



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	

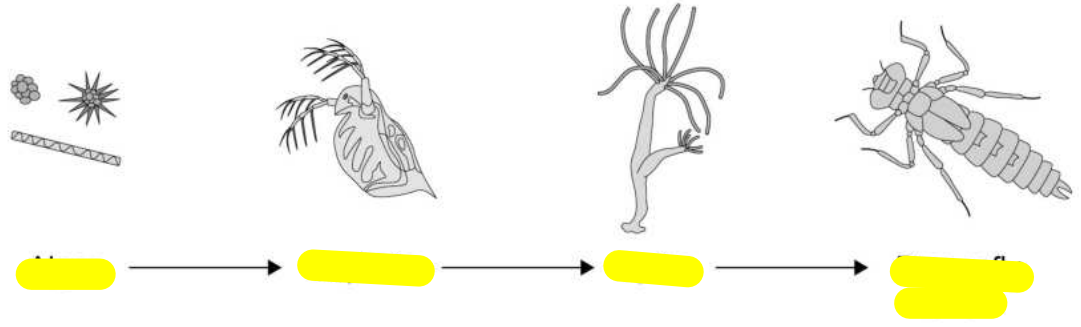
*

Answer all questions in the spaces provided

0 1

Figure 1 shows a food chain in a pond.

Figure 1



0 1

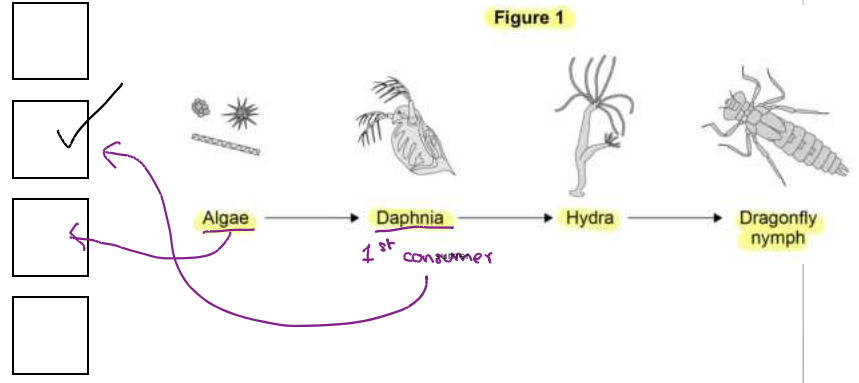
Which term describes the Daphnia in this food chain?

[1 mark]

Tick () one box.

- Apex predator
- Primary consumer
- Producer
- Secondary consumer

Figure 1



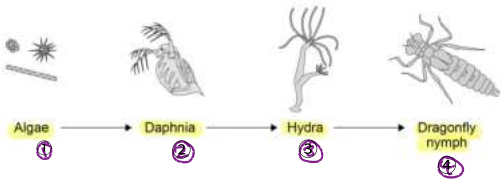
0 1 2

Draw a pyramid of biomass for the food chain.

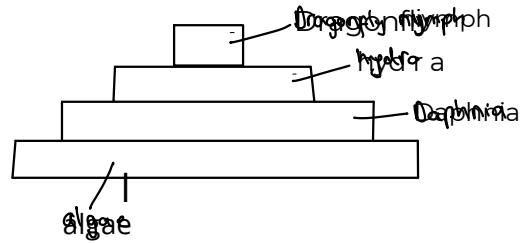
Label each trophic level, biological material derived from living or recently living organisms

[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 - Not all absorbed
digestible parts lost in

- Non-digestible parts lost in faeces

.....

- Lost in urine

Algae not all eaten - Used in respiration / lost

- Used in respiration / lost as O_2

SS "COZQQu

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

This is the method used.

1. Collect 1 dm³ 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 m³ of pond water.

Ty
 $1 \text{ m}^3 = 1000 \text{ dm}^3$
 $\frac{\text{sum of values}}{\text{no. of values}}$

Table 1

[2 marks]

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

$$\frac{5 + 21 + 0 + 16 + 28}{5} = 14$$

14 × 1000 = 14000

14 daphnia in 1 dm³ water

Mean number of Daphnia in 1 m³ of pond water = 14000

0 1 5

The pond was a rectangular shape, measuring:

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

Volume = length x width x depth

Mean no. daphnia in 1m³ = 14000

Calculate the estimated number of Daphnia in the pond.

Use your answer from [Mean number of Daphnia in 1 m³ of pond water] Calculate the estimated number of Daphnia in the pond.

