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.

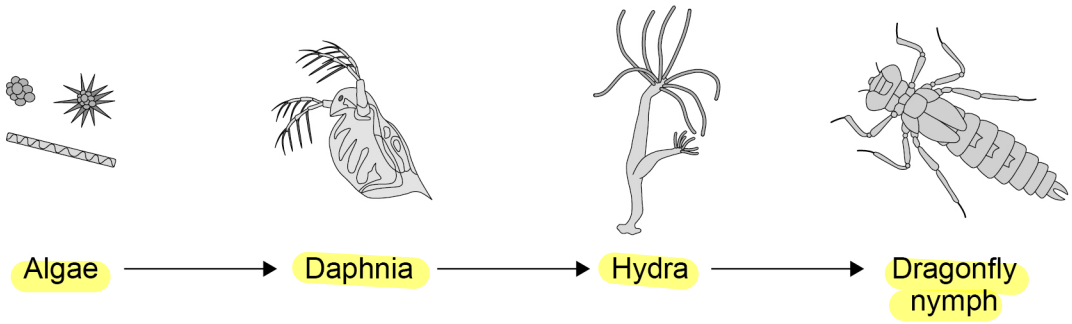
Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

Do not write outside the box

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

Figure 1

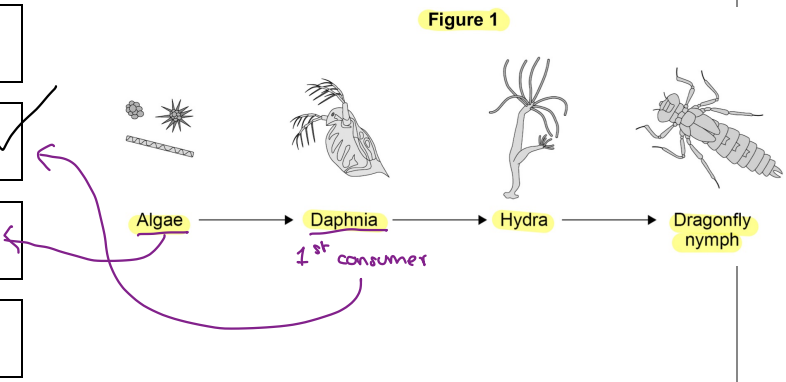


0 1 . 1 Which term describes the Daphnia in this food chain?

[1 mark]

Tick (✓) **one** box.

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



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

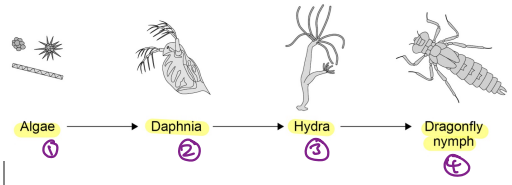
Label each trophic level.

biological material derived from living or recently living organisms

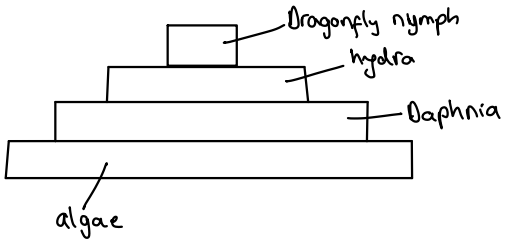
group of organisms within an ecosystem which occupy the same level in the food chain

[2 marks]

Figure 1



- Tiers = number of different organisms (on different levels)
- Bottom tier > middle tier > top tier (etc)



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]

Not all absorbed

- Non-digestible parts lost in faeces
- Lost in urine
- Algae not all eaten
- Used in respiration/lost as CO_2

Turn over ▶

Do not write outside the box

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

sum of values / no. of values

[2 marks]

Table 1

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

$\frac{5+21+0+16+28}{5} = 14$ ← no. daphnia in 1 dm^3 water

$14 \times 1000 = 14000$

Mean number of Daphnia in 1 m^3 of pond water = 14 000

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.

Volume = length x width x depth

Mean no. daphnia in $1m^3$ = 14000

Calculate the estimated number of Daphnia in the pond.

