



Surname _____

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I declare this is my own work.

A-level

BIOLOGY

Paper 1

7402/1

Wednesday 5 June 2024 Afternoon

Time allowed: 2 hours

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]



J U N 2 4 7 4 0 2 1 0 1

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MATERIALS

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator.

INSTRUCTIONS

- Use black ink or black ball-point pen.
- Answer ALL questions.
- You must answer the questions in the spaces provided. Do not write on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

INFORMATION

- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 91.

DO NOT TURN OVER UNTIL TOLD TO DO SO

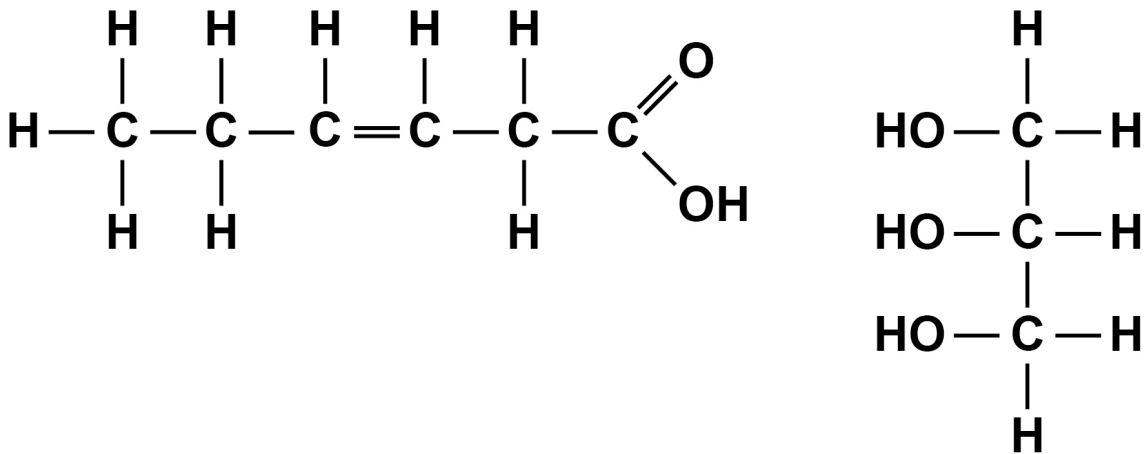


Answer ALL questions in the spaces provided.

01.1

FIGURE 1 shows the structure of a fatty acid molecule and the structure of a glycerol molecule.

FIGURE 1



On FIGURE 1, DRAW A CIRCLE around the part of the fatty acid molecule AND the part of the glycerol molecule that is removed to form a bond in a triglyceride molecule.



Name the bond formed between a fatty acid and glycerol in a triglyceride molecule.

Name the reaction involved in forming a bond between a fatty acid and glycerol in a triglyceride molecule.
[3 marks]

Bond _____

Reaction _____

[Turn over]





01.2

Name the fatty acid shown in TABLE 1 that is a saturated fatty acid. [1 mark]

01.3

The melting point is the temperature at which a solid changes state to be a liquid.

Use TABLE 1 to describe the relationship between fatty acid structure and fatty acid melting point. [1 mark]

[Turn over]

01.4

The ratio of saturated to unsaturated fatty acids in a cell-surface membrane determines the extent of the membrane's fluidity.

Scientists provided a cell culture of mouse phagocytes with liquid broth rich in unsaturated fatty acids.

The scientists observed:

- an increase in the proportion of phospholipids in the phagocytes containing unsaturated fatty acids
- more phagocytosis.

Suggest and explain why there was more phagocytosis.
[3 marks]

[Turn over]

8



0 2 . 2

What are microvilli? [1 mark]

[Turn over]



[Turn over]

7



[Turn over]



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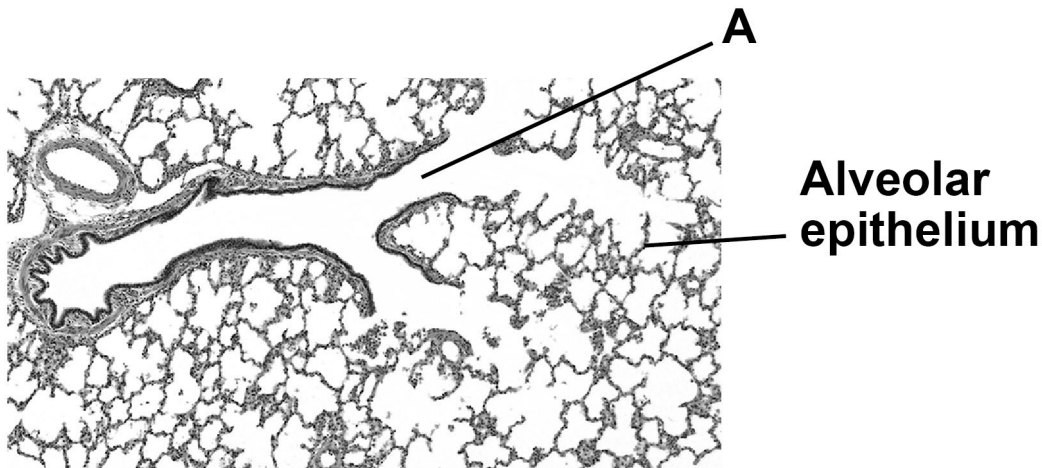
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03.3

