

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

J257/01 Breadth in biology (Foundation Tier)

Tuesday 15 May 2018 – Afternoon

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, use the lined page(s) at the end of this 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 [].
- This document consists of **24** pages.

Answer **all** the questions.

1 The eye is a sense organ.

(a) Each part of the eye is adapted to its specific function.

The table describes the functions of different parts of the eye.

Complete the table by writing the **part of the eye** that matches each **description**.
Choose from the words below:

ciliary muscle cornea iris lens

Part of the eye	Description
	A ring of tissue that changes size to alter the diameter of the pupil, to control the amount of light entering the eye.
	A thin layer of transparent tissue in front of the pupil which bends light as it enters the eye.
	A thick layer of transparent tissue behind the pupil which bends light so it focusses on the retina.
	Changes the thickness of the lens to focus light from far and near objects.

[3]

(b) Amir is investigating what happens to pupil size when a person moves from an area of bright light to an area of darkness.

He measures the size of his friend's pupil in bright light.

His results are shown in the table below.

Experiment number	Pupil size (mm)
1	4.0
2	3.8
3	6.0

(i) Calculate the mean pupil size.

Mean pupil size = mm [2]

Amir reads an article that suggests the average pupil size in bright light should be in the range of 2–4 mm.

(ii) Amir thinks one of his results is an anomalous result.

Which result is most likely to be the anomalous result?

Give a reason for your choice.

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

(iii) What can Amir do to make his results more precise?

..... [1]

(iv) To create dark conditions Amir asks his friend to put on sunglasses.

Amir draws two diagrams (**Fig. 1.1** and **Fig. 1.2**) to show how the pupil changes when the light conditions change.

Fig. 1.2 is incomplete.

Complete **Fig. 1.2** to show the pupil in dark conditions.

Pupil in bright light

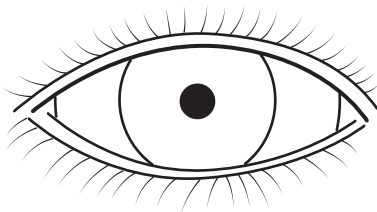


Fig. 1.1

Pupil in the dark

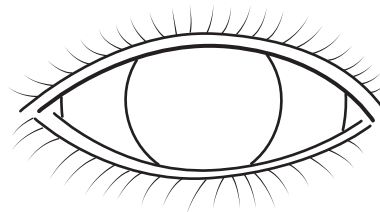


Fig. 1.2

[1]

(v) The change in pupil size is an example of a reflex.

Which statement best describes a reflex?

Tick (✓) **one** box.

A rapid and involuntary response.

A rapid and voluntary response.

A slow and involuntary response.

A slow and voluntary response.

[1]

(vi) What name is given to the structure that transmits electrical impulses from the eye to the central nervous system?

Put a **ring** around the correct answer.

effector

receptor

relay neuron

sensory neuron

[1]

(c) Amir is reading a newspaper but the words look blurry.

When he looks out the window he can see everything outside clearly.

Explain to Amir why the words in the newspaper look blurry and explain how this defect could be corrected.

Explanation

.....

.....

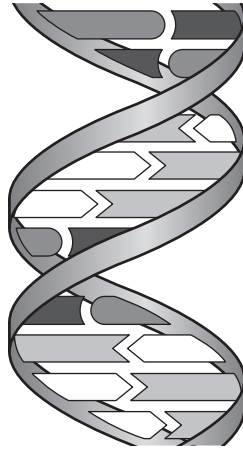
Correction

.....

..... [3]

2 DNA is a polymer made of nucleotides. A nucleotide is made of a sugar, a phosphate and a base.

The diagram shows the structure of DNA.



(a) (i) On the diagram label the location of a base. [1]

(ii) On the diagram label the location of the sugar and phosphate group. [1]

(b) DNA has four different bases.

A always pairs with T.
C always pairs with G.

