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# AS Level Biology A

## H020/01 Breadth in biology

## Thursday 24 May 2018 – Afternoon

### Time allowed: 1 hour 30 minutes

*7001386114*

**You may use:**
- a scientific or graphical calculator
- a ruler (cm/mm)

*H020001*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| First name | | | | | | | | | |
| Last name | | | | | | | | | |
| Centre number | | | | | | Candidate number | | | | |

**INSTRUCTIONS**
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

**INFORMATION**
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **24** pages.

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## SECTION A

**You should spend a maximum of 25 minutes on this section.**

**Write your answer in the box provided.**

Answer **all** the questions.

**1** Which organelle, **A** to **D**, is **not** involved in the production and secretion of enzymes in eukaryotes?

**A** golgi apparatus

**B** ribosomes

**C** smooth endoplasmic reticulum

**D** vesicle

Your answer ☐ **[1]**

**2** Autoimmune diseases are often treated with a course of antibody injections.

Which of the following statements, **A** to **D**, describes the immunity arising from this treatment?

**A** active natural immunity

**B** active artificial immunity

**C** passive natural immunity

**D** passive artificial immunity

Your answer ☐ **[1]**

**3** A student designed an investigation into the rate of transpiration in plants. They used eight leaves of the same size, age and species. They kept environmental conditions such as wind speed, temperature and humidity constant.

Why did the student take readings from eight different leaves?

**A** to make their investigation valid

**B** to increase the accuracy of their readings

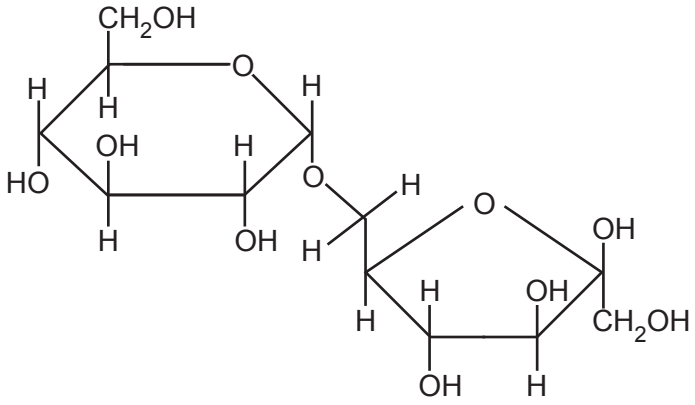
**C** to assess the repeatability of their data

**D** to improve the precision of their results

Your answer ☐ **[1]**

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**4** The image below shows isomaltulose, a disaccharide formed from α-glucose and fructose.




Name the bond that holds the α-glucose and the fructose together.

**A** 1,6-glycosidic bond

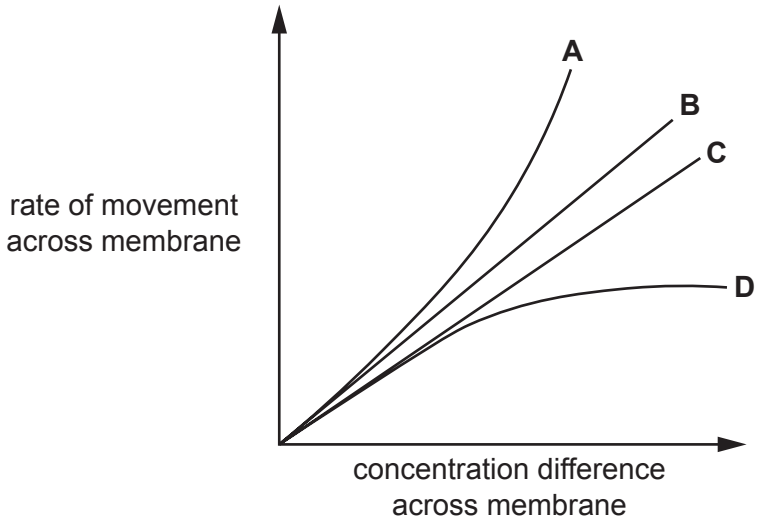
**B** phosphodiester bond

**C** ester bond

**D** 1,4-glycosidic bond

Your answer ☐ **[1]**

**5** The graph shows the rate of movement of four different substances across a membrane.




The substances shown in the graph are: carbon dioxide, testosterone (a lipid-based hormone), ethanol and sodium ions.

