AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.1.7 WATER

SCORE	PERCENTAGE
/45	%

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Q1.

(a) State **and** explain the property of water that can help to buffer changes in temperature.

_____

_____

_____

_____

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_____

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_____

(2)

(b) Water is used to hydrolyse ATP.

Name the **two** products of ATP hydrolysis.

1. _____

2. _____

(1)

Hydrolysis of ATP is catalysed by the enzyme ATP hydrolase.

A student investigated the effect of ATP concentration on the activity of ATP hydrolase. She used shortening of strips of muscle tissue caused by contraction as evidence that ATP was being hydrolysed.

- She took four slides **A**, **B**, **C** and **D**, and added strips of muscle tissue of the same length to each slide.
- She then added the same volume of ATP solutions of different concentrations to the four slides and left each slide for five minutes.
- She then recorded the final length of each strip of muscle tissue.

Her results can be seen in the table.

Slide	Concentration of ATP solution added to slide / $\times 10^{-6}$ mol dm^{-3}	Final length of muscle tissue after 5 minutes / mm
A	2	36

B	4	31
C	6	29
D	8	26

(c) Other than those given, name two variables the student should have controlled.

1. _____

_____

2. _____

_____

(2)

(d) Describe and explain the pattern shown by the data in the table.

Description

_____

_____

_____

_____

_____

Explanation _____

_____

_____

_____

_____

(2)

(e) The hydrolysis of 1 dm^3 of a 1 mol dm^{-3} solution of ATP releases 30 500 J of energy.

60% of the energy released during the hydrolysis of 1 mol dm^{-3} of ATP is released as heat; the rest is used for muscle contraction.

The student added 0.05 cm^3 of ATP solution to slide **D**.

Calculate the energy available from ATP for contraction of the muscle on this slide.

Answer = _____ J

(3)

(Total 10 marks)

Q2.

Water and inorganic ions have important biological functions within cells.

(a) Give **two** properties of water that are important in the cytoplasm of cells.
For each property of water, explain its importance in the cytoplasm.

Property 1_____

Biological importance within cells_____

_____

_____

Property 2_____

Biological importance within cells_____

_____

_____

(4)

(b) Other than sodium, name **one** inorganic ion and give **one** example of its biological importance in a cell.

Name of inorganic ion_____

Biological importance_____

_____

_____

(2)

(c) Compare and contrast the processes by which water and inorganic ions enter cells.

_____

_____

_____

_____

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(3)

(Total 9 marks)

Q3.

The UK government pays farmers to leave grassy strips around the edges of fields of crops. These grassy strips contain a variety of plant species. Leaving the strips is an attempt to encourage biodiversity of animals.

(a) Give **two** reasons why the grassy strips increase the biodiversity of animals.

1. _____

2. _____

(2)

A group of scientists investigated the effect of grassy strips on the biodiversity of soil animals.

- They divided a field into plots measuring 25 m × 5 m, with a 5-metre-wide grassy strip of land between each plot.
- Each year, they planted wheat in each of the plots.
- In the fifth year, they removed samples of soil from each plot where wheat was growing and from the grassy strips around them.
- They sorted each soil sample by hand for 40 minutes to collect the soil animals within the sample.

(b) The scientists decided to collect animals from the soil samples for 40 minutes.

Suggest how the scientists decided that 40 minutes was an appropriate time.

_____

_____

_____

_____

_____

(2)

(c) The table below shows how the scientists published their results. They calculated mean values and two times the standard deviation (SD) of the mean.

Two standard deviations above and below the mean includes 95.4% of the data.

Group of animals	**Mean number of animals per m^2 (± 2 × SD)**		**Mean number of species per m^2 (± 2 × SD)**	
	Soil under wheat crop	**Soil under grassy strips**	**Soil under wheat crop**	**Soil under grassy strips**
Beetles	41.2 (± 6.4)	80.1 (± 10.1)	10.0 (± 1.6)	17.3 (± 1.0)
Centipedes	18.4 (± 3.6)	13.5 (± 1.0)	1.8 (± 0.3)	2.1 (± 0.2)
Earthworms	244.5 (± 27.1)	281.2 (± 39.4)	3.8 (± 0.3)	5.1 (± 0.2)
Millipedes	38.4 (± 12.2)	36.2 (± 2.9)	3.5 (± 0.3)	3.2 (± 0.2)

Woodlice	0.0	73.9 (± 8.5)	0.0	2.8 (± 0.2)

It would **not** be possible to calculate an index of diversity from the results in the table.

Explain why.

_____

_____

_____

(1)

A summary of this research was published in a farming magazine. The journalist concluded that creating grassy strips around fields had little effect on the diversity of soil animals.

Do you agree with this conclusion?

Use evidence from the table to justify your answer.

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_____

_____

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_____

(4)

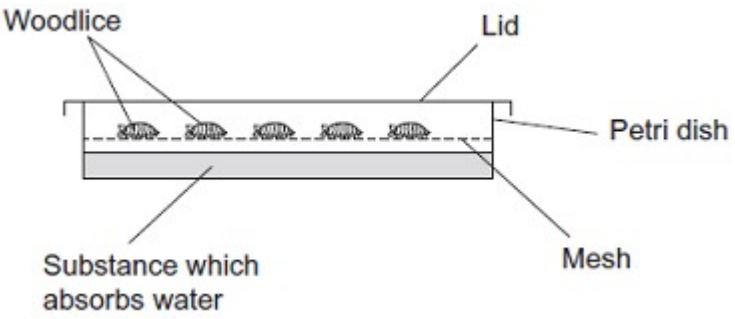
(Total 9 marks)

Q4.

