AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
BIOLOGY

H

Higher Tier Paper 2H

Friday 7 June 2019 Afternoon Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Answer **all** questions in the spaces provided.

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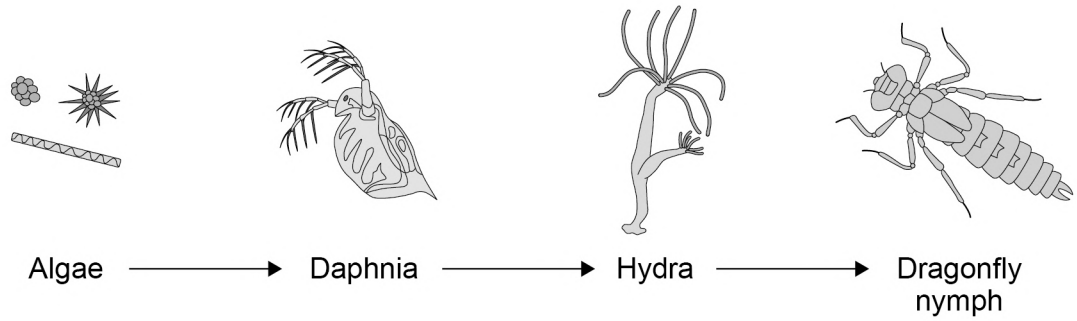
0 1 **Figure 1** shows a food chain in a pond.

Figure 1



0 1 . 1 Which term describes the Daphnia in this food chain?

[1 mark]

Tick (✓) **one** box.

- Apex predator ☐
- Primary consumer ☑
- Producer ☐
- Secondary consumer ☐

Do not write outside the box

0 1 . 2 Draw a pyramid of biomass for the food chain.

Label each trophic level.

[2 marks]

correct shape: 4 tiers with largest at bottom and smallest at top

correctly labelled:

dragonfly / nymph

+ hydra

+ daphnia

+ algae

0 1 . 3 Give **one** reason why the total biomass of the Daphnia in the pond is different from the total biomass of the algae.

[1 mark]

(Daphnia biomass smaller because)

• non-digestible parts (of algae) or lost in faeces

Question 1 continues on the next page

Students investigated the size of the population of Daphnia in the pond.

This is the method used.

1. Collect 1 dm^3 of pond water from near the edge of the pond.
2. Pour the water through a fine net.
3. Count the number of Daphnia caught in the net.
4. Repeat steps 1–3 four more times.

Table 1 shows the results.

Table 1

Sample number	Number of Daphnia in 1 dm^3 water
1	5
2	21
3	0
4	16
5	28

0 1 . 4 Calculate the mean number of Daphnia in 1 m^3 of pond water.

1 m^3 = 1000 dm^3

[2 marks]

14

14 000

Mean number of Daphnia in 1 m^3 of pond water = _____

Do not write outside the box

0 1 . 5 The pond was a rectangular shape, measuring:

- length = 2.5 metres
- width = 1.5 metres
- depth = 0.5 metres.

Calculate the estimated number of Daphnia in the pond.

Use your answer from Question **01.4**.

Give your answer in standard form.

[4 marks]

(volume of pond =) 1.875

or 2.5 × 1.5 × 0.5

14 000 × 1.875

26250

Number of Daphnia in the pond = 2.625×10^4

Question 1 continues on the next page

Do not write outside the box

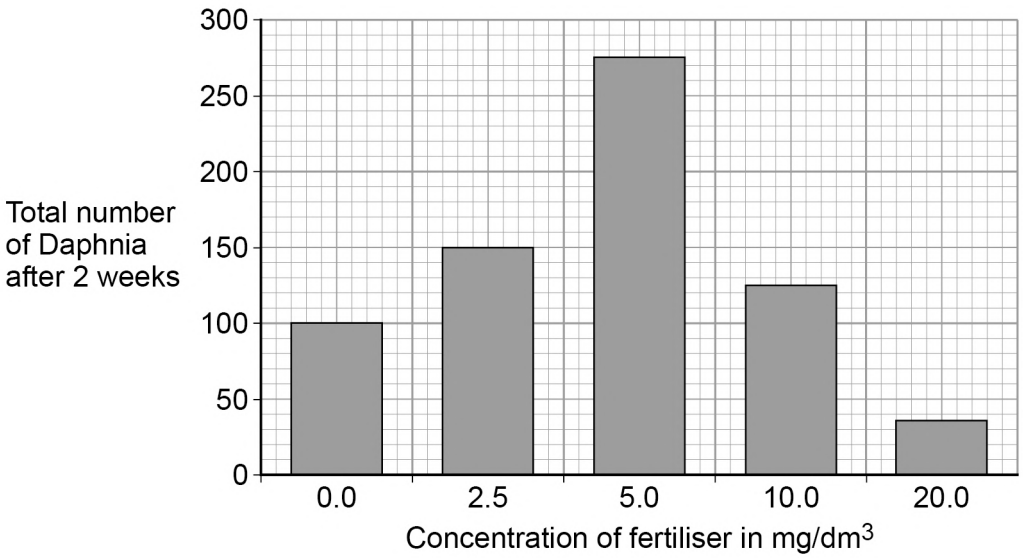
Rainfall can cause fertiliser to be washed from farmland into a pond.