A scientist is analysing a sample of DNA. She works out that 23% of DNA is made up of the base A.

Which **two** statements about the sample are correct?

Tick (✓) **two** boxes.

23% of the sample will be the base T.

23% of the sample will be the base C.

27% of the sample will be the base T.

27% of the sample will be the base C.

77% of the sample will be the base T.

[2]

- 3 (a) Jack dislikes the taste of sprouts. He thinks they taste bitter. His partner Nina loves the taste of sprouts.

Jack reads that a gene affects how people taste sprouts. There are several variants of this gene.

An individual with the dominant variant, T, can taste a bitter substance in sprouts.

- (i) Jack is homozygous for this gene.

What is Jack's genotype?

Tick (✓) **one** box.

TT	<input type="checkbox"/>
Tt	<input type="checkbox"/>
tT	<input type="checkbox"/>
tt	<input type="checkbox"/>

[1]

- (ii) Jack wants to know if any of his children will be able to taste the bitter substance.

Nina has the genotype tt.

Complete the Punnett square to show the possible genotypes of any children Jack may have with Nina.

[2]

- (iii) What is the probability that any children born will be able to taste the bitter substance.

Probability = [1]

(iv) Jack and Nina have two children, one boy and one girl.

Describe how sex is determined in humans.

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

(v) Jack and Nina do not want any more children.

They have considered different forms of contraception.

Suggest a form of contraception that would be suitable for them and justify your choice.

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

4 Cancer of the ovaries is a common type of cancer in women.

(a) Complete the following sentences about cancer.

Put a **ring** around the correct option in each sentence.

Cancer is a **communicable** / **non-communicable** / **sexually-transmitted** disease.

It is caused by changes in the **cell membranes** / **DNA** / **mitochondria**.

The changes cause cells to divide many times by

asexual reproduction / **meiosis** / **mitosis**.

This uncontrolled growth and division creates **an infection** / **fatty deposits** / **a tumour**.

[4]

(b) The table shows the number of women diagnosed with cancer of the ovaries between 2012–2014.

Age range (years)	Number of cases
Below 20	56
20–29	208
30–39	333
40–49	766
50–59	1300
60–69	1818
70–79	1685
80–89	1020
90+	213

Calculate the percentage of cases seen in women aged 60 and over.

Percentage of cases = % [2]

(c) Most women diagnosed with cancer of the ovaries will have an operation to remove their ovaries.

Before the operation, the doctor will discuss the risks of the operation with the patient.

Give **one** example of a risk to the patient.

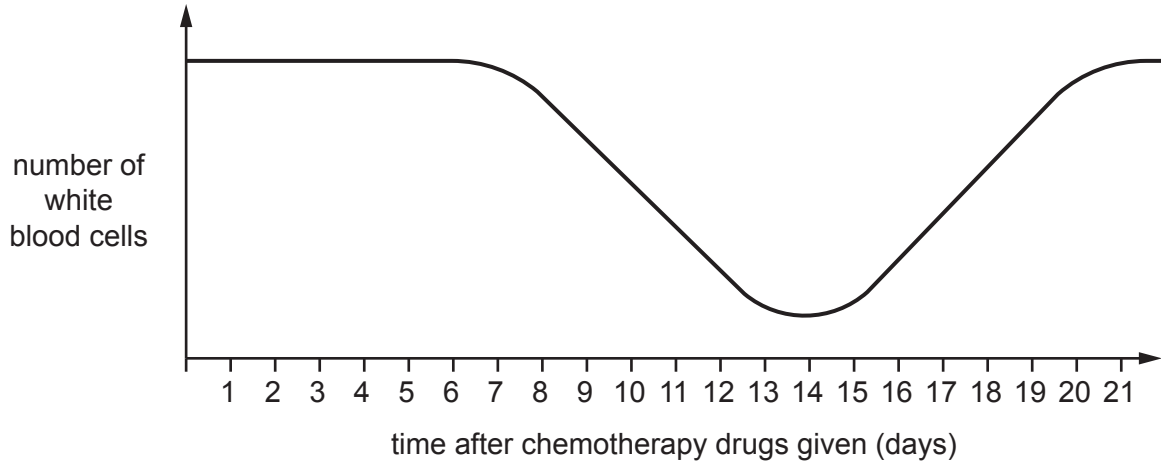
..... [1]

(d) After surgery the patient may be given chemotherapy drugs to kill any remaining cancer cells.