Which of the lines, **A** to **D**, represents the pattern of movement of sodium ions across a membrane?

Your answer ☐ **[1]**

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**6** The aquatic crustacean *Daphnia magna* has a heart that pumps a blood-like liquid called haemolymph around the body cavity.

Which of the statements, **A** to **D**, describes the circulatory system of *Daphnia magna*?

**A** single closed

**B** single open

**C** double open

**D** double closed

Your answer ☐ **[1]**

**7** DNA polymerase catalyses the formation of phosphodiester bonds during DNA replication.

Which of the statements, **A** to **D**, will **not** affect the rate of phosphodiester bond formation?

**A** temperature

**B** length of DNA molecule

**C** pH

**D** free nucleotide availability

Your answer ☐ **[1]**

**8** Which of the following types of cells is **not** involved in a primary immune response?

**A** T-memory cells

**B** T-helper cells

**C** T-killer cells

**D** plasma cells

Your answer ☐ **[1]**

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**9** Which of the following, **A** to **D**, is **not** an adaptation to reduce water loss in plants?

**A** an extensive root system that extends far from the plant

**B** leaves that are reduced to spines that prevent damage from animals

**C** the ability to store carbon dioxide so stomata only need to open at night

**D** the surface covered in reflective hairs

Your answer ☐ **[1]**

**10** A scientist was investigating the effect of two different temperatures on the rate of enzyme controlled decomposition of ammonia, in soil bacteria.

They repeated their experiment ten times for each of the two different temperatures.

Which of the following, **A** to **D**, should they use to determine if there was a significant difference between these two sets of times?

**A** standard deviation

**B** Student's t-test

**C** chi squared test

**D** Spearman's rank correlation coefficient

Your answer ☐ **[1]**

**11** The hydroxyl (-OH) group of carbohydrates is polar and makes the molecule soluble in water. The greater the number of free hydroxyl groups as a proportion of the number of carbon atoms, the more soluble the carbohydrate.

Which of the rows, **A** to **D**, lists the carbohydrates in order of most soluble to least soluble?

| | **Most soluble** | ⟷ | | **Least soluble** |
|---|---|---|---|---|
| **A** | glucose | ribose | amylose | amylopectin |
| **B** | amylose | amylopectin | glycogen | ribose |
| **C** | glucose | ribose | amylopectin | amylose |
| **D** | ribose | amylose | glucose | amylopectin |

Your answer ☐ **[1]**

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**12** The bacterium *Sorangium cellulosum* and the fungus *Armillaria mellea* are both found in soil.

Which of the rows, **A** to **D**, correctly shows the structures present in each organism?

| | **Free ribosomes in cytoplasm** | **Membrane bound nucleus** | **DNA in a single loop** | **Cell wall present** |
|---|---|---|---|---|
| **A** | *S. cellulosum* and *A. mellea* | *A. mellea* | *S. cellulosum* | *S. cellulosum* and *A. mellea* |
| **B** | *S. cellulosum* and *A. mellea* | *A. mellea* | *S. cellulosum* and *A. mellea* | *S. cellulosum* and *A. mellea* |
| **C** | *S. cellulosum* | *S. cellulosum* and *A. mellea* | *S. cellulosum* | *A. mellea* |
| **D** | *A. mellea* | *S. cellulosum* | *S. cellulosum* and *A. mellea* | *S. cellulosum* |

Your answer ☐ **[1]**

**13** Carbon dioxide release during respiration can affect the % oxygen saturation of haemoglobin.

The tertiary structure of haemoglobin is affected when carbon dioxide reacts with water to form carbonic acid. This reaction releases hydrogen ions.

