AQA

Please write clearly in block capitals.

Centre number ☐☐☐☐☐   Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
BIOLOGY

F

Foundation Tier   Paper 2F

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.

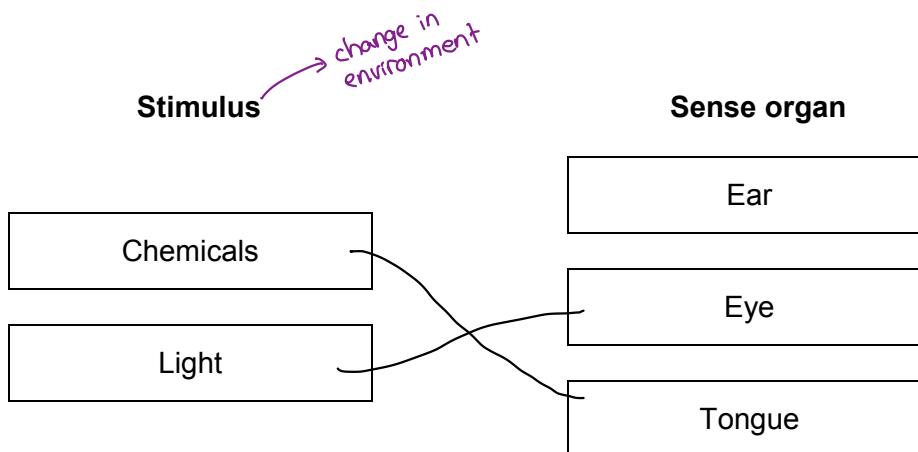| For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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

0 1 The nervous system allows a person to detect stimuli.

0 1 . 1 Draw **one** line from each stimulus to the sense organ that detects the stimulus.

[2 marks]

→ change in environment

Stimulus   **Sense organ**

Chemicals		Ear
Light		Eye
	Tongue

Moving a hand away from a hot object is an example of a reflex action.

0 1 . 2 What is a reflex action?

[2 marks]

Rapid, involuntary response to protect the body from harm

Do not write outside the box

0 1 . 3 A muscle in the arm moves the hand away from the hot object.

How does the arm muscle do this?

[1 mark]

Tick (✓) **one** box.

The muscle contracts. ✓

The muscle expands. ☐

The muscle relaxes. ☐

The muscle shrinks. ☐
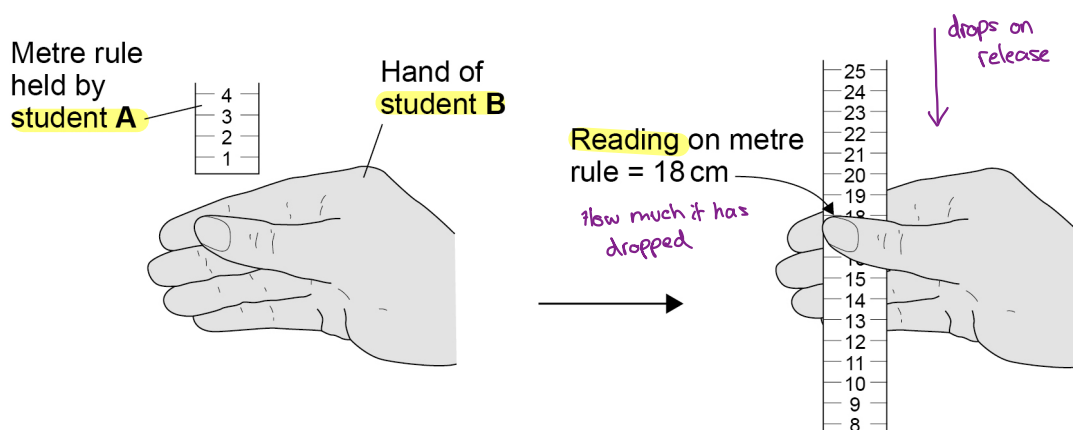
Question 1 continues on the next page

Turn over ▶

Two students investigated the effect of drinking coffee on reaction time.

This is the method used.

1. Student **A** holds a metre rule just above student **B**'s hand, as shown in **Figure 1**.

2. Student **A** lets go of the metre rule.

3. Student **B** catches the metre rule as quickly as possible.

4. Student **A** writes down the reading from the scale on the metre rule.

5. Students **A** and **B** repeat steps 1–4 another four times.

6. Student **B** then drinks a cup of coffee.

7. After 15 minutes, students **A** and **B** repeat steps 1–5.

Figure 1

Metre rule held by student **A**

Hand of student **B**

Reading on metre rule = 18 cm

drops on release

How much it has dropped

Table 1 shows some of the results.

Table 1

Test	Reading from scale on metre rule in cm	
	Before drinking coffee	**After drinking coffee**
1	18	10
2	21	14
3	15	8
4	12	11
5	19	13

Figure 2 shows the results after drinking the coffee for tests 3, 4 and 5.

Figure 2

Test 3   Test 4   Test 5
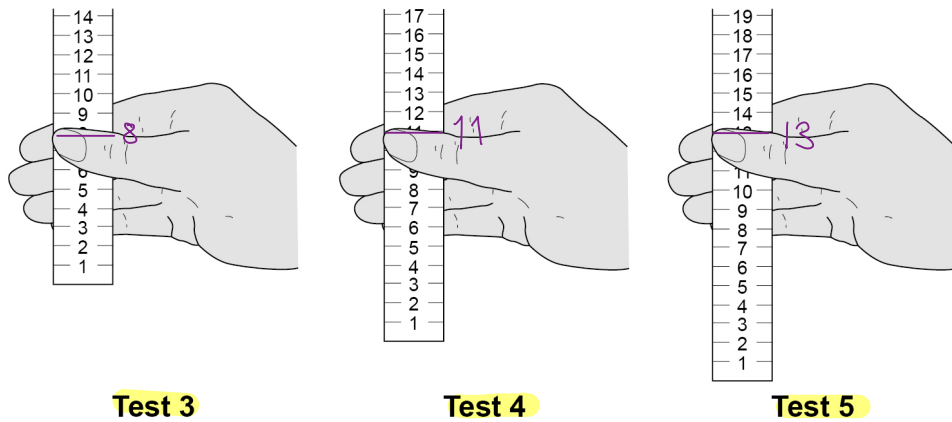
0 1 . 4 Complete **Table 1**.

Use results from **Figure 2**.

[2 marks]

The students made the following conclusion:

'Drinking coffee speeds up reactions.'