Use your answer in standard form: 0.14

[4 marks]

Give your answer in standard form

[4 marks]

Volume of pond = 2.5 x 1.5 x 0.5 = 1.875 m³

Daphnia in 1.875 m³: 1.875 x 14000 = 26250

2.6250 = 2.625 x 10⁴

BY a-g-o

Question 1 continues on the next page

Turn over ▶

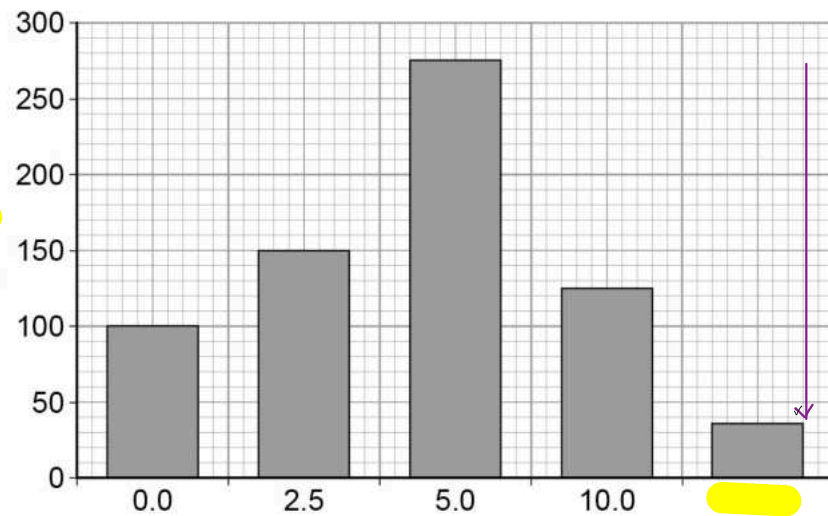
Rainfall can cause fertiliser to be washed from farmland into a pond.

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



decreased
Daphnia
population

0 1 6

A concentration of 5.0 mg/dm³ of fertiliser caused a large increase in the population of Daphnia.

Explain why.

[2 marks]

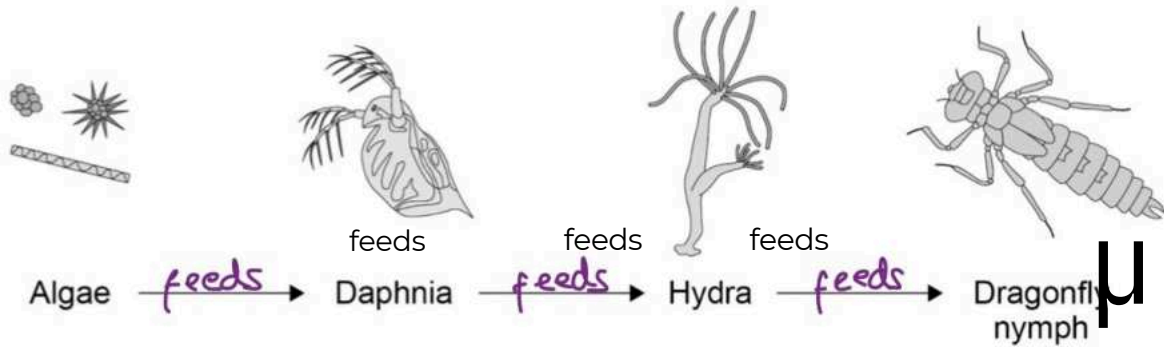
- Increased growth of algae, so more food for Daphnia

01.7 are repeated below.

Figure 1 is repeated below.

Figure 1

Figure 1



The population of Hydra will decrease when 20 mg/dm³ of fertiliser is added to the pond.

Explain why.

The population of Hydra will decrease when 20 mg/dm³ of fertiliser is added to the pond. [2 marks]

Explain why.

[2 marks]

Hydra have less food because there are fewer Daphnia

Turn over for the next questions

Turn over ►

0 2

Genetic material is made of DNA.

0 2 1

Which structures in the nucleus of a human cell contain DNA?