Chemotherapy also affects the number of white blood cells in a patient.

The graph shows what happens to the number of white blood cells during chemotherapy.

The patient receives the chemotherapy drugs on day 1.



(i) Describe what happens to the number of white blood cells after chemotherapy. Use information from the graph in your answer.

.....

.....

.....

..... [2]

(ii) Explain how white blood cells protect us from disease **and** how they are adapted for this function.

.....

.....

.....

.....

.....

..... [3]

(iii) White blood cells are one component of the blood.

There are three other major components of the blood, which all have specific functions.

Draw a line to link each **blood component** to its **function**.

Blood component	Function
Plasma	Cell fragment that helps the blood clot at injury sites and helps seal wounds.
Red blood cell	Transports dissolved substances such as hormones, urea and food molecules.
Platelet	Contains haemoglobin and transports oxygen around the body.

[2]

(iv) A chemotherapy patient is told to go to accident and emergency if they feel ill and have a temperature above 38°C.

Some students have a discussion about why this is important.

Which **two** students made the best suggestions?

..... and

[2]

- (e) A clinical trial investigated the effect of different combinations of chemotherapy drugs on survival rates of cancer patients.

Two groups of cancer patients were given different combinations of drugs.

- Patients in group **A** were given two drugs: 1 and 2.
- Patients in group **B** were given two drugs: 3 and 4.

- (i) A placebo was not used in the trial.

Explain why.

.....
 [2]

- (ii) The results of the trial are shown in the table.

	Group A (Drugs 1 and 2)	Group B (Drugs 3 and 4)
Number of people in the trial	305	314
Number of people still alive two years after treatment	247	222

What conclusion could be made from these results?

Tick (✓) **one** box.

The drugs given to the patients in Group **A** cured their cancer.

The combination of drugs given to Group **B** was not effective.

The combination of drugs given to Group **A** was the most effective.

The patients in Group **B** were given a placebo.

[1]

- (iii) New drugs are tested to see how safe they are to use and how well they work (their effectiveness).

Put a tick (✓) in **one** box in each row of the table to show what each stage of the drug development process tests for.

Clinical trial stage	Tests for both safety and effectiveness	Tests only for safety	Tests only for effectiveness
Preclinical trial using human cells and animals			
Clinical testing – using healthy human volunteers			
Clinical trials – using humans with the disease			

[3]

5 Jane's dog has arthritis in its hip joint. This makes the joint stiff and painful.

(a) Jane reads an article in a magazine. Here is the article's headline:

Stem cell therapy to help dogs with arthritis

(i) Explain what a stem cell is and why they are used in medicine.

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

(ii) The article explains that stem cells were removed from a dog's fat tissues and were then grown in a laboratory.

Explain why a vet would have used aseptic techniques when growing the stem cells.

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

(iii) Which of the following are also sources of stem cells?

Tick (✓) **two** boxes.

- Bone marrow
- Embryos
- Hair
- Nerve cells
- Red blood cells

[2]

- (iv) The use of stem cells in veterinary medicine is increasing but there are no peer reviewed case studies.

Describe the peer review process and explain why peer review is important.

.....

.....

..... [2]

- (b) Dogs have 78 chromosomes.

Complete the table to show the number of chromosomes in different cells of a dog.

Cell	Number of chromosomes
Nerve	78
Skin	
Sperm	

[2]

6 Bulldogs are an example of a breed of dog that has been selectively bred.

(a) (i) Describe how dogs are selectively bred.

