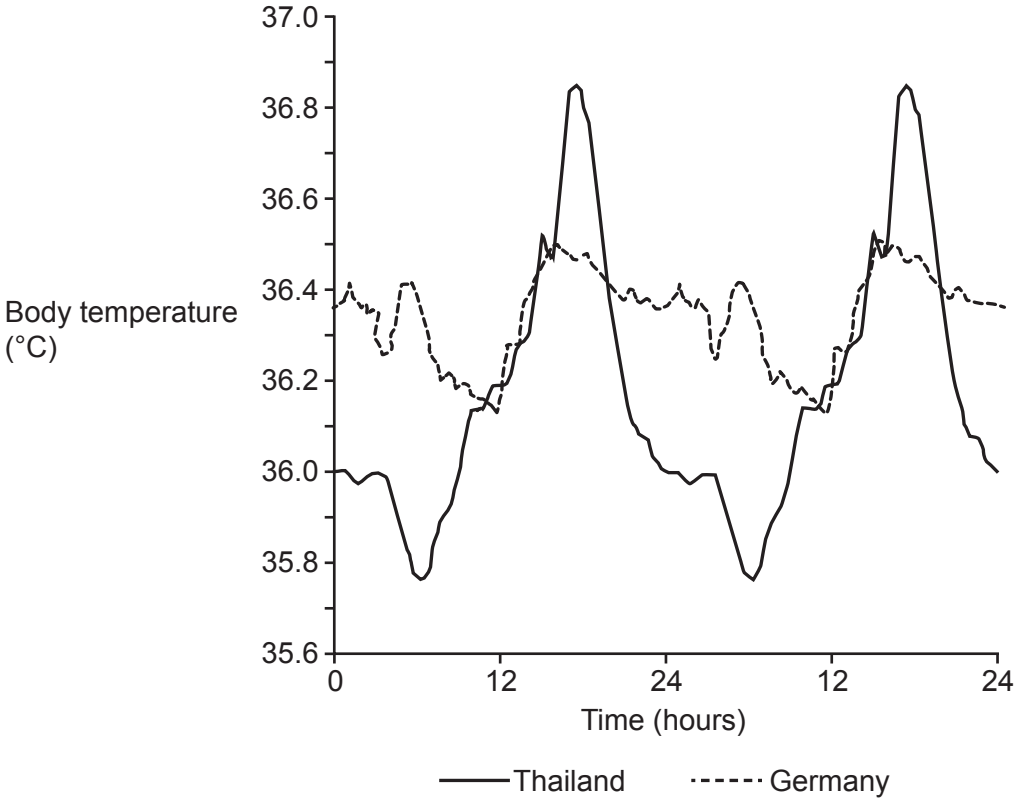
[1]

Elephants cope with these high temperatures using heterothermy.

This means the elephants do not regulate their body temperature during the daytime, so it increases in the sun.
The elephants regulate their body temperature back down to **below** normal overnight.

Scientists monitored the temperature of elephants in a zoo in Germany and in Thailand to see if they used heterothermy to regulate their body temperature.

The graph shows the scientists' data.



(b) The normal body temperature of an elephant is 35.9 °C.

Does the graph provide evidence for heterothermy in elephants? Explain your answer.

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.....

.....

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

(c) Elephants have large ears which are very thin and have a good blood supply.

(i) Describe **one** method that both elephants and humans use to **regulate** their temperature.

.....

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

(ii) Describe how the human body **monitors** its temperature.

.....

.....

.....

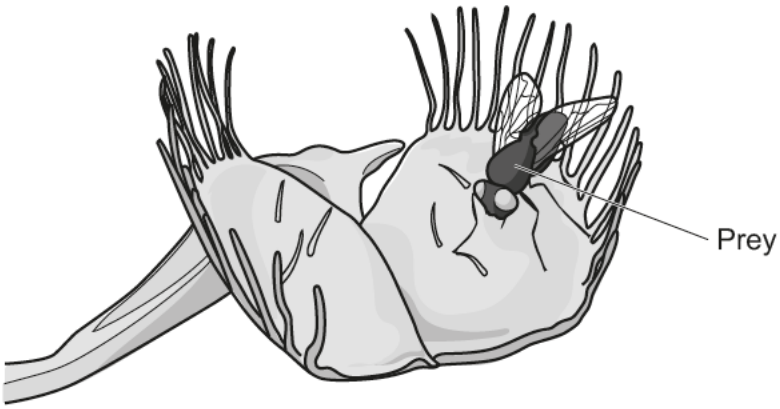
.....

.....

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

10 Venus fly traps, shown in the diagram, are carnivorous plants.

They attract prey using nectar. When prey land on the leaves, they touch hairs and this triggers the leaves to close and lock.



The prey contains different biological molecules that need to be broken down so that they can be absorbed by the plant.

The Venus fly trap secretes enzymes to digest the prey.

(a) Use ideas of the lock and key model to describe how the enzymes break down different biological molecules found in the prey so they can be absorbed.

.....

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

(b) Explain why several types of enzymes are secreted by the plant.

.....

.....

.....

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

(c) The Venus fly trap evolved to live in damp soil that is low in nitrogen and phosphorus.

Complete the sentences describing why plants require nitrogen and phosphorus.

Put a (ring) around the correct answer.

Nitrogen is needed by plants to make **fats / glucose / protein**.

Phosphorus is needed by the plants to make **DNA / glucose / starch**.

[2]

(d) Venus fly traps use the glucose produced in photosynthesis for aerobic cellular respiration.

Give the balanced symbol equation for aerobic cellular respiration.

..... + ... ⟶ ..... + ... **[2]**

(e) Venus fly traps produce flowers which are pollinated.

Name this type of reproduction **and** give one advantage of reproducing in this way.

Type of reproduction .....

.....

Advantage .....

.....

[2]

11 Scientists have used genes from jellyfish to genetically engineer Zebra fish to glow in the dark.

(a) Describe how the scientists genetically modify the Zebra fish eggs.

.....

.....

.....

.....

.....

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

(b) The Zebra fish were modified because their embryos are very sensitive to water pollutants. When water pollutants are present, the fish glow.

Suggest how scientists use Zebra fish to determine if an area of water is polluted **and** describe one limitation of this method.

Method .....

.....

Limitation .....

.....

[2]

(c) Oestrogen is an example of a pollutant that can be detected by the Zebra fish.

(i) Describe **two** roles that oestrogen has in the human body.

Role 1 .....

Role 2 .....

[2]

(ii) Suggest why oestrogen may be found in rivers and oceans.

.....

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

(d) The genetically engineered Zebra fish are now sold as pets that glow under UV light.

Suggest why this concerns some scientists.

.....

.....

..... **[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).