[1 mark]

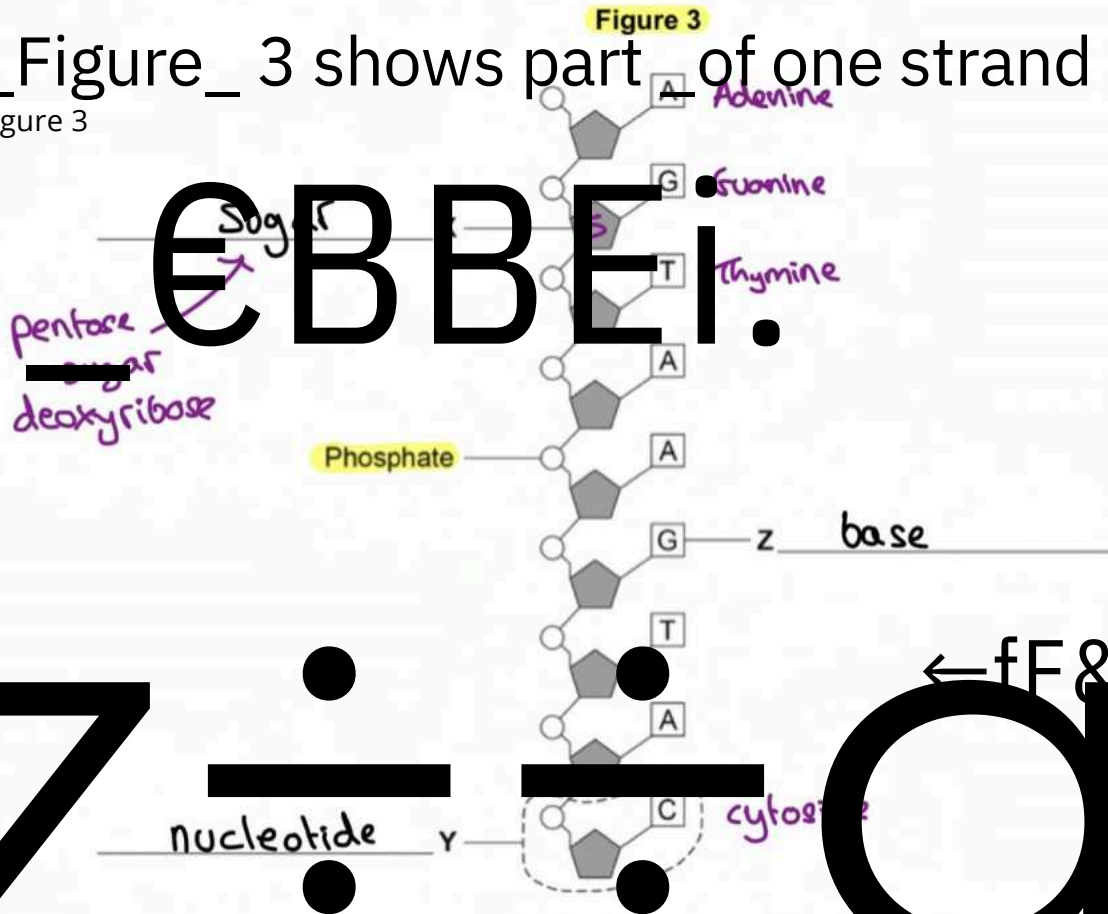
chromosomes

chromosomes

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

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

Figure 3



Base	Fatty acid	Nucleotide	Sugar	Glycerol
------	------------	------------	-------	----------

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

Choose answers from the box.

[3 marks]

Base Fatty acid Nucleotide

		Sugar	Glycerol
--	--	-------	----------

*

0 2 3

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

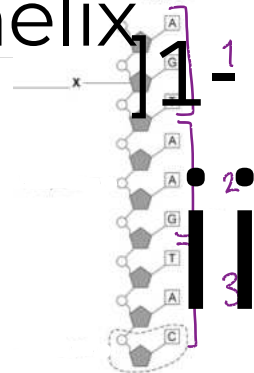
What scientific term describes this structure?

double helix

[1 mark]