0 1 . 5 Give evidence from **Table 1** to support the students' conclusion.

[1 mark]

After coffee, ruler falls less far

0 1 . 6 The students' conclusion may **not** be valid.

Suggest **two** improvements the students could make to their method.

[2 marks]

1 _____ more repeats _____ use ruler with more precise scale

_____ drop from same height above hand

2 _____ test more students _____ ensure student B's hand stationary

10

Turn over ▶

05

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
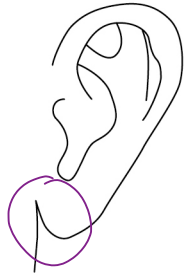**ANSWER IN THE SPACES PROVIDED**
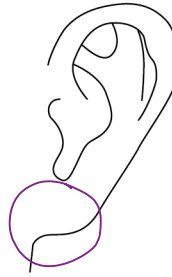
Do not write outside the box

0 2 The shape of a person's earlobes is controlled by a gene.

Figure 3 shows two types of earlobe.

Figure 3

Free earlobe   Attached earlobe

A dominant allele codes for free earlobes.

0 2 . 1 What is a dominant allele?

→ always expressed

Tick (✓) **one** box.

[1 mark]

An allele expressed even if a person only has one copy of the allele   ✓

An allele expressed only if a person has two copies of the allele   ☐

× recessive

An allele expressed only if a person has no recessive allele   ☐
×

An allele expressed only if it is inherited from the male parent   ☐
×

Question 2 continues on the next page

Turn over ▶

0 2 . 2 A man with free earlobes and a woman with attached earlobes have children together.

Complete **Figure 4** to show the possible genotypes of the children.

Use the symbols:

E = allele for free earlobes
e = allele for attached earlobes

[2 marks]

Figure 4

Woman

		e	e
Man	**E**	**Ee**	*Ee*
	e	*ee*	*ee*

0 2 . 3 What is the probability that one of the children would have attached earlobes?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

0.125 ☐   0.25 ☐   0.5 ☑   0.75 ☐

Woman

		e	e
	E	**Ee**	*Ee*
Man			
	e	(*ee*)	(*ee*)

2/4 = 0.5

E = allele for free earlobes
e = allele for attached earlobes

Do not write outside the box

0 2 . 4 **Figure 5** shows the inheritance of the sex chromosomes, **X** and **Y**.

Complete **Figure 5** to show the sex chromosomes in the gametes of the man and the woman.

[2 marks]

Figure 5

Woman

	X	X
X	XX	XX
Y	XY	XY

Man

0 2 . 5 Calculate the probability that the man and the woman's next child will be a girl with attached earlobes.

[2 marks]

Use the equation:

probability of a girl with attached earlobes

= probability of attached earlobes × probability of being a girl

0.5 × 0.5 = 0.25

Probability of a girl with attached earlobes = ___0.25___ (25% or ¼)

E = allele for free earlobes
e = allele for attached earlobes

Woman

	e	e
E	Ee	Ee
e	ee	ee

Man

Woman

	X	X
X	XX	XX
Y	XY	XY

Man

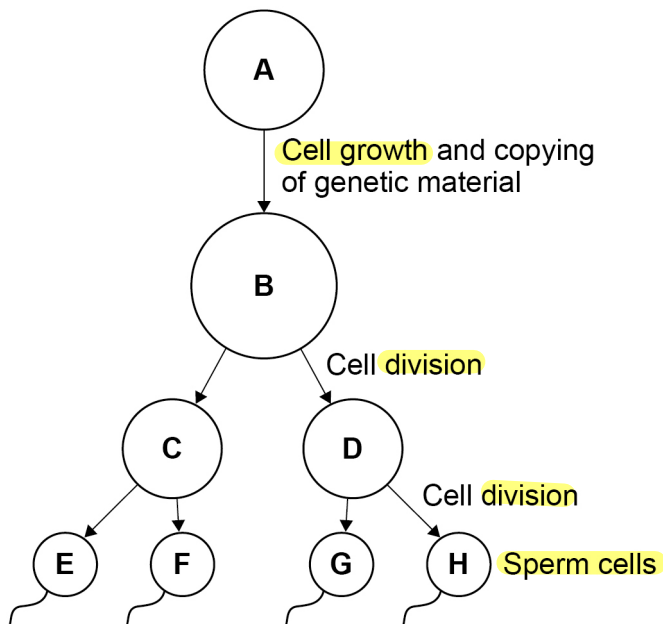2/4 = 0.5   2/4 = 0.5

8

Turn over ▶

0 3 **Figure 6** shows the production of sperm cells in humans.

Figure 6

0 3 . 1 Cell **A** is a normal body cell.

How many chromosomes are there in cell **A**?

[1 mark]

Tick (✓) **one** box.

23 ☐   46 ☑   48 ☐   92 ☐

no. pairs

0 3 . 2 What is the mass of DNA in cell **E**?

[1 mark]

Tick (✓) **one** box.

A quarter of the mass of the DNA in cell **A** ☐

Half the mass of the DNA in cell **A** ☑

The same mass as the DNA in cell **A** ☐

Twice the mass of the DNA in cell **A** ☐

Figure 6
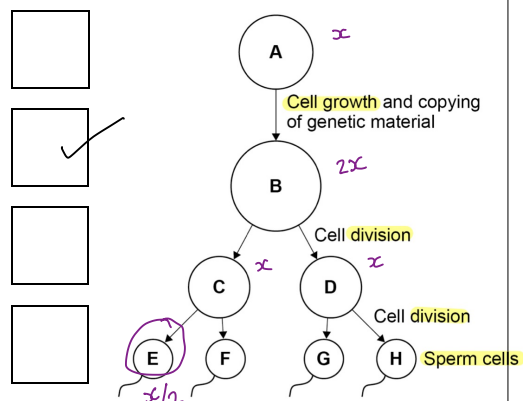
Do not write outside the box

0 3 . 3 What type of cell division produces sperm cells?

[1 mark]

Tick (✓) **one** box.

Binary fission   ← bacteria   ☐

Differentiation   ← specialisation of cells   ☐

Meiosis ✓   ☑ ✓

0 3 . 4 Sometimes there are errors in copying the genetic material.

What term describes an error in the genetic material?

[1 mark]

Tick (✓) **one** box.

Absorption   ☐

Fertilisation   ☐

Mitosis   ☐

Mutation   ☑ ✓   'change in genetic material'

0 3 . 5 A woman has three children, aged 4, 6 and 9 years.