The students investigated the effect of fertiliser on the population of Daphnia in water from the pond.

- The students put 20 Daphnia in each of five different concentrations of fertiliser.
- The students counted the total number of Daphnia in each concentration of fertiliser after 2 weeks.

Figure 2 shows the results.

Figure 2



0 1 . 6 A concentration of 5.0 mg/dm^3 of fertiliser caused a large increase in the population of Daphnia.

Explain why.

[2 marks]

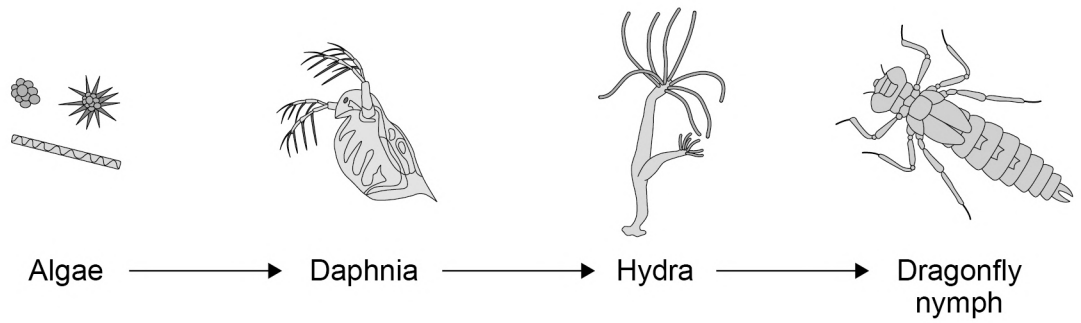
increased (growth / reproduction of) algae

(more algae so) more food for Daphnia

Do not write outside the box

0 1 . 7 **Figure 1** is repeated below.

Figure 1



The population of **Hydra** will decrease when 20 mg/dm^3 of fertiliser is added to the pond.

Explain why.

[2 marks]

(Hydra have) less food

because (graph shows) fewer Daphnia (with more fertiliser)

14

Turn over for the next question

Do not write outside the box

0 2 Genetic material is made of DNA.

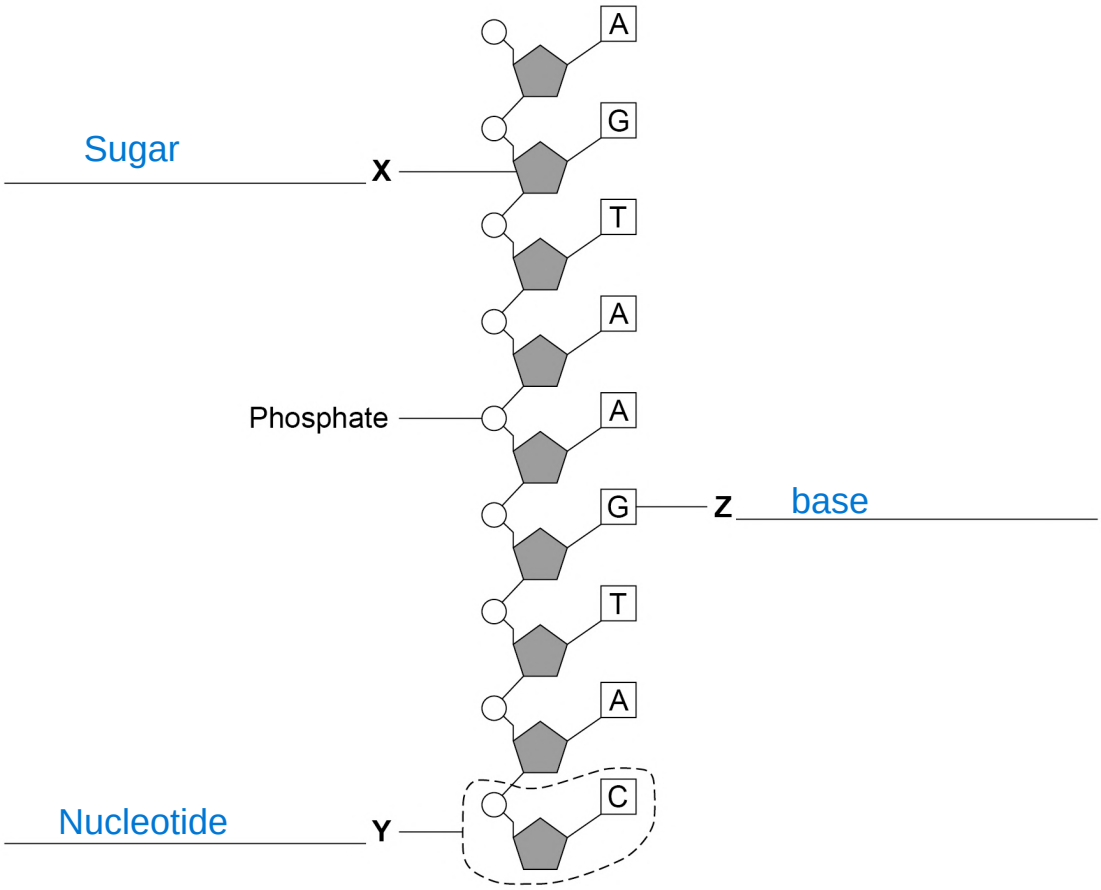
0 2 . 1 Which structures in the nucleus of a human cell contain DNA?