= 3 bases

- 1 amino acid = 3 bases



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 genetic disorders

Understanding evolution / ancestry ethnic origins

2 treatment for inherited disorders

- Tracing human migration patterns

8

_Turn o-ver for th-e next q_uestion

Turn over ►

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

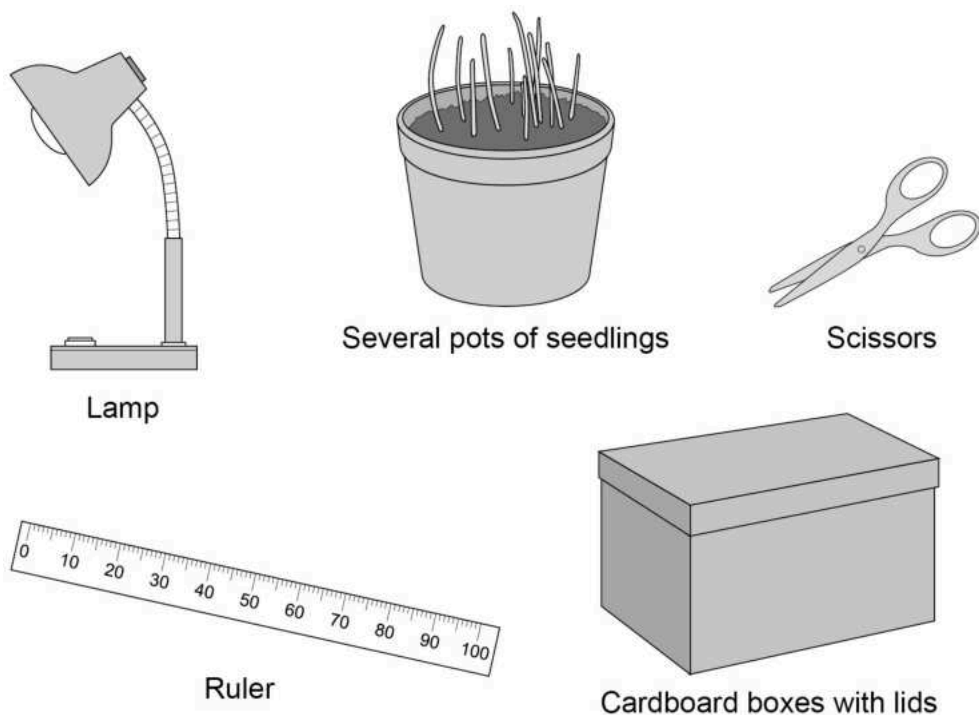
Plan an investigation to show the effect of light from one direction on the growth of plant seedlings.

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



box

valid outcome ✓

given the same amount of water and the same

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

- 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 light -
- Measure seedling height at the beginning of the experiment by straightening them out against a ruler (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 compare with the direction of light



load * order of procedure
investigate
soil type
entry

there is light all around



- Plant leaves receive more light so more photosynthesis occurs and the plant produces more glucose
↑ starch / carbohydrate / organic materials

! in in
at the

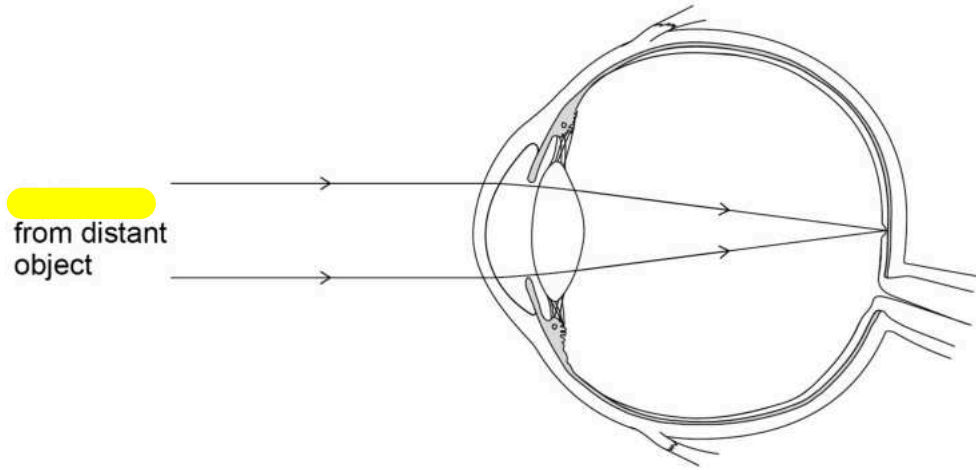
Turn over ▶

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.

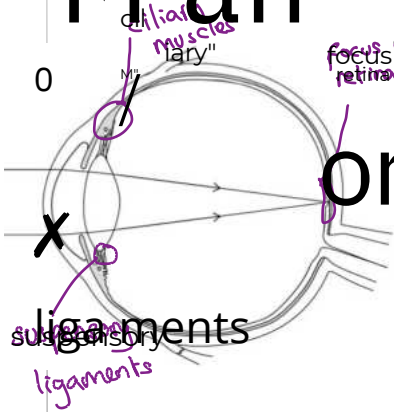
Figure 5



Man

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 loose

- Lens therefore thickens and becomes more rounded

- The lens is more converge.

↳ bends light rays inwards more

- Image thus focused on the retina

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

Lens not sufficiently
elastic

Ciliary muscles
too weak

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

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.