Why are the children **not** genetically identical?

[2 marks]

Different egg/sperm each time, each gamete has different
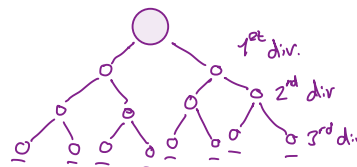
genetic information

Genes from two parents

Turn over ▶

*Do not write
outside the
box*

In sexual reproduction, a sperm cell fuses with an egg cell to form a new single cell.

An embryo develops from the single cell.

The cell divides three times to produce the embryo.

0 3 . 6 How many cells are there in the embryo after three cell divisions?
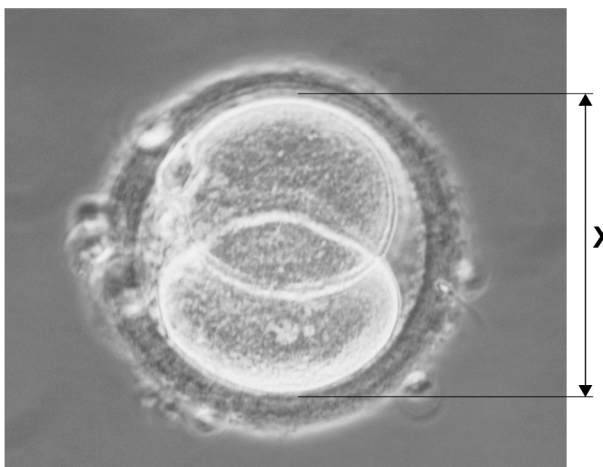
[1 mark]

Tick (✓) **one** box.

3 ☐   6 ☐   8 ✓   9 ☐

Figure 7 shows a different human embryo.

Figure 7

0 3 . 7 Measure image length **X** on **Figure 7**.

[1 mark]

Give your answer in millimetres (mm).

X = _____40_____ mm

Do not write outside the box

0 3 . 8 The image in **Figure 7** has been magnified ×500

Calculate the real length of the embryo.

Use the equation:

$$\text{real length of the embryo} = \frac{\text{image length}}{\text{magnification}}$$

Give your answer in micrometres (μm).

1 mm = 1000 μm

[3 marks]

Image length = 40 mm → 40 × 1000 = 40 000

Magnification = 500 X $\frac{40\,000}{500} = 80$

Real length of the embryo = ____80____ μm

0 3 . 9 The embryo may **not** implant in the lining of the uterus.

The embryo will then be lost from the woman's body several days later.

Explain why the woman may **not** notice this has happened.

[2 marks]

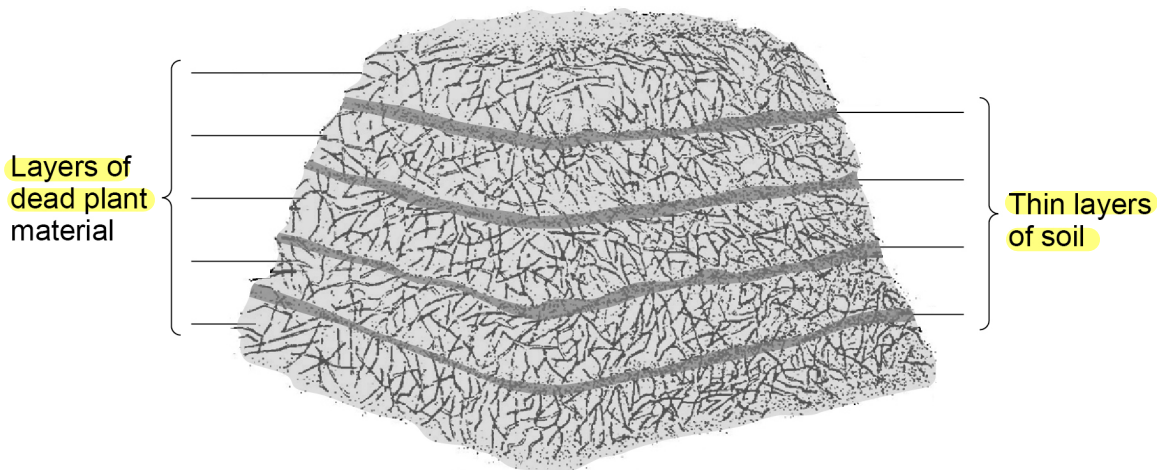Embryo is very small, so is not seen/felt

(or) lost in normal menstrual flow

13

Turn over ▶

0 4 Gardeners sometimes make compost heaps from dead plant material.

The dead plants decay in the compost heap.

Figure 8 shows a compost heap.

Figure 8

Layers of dead plant material

Thin layers of soil

The thin layers of soil contain organisms that cause decay.

Which **two** types of organism cause decay?

[2 marks]

Tick (✓) **two** boxes.

Bacteria ☑

Fungi ☑

Grass ☐

Insects ☐

Worms ☐

Do not write outside the box

The rate of decay in the compost heap depends on several environmental factors.

0 4 . 2 Explain how the rate of decay would be affected by:

- an increase in oxygen concentration

- a temperature increase from 5 °C to 25 °C

[3 marks]

Both increase rate

Because oxygen is needed for (aerobic) respiration

Increased temperature causes faster reactions

0 4 . 3 Give **one** environmental factor needed for decay.

Do **not** refer to oxygen or temperature in your answer.
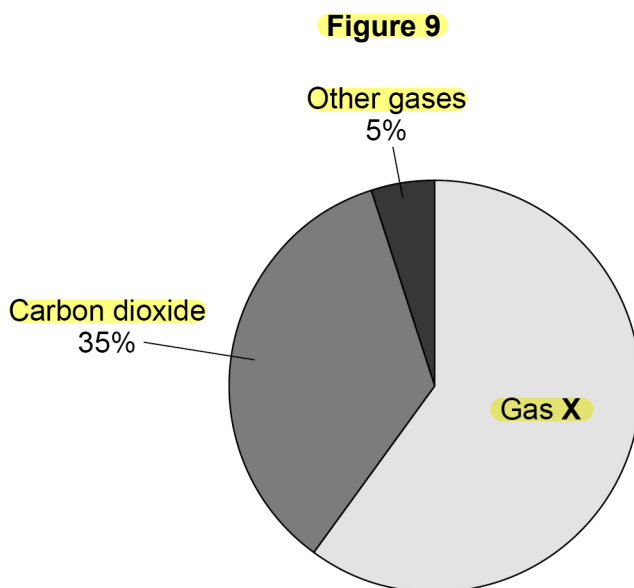
[1 mark]

water   (H₂O)

Question 4 continues on the next page

Turn over ▶

Dead plant material can also be decayed in a biogas generator.