[1 mark]

chromosome(s)

Figure 3 shows part of one strand of a DNA molecule.

Figure 3



0 2 . 2 Label parts **X**, **Y** and **Z** on **Figure 3**.

[3 marks]

Choose answers from the box.

Base	**Fatty acid**	**Nucleotide**	**Sugar**	**Glycerol**

Do not write outside the box

0 2 . 3 A complete DNA molecule is made of two strands twisted around each other.

What scientific term describes this structure?

[1 mark]

double helix

0 2 . 4 DNA codes for the production of proteins.

A protein molecule is a long chain of amino acids.

How many amino acids could be coded for by the piece of DNA shown in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☑ 9 ☐ 18 ☐

0 2 . 5 Scientists have now studied the whole human genome.

Give **two** benefits of understanding the human genome.

[2 marks]

1 diagnosis of inherited / genetic disorder

2 • gene therapy or treatment of inherited disorders

8

Turn over for the next question

Do not write outside the box

0 3 Phototropism is a growth response by part of a plant to light.

0 3 . 1 Name **one** other tropism.

Give the stimulus the plant responds to in the tropism you have named.

[2 marks]

Tropism named example of tropism – eg geotropism / gravitropism

Stimulus correct corresponding stimulus – eg gravity

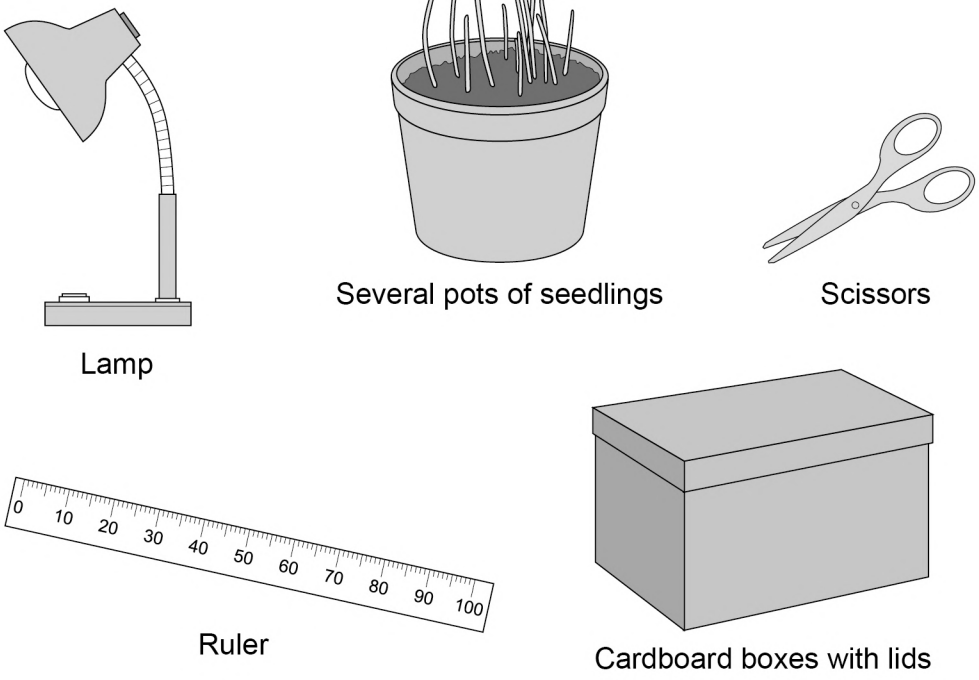
0 3 . 2 Plan an investigation to show the effect of light from one direction on the growth of plant seedlings.

Include details of any controls needed.

You may use some of the equipment shown in **Figure 4** and any other laboratory apparatus.

[6 marks]

Figure 4



Do not write outside the box

Indicative content

• several seedlings in each batch
or one pot of seedlings in each batch

• measure heights of shoots
• leave some in dark with light from one side / direction in box with hole
• control(s) with all-round light or rotating on clinostat or in dark

• control variable(s) eg same temperature / water / soil type
• after suitable time (at least several hours)
• record appearance of seedlings re. light direction
• re-measure heights of shoots

• detail of how bent shoots were measured – eg use thread or straighten them out
• calculate mean height increase for each group
• use ruler / protractor to estimate angle of bending

0 3 . 3 Explain how phototropism in a plant shoot helps the plant to survive.