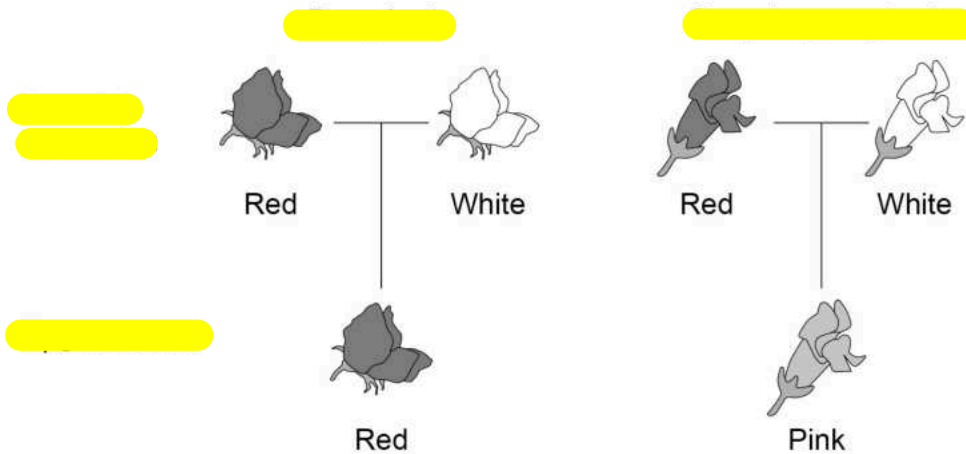
What information in Table 2 gives evidence for this?

[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.

In heterozygous pea plants, the allele for red flower colour is dominant. Will always be expressed if present.

In heterozygous snapdragon plants, the allele for red flower colour is dominant, expressed. Will always be expressed if present.

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

Pea plants Snapdragon plants

Dominant R = allele for red flowers both R

Recessive r = allele for white flowers

both expressed $C^R C^W$

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 F1 generation?

[1 mark]

Rr

0 5 3

What is the genotype of a white-flowered snapdragon plant?

[1 mark]

$C^W C^W$

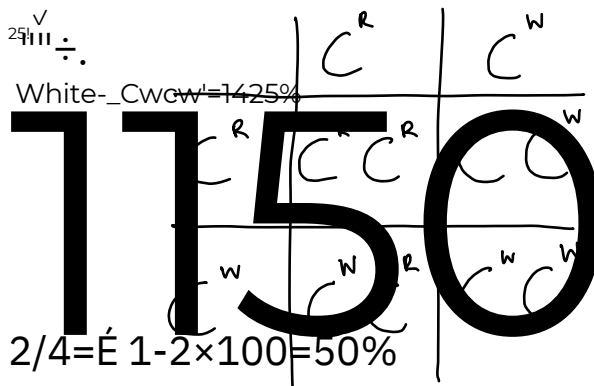
$v \div \div \div \div \div \div$ white

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.

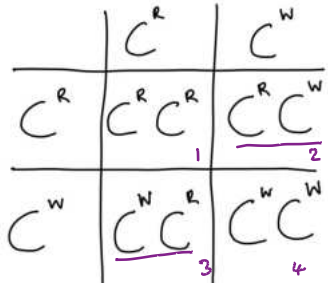
Identify the phenotypes of all the offspring plants.



Red = $C^R C^R = \frac{1}{4} = 25\%$
 White = $C^W C^W = \frac{1}{4} = 25\%$
 Pink = $C^R C^W = \frac{2}{4} = 50\%$

2

3 4



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

0 5 5

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

[1 mark]