Figure 9 shows the percentages of the gases found in a sample of biogas.

Figure 9

Other gases
5%

Carbon dioxide
35%

Gas **X**

0 4 . 4 Gas **X** is the main fuel gas found in the biogas.

What is gas **X**?

[1 mark]

Tick (✓) **one** box.

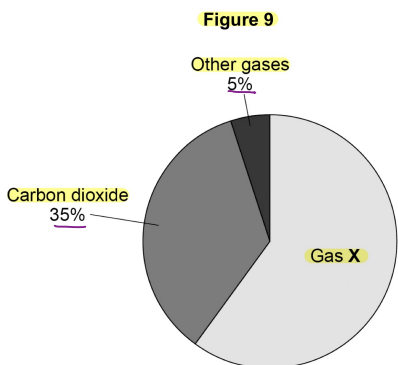Carbon monoxide ☐

Hydrogen ☐

Methane ✓

Nitrogen ☐

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0 4 . 5 What is the percentage of gas **X** in the biogas?

[1 mark]

Figure 9

Other gases
5%

Carbon dioxide
35%

Gas **X**

Total % = 100%

100 − 5 − 35 = 60%

Percentage = _60_ %

0 4 . 6 The dead plant material in the compost heap and biogas generator does **not** decay completely.

Explain why a farmer might spread the remaining dead plant material onto his fields.

[2 marks]

So plants/crops grow faster

Dead plant material contains mineral ions

↳ fertiliser   ↳ suppresses weed growth

↳ Improves drainage   ↳ insulates

↳ Improves soil structure

10

Turn over ▶

0 5   **Figure 10** shows a flightless bird called the dodo (*Raphus cucullatus*).

[handwritten: Genus, species]

Figure 10

The dodo:

- was 1 m tall

- had a mass of 20 kg

- lived in rainforests on a tropical island

- ate fruits

- made its nest on the ground.

A female dodo laid only one egg each year.

Humans arrived on the island in the year 1507. By 1681 the dodo was extinct.

0 5 . 1   What is the genus of the dodo?

[1 mark]

Tick (✓) **one** box.

Animal   ☐

Bird   ☐

Raphus   ☑

Do not write outside the box

0 5 . 2 Before the arrival of humans, there were no other large animals living on the island.

Suggest **two reasons** why the dodo became extinct soon after the arrival of humans.

[2 marks]

or the dodo's eggs

1 ___Humans hunted /killed /ate the dodo___

2 ___Humans ate the dodo's food___   *Diseases introduced by humans/by imported animals*

___Animals brought by humans ate dodos___

Humans destroyed dodo habitats

Today, humans are cutting down large areas of tropical rainforests.

0 5 . 3 Suggest **one use** of the land after the trees have been removed.

[1 mark]

___Growing crops /biofuels___   *Grazing animals*

___Quarrying /mining___   *Building houses*

Dumping waste

0 5 . 4 Why does the removal of trees cause an increase in carbon dioxide in the atmosphere?

[2 marks]

Tick (✓) **two** boxes.

There are fewer animals. ˣ
animals exhale CO_2   ☐

There is less photosynthesis. ✓
$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$ ☑

There is less respiration. ✗
trees photosynthesise more   ☐

The soil dries out. ✗   ☐

The trees are burned. ✓
combustion produces CO_2   ☑

Turn over ▶

0 5 . 5 What effect would an increase in carbon dioxide in the atmosphere have on global air temperature?

↳ more greenhouse gas → more greenhouse effect → heating

[1 mark]

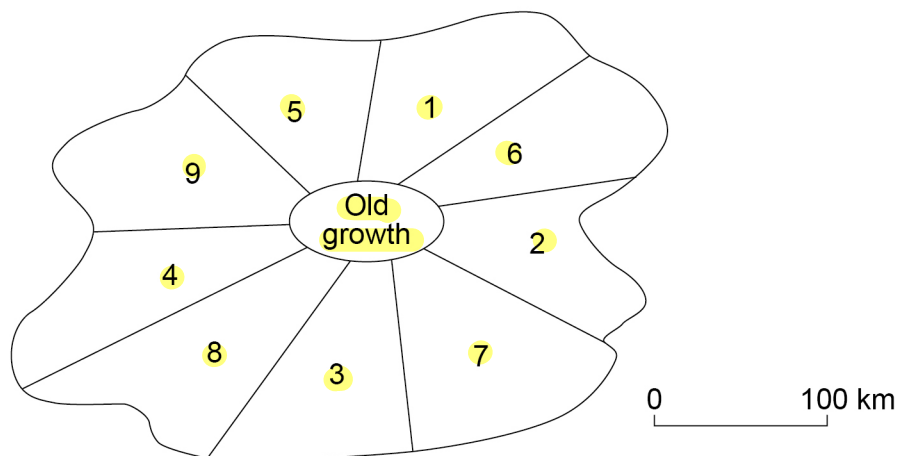Tick (✓) **one** box.

Decrease ☐

Increase ✓

Stay the same ☐

'Sustainable forestry' reduces the harmful effects of cutting down trees on the environment.

Figure 11 shows a method of 'sustainable forestry'.

Numbers 1–9 show different parts of a rainforest.

Figure 11

Map of the rainforest

0   100 km

The trees are cut down in the sequence 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9

- The trees are cut down in only one area at any one time.

- It takes 30 years to cut down the trees in each area.

- The trees in the 'Old growth' area are never cut down.

0 5 . 6 How many years would it take to cut down the trees in all of the numbered areas in **Figure 11**?
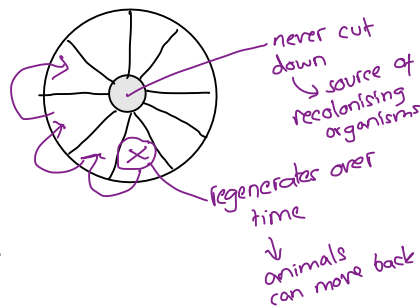
[2 marks]

1 → 9   30 years/area   9 × 30 = 270

Number of years = _270_

0 5 . 7 The rainforest contains:

- 750 species of trees

- 400 species of birds

- 150 species of butterflies

- many other species of plants and animals.

never cut down
↳ source of recolonising organisms

regenerates over time
↓
animals can move back

Explain how the pattern of cutting down trees shown in **Figure 11** stops the biodiversity of the rainforest being reduced.