[3 marks]

leaves / plant receive(s) / absorb(s) more light

(so) more photosynthesis

(so plant) produces more glucose

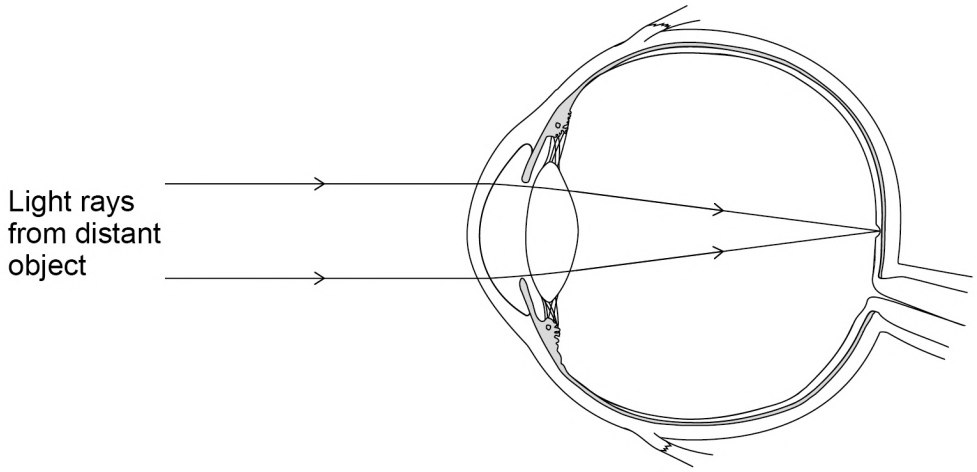
11

Do not write outside the box

0 4 The human eye can focus on objects at different distances.

Figure 5 shows how a clear image of a **distant** object is formed in a person's eye.

Figure 5



0 4 . 1 Explain how the person's eye could adjust to form a clear image of a **nearer** object.

[6 marks]

ciliary muscles contract

(so ciliary muscles have a) smaller diameter

(so) suspensory ligaments loosen / slacken

(so) lens thickens or lens becomes more curved / rounded

(thicker) lens is more convergent

light rays / image focused on retina

Do not write outside the box

0 4 . 2 Explain why a long-sighted person has difficulty seeing near objects clearly.

[2 marks]

eye(-ball) is (too) short or lens cannot be thickened enough

(so) light 'focuses' behind retina

0 4 . 3 Long-sightedness can be corrected by wearing spectacles.

Describe how spectacle lenses can correct long-sightedness.

[3 marks]

convex / converging lens

light rays bent / refracted (inwards) more

light rays focused on retina

11

Do not write outside the box

0 5 **Table 2** gives the classification of four plant species.

Table 2

Group	Species 1	Species 2	Species 3	Species 4
Kingdom	*Plantae*	*Plantae*	*Plantae*	*Plantae*
Phylum	*Spermatophyta*	*Spermatophyta*	*Spermatophyta*	*Spermatophyta*
Class	*Monocotyledonae*	*Dicotyledonae*	*Monocotyledonae*	*Dicotyledonae*
Order	*Poales*	*Fabales*	*Poales*	*Scrophulariales*
Family	*Cyperaceae*	*Fabaceae*	*Poaceae*	*Scrophulariaceae*
Genus	*Eriophorum*	*Pisum*	*Poa*	*Antirrhinum*
Species	*angustifolium*	*sativum*	*annua*	*majus*

0 5 . 1 Species **1** and **3** are the most closely related.

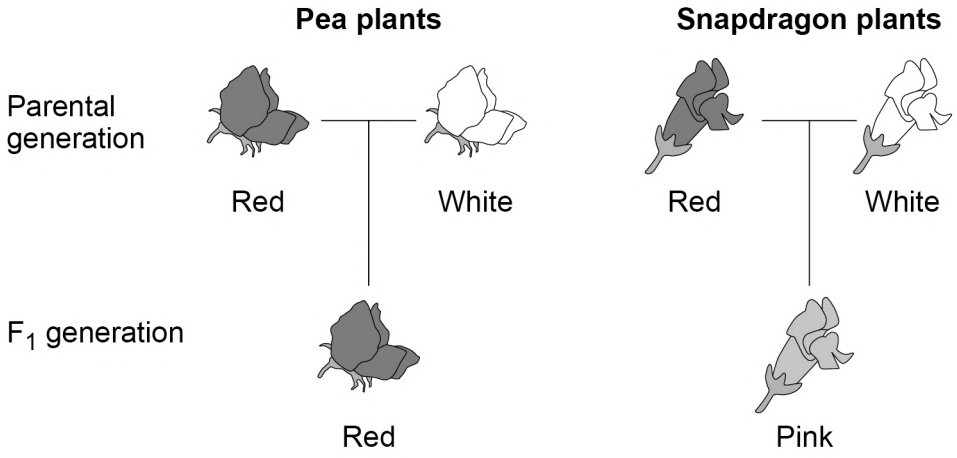
What information in **Table 2** gives evidence for this?

[1 mark]

same kingdom + phylum + class + order
or same order or they have the top four groups the same

Figure 6 shows the inheritance of flower colour in two species of plant.