Which of the statements, **A** to **D**, explains this change?

**A** The release of hydrogen ions causes the pH to rise, which reduces haemoglobin's affinity for oxygen.

**B** The release of hydrogen ions causes the pH to rise, which increases haemoglobin's affinity for oxygen.

**C** The release of hydrogen ions causes the pH to fall, which increases haemoglobin's affinity for oxygen.

**D** The release of hydrogen ions causes the pH to fall, which reduces haemoglobin's affinity for oxygen.

Your answer ☐ **[1]**

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**14** During translocation of photosynthetic products in the phloem sieve tube, hydrogen ions are moved out of companion cells, then sucrose enters the companion cells and moves through plasmodesmata into the sieve tube.

Which of the rows, **A** to **D**, correctly identifies how these substances enter or leave companion cells?

| | **hydrogen ions out of companion cell** | **sucrose into companion cell** | **sucrose out of companion cell** |
|---|---|---|---|
| **A** | diffusion | facilitated diffusion | diffusion |
| **B** | diffusion | active transport | active transport |
| **C** | active transport | facilitated diffusion | diffusion |
| **D** | active transport | active transport | facilitated diffusion |

Your answer ☐ **[1]**

**15** The Millennium Seed Bank has over two billion seeds in storage.

Which of the options, **A** to **D**, describes the type of conservation carried out at the Millennium Seed Bank?

**A** in-situ conservation of species biodiversity

**B** in-situ conservation of habitat biodiversity

**C** ex-situ conservation of species biodiversity

**D** ex-situ conservation of habitat biodiversity

Your answer ☐ **[1]**

**16** Plants such as the soybean have a number of defence strategies to prevent infection by pathogens.

Which of the following strategies is a chemical defence against pathogen infection?

**A** callose deposits at sieve tube ends that prevent pathogen movement in phloem

**B** hydrolytic enzymes such as chitinase found between cells

**C** stomata can be closed by guard cells if pathogens are detected

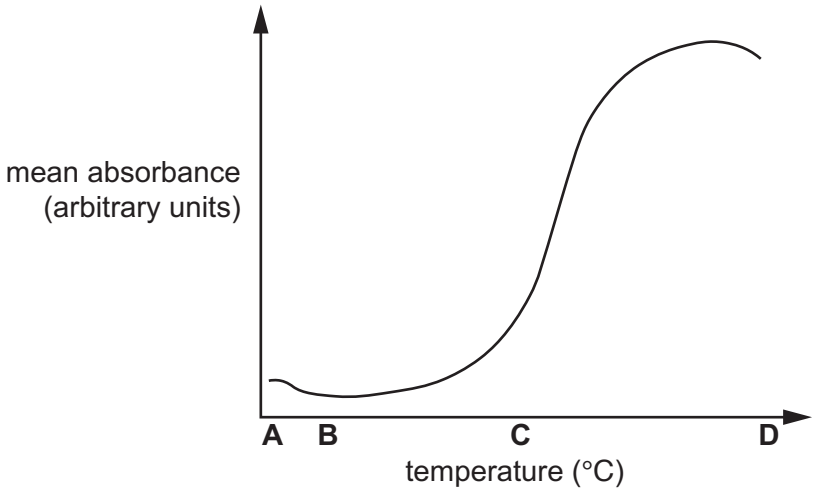
**D** cell walls can be thickened by lignin, making cell entry very difficult for pathogens

Your answer ☐ **[1]**

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**17** Swiss chard is a leafy green vegetable related to spinach. Some varieties have yellow stalks that have vacuoles containing yellow betaxanthin pigments.

The graph below shows the effect of temperature on the release of these pigments recorded as mean absorbance, when measured with a colorimeter.




It was deduced that the betaxanthins were released from the vacuole due to the denaturing of proteins in the tonoplast (vacuolar membrane).

Which letter, **A** to **D**, shows the temperature at which the proteins denature?

Your answer ☐ **[1]**

**18** An investigation into how a change in sodium chloride concentration effects osmosis in potato cells concluded that the isotonic point of the potato was 0.25 M.