[4 marks]

Displaced animals can move to adjacent zones where suitable habitat is present as trees not cut down. Seeds return to deforested area from other forested areas

Sufficient time for regeneration, plants/trees begin to grow back, so shelter provided (and food) for animals

Animals return to re-growing area

Old growth area source of recolonising organisms

13

Turn over ▶

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0 6 Two of the substances the body excretes are urea and carbon dioxide.

0 6 . 1 Complete the sentence.

[1 mark]

Choose the answer from the box.

| carbohydrate | lipid | (protein) | salt |

A person makes a lot of urea if the person's diet contains

a lot of ___protein___ .

0 6 . 2 Why must urea be excreted from the body?

[1 mark]

___Urea is a waste product___

___Urea is toxic / may damage cells / denature proteins___

0 6 . 3 A person produces more carbon dioxide during exercise than when resting.

Complete the sentences.

[2 marks]

Choose answers from the box.

→ large food molecules broken into small molecules

→ excretion of waste

| **breathing** | **digestion** | **egestion** |

↳ gas exchange O_2 & CO_2

→ movement of H_2O across partially permeable membrane along water potential

osmosis   **respiration**

$6O_2 + C_6H_{12}O_2 \rightarrow 6CO_2 + 6H_2O$

The process that makes carbon dioxide is ___respiration___ .

During exercise, extra carbon dioxide can be removed from the body by increasing

the rate of ___breathing___ .

0 6 . 4 Excess water must also be removed from the body.

If a person sweats a lot, less water will be excreted in the urine.

A healthy person did the same amount of exercise on each of 3 days.

Table 2 shows information for the 3 days.

Table 2

Day	Air temperature in °C	Volume of water consumed in cm³	Relative amount of urine produced by the kidneys
1	30 *hotter*	1500	*least*
2	20	1500	*medium*
3	15	2000	*most*

same (written beside 1500 values for days 1 and 2)

lower temperature ∝ less sweat (written below the 15 value)

Complete **Table 2**.

[2 marks]

Choose answers from the box.

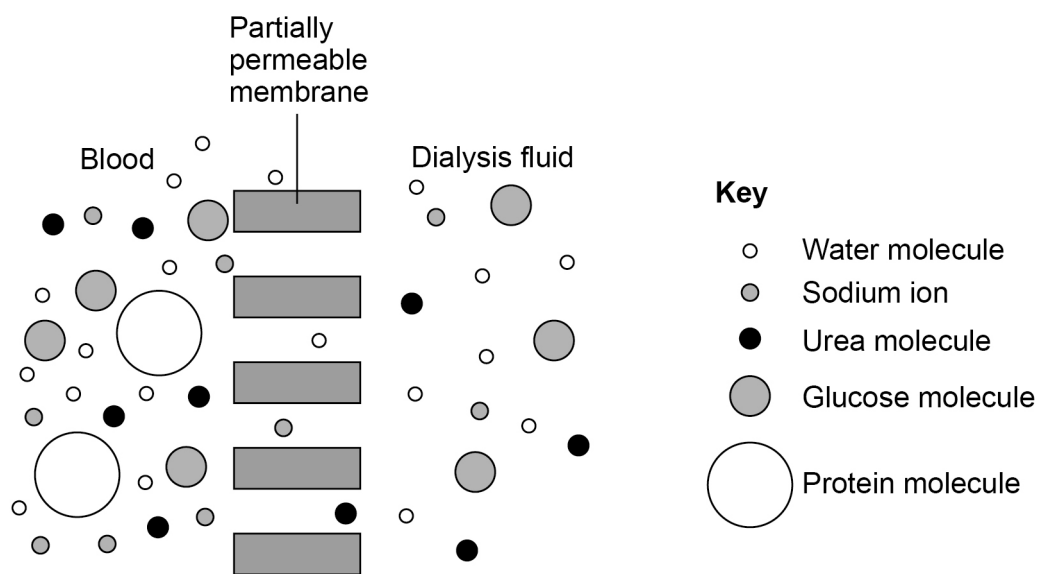|		
least	**medium**	**most**

Turn over ▶

Some people have kidney disease.

Kidney disease may be treated by dialysis or by having a kidney transplant operation.

- During dialysis, a person is connected to a machine that filters the blood.

- Each dialysis session lasts about 6 hours.

- The person has several dialysis sessions each week.

Figure 12 shows how dialysis works.

Figure 12

Partially permeable membrane

Blood   Dialysis fluid

Key

○ Water molecule

◐ Sodium ion

● Urea molecule

⬤ Glucose molecule

◯ Protein molecule

0 6 . 5   How does urea move out of the blood during dialysis?

[1 mark]

Tick (✓) **one** box.

Diffusion   ✓   *Movement of substance from area of higher concentration to area of lower concentration along concentration gradient*

Digestion *(food)x*

Osmosis *(water)x*

Respiration *(breathing)x*

blood ↑ *has more urea*   *dialysis fluid* ↑ *has less urea*
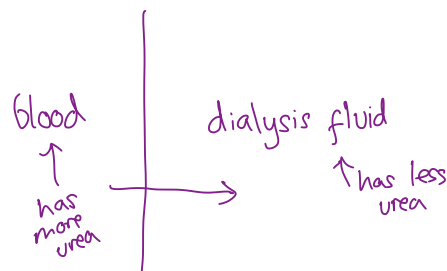
0 6 . 6 Which substance in **Figure 12** does **not** pass from the blood into the dialysis fluid?
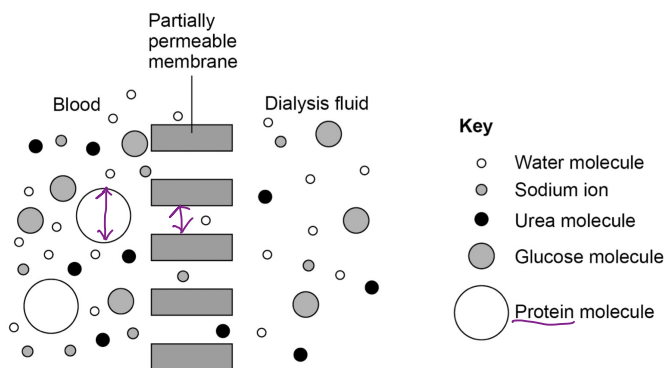
Give the reason for your answer.