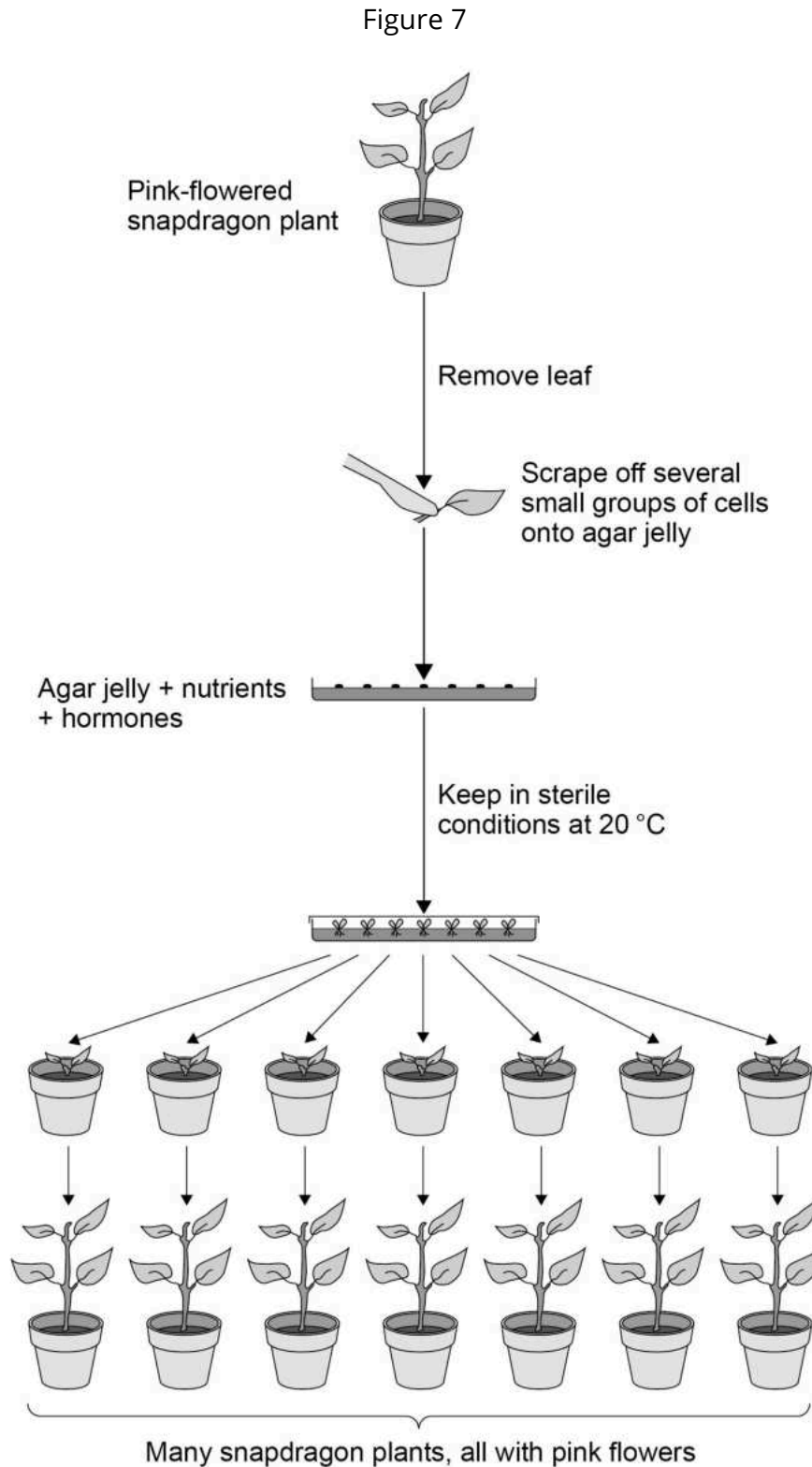
Percentage = 50

50 %

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.



0 5 6 gG yi v

box - [05 marks]

Give a reason for each of the following steps shown in Figure 7

Several groups of cells are scraped off the leaf: so that many plants can be produced

Nutrients are added to the agar jelly: providing energy

Hormones are added to the agar jelly: for providing energy

The plant cells are kept in sterile conditions: to prevent the entry of microorganisms

The plant cells are kept at 20 °C: optimum for growth

Nutrients
8
6
8
8

0 5 7

Explain why the method shown in Figure 7 produces only

- All the new plants were produced by asexual reproduction, so all are genetically identical

[2 marks] clones

produced by asexual reproduction
identical clones

↳ All have the same

↳ All have the same genes / DNA

Turn over ▶

14

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 x adrenaline | <input type="checkbox"/> | x | adrenaline |
| ^x Pancreas | <input type="checkbox"/> | x | digestion |
| Pituitary | <input checked="" type="checkbox"/> | | ADH |
| Thyroid | <input type="checkbox"/> | x | thyroxine |

0 6 2

Which hormone helps the kidneys to control water loss from the body?

[1 mark]

Tick () one box.

- | | | | |
|------------------------------|-------------------------------------|---|--------------|
| ADH ✓ | <input checked="" type="checkbox"/> | | |
| ^x etc. Adrenaline | <input type="checkbox"/> | x | energy etc. |
| LH | <input type="checkbox"/> | x | reproductive |
| Thyroxine | <input type="checkbox"/> | x | metabolism |

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]

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

Turn over ►

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

↳ osmotic stress
urea poisoning

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

chance of blood infection

blood infection

for anti-clotting medication

↳ blood clots → no need for anti-clotting medication

9

0 7

Ragwort is a weed that grows on farmland.

- Valid estimate

Ragwort is poisonous to horses.