Use your answer from [Mean number of Daphnia in 1 m^3 of pond water]

Give your answer in standard form. $y \times 10^x$ $0 < y < 10$ ✓ **[4 marks]**

Volume of pond: $2.5 \times 1.5 \times 0.5 = 1.875 m^3$

Daphnia in $1.875 m^3$: $1.875 \times 14000 = 26250$ ✓ ✓

1 2 3 4

$2.6250 = 2.625 \times 10^4$ ✓

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

Question 1 continues on the next page

Do not write outside the box

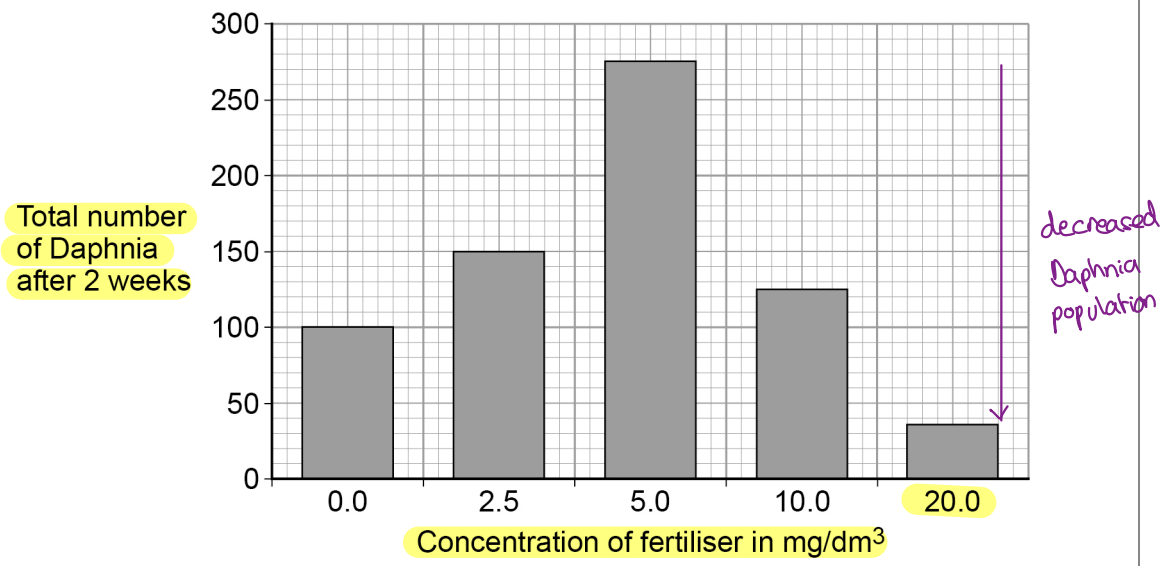
Rainfall can cause fertiliser to be washed from farmland into a pond.

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.

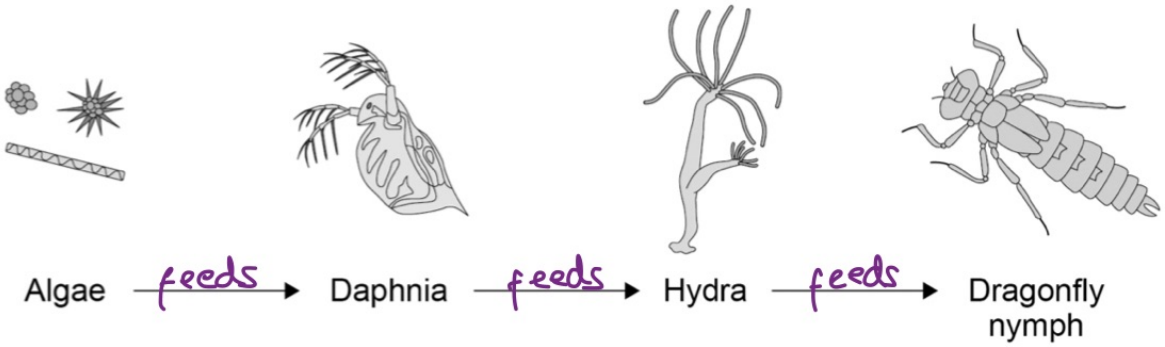
[2 marks]

- Increased growth of algae, so more food for Daphnia

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 there are fewer Daphnia

14

Do not write outside the box

0 2 Genetic material is made of DNA.