Figure 6



- In pea plants and in snapdragon plants, flower colour is controlled by one pair of alleles.
- In **Figure 6** the parental generation plants are homozygous for flower colour.
- In heterozygous **pea** plants, the allele for red flower colour is dominant.
- In heterozygous **snapdragon** plants, the alleles for flower colour are both expressed.

Do not write outside the box

Use the following symbols for alleles in your answers to Questions **05.2** to **05.4**:

Pea plants

R = allele for red flowers
r = allele for white flowers

Snapdragon plants

C^R = allele for red flowers
C^W = allele for white flowers

0 5 . 2 What is the genotype of the red-flowered pea plants in the F_1 generation?

[1 mark]

Rr / rR

0 5 . 3 What is the genotype of a white-flowered snapdragon plant?

[1 mark]

$C^W C^W$

A gardener crossed two pink-flowered snapdragon plants.

0 5 . 4 Draw a Punnett square diagram to show why only some of the next generation plants had pink flowers.

Identify the phenotypes of all the offspring plants.

[3 marks]

parental genotypes / gametes
correct for both parents:
CR CW CR CW / CR and CW

genotypes of offspring correctly
derived in a Punnett square:
CRCR CRCW CWCW

correct identification of
phenotypes from their cross:
CRCR = red
CRCW = pink
CWCW = white

0 5 . 5 What percentage of the offspring would you expect to have pink flowers?

[1 mark]

answer correctly derived from
Question 05.4
to match stated phenotypes

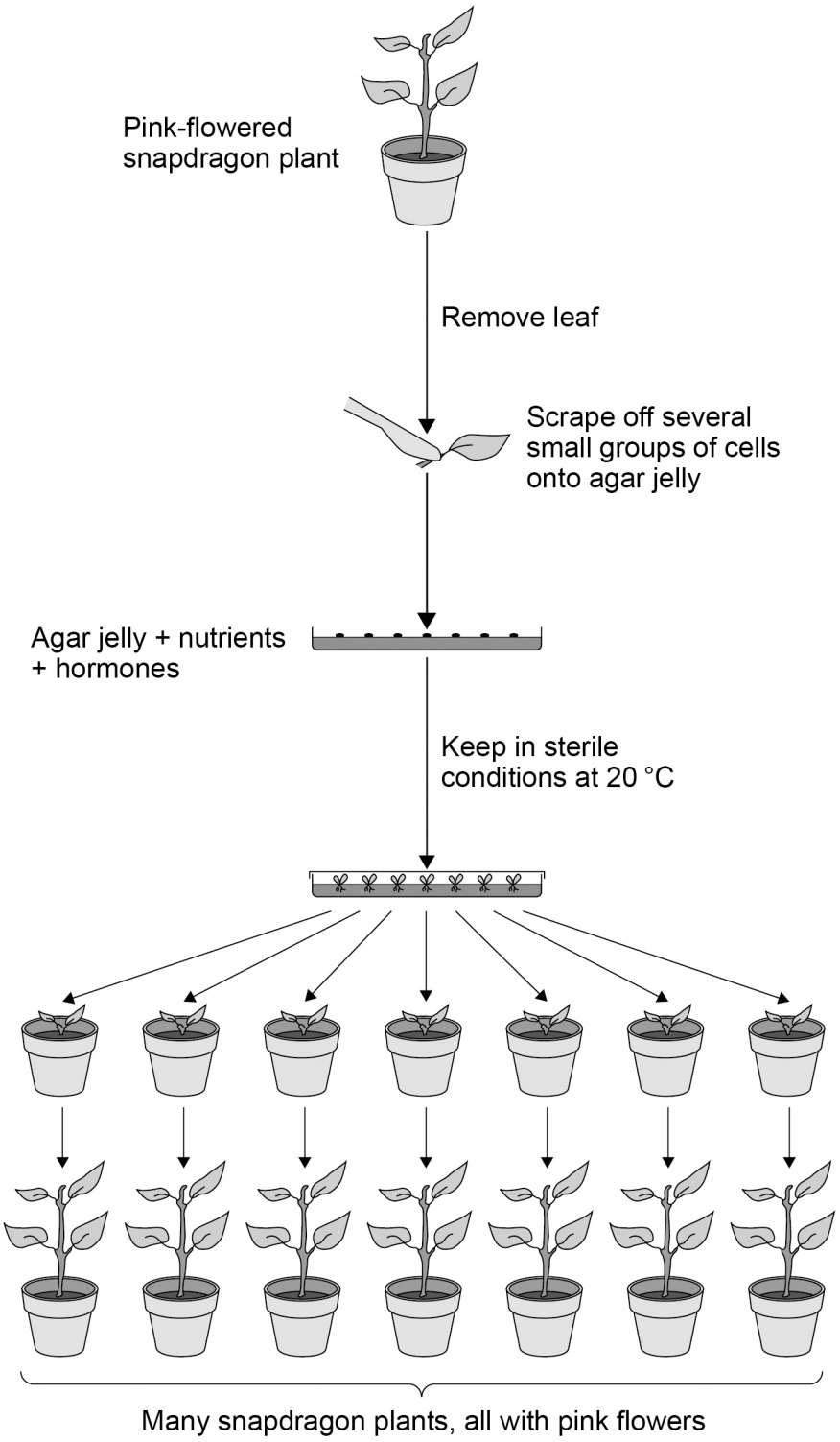
Percentage = _____ %

Turn over ►

Commercially, hundreds of pink-flowered snapdragon plants can be produced from one pink-flowered plant.