Which of the statements, **A** to **D**, describes what is happening at the isotonic point?

**A** there is a net movement of water from the sodium chloride solution into the potato cells

**B** there is a net movement of water from the cytoplasm of the potato cells into the sodium chloride solution

**C** there is no movement of water into or out of the potato cell cytoplasm

**D** the movement of water into the potato cells is equal to the movement of water out of the potato cells

Your answer ☐ **[1]**

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**19** The table below shows four biological molecules and their component elements.

Which of the rows, **A** to **D**, correctly identifies the elements in each molecule?

| | **sucrose** | **cholesterol** | **insulin** | **ATP** |
|---|---|---|---|---|
| **A** | C, H, O | C, H, O, N | C, H, O, N, S | C, H, O, N, P |
| **B** | C, H, O, N | C, H, O | C, H, O, N, S | C, H, O, N, S |
| **C** | C, H, O | C, H, O | C, H, O, N, S | C, H, O, N, P |
| **D** | C, H, O | C, H, O | C, H, O, N, P | C, H, O, N, P |

Your answer ☐ **[1]**

**20** In human cells, the tumour suppressor gene *TP53* codes for a protein that interrupts the cell cycle if there is any damage to the DNA and prevents the copying of damaged DNA.

Which of the stages, **A** to **D**, could *TP53* interrupt the cell cycle?

**A** mitosis

**B** $G_1$

**C** S

**D** cytokinesis

Your answer ☐ **[1]**

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**21** The Titicaca water frog, *Telmatobius culeus*, is an aquatic amphibian found in Lake Titicaca in sub-tropical South America. The water frog has an unusual appearance with large folds of skin as shown in Fig. 21.1.