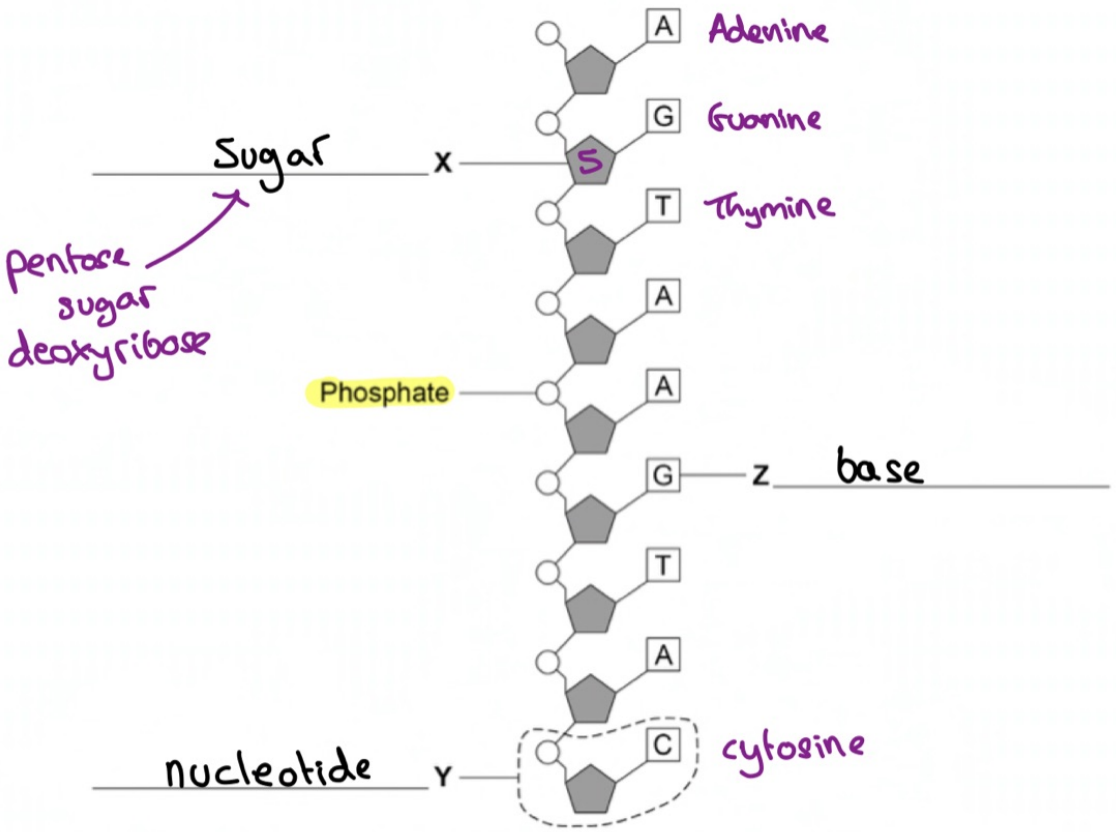
0 2 . 1 Which structures in the nucleus of a human cell contain DNA?

[1 mark]

chromosomes

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

Figure 3



Base	Fatty acid	Nucleotide	Sugar	Glycerol

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

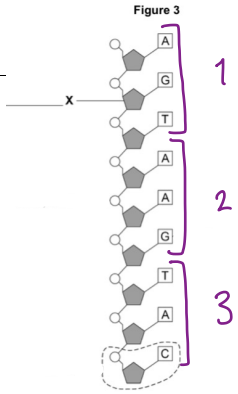
0 2 . 3 A complete DNA molecule is made of two strands twisted around each other.

What scientific term describes this structure?

double helix

1 amino acid = 3 bases

Figure 3



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 genetic disorders – Understanding evolution / ancestry / ethnic origins

2 treatment for inherited disorders – Tracing human migration patterns

8

Turn over ►

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 _____ geotropism hydrotropism thermotropism

Stimulus _____ gravity water heat

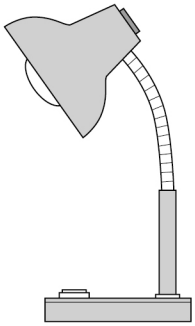
0 3 . 2 Plan an investigation to show the effect of light from one direction on the growth of plant seedlings.

Include details of any controls needed.

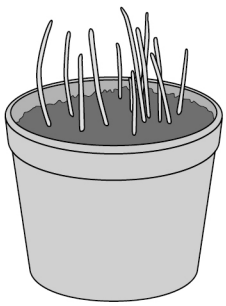
You may use some of the equipment shown in **Figure 4** and any other laboratory apparatus.