Figure 7 shows a tissue culture technique used for producing many plants from one plant.

Figure 7



Do not write outside the box

0 5 . 6 Give a reason for each of the following steps shown in **Figure 7**.

[5 marks]

Several groups of cells are scraped off the leaf:

so many / several plants can be produced

Nutrients are added to the agar jelly:

for making protein / amino acids or for making chlorophyll
or for providing energy or for respiration

Hormones are added to the agar jelly:

so differentiation occurs
or so roots / shoots develop

The plant cells are kept in **sterile** conditions:

to prevent growth / entry of
microorganisms / named type
or prevent decay / disease

The plant cells are kept at **20 °C**:

(temperature = 20 oC)
so optimum / good growth

0 5 . 7 Explain why the method shown in **Figure 7** produces **only** pink-flowered plants.

[2 marks]

(all new plants have been) produced by asexual

reproduction / mitosis or produced without (fusion of) gametes

(so) all are genetically identical / clones

or all are CRCW / heterozygous

14

Turn over ►

Do not write outside the box

0 6 Water conservation is important to the human body.

0 6 . 1 Which gland releases the hormone that controls water loss from the body?

[1 mark]

Tick (✓) **one** box.

- Adrenal ☐
- Pancreas ☐
- Pituitary ☑
- Thyroid ☐

0 6 . 2 Which hormone helps the kidneys to control water loss from the body?

[1 mark]

Tick (✓) **one** box.

- ADH ☑
- Adrenaline ☐
- LH ☐
- Thyroxine ☐

Do not write outside the box

0 6 . 3 A man is walking across a desert.

The man has used up his supply of drinking water.

Explain how the gland you named in Question **06.1** and the kidneys reduce water loss.

[3 marks]

high(er) concentration of blood causes (more) ADH / hormone release

(and hormone / ADH causes) increased permeability of kidney tubules (to water)

(so) increased water reabsorption

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 Some people have kidney failure.

Doctors may treat patients with kidney failure by either:

- dialysis
- a kidney transplant.

Explain **two** biological reasons why most doctors think that a kidney transplant is a better method of treatment than dialysis.

Do **not** refer to cost or convenience.

[4 marks]

Reason 1 changes in concentrations / levels of substances / urea are minimised (so) less / no chance of causing damage to body cells / tissues

Reason 2 not repeatedly puncturing skin or blood not in contact with machine (so) less / no chance of infection or less / no chance of blood clots or no need to take anti-clotting drugs

9

Do not write outside the box

0 7 Ragwort is a weed that grows on farmland.

Ragwort is poisonous to horses.

0 7 . 1 Plan an investigation to estimate the size of a population of ragwort growing in a rectangular field on a farm.

[4 marks]

Indicative content

- use of quadrat
- (quadrat) of given area / dimensions – eg 0.25 m2 or 1 m × 1 m
- quadrats are placed randomly
- method of obtaining randomness – eg random coordinates from a calculator or throw over shoulder or throw with eyes closed
- suitable number of quadrats (10 or more or a large number)
- count number of plants (in each quadrat)
- calculation of mean per quadrat or per unit area
- determination of area of field (length × width)
- population = mean per m2 × area of field