[2 marks]

Substance   _Protein_

Reason   _Molecules too large_   _(allows pores too small in membrane)_

Figure 12

Partially permeable membrane

Blood

Dialysis fluid

Key

○   Water molecule

⚫   Sodium ion

●   Urea molecule

◯   Glucose molecule

◯   Protein molecule

Turn over ▶

Do not write outside the box

Two people have kidney disease.

- Person **A** is treated by dialysis.

- Person **B** has had a kidney transplant.

Figure 13 shows changes in the urea concentration in the blood of each person over 2 weeks.

Figure 13

Concentration of urea in the blood in mmol/dm³

Person **A**

Person **B**

Time in days
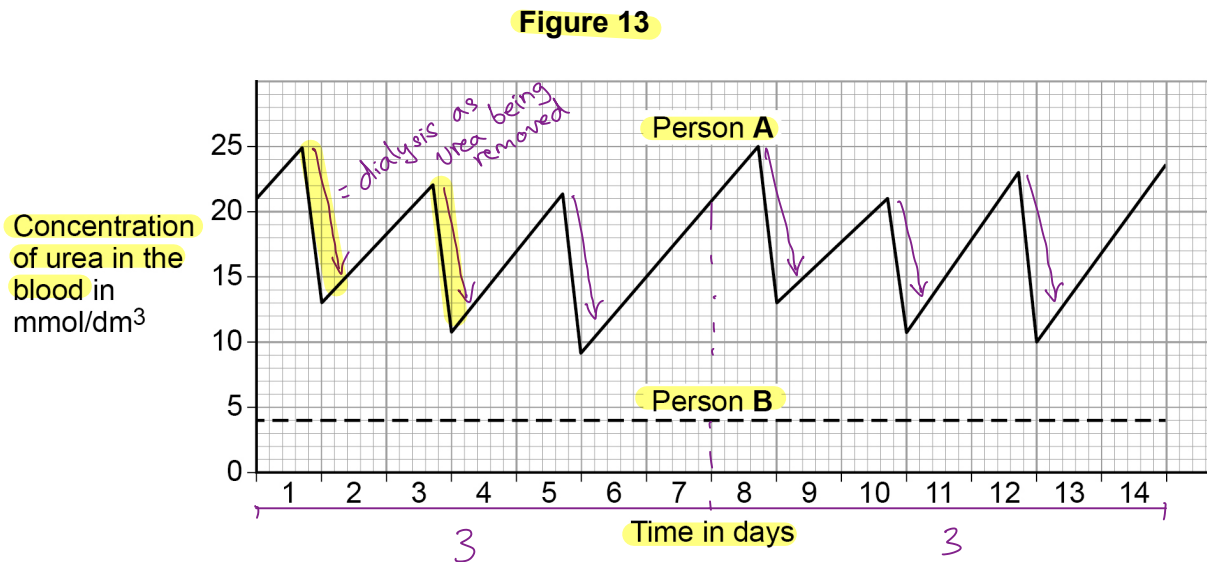
| 0 | 6 | . | 7 | How many dialysis sessions did person **A** have **each week**?

[1 mark]

3

| 0 | 6 | . | 8 | What happens to the concentration of urea in the blood between dialysis sessions?

[1 mark]

Increase

| 0 | 6 | . | 9 | Give **two** reasons why a kidney transplant is a better method for treating kidney disease than dialysis.

[2 marks]

1   lower concentration of urea   less hospital visits/time on machine

less restriction on travel

2   constant urea concentration   no repeated piercing of skin

no diet restrictions   cheaper in long term

13

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Turn over ▶

0 7 **Figure 14** shows a food chain in a pond.

Figure 14

Algae   ⟶   Daphnia   ⟶   Hydra   ⟶   Dragonfly nymph

Producer   *1ʳˢ consumer*   *2ⁿᵈ consumer*   *3ʳᵈ consumer*
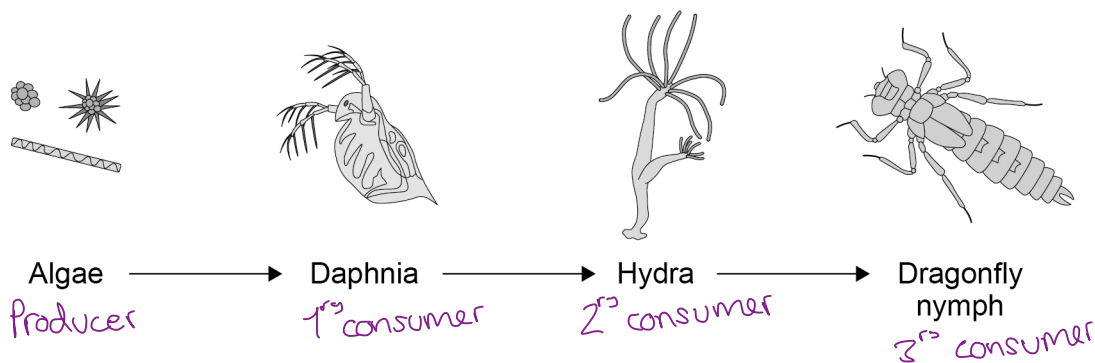
0 7 . 1 Which term describes the Daphnia in this food chain?

[1 mark]

Tick (✓) **one** box.

Apex predator   ☐

Primary consumer   ☑

Producer   ☐

Secondary consumer   ☐

0 7 . 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]

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

- Tiers = number of different organisms (on different levels)

- Bottom tier > middle tier > top tier

dragonfly nymph

hydra
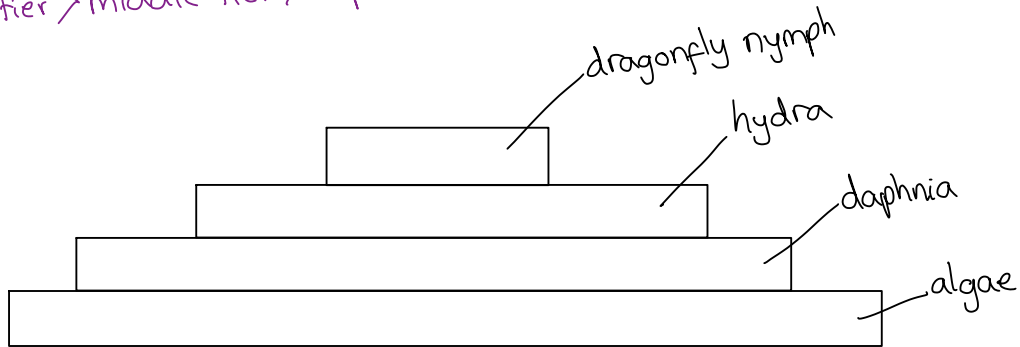
daphnia

algae

0 7 . 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 digestable parts lost in faeces

- Use in respiration / lost as CO_2 - Lost in urine
                                               - Algae not all eaten

Question 7 continues on the next page

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 3 shows the results.