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

(ii) Explain the impact of selective breeding on domesticated animals such as dogs.

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

(b) A cockapoo is a dog that results from the mating of two different breeds of dog; a cocker spaniel and a poodle.

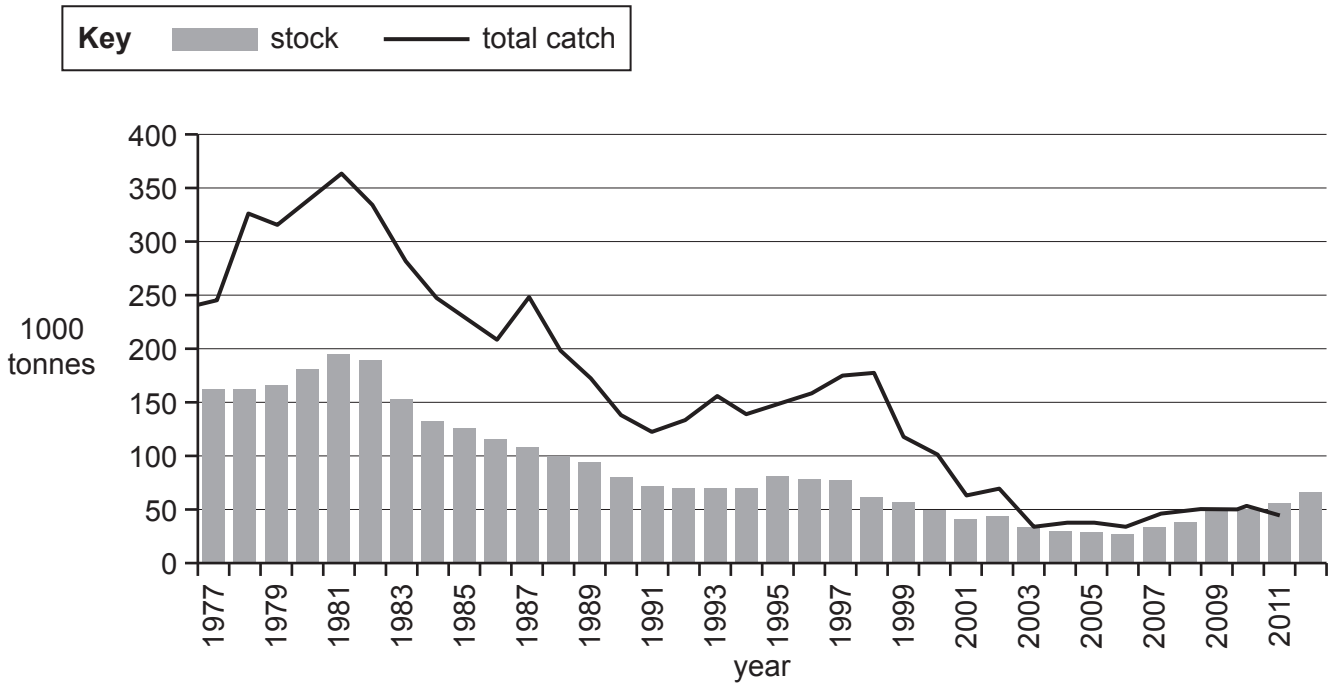
The cockapoo is not a new species.

Explain why.

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

- 7 Cod is a type of fish that is served in fish and chip shops. Much of the cod sold in fish and chip shops is caught in the North Sea.

The graph shows the stocks of cod in the North Sea off the coast of Britain and the amount of cod caught (total catch).



- (a) (i) Describe and explain the trend shown in the graph.

.....

 [3]

- (ii) In 2002 very little cod was served in fish and chip shops, instead haddock was used.

Use the graph to explain why cod was removed from the menu.

.....
 [1]

(iii) Human activities are having an impact on the biodiversity of the Earth.