[6 marks]

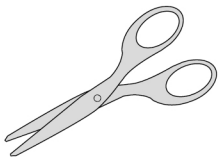
Figure 4



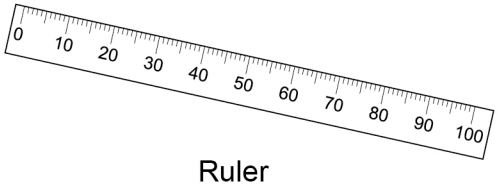
Lamp



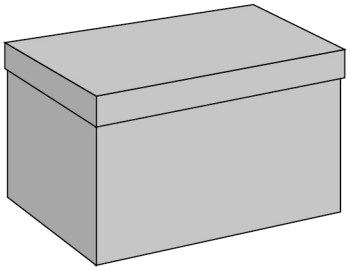
Several pots of seedlings



Scissors



Ruler



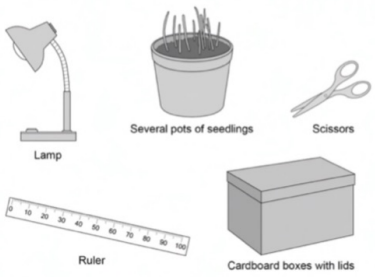
Cardboard boxes with lids

Do not write outside the box

- Use several pots of seedlings that will be given the same amount of water and the same temperature and soil type
- Have one pot of seedlings in an area where there is light all around
- Have other pots of seedlings in boxes with lids and a hole in one side with lamp light shining through
- Measure seedling height at the beginning of the experiment by straightening them out against a rular (calculate an average for each pot) and measure again after three days using the same method
- Calculate the mean height increase for each group
- Use a protractor to measure the angle of bending and compare with the direction of light entry

- Method must lead to a valid outcome
- Must be sequenced in a logical order

Figure 4



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

[3 marks]

- Plant leaves receive more light so more photosynthesis occurs and the plant produces more glucose

↑ starch / carbohydrate / organic material

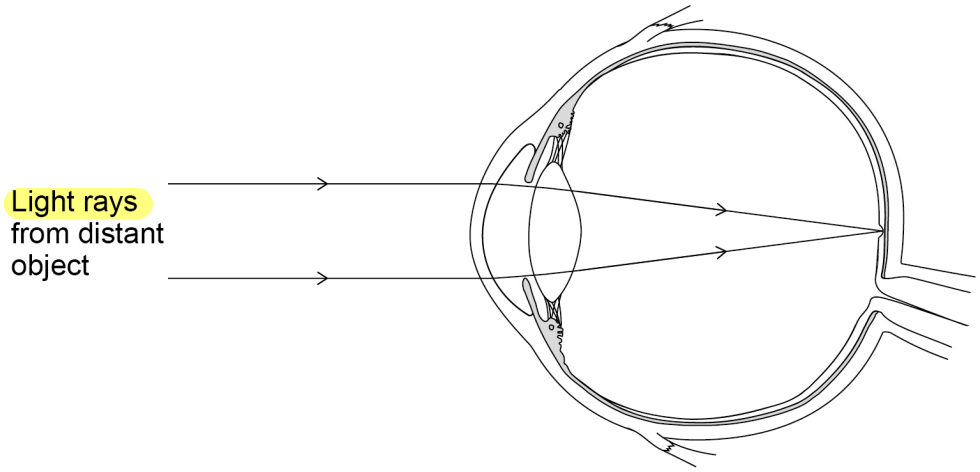
11

Do not write outside the box

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

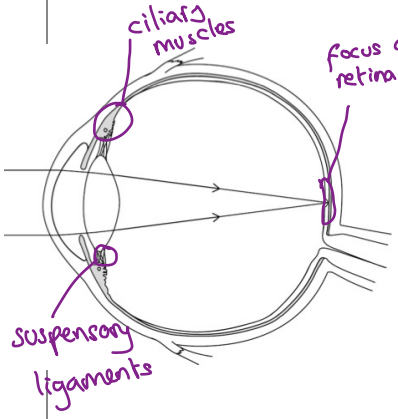
Figure 5 shows how a clear image of a **distant** object is formed in a person's eye.

Figure 5



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

[6 marks]



- Ciliary muscles contract, so they have a smaller diameter and suspensory ligaments loosen

- Lens therefore thickens and becomes more rounded

- The lens is more convergent → bends light rays inwards more

- Image is thus focused on the 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 / lens cannot be thickened enough ...
- ... so light focuses behind the retina

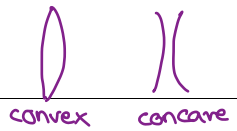
Ciliary muscles too weak

Lens not sufficiently elastic

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

Describe how spectacle lenses can correct long-sightedness.

[3 marks]



- Convex ✓ / converging lens is used to refract ✓ light rays inwards more

- This focuses the light rays onto the 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.