Question 7 continues on the next page

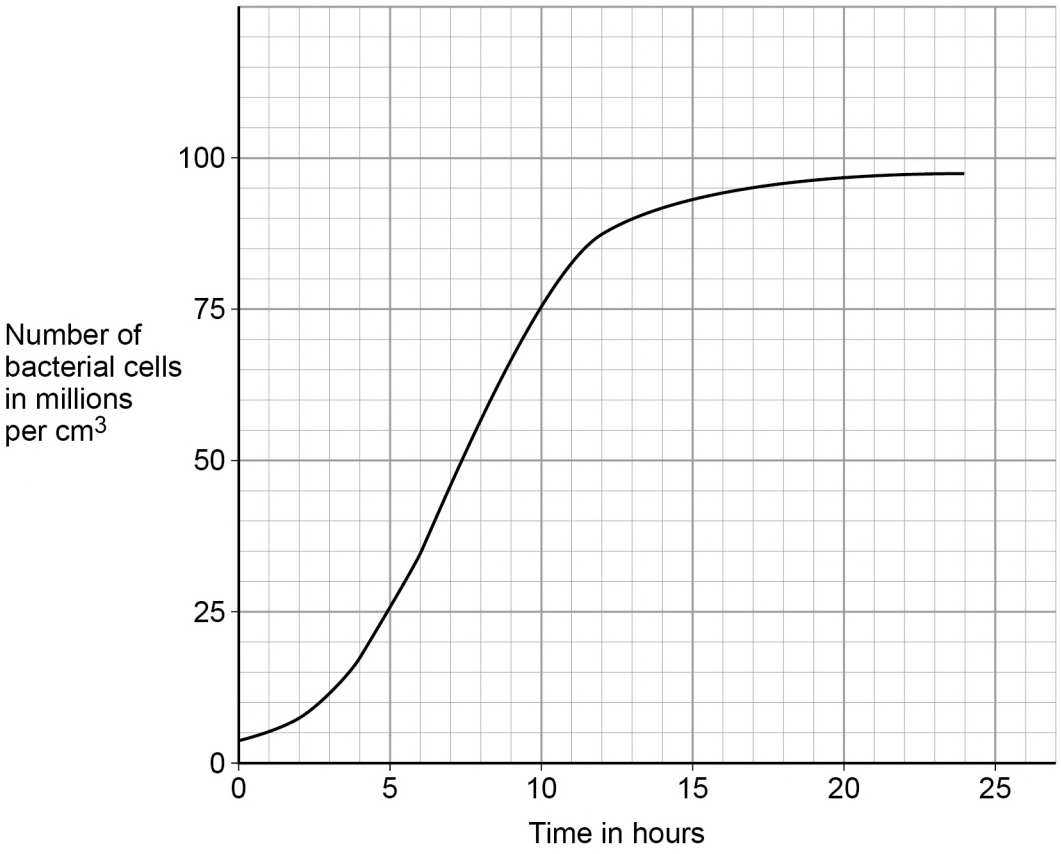
Do not write outside the box

The herbicide glyphosate will kill ragwort and other weeds.

Scientists use bacteria for the genetic engineering of crop plants to make the crops resistant to glyphosate.

Figure 8 shows the growth of a culture of the bacteria in a solution of nutrients at 25 °C

Figure 8



0 7 . 2 Why did the rate of reproduction increase between 2 hours and 7 hours?

[1 mark]

more bacteria so more divisions / reproduction (per unit time)

Do not write outside the box

0 7 . 3 After 12 hours, the rate of reproduction decreased.

Suggest **three** ways the scientists could maintain a high rate of reproduction in the bacterial culture.

[3 marks]

1 add (more) sugar

2 • add (more) amino acids / protein

3 • add (more) oxygen

0 7 . 4 The rate of reproduction of the bacteria is fastest at 7 hours.

How many times faster is the rate of reproduction at 7 hours than the rate at 12 hours?

[4 marks]

tangent drawn to the curve at 12 hours

calculation of rate at 7 hours yy xx

calculation of rate at 12 hours yy xx

Rate at 7 hours is 3.3 times faster.

Question 7 continues on the next page

Do not write outside the box

0 7 . 5 Scientists transferred a gene for resistance to the herbicide glyphosate into the bacteria.

The genetically-modified (GM) bacteria can then transfer the glyphosate-resistance gene to a crop plant.

Explain the advantage of making crop plants resistant to glyphosate.

[3 marks]

can use the glyphosate / weed killer to kill weeds but not kill / affect crop

(so) less competition for light / water / minerals / ions

(so) crops have high(er) yield

15

Do not write outside the box

0 8 It is important to keep the blood glucose concentration within narrow limits.

0 8 . 1 A person eats a meal containing a lot of carbohydrate. This causes an increase in the person's blood glucose concentration.

Explain how the hormones insulin **and** glucagon control the person's blood glucose concentration after the meal.

[5 marks]

(blood glucose increases after meal causing) insulin secretion

insulin causes glucose to enter cells / liver / muscles

(insulin causes) glucose conversion to glycogen

(so) blood glucose decreases causing glucagon secretion

glucagon causes glycogen to be converted to glucose

0 8 . 2 The body cells of a person with Type 2 diabetes do **not** respond to **insulin**.

A person with Type 2 diabetes often has a higher blood **insulin** concentration than a non-diabetic person.

Explain why.

[3 marks]

cells / liver / muscles absorb less glucose

(so) glucose concentration in blood remains high

(high blood glucose stimulates / causes) pancreas to release more insulin

Do not write outside the box

Metformin is a drug used for treating people who have Type 2 diabetes.

Scientists investigated the effects of metformin and two other drugs, **A** and **B**.

The scientists wanted to see how the drugs affected the blood glucose concentrations of 220 people with Type 2 diabetes.

This is the method used.

1. Put the 220 people into five groups.
2. Treat each group with a different drug or combination of drugs for several weeks.
3. Give each person a meal high in carbohydrate.
4. Measure the blood glucose concentration of each person 30 minutes after the meal and again 3 hours after the meal.

0 8 . 3 Suggest **three** variables that the scientists should have controlled in the investigation.

[3 marks]

1 age

2 • height and mass

3 • proportion of males and females or group size

The scientists recorded their results as a mean value for each group.

The scientists calculated the 'standard deviation' for each group's result.

Standard deviation is a measure of the spread of the individual results above or below (±) the mean value.

The scientists gave each group's result as:

mean ± standard deviation

The larger the standard deviation, the greater is the spread of results around the mean.

0 8 . 4 Which of the results is the most precise?