Explain why it is important to conserve biodiversity.

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

(iv) Fish such as cod reproduce sexually.

Give **one** advantage of cod reproducing sexually.

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

(b) Fish are an important source of protein in our diet.

Ben wants to show that fish contain protein.

He uses the following method:

1. He adds a small sample of fish to a test tube.
2. He adds a small amount of Benedict's solution to the sample.
3. He observes a colour change.

(i) Ben's friend thinks he has made a mistake in his method.

Describe the mistake Ben has made and how he should correct it.

Mistake

Correction

(ii) What change would Ben observe when using the correct method?

Tick (✓) **one** box.

- Colourless to cloudy white emulsion
- Light blue to lilac/purple
- Red-brown precipitate formed
- Pale brown to blue-black

[1]

8 The Galapagos Islands are a group of 13 islands found in the Pacific Ocean.

(a) Charles Darwin visited the Galapagos Islands during the 19th century.

He collected samples and made many observations.

This work helped Darwin to develop a new explanation for the evolution of species.

(i) Which of the following are observations made by Darwin?

Tick (✓) **two** boxes.

There are differences between fossils and living examples of similar organisms.

Pea plants with red flowers can produce offspring with white flowers.

There is usually extensive variation within a population of a species.

Some bacteria have become resistant to antibiotics.

Isolated populations of the same species living in different places have different characteristics.

[2]

(ii) Darwin suggested a theory to explain his observations.

Write down the name of the theory he suggested.

..... [1]

(b) Algae live in the marine environment around the Galapagos Islands.

Photosynthesis takes place in the cells of algae.

(i) In which cell structure does photosynthesis take place?

..... [1]

(ii) Many factors can limit the rate of photosynthesis.

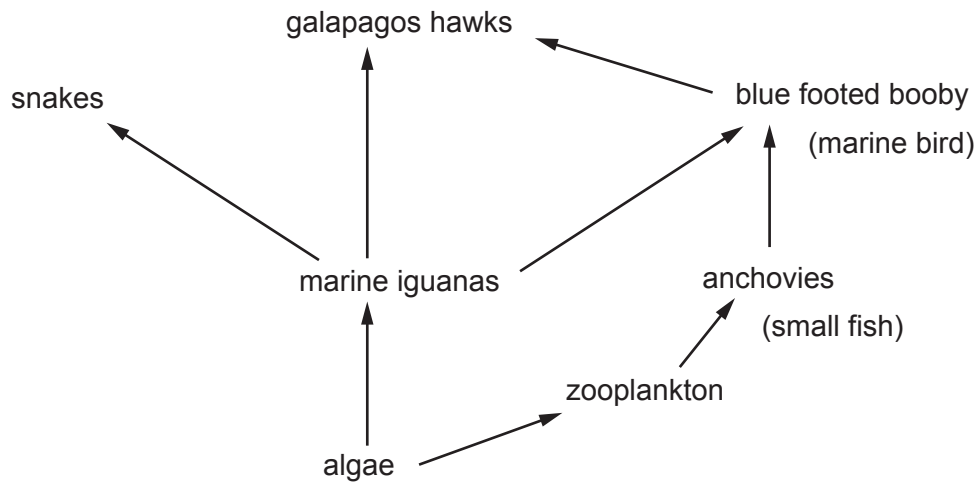
Which factor will **not** limit the rate of photosynthesis in the algae?

Put a **ring** around the correct answer.

carbon dioxide concentration light intensity temperature water availability

[1]

(c) The food web shows the feeding relationships of some Galapagos Islands species.



(i) A weather event called El Niño occurs every three years. This causes the population of algae to decrease.

Explain what effect this could have on the population of marine iguanas.

.....

.....