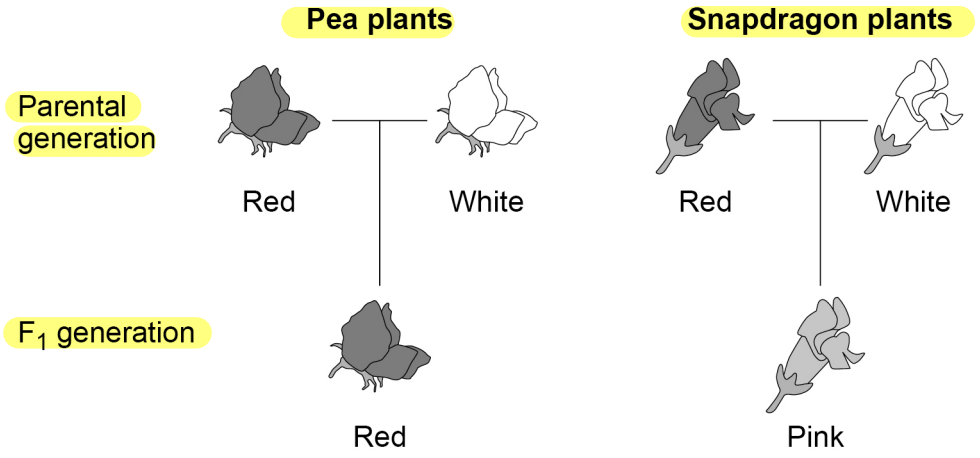
What information in **Table 2** gives evidence for this?

[1 mark]

Species 1 and 3 have the same kingdom, phylum, class and order

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. → a version of a gene
- In **Figure 6** the parental generation plants are homozygous for flower colour. → both the same
- In heterozygous **pea** plants, the allele for red flower colour is dominant. → Will always be expressed if present
- In heterozygous **snapdragon** plants, the alleles for flower colour are both expressed.

one dominant, one recessive

Do not write outside the box

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

Pea plants

Dominant → **R** = allele for red flowers
Recessive → **r** = allele for white flowers

Snapdragon plants

both expressed → **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

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. → came from homozygous red and homozygous white so all heterozygous $C^R C^W$

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

Identify the phenotypes (→ observable characteristics (i.e. colour)) of all the offspring plants.

[3 marks]

	C^R	C^W
C^R	$C^R C^R$	$C^R C^W$
C^W	$C^W C^R$	$C^W C^W$

Red = $C^R C^R$ = 1/4 25%
White = $C^W C^W$ = 1/4 25%
Pink = $C^W C^R$ = 2/4 50%

∴ not all pink

	C^R	C^W
C^R	$C^R C^R$ (1)	$C^R C^W$ (2)
C^W	$C^W C^R$ (3)	$C^W C^W$ (4)

2/4 = 1/2 $\frac{1}{2} \times 100 = 50\%$

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

[1 mark]