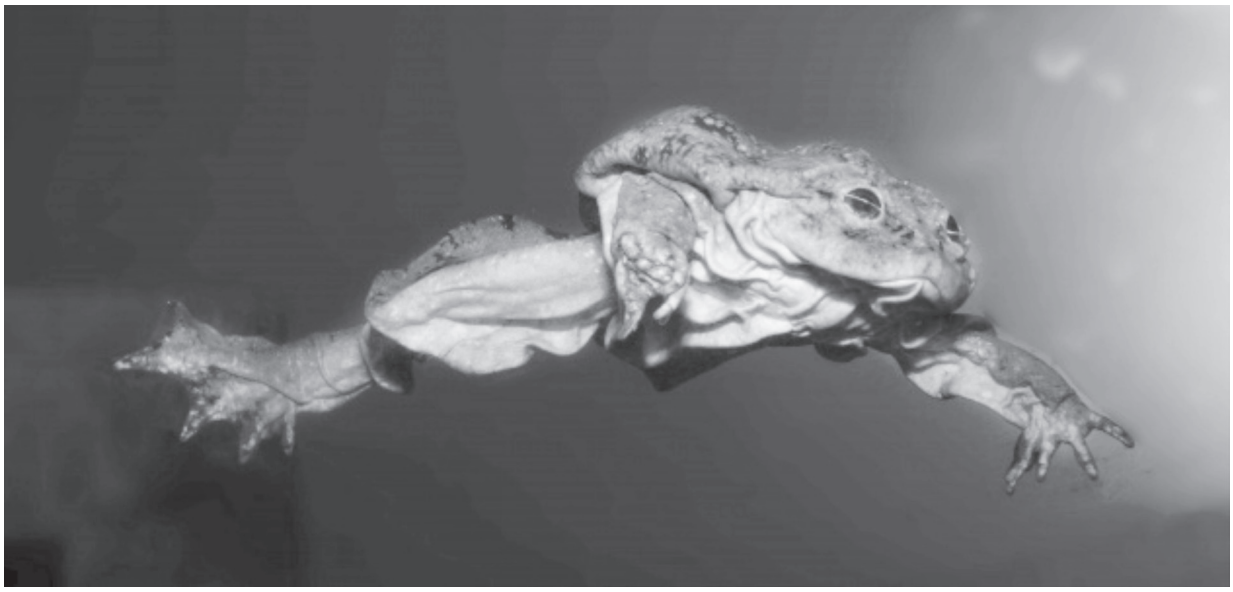


**Fig. 21.1**

**(a)** Name the genus of the Titicaca water frog.

..... **[1]**

**(b)** Outline the properties of water which make it an ideal habitat for an amphibian.

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..... **[2]**

**(c)** Like all amphibians, frogs are able to absorb oxygen through the skin as well as their lungs.

**(i)** Suggest why the Titicaca water frog has evolved the unusually large folds of skin seen in Fig. 21.1.

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..... **[2]**

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**(ii)** When out of the water, the Titicaca water frog is able to use its lungs to absorb oxygen.

Lungs contain specialised gaseous exchange surfaces.

Describe and explain how **one** feature of the lungs provides an efficient gas exchange surface.

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..... **[2]**

**(d)** A student was investigating the effect of cell size on the rate of diffusion into model cells. They had two cubes of agar containing phenolphthalein indicator as shown in Fig. 21.2.

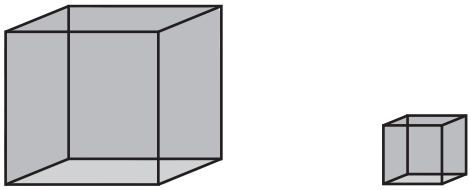



**Fig. 21.2**

The student placed the cubes in beakers of dilute hydrochloric acid, which caused the indicator to become colourless. They then measured how much of each cube became colourless over time.

**(i)** State **two** ways the student could have ensured they had confidence in their results.

1 .....

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2 .....

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**[2]**

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**(ii)** In Fig. 21.2, Cube A is 10 mm along each side and Cube B is 4 mm along each side. Calculate the surface area to volume ratio (SA:V) for both cubes A and B.

Show your working. Give your answers to **one** decimal place.

Cube A .....

Cube B .....

**[2]**

**(iii)** Explain why the surface area to volume ratio of an organism determines whether it needs a circulatory system.

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**Question 22 begins on page 14**

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**22** Fig. 22 shows a triglyceride molecule found in sunflower oil.

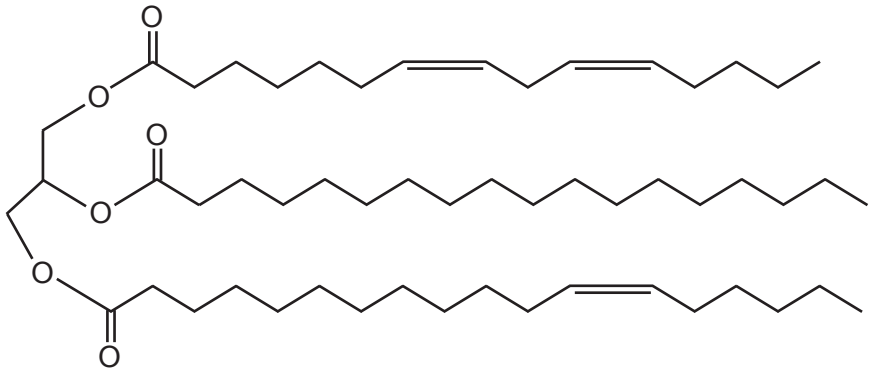


**Fig. 22**

**(a)** On Fig. 22 circle an ester bond.

[Answer on Fig. 22] **[1]**

**(b)** Sunflower oil is used to make biodiesel, which contains methyl esters. The fatty acids in the triglyceride molecule are reacted with methanol in a process called transesterification.

After the reaction, two liquid products form which naturally separate from each other. The methyl esters float on top of a more dense liquid.

Name the part of the molecule seen in Fig. 22 that forms this more dense liquid.

..... **[1]**

**(c)** Living organisms have many uses for triglycerides, one of which is the production of phospholipids.

**(i)** Name three **other** functions of triglycerides in living organisms.

1 .....

2 .....

3 .....