Table 3

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

0 7 . 4   Calculate the mean number of Daphnia in 1 m^3 of pond water.

1 m^3 = 1000 dm^3 →   sum of values / no. values

[2 marks]

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

$$14 \times 1000 = 14000$$

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

Do not write outside the box

0 7 . 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 **07.4**.

Give your answer in standard form. $\leftarrow y \times 10^x$ — $0 < y < 10$

[4 marks]

Volume = length × width × depth

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

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

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

$2.6250 \longrightarrow 2.6250 \times 10^4$ ✓

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

Question 7 continues on the next page

Turn over ▶

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 15 shows the results.

Figure 15

Total number of Daphnia after 2 weeks

Decreased daphnia population

Concentration of fertiliser in mg/dm^3
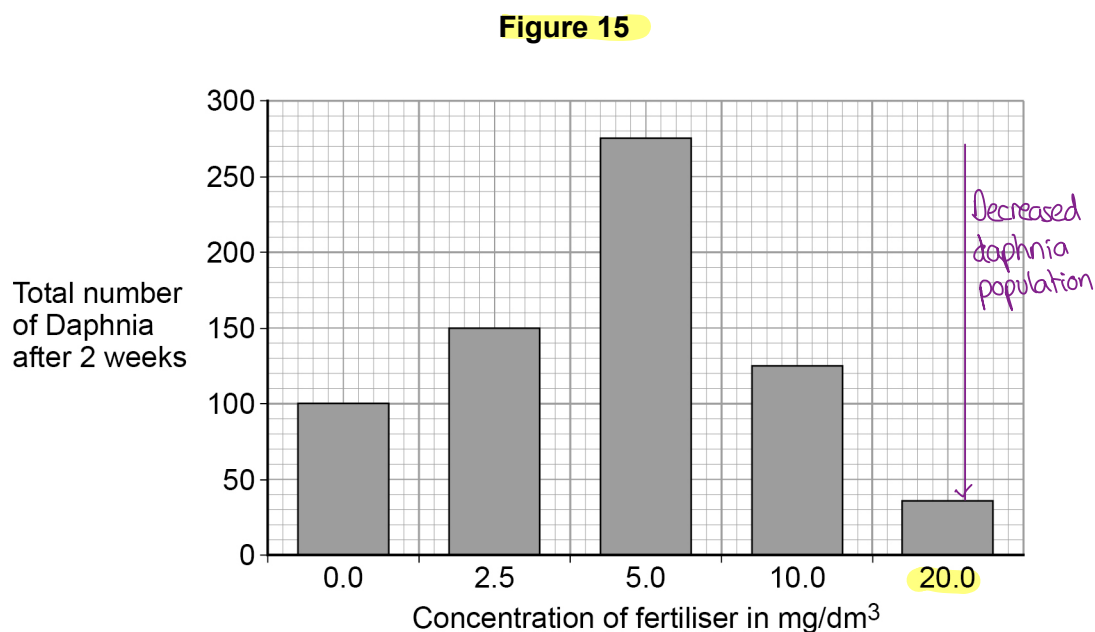
0 7 . 6   A concentration of 5.0 mg/dm^3 of fertiliser caused a large increase in the population of Daphnia.

Explain why.

[2 marks]

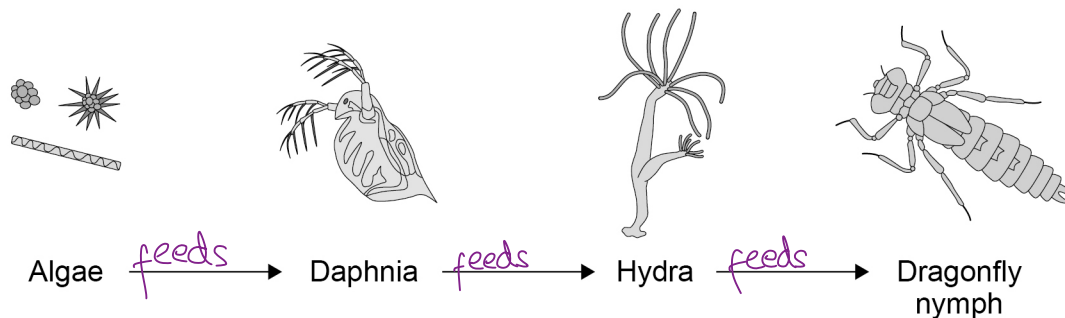- Increased ✓ growth of algae, so more food ✓ for Daphnia

0 7 . 7 **Figure 14** is repeated below.

Figure 14

Algae ~~feeds~~ → Daphnia ~~feeds~~ → Hydra ~~feeds~~ → Dragonfly nymph

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

Explain why.

[2 marks]

Hydra have less food because there are fewer Daphnia

Turn over for the next question

14

Turn over ▶

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| 0 | 8 | Genetic material is made of DNA.

| 0 | 8 | . | 1 | Which structures in the nucleus of a human cell contain DNA?

[1 mark]

chromosomes

Figure 16 shows part of one strand of a DNA molecule.