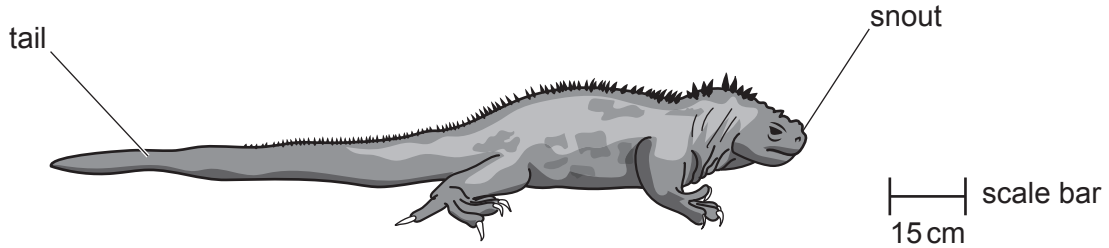
.....

..... [2]

Scientists have discovered that during this event the marine iguanas can shrink in size.

- (ii) The length of the marine iguana is determined by measuring the distance from the snout to the end of the tail.

Below is a drawing of a marine iguana.



Use the scale bar to calculate the actual length of this marine iguana in metres.

Length of marine iguana = m [2]

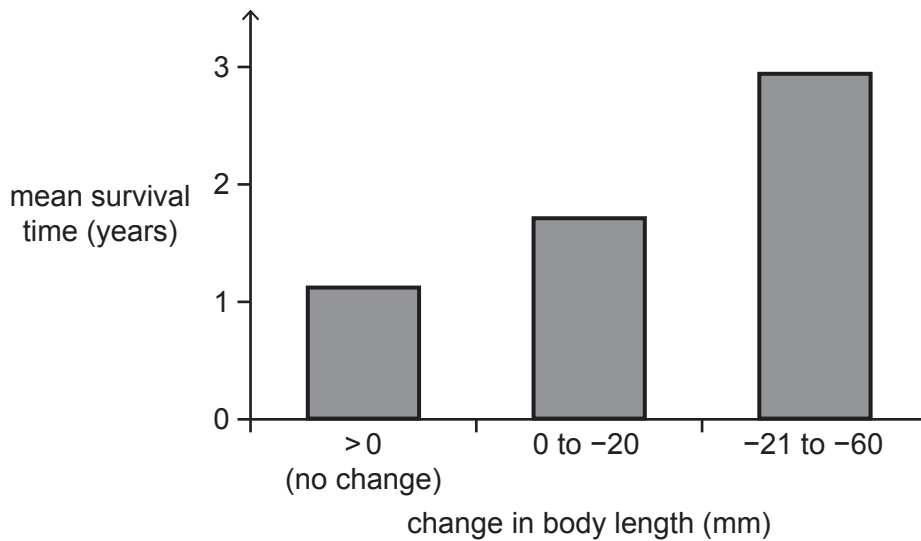
- (iii) Some marine iguanas can shrink by up to 20% of their original length.

Calculate the length of this marine iguana after maximum shrinkage.

Length after maximum shrinkage = m [1]

Scientists calculated the change in body length of the iguanas and measured how long they survived during the El Niño event.

The results are shown in the graph.



(iv) What can be concluded from the data?

Tick (✓) **two** boxes.

The marine iguanas that decreased in size the least survived longer.

The change in body length made no difference to the survival time of the marine iguanas.

The marine iguanas that decreased in size the most on average lived for a greater length of time.

The marine iguanas that did not decrease in size survived for approximately 2 years less than the marine iguanas that decreased in size by up to 60 mm.

The marine iguanas that decreased in size by 20 mm survived more than double the length of time than those that did not change in size.

[2]

9 A student is carrying out a field investigation to determine the population of woodlice in the school's wildlife garden.

(a) Describe a method the student could use to determine the population size of woodlice.

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

(b) Woodlice are often found under logs and bark where it is damp.

Suggest why woodlice prefer damp places.

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

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).

A large area of lined paper for writing, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.

A large rectangular area for writing, bounded by a solid vertical line on the left and horizontal dotted lines on the top, bottom, and right.



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