**[3]**

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**(ii)** Table 22 shows the melting points of some of the methyl esters made from the transesterification of sunflower oil fatty acids.

| Methyl ester | Formula | Melting point (°C) |
|---|---|---|
| Methyl sterate | $C_{19}H_{38}O_2$ | 39.1 |
| Methyl oleate | $C_{19}H_{36}O_2$ | –19.9 |
| Methyl linoleate | $C_{19}H_{34}O_2$ | –35.0 |

**Table 22**

Describe and explain the pattern of the melting points of these three methyl esters.

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..... **[2]**

**(d)** Phospholipid molecules also contain fatty acids.

Explain how the fatty acids in phospholipids allow the formation of membranes.

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..... **[2]**

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**23** Fig. 23 shows a microscope image of a cross section taken from the stem of a sunflower, *Helianthus annuus*.

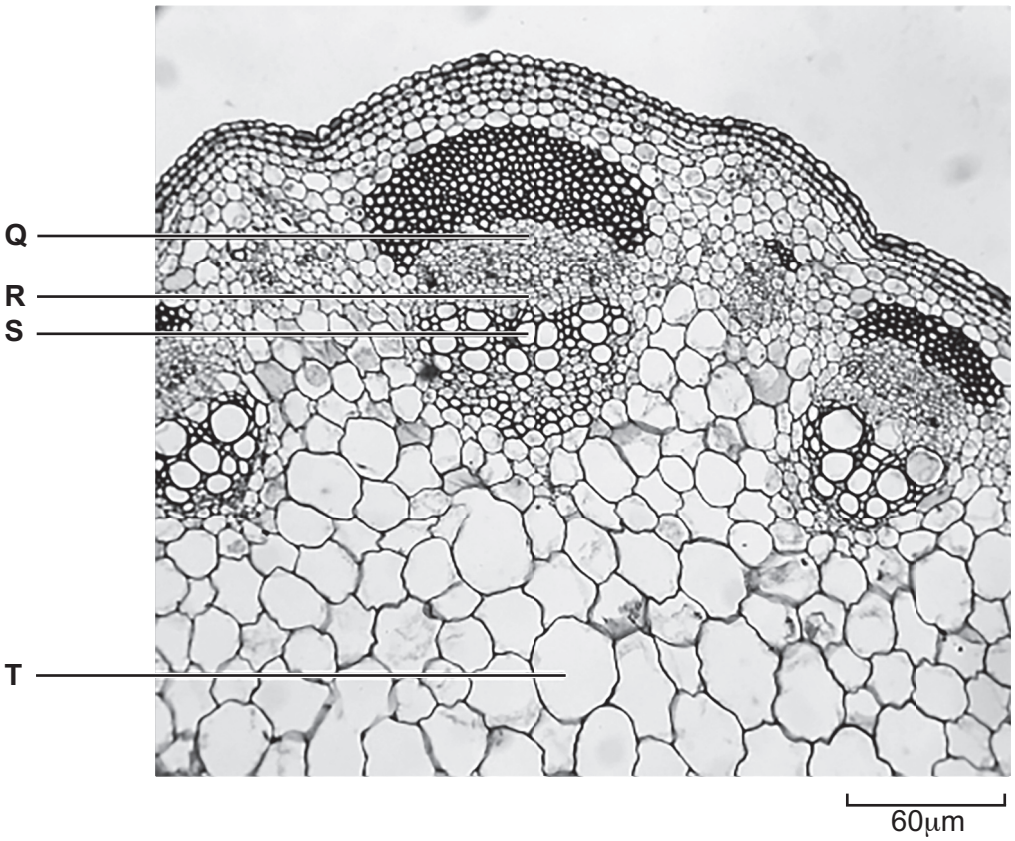



**Fig. 23**

**(a)** Calculate the magnification of this image.

..... **[2]**

**(b)** **(i)** The cell labelled **T** on Fig. 23 is a parenchyma cell which carries out photosynthesis and stores starch. Suggest why cell **T** and the cells surrounding it, can be classified as parenchyma **tissue**.