Figure 16

- A Adenine
- G Guanine
- sugar — **X**
- pentose sugar deoxyribose
- T Thymine
- A
- Phosphate — A
- G — **Z** base
- T
- A
- C — cytosine
- nucleotide — **Y**
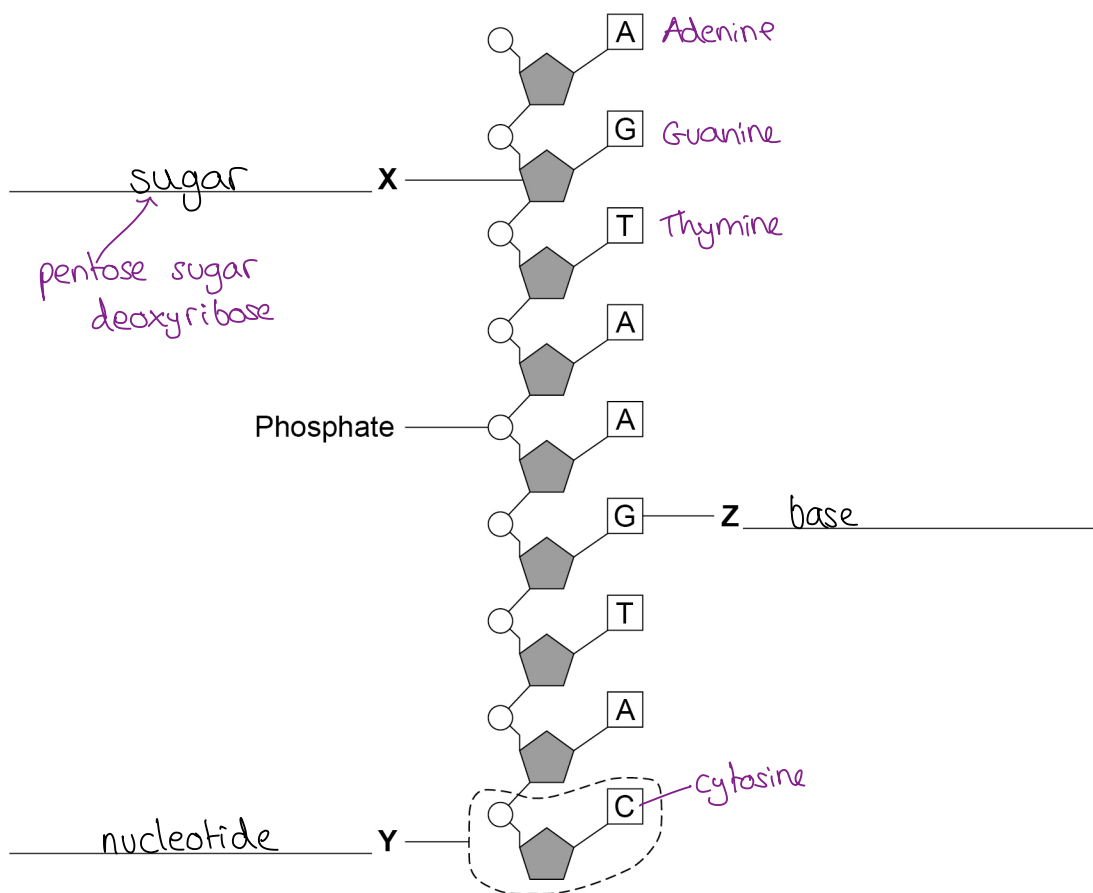
| 0 | 8 | . | 2 | Label parts **X**, **Y** and **Z** on **Figure 16**.

[3 marks]

Choose answers from the box.

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

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0 8 . 3 A complete DNA molecule is made of two strands twisted around each other.

What scientific term describes this structure?

[1 mark]

double helix

1 amino acid = three bases

0 8 . 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 16**?

[1 mark]

Tick (✓) **one** box.

2 ☐   3 ☑   9 ☐   18 ☐

0 8 . 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_

2 _treatment for inherited disorders_   _- tracing human migration patterns_

8

Turn over for the next question

Turn over ▶

0 9   Phototropism is a growth response by part of a plant to light.

0 9 . 1   Name **one** other tropism.

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

[2 marks]

Tropism _____geotropism_____ _hydrotropism_ _thermotropism_
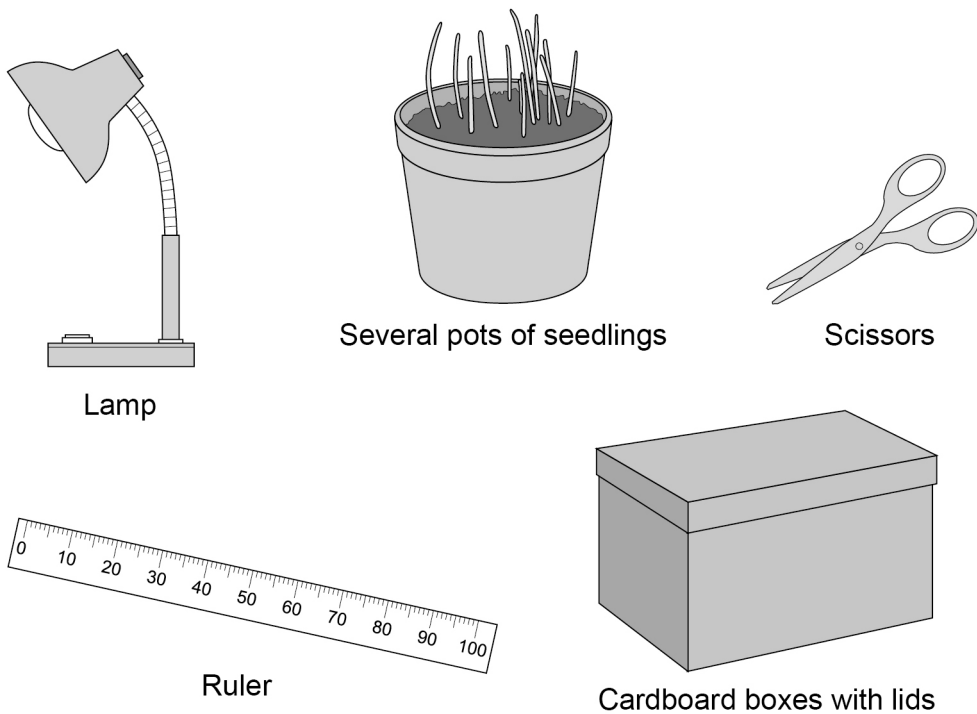
Stimulus _____gravity_____ _water_ _heat_

0 9 . 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 17** and any other laboratory apparatus.

[6 marks]

Figure 17

Lamp

Several pots of seedlings

Scissors

Ruler

Cardboard boxes with lids

· 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 through
—Measure seedling height at the beginning of ✓ the experiment by straightening them out again 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 and compare with the direction of light entry

0 9 . 3 Explain how phototropism in a plant shoot helps the plant to survive.

[3 marks]

Plant leaves recieve more light ✓ so photosynthesis ✓ occurs and the plant produces more glucose ✓

starch/carbohydrate/organic material

11

END OF QUESTIONS

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