- 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.

square frame

[4 marks]

- //
- Use a $1\text{m} \times 1\text{m}$ quadrat → square frame
 - Place quadrants 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 / $\text{m}^2 \times \text{area of field}$

-Question 7 continues on -the next_ page

Turn over ►

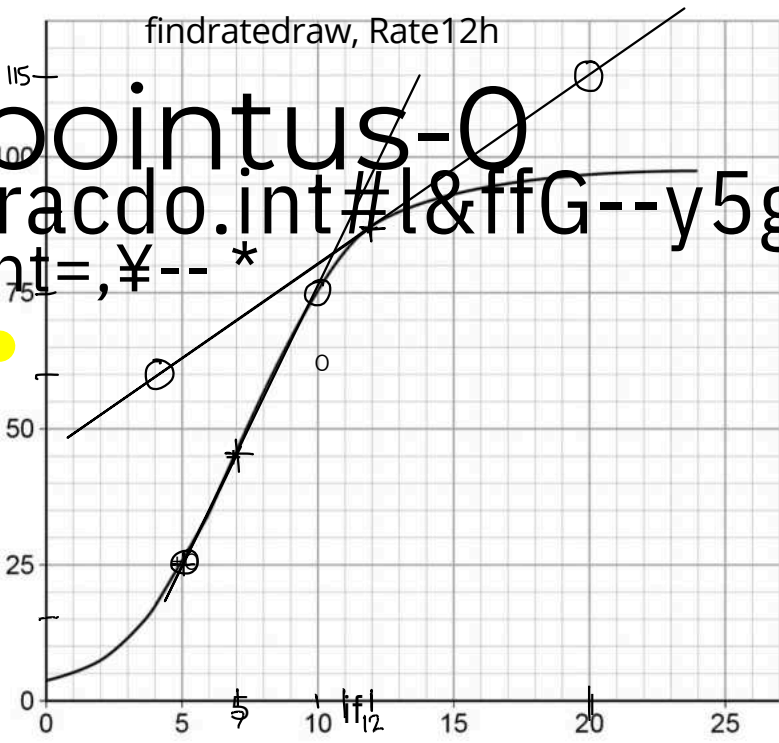
The herbicide glyphosate will kill ragwort and other weeds.

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 tangent on that point of the curve
 Rate = gradient = $\frac{\Delta y}{\Delta x}$



Rate 12h = $\frac{115 - 75}{20 - 10}$
 $= \frac{40}{10} = 4$
 ≈ 3.4

Rate 7h = $\frac{75 - 25}{10 - 2}$
 $= \frac{50}{8} = 6.25$
 ≈ 1000

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

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~~ more sugar
sugar Increase temperature

- Increase temperature

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

- Remove toxins / waste

add more oxygen

- Maintain pH

3 add more
oxygen - Maintain pH

- Stir the culture

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]

Ⓢ Tangent

Rate 12h = 3.4 ✓

Rate 7h = 10.0 ✓

$$\text{scale factor} = \frac{\text{Rate 7h}}{\text{Rate 12h}} = \frac{10.0}{3.4} = 2.9411... \approx 2.9$$

g. between 2.9 and 3.4

Rate at 7 hours is 2.9 ✓ times faster.

Question 7 continues on the next page

Turn over ►

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

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 ►

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.

Maan

[3 marks]

- 1 age - severity of diabetes
- 2 height and mass - Dose of drug
- 3 proportion of males to females - starting blood glucose concentration
- Other health condition

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 (\pm) the mean value.

The scientists gave each group's result as:

mean \pm 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?

Tick () one box.

Mean = 171.6 \pm 16.3

Mean = 177.2 \pm 15.4

Mean = 182.5 \pm 18.2

Mean = 205.2 \pm 19.4

\rightarrow Precision: how close together the values are

[1 mark]