.....

..... **[1]**

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**(ii)** **Name** the two tissues labelled **Q** and **S** on Fig. 23.

**Q** .....

**S** ..... **[2]**

**(c)** The tissues labelled **Q** and **S** in Fig. 23 are produced by mitosis from the tissue labelled **R** on Fig. 23. Identify the tissue labelled **R**.

**R** ..... **[1]**

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**24** Fig. 24 shows a DNA nucleotide.

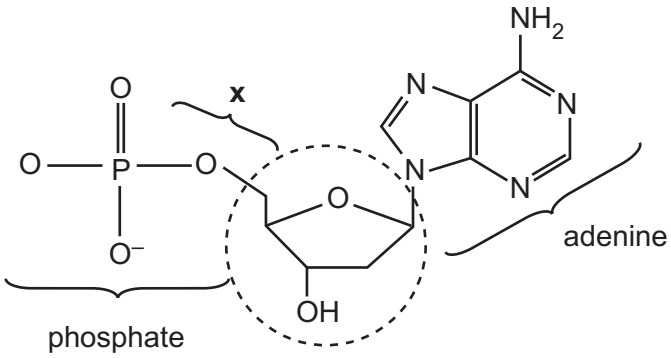



**Fig. 24**

**(a) (i)** Name the circled component in Fig. 24.

..... **[1]**

**(ii)** Name the bond labelled **x** in Fig. 24.

..... **[1]**

**(b)** Identify two similarities and two differences between the DNA nucleotide shown in Fig. 24 and a molecule of ATP.

Similarities .....

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Differences .....

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**[4]**

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**25** The downy birch tree, *Betula pubescens*, produces varying numbers of leaf hairs.

These hairs are between 200 μm and 500 μm long in response to different environmental conditions.

**(a)** State the **pattern** of variation shown by leaf hair density.

..... **[1]**

**(b)** Leaf hair density can be measured in the laboratory.

Outline a practical method that could be used to determine the density of hairs on the underside of a leaf.

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..... **[3]**

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**(c)** A group of students investigated the relationship between the distance of different trees from a river and the mean leaf hair density.

Table 25 shows the results of their investigation.

| Distance from river (m) | Rank of distance | Mean leaf hair density (number $mm^{-2}$) | Rank of hair density | Difference in ranks ($d$) | Difference squared ($d^2$) |
|---|---|---|---|---|---|
| 9.1 | 4 | 33.1 | | | |
| 13.7 | 1 | 34.8 | | | |
| 5.5 | 7 | 11.3 | | | |
| 0.3 | 10 | 3.4 | | | |
| 5.4 | 8 | 27.3 | | | |
| 11.5 | 3 | 30.3 | | | |
| 1.7 | 9 | 6.3 | | | |
| 6.0 | 6 | 22.9 | | | |
| 11.9 | 2 | 5.7 | | | |
| 6.8 | 5 | 23.2 | | | |

**Table 25**

**(i)** Complete Table 25 by calculating the difference between the ranks and then squaring the difference.

[Answer on Table 25] **[2]**

**(ii)** Use the formula below to calculate Spearman's rank correlation coefficient for this data.

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)}$$

..... **[2]**

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**(d)** The students concluded that there is a positive correlation between distance of the tree from the river and mean leaf hair density.

**(i)** Suggest reasons for this positive correlation.

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..... **[2]**

**(ii)** For this investigation, the students randomly selected leaves from ten downy birch trees at varying distances from the river.

Suggest **three** ways in which the students could improve the validity of their sampling method.

1 .....

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2 .....

.....

3 .....

.....

**[3]**

**(e)** Another group of students repeated this investigation and calculated $r_s$ = 0.589. The critical value of $r_s$ at the 5% level for 9 degrees of freedom is 0.600.

They concluded that their results showed a weak positive correlation between leaf hair density and distance of the tree from the river.

Evaluate the conclusion of this group of students.

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..... **[2]**

**END OF QUESTION PAPER**

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## ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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