[1 mark]

Tick (✓) **one** box.

Mean = 171.6 ± 16.3 ☐

Mean = 177.2 ± 15.4 ☑

Mean = 182.5 ± 18.2 ☐

Mean = 205.2 ± 19.4 ☐

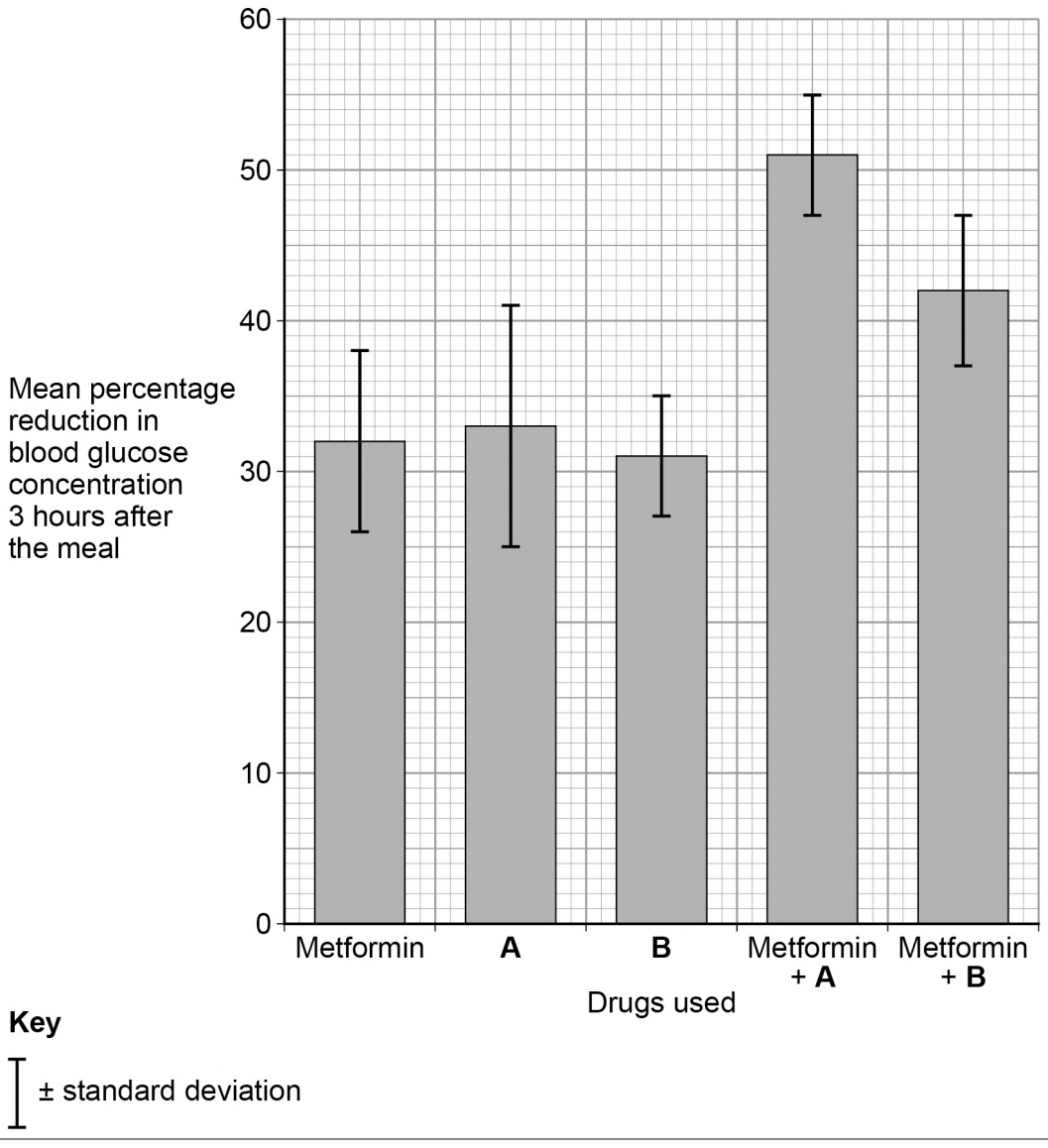
Question 8 continues on the next page

Table 3 and **Figure 9** show the scientists' results.

Table 3

Drugs used	**Metformin**	**A**	**B**	**Metformin + A**	**Metformin + B**
Number of people	60	40	25	65	30
Mean blood glucose concentration 30 minutes after the meal in mg/100 cm^3 ± standard deviation	177.2 ± 15.4	182.5 ± 18.2	171.6 ± 16.3	205.2 ± 19.4	206.5 ± 19.6

Figure 9



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0 8 . 5 In **Table 3** and **Figure 9** some standard deviations of results overlap.

- An overlap of standard deviations shows the difference between the means is **not** significant.
- **No** overlap of standard deviations shows a significant difference between the means.

A student looked at the scientists' method and the results in **Table 3** and **Figure 9**.

The student stated:

'Metformin works better when used with other drugs.'

Evaluate the student's statement.

[6 marks]

END OF QUESTIONS

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