FIGURE 2 is an image of the lung tissue observed using an optical microscope.

FIGURE 2



Identify the tube labelled A. [1 mark]

A _____

The scientist used a ruler to measure the diameter of some of the alveoli.

TABLE 2 shows the scientist's results.

TABLE 2

ALVEOLUS DIAMETER / mm								
Alveolus diameter / mm	4	2	5	1	2	3	5	2



0	3	.	4
---	---	---	---

The magnification of the image in FIGURE 2 is $\times 40$

Use this information and TABLE 2 to calculate the mean diameter, in μm , of the alveoli.

Show your working. [2 marks]

Answer _____ μm

[Turn over]



0	3	.	5
---	---	---	---

Give the uncertainty associated with taking a measurement using a ruler with 1 mm graduations.

Calculate the percentage error for a measurement using the ruler of 4 mm [2 marks]

Uncertainty \pm _____ mm

Percentage error _____

10



0	4	.	1
---	---	---	---

Molasses is a solution obtained from sugar beet plants. The sugars present in molasses are sucrose, glucose and fructose.

Give the number of different types of monosaccharides present in molasses. [1 mark]

[Turn over]



04.2

A student used the biochemical test for reducing sugars on a clear sample of molasses.

Describe the biochemical test for a reducing sugar.

Explain the result expected from the test on the sample of molasses. [3 marks]

Description of biochemical test _____

Explanation of expected result _____

[Turn over]



0	4	.	3
---	---	---	---

‘Free sugar’ is the sugar in food and drinks released when food is crushed or when sugar is added to food at home or by manufacturers.

Scientists recommend that no more than 5% of the energy consumed per day should come from ‘free sugar’.

The mean daily energy requirement for a 10-year-old child is 8100 kJ

The ‘free sugar’ in one tablespoon of molasses contains 250 kJ of energy.

Calculate the number of tablespoons of molasses required for a 10-year-old child to reach the recommendation for energy consumed in ‘free sugar’ per day. [1 mark]

Number of tablespoons _____ per day



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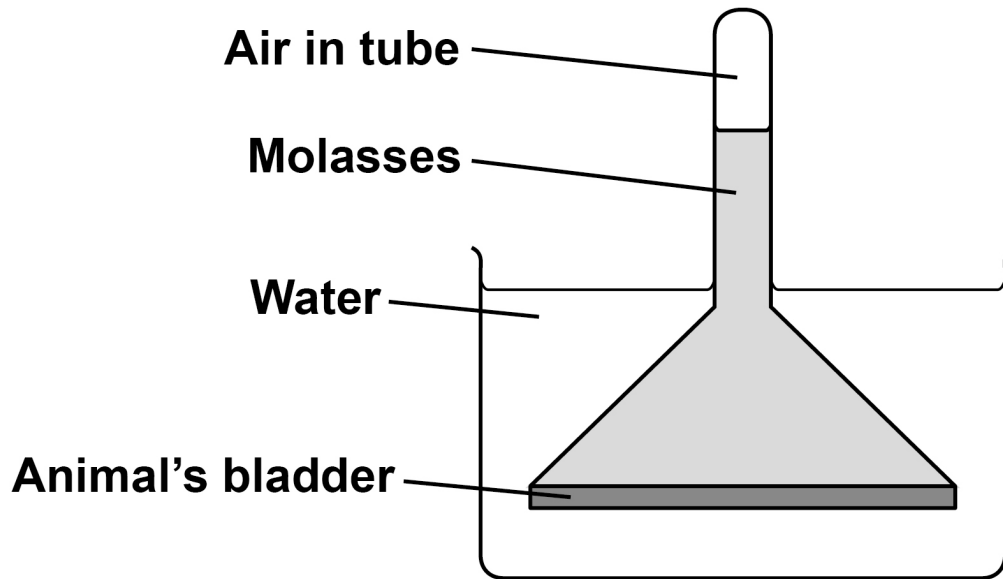
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04.4

A scientist used the apparatus in FIGURE 3 to investigate osmosis.