\downarrow
smallest S.D

-Que3stion 8 con-tinues o-n the ne6xt pag

Turn over ►

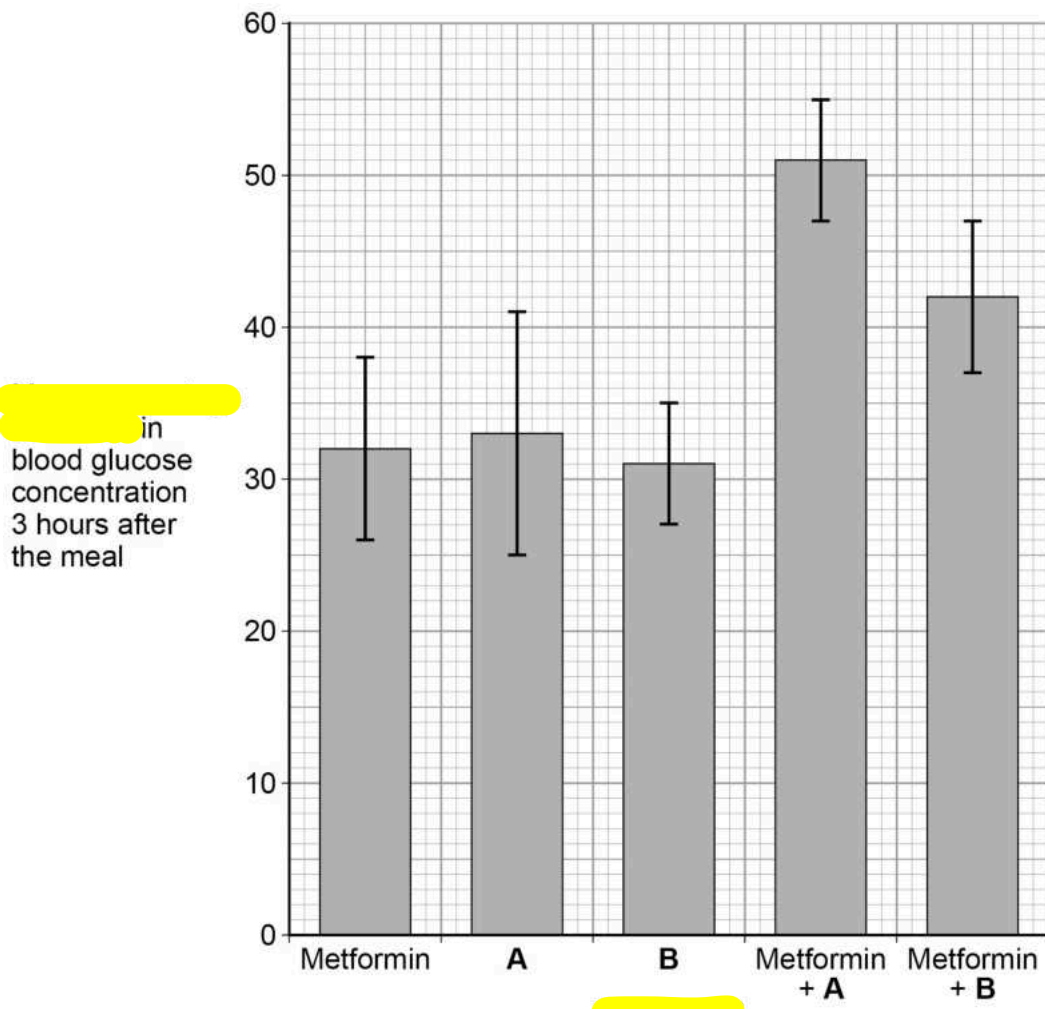
Table 3 and Figure 9 show the scientists' results.

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

groups not very large
Groups of different sizes

Figure 9



in blood glucose concentration 3 hours after the meal

± standard deviation

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.

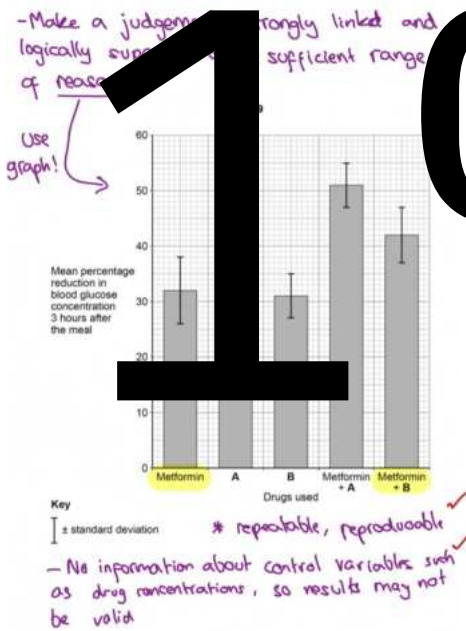
A student looked at the scientists' method and the results in Table 3 and Figure 9.

The student stated:

'Metformin works better when used with other drugs.'

Evaluate the student's statement.

[6 marks]



Reasons supporting statement:

Metformin (Met) + A gives a significantly greater reduction in blood glucose compared with Met alone [A supports 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 \therefore 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.

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 \pm standard deviation	177.2 \pm 15.4	182.5 \pm 18.2	171.6 \pm 16.3	205.2 \pm 19.4	206.5 \pm 19.6

END OF QUESTIONS

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