Percentage = 50 %

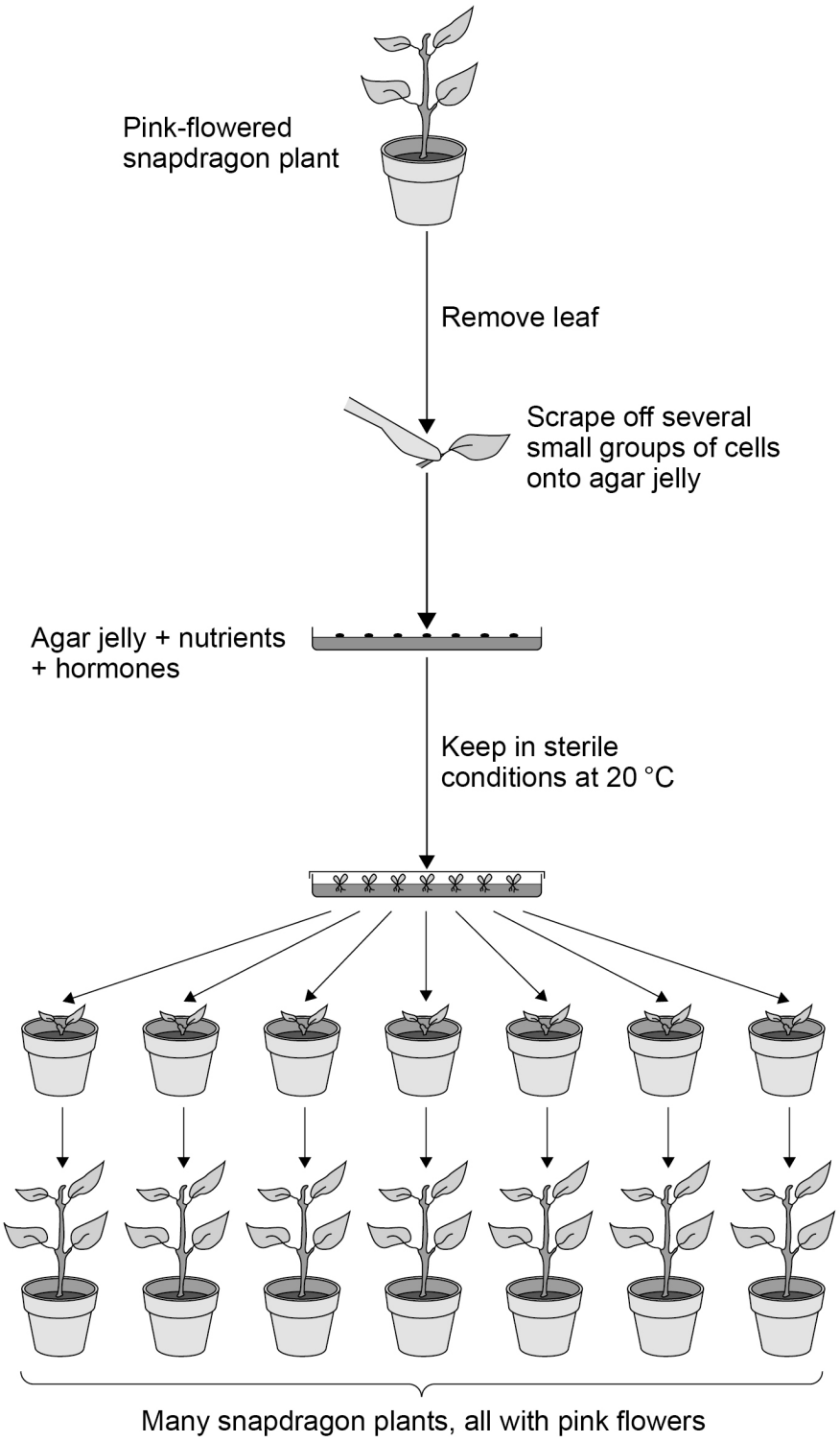
Turn over ►

Do not write outside the box

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 that many plants can be produced

Nutrients are added to the agar jelly: for making amino acids/ protein - for providing energy - for respiration ← growth

Hormones are added to the agar jelly: So root/ shoots develop → so differentiation occurs

The plant cells are kept in **sterile** conditions: to prevent the entry/ growth of microorganisms → prevents decay/disease

The plant cells are kept at **20 °C**: optimum for growth → optimum for enzyme function

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

[2 marks]

- All the new plants were produced by asexual reproduction (mitosis), so all are genetically identical → clones → All are C^RC^W → All have the same genes/ DNA

14

Do not write outside the box

0 6 Water conservation is important to the human body.

Which gland releases the hormone that controls water loss from the body?

[1 mark]

Tick (✓) **one** box.

- Adrenal ☐ × adrenaline
- Pancreas ☐ × digestion
- Pituitary ☑ ADH
- Thyroid ☐ × thyroxine

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

[1 mark]

Tick (✓) **one** box.

- ADH ☑
- Adrenaline ☐ × energy etc.
- LH ☐ × reproductive cycle
- Thyroxine ☐ × metabolism

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 and the kidneys reduce water loss.

[3 marks]

- Higher concentration of blood (because less water in blood) causes more ADH to be released
- 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 chance of causing damage to body cells

↳ osmotic stress
urea poisoning

Reason 2 blood not in contact with dialysis machine, so less chance of blood infection

↳ blood clots → no need for anti-clotting medication

9

Do not write outside the box

0 7 Ragwort is a weed that grows on farmland.

Ragwort is poisonous to horses.