FIGURE 3



Use your understanding of osmosis to explain why the air pressure in the tube increased. [3 marks]



[Turn over]



0	4	.	5
---	---	---	---

The scientist repeated the investigation, but made **ONE** change to the molasses. The scientist did **NOT** change the volume of molasses at the start of the investigation.

The scientist observed that the air pressure inside the tube increased by 160 kPa compared with 800 kPa in the first investigation.

Suggest the change the scientist made to the molasses to cause this smaller increase in air pressure.

Use the air pressure figures in a calculation to support your answer. [2 marks]

Suggested change _____



0 5 . 1

Describe the appearance AND behaviour of chromosomes during prophase and during anaphase of mitosis. [4 marks]

Prophase _____

Anaphase _____

[Turn over]



05.2

A scientist used an optical microscope to determine the mitotic index in cells at different distances from the tip of onion roots.

FIGURE 4 shows the results.

FIGURE 4

FIGURE 4 not reproduced here due to third-party copyright restrictions.

The figure is taken from the following website:

<https://legacy.nimbios.org/~gross/bioed/webmodules/mitoticindex.htm#:~:text=Interpretation%3A%20In%20general%2C%20the%20mitotic,of%20the%20root's%20dividing%20cells>



Complete the word equation used to determine each mitotic index in FIGURE 4. [1 mark]

Mitotic Index =

0 5 . 3

The scientist used data from FIGURE 4 to calculate a correlation coefficient (r). The scientist then used a statistical test to determine the probability (P) associated with the value of r.

$r = -0.98$ ($P < 0.05$)

What can you conclude from this result? [2 marks]

[Turn over]



[Turn over]

10



06.1

Give **THREE** structural differences between an mRNA molecule and a tRNA molecule. [3 marks]

mRNA	tRNA

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[Turn over]



06.2

TABLE 3 shows mRNA codons and the amino acid coded by each codon.

TABLE 3

FIRST BASE	SECOND BASE				THIRD BASE			
	U	C	A	G				
U	Phe	Ser	Tyr	Cys	U			
	Leu		Stop	Stop	C			
					Trp	A		
	C		Leu	Pro	His	Arg	G	
Gln		U						
		Asn			C			
A					Ile		Thr	Ser
	Met	Lys	G					
		G	Val	Ala	Asp	Gly		U
	Glu				C			
G					A			
	G				G			



FIGURE 5 shows the mRNA base sequence produced when part of a gene coding for an enzyme is transcribed.

FIGURE 5

UUU	CGG	GCG
------------	------------	------------

Use **TABLE 3** to give the amino acids coded by the mRNA base sequence in **FIGURE 5**. [1 mark]

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[Turn over]



06.3

A mutation occurred in the part of the gene transcribed in Question 06.2, on pages 36–37.

FIGURE 6 shows the mRNA base sequence produced when the identical part in the mutated gene is transcribed.

FIGURE 6

UUU	AGG	GCG
-----	-----	-----

The amino acids coded by this mRNA base sequence form part of the enzyme's active site.

Use all the information in this question to:

- name the type of mutation that occurred to produce the mutated gene
- give the change in DNA caused by this mutation
- explain the effect this mutation will have on the function of the enzyme.

[4 marks]

Type of mutation _____

Change in DNA _____



Explanation of effect on function of enzyme

[Turn over]

8



0	7	.	1
---	---	---	---

A student investigated the activity of the enzyme polyphenol oxidase (PPO) in apple tissue.

When apple tissue is exposed to air, PPO catalyses a reaction between colourless phenol compounds in apple tissue and oxygen.

FIGURE 7 shows the reaction.

FIGURE 7



The student measured the time taken for the brown pigment to appear in two apple varieties (D and E).

METHOD

1. Cut a 1 cm cube of apple tissue from variety D.
2. Put the cube on a plate and leave the plate at 30 °C
3. Measure the time for the brown pigment to appear.
4. Repeat steps 1 to 3 two more times.
5. Repeat steps 1 to 4 with apple tissue from variety E.

The student obtained the results shown on the opposite page, but did not record the data in a results table.



Variety D = 15 min 50 s, 18 min, 14 min 30 s

Variety E = 6 min 30 s, 8 min, 7 min

In the box labelled FIGURE 8, on page 43, design a suitable results table.