Scientists investigated the effect of relative humidity on the activity of woodlice. They set up a Petri dish as shown in **Figure 1**.

In the bottom half they put a substance which absorbs water. Different concentrations of this substance produced different humidities in the air above the mesh.

Figure 1

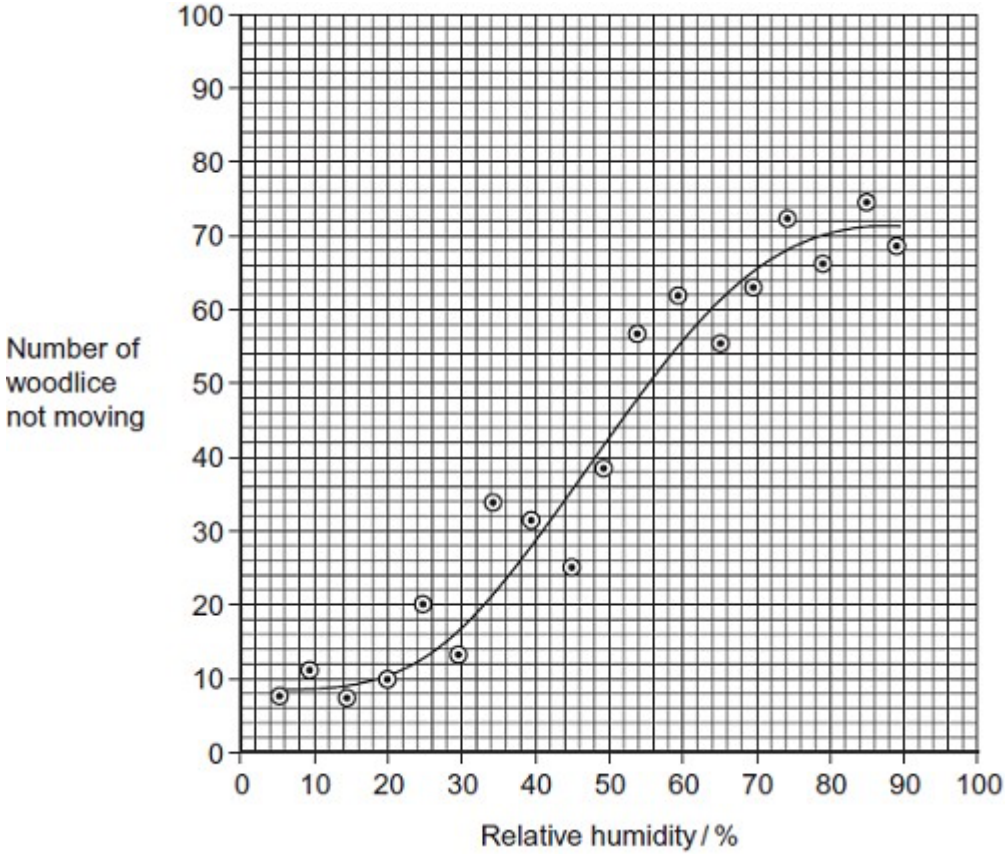


The scientists

- placed 10 woodlice in the top half of the dish
- replaced the lid and left the apparatus for 15 minutes in the laboratory
- recorded the number of woodlice **not** moving during the next 30 seconds
- repeated the experiment to obtain data for 100 woodlice
- repeated the experiment at different humidities.

The results are shown in **Figure 2**.

Figure 2



The movement of the woodlice in low relative humidity is an advantage to their survival. Explain how.

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_____

(Total 2 marks)

Q5.

Read the following passage.

Straw consists of three main organic substances – cellulose, hemicellulose and lignin. Cellulose molecules form chains which pack together into fibres. Hemicellulose is a small molecule formed mainly from five-carbon (pentose) sugar monomers. It acts as a cement holding cellulose fibres together. Like hemicellulose, lignin is a polymer, but it is not a carbohydrate. It covers the cellulose in the cell wall and supplies additional strength. In addition to these three substances, there are small amounts of other biologically important polymers present.

The other main component of straw is water. Water content is variable but may be determined by heating a known mass of straw at between 80 and 90°C until it reaches a constant mass. The loss in mass is the water content.

Since straw is plentiful, it is possible that it could be used for the production of a range of organic substances. The first step is the conversion of cellulose to glucose. It has been suggested that an enzyme could be used for this process. There is a difficulty here, however. The lignin which covers the cellulose protects the cellulose from enzyme attack.

Use information from the passage and your own knowledge to answer the following questions.

(a) (i) Give **one** way in which the structure of a hemicellulose molecule is similar to the structure of a cellulose molecule.

_____

_____

(1)

(ii) Complete the table to show **two** ways in which the structure of a hemicellulose molecule differs from the structure of a cellulose molecule.

Hemicellulose	Cellulose
_____ _____	_____ _____
_____ _____	_____ _____

(2)

(b) Name **one** biologically important polymer, other than those mentioned in the passage, which would be found in straw.

_____

(1)

(c) Explain why the following steps were necessary in finding the water content of straw:

(i) heating the straw *until it reaches constant mass* (line 9);

_____

_____

_____

(1)

(ii) not heating the straw above 90°C (line 9).

_____

_____

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_____

(2)

(d) A covering of lignin protects cellulose from enzyme attack (line 14). Use your knowledge of the way in which enzymes work to explain why cellulose-digesting enzymes do not digest lignin.

_____

_____

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(2)

(e) Describe the structure of a cellulose molecule and explain how cellulose is adapted for its function in cells.

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(6)

(Total 15 marks)