- Valid outcome
- Logically sequenced

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]

- Use a 1m × 1m quadrat (→ square frame)
- Place quadrats randomly with use of random computer/ calculator generated coordinates (↳ Throw with closed eyes etc)
- Throw / place at least 10 times and count plant number within quadrat each time. Calculate the mean number of plants per m^2
- find area of field
- Population = mean no. plants / m^2 × area of field

Turn over ►

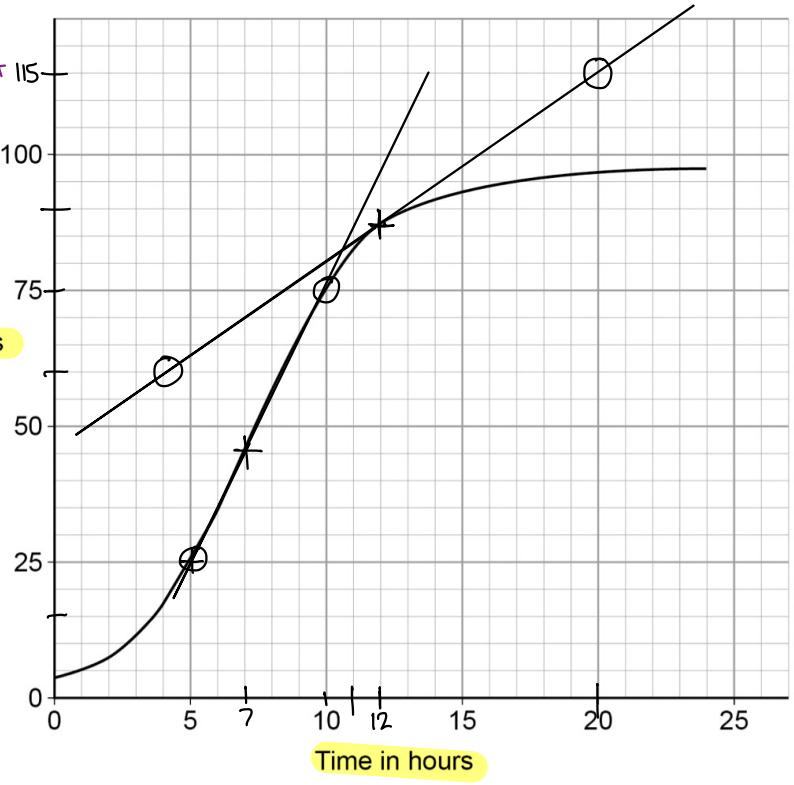
Do not write outside the box

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



To find rate, draw a tangent on that point on the curve

Rate = gradient = $\frac{\Delta y}{\Delta x}$

Rate 12h = $\frac{115-60}{20-4}$

$= \frac{55}{16} = 3.4375$

≈ 3.4

Rate 7h = $\frac{75-25}{10-5}$

$= \frac{50}{5} = 10.00$

≈ 100

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

[1 mark]

More bacteria at this time 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 - Increase temperature

2 add more amino acids / protein - Remove toxins / waste

3 add more oxygen - Maintain pH

- Stir the culture

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]

① Tangent

Rate 12h = 3.4 ✓

Rate 7h = 10.0 ✓

$$\text{scale factor} = \frac{\text{Rate 7h}}{\text{Rate 12h}} = \frac{10.0}{3.4} = 2.9411\ldots$$

$$\approx 2.9$$

between 2.9 and 3.4

Rate at 7 hours is 2.9 ✓ 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]

- Causes the glyphosate to kill the weeds ✓ but not the crop
- Less competition ✓ for light, water, nutrients (etc) ...
- ... so crops have higher 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 to be converted 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 ✓
- Glucose concentration in blood remains high ✓
- High blood glucose stimulates pancreas to release more insulin ✓

Turn over ►

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.

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

[3 marks]

1 age - Severity of diabetes

- Dose of drug

2 height and mass - Starting blood glucose concentration

- Other health condition

3 proportion of males to females

Do not write outside the box

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]**

→ Precision: how close together the values are

↓

smallest S.D

Tick (✓) **one** box.