- **Enter the student's results into the table.**
- **Calculate the mean results and include these in the table.**
- **Use 1 decimal place for both mean results.**

[3 marks]

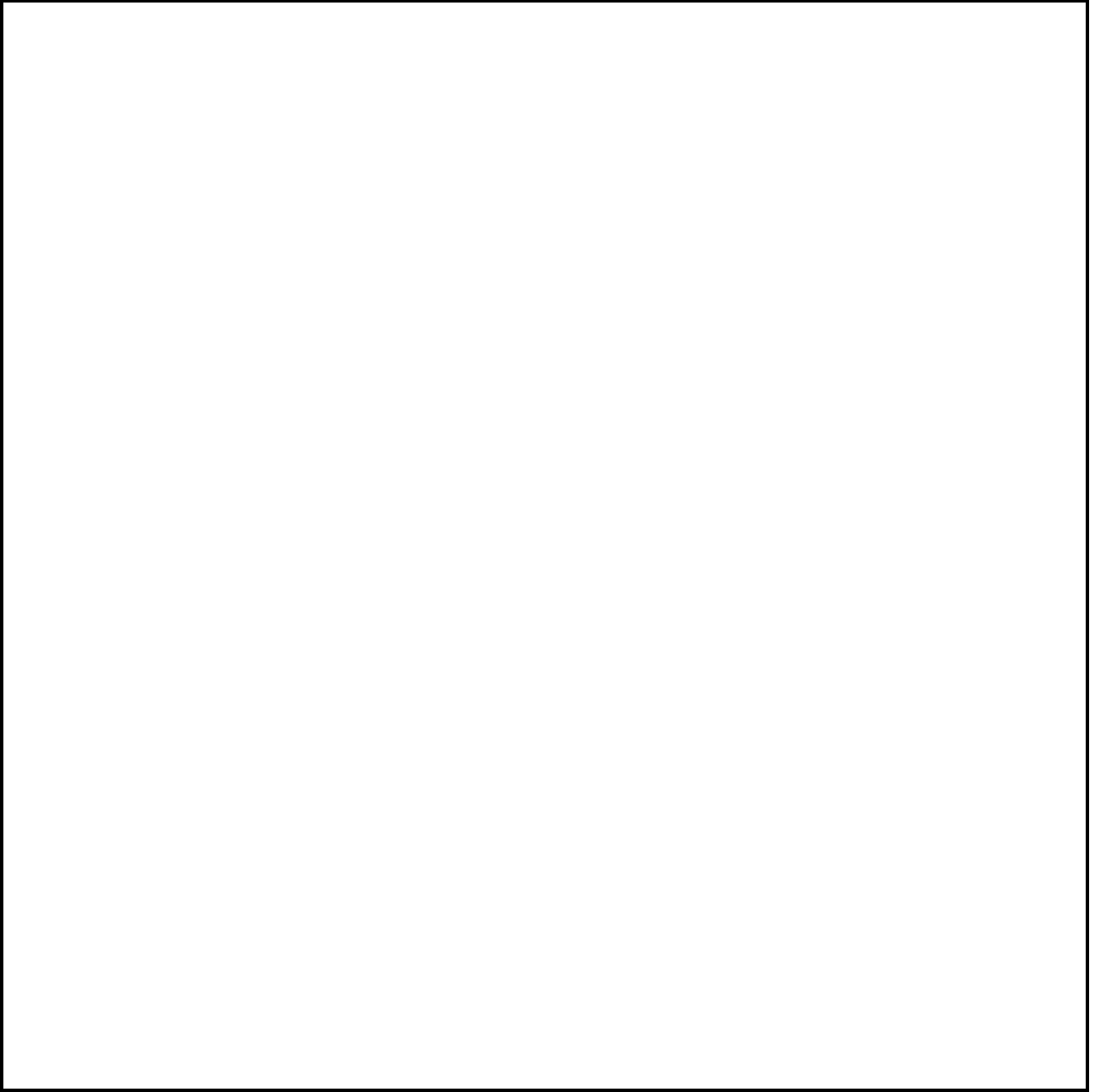
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FIGURE 8



[Turn over]



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[Turn over]



0	7	.	3
---	---	---	---

The student repeated the investigation but made **ONE** change to the method used to prepare the apple tissue.

The student then observed shorter times for the brown pigment to appear in both apple varieties.

Suggest the change the student made to the method of preparing the apple tissue.

Explain why the brown pigment appeared in a shorter time.

Do **NOT** suggest using a different volume or mass of apple. [3 marks]

Change to method _____

Explanation _____



[Turn over]



07.4

The student wants to change the procedure to obtain a measure of PPO activity either in terms of how much substrate is used or how much product is produced.

Which change in procedure will provide a successful measure of PPO activity for the student? [1 mark]

Tick (✓) ONE box.

Measure the increase in oxygen concentration in the air around the cube of apple tissue on a plate.

Measure the intensity of brown colour by comparing apple tissue with a colour chart showing a range of apple tissues of known pigment concentration.

Measure the intensity of colour produced from brown apple tissue in a biuret test.

Measure the percentage of light transmitted through a cube of brown apple tissue using a colorimeter.

9



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[Turn over]



0	8	.	1
---	---	---	---

Give TWO structural features of an aorta wall and explain how they are related to the function of an aorta. [2 marks]

1 _____

2 _____



[Turn over]



08.2

Small tears may occur in the layers of tissue in an aorta wall. These tears weaken the wall without bursting the aorta.

Scientists:

- measured the aorta diameter (d) in a large population of people over 60 years of age
- calculated the risk of an aorta wall developing a tear.

TABLE 4 shows their results.

TABLE 4

AORTA DIAMETER d / cm	Number of people in the population	Risk of an aorta wall developing a tear
$d \leq 3.5$	2765	0.06
$3.5 < d \leq 4.0$	630	0.33
$4.0 < d \leq 4.5$	98	4.64
$d > 4.5$	7	380.00

Blood may push through the tears in the aorta wall. This produces a balloon-like swelling called an aneurysm and increases the aorta diameter. Aneurysms can cause the aorta to burst.



08.3

A scientist investigated changes in a diseased heart and changes in a healthy heart during cardiac cycles.

For each heart, the scientist obtained a value for:

- the mean blood volume in a full ventricle just before the ventricle contracts (BVB)
- the mean ejection fraction (EF).

The EF is the proportion of blood pumped out of a full ventricle in one heartbeat.

The EF is calculated using this formula:

$$EF = \frac{\text{Blood volume pumped out of a full ventricle in one heartbeat (stroke volume)}}{\text{BVB}}$$

TABLE 5 shows the scientist's results.

TABLE 5

	DISEASED HEART	HEALTHY HEART
Mean BVB / cm ³	100	120
Mean EF	0.45	0.58



Using TABLE 5, a student calculated that the percentage change in the stroke volume of the diseased heart compared with the stroke volume of a healthy heart is -30% .

The student's answer is wrong because the final step of the calculation was performed incorrectly.

Using the equation and TABLE 5, calculate the correct percentage change in the stroke volume of the diseased heart compared with the stroke volume of the healthy heart.

Identify the mathematical error in the final step of the student's calculation. [3 marks]

Correct answer _____ %

Mathematical error _____

[Turn over]

8



09

Courtship behaviour in the frog species, ‘Xenopus laevis’, involves male frogs calling to:

- **attract sexually active females – these are advertisement calls**
- **start and continue mating – these are mating calls**
- **signal when a male is not sexually active – these are rasping calls.**

Scientists investigated frog courtship behaviour by feeding a population of sexually active male frogs a diet containing the hormone EE2. The scientists also fed a separate control population of sexually active male frogs a diet without EE2.

They determined the percentage of males making advertisement calls or rasping calls in each population.

TABLE 6 shows their results.

TABLE 6

POPULATION	PERCENTAGE OF MALES MAKING:	
	ADVERTISEMENT CALLS	RASPING CALLS
Males fed EE2	94.0	4.0
Males not fed EE2 (control)	97.0	0.5



0	9	.	1
---	---	---	---

There were 800 males in the control population.

Each male made one type of call.

Use this information and TABLE 6 to calculate the number of males making mating calls in the control population. [1 mark]

Answer _____ males

[Turn over]



0	9	.	2
---	---	---	---

**Suggest ONE change the scientists could make to both frog populations to increase the number of mating calls.
[1 mark]**



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[Turn over]



09.3

The scientists also investigated the effect on FEMALE frog courtship behaviour of feeding EE2 to male frogs.

Table 7 shows their results.

TABLE 7

POPULATION	MEDIAN TIME FEMALES SPENT IN COURTSHIP / s
Males fed EE2	8
Males not fed EE2 (control)	16

EE2 is contained in human contraceptive pills. Some EE2 is released in human urine and collects in sewage. Untreated sewage pollutes the water in frog habitats.

Suggest and explain the effect EE2 pollution in frog habitats will have on frog breeding.

Use information from TABLE 6, on page 56, and TABLE 7 in your answer. [4 marks]

Effect on frog breeding _____

Explanation _____





[Turn over]



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