Mean = 171.6 ± 16.3 ☐

Mean = 177.2 ± 15.4 ☑

Mean = 182.5 ± 18.2 ☐

Mean = 205.2 ± 19.4 ☐

Turn over ►

Do not write outside the box

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

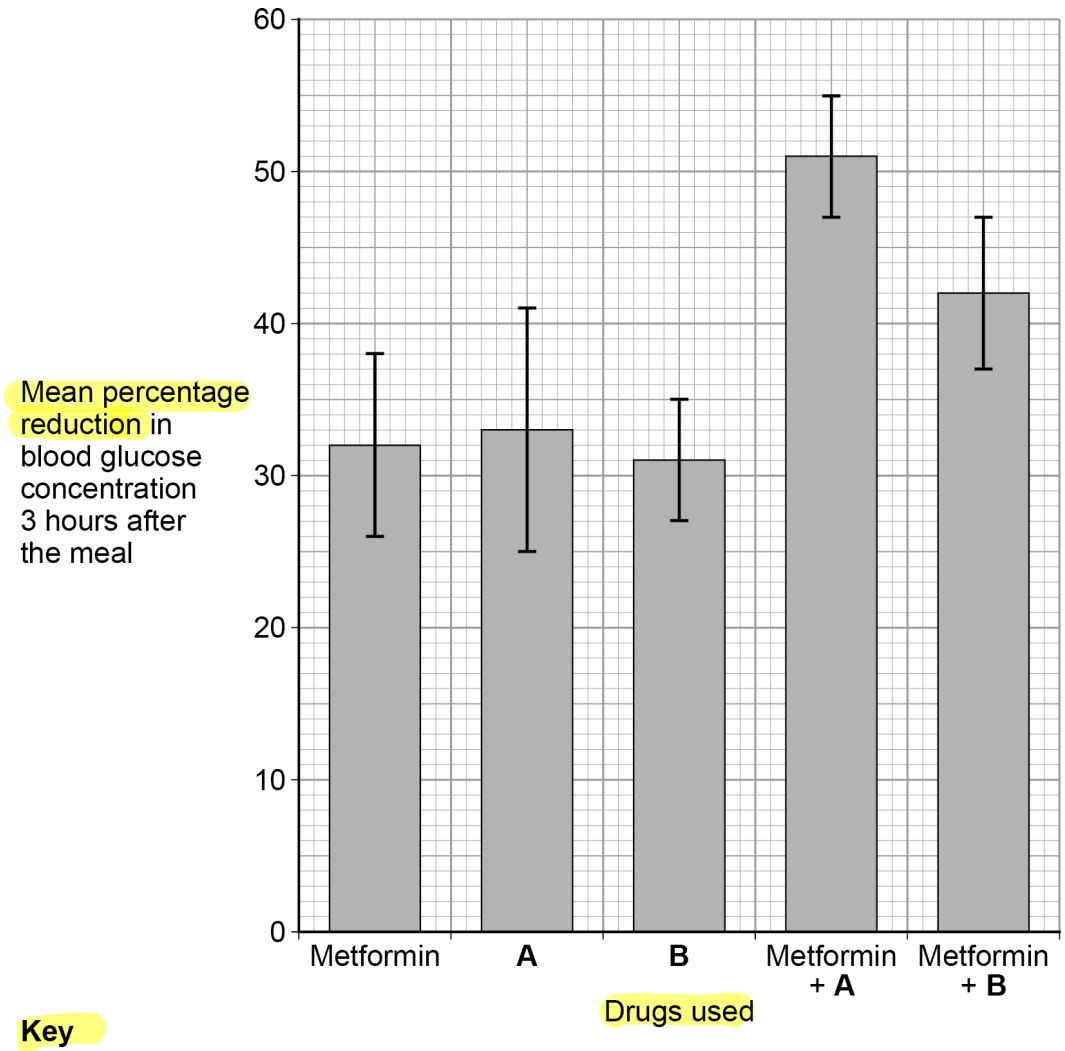
Table 3

groups not very large

Groups of different size

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.'

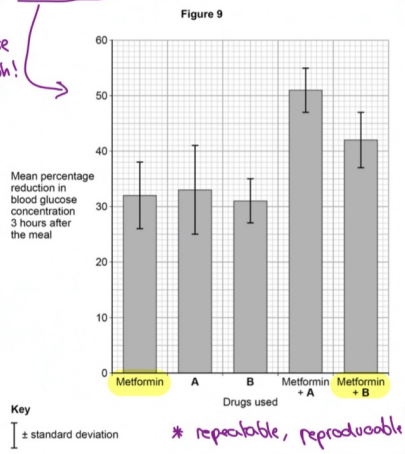
Evaluate the student's statement.

[6 marks]

-Make a judgement, strongly linked and logically supported by a sufficient range of reasons

Use graph!

Figure 9



* repeatable, reproducible

- No information about control variables such as drug concentrations, so results may not be valid

Reasons supporting statement:

Metaformin (Met) + A gives a significantly greater eduction in blood glucose compared with Met alone [this supports the statement]

· Met + B gives a greater (average) reduction in blood glucose than Met alone [this...]

Met +A standard deviation does not overlap with Met standard deviation ∴ significant difference

however Met + B SD overlaps with Met SD so difference is not significant. Group sizes are small and not the same, so results may not be representative *

Conclusively, Met works better on average when used with other drugs based on these results, however the data may not be reliable enough to validate this. Further investigation needed.

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

Groups not very large

Groups of different sizes

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