2021 ASSESSMENT RESOURCE

AS
BIOLOGY

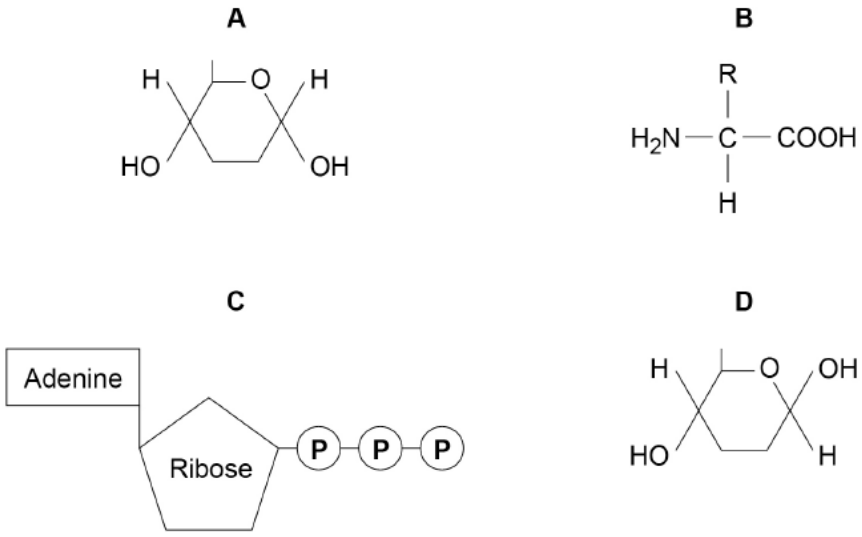
Biological Molecules and Cells

Version 0.1

Total number of marks: 49

0 1 **Figure 1** shows the structure of molecules found in organisms.

Figure 1



0 1 . 1 Complete **Table 1** by putting the correct letter, **A**, **B**, **C** or **D**, in the box next to each statement. Each letter may be used once, more than once, or not at all.

[4 marks]

Table 1

Letter	Statement
B	is a monomer in an enzyme's active site
D	is a monomer in cellulose
A	is produced during photosynthesis and respiration
B	forms a polymer that gives a positive result with a biuret test

0 1 . 2 Raffinose is a trisaccharide of three monosaccharides: galactose, glucose and fructose. The chemical formulae of these monosaccharides are:

- galactose = $C_6H_{12}O_6$
- glucose = $C_6H_{12}O_6$
- fructose = $C_6H_{12}O_6$

Give the number of carbon atoms, hydrogen atoms and oxygen atoms in a molecule of raffinose.

[1 mark]

Number of carbon atoms 18

Number of hydrogen atoms 32

Number of oxygen atoms 16

0 1 . 3 A biochemical test for reducing sugar produces a negative result with raffinose solution.

Describe a biochemical test to show that raffinose solution contains a non-reducing sugar.

[3 marks]

Hydrolyse the raffinose solution by heating it with dilute hydrochloric acid. Neutralise the solution by adding sodium hydrogencarbonate, then carry out the Benedict's test. Add Benedict's reagent to the solution and heat in a water bath. A positive result is indicated by orange-red precipitate.

0 5 . 1 A student prepared a stained squash of cells from the tip of an onion root and observed it using an optical microscope.

During the preparation of the slide, he:

- cut the first 5 mm from the tip of an onion root and placed it on a glass slide
- covered this tip with a drop of stain solution and a cover slip
- warmed the glass slide
- pressed down firmly on the cover slip.

He identified and counted nuclei in different stages of the cell cycle.

Explain why the student:

[2 marks]

1. used only the first 5 mm from the tip of an onion root.

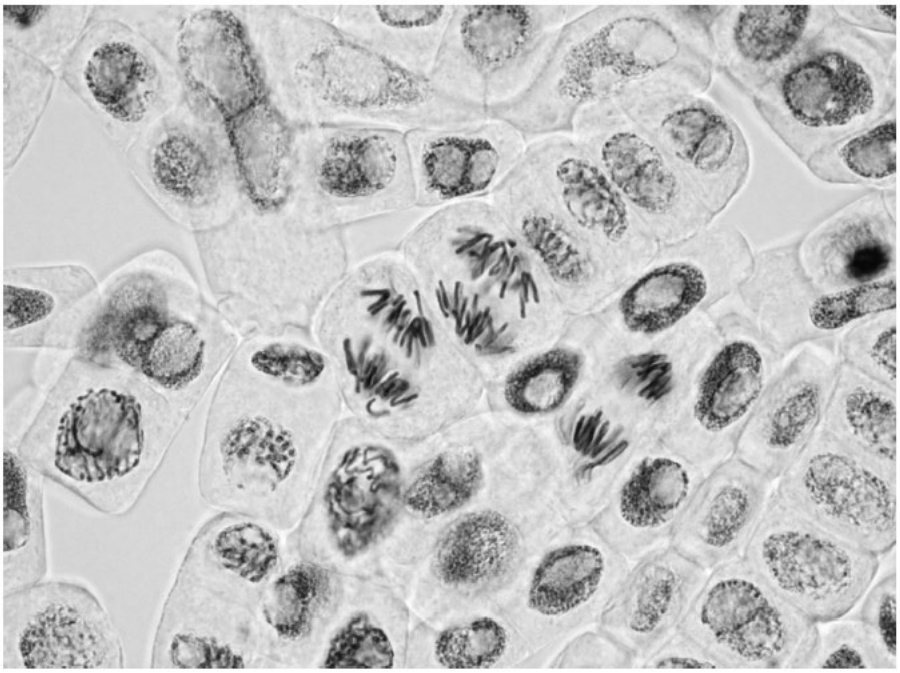
Cells at the tip of onion root are dividing

2. pressed down firmly on the cover slip.

to form a thin layer of cells which light can pass through and make the cells visible

Figure 2 shows the cells the student saw in one field of view. He used this field of view to calculate the length of time these onion cells spent in anaphase of mitosis.

Figure 2



0 5 . 2 Scientists have found the mean length of time spent by onion cells in anaphase of mitosis is 105 minutes. They also found the cell cycle of cells in the onion root shown in **Figure 2** takes 1080 minutes.

32 whole cells are shown in **Figure 2**.

Use this information and **Figure 2** to calculate the length of time the cells of this onion root are in anaphase **and** then calculate the percentage difference between your answer and the mean length of time found by the **scientists**.

Show your working.

[2 marks]

$\frac{3}{32} \times 1080 = 101.25$ mins

$\frac{105 - 101.25}{105} \times 100 = 3.57\ \%$

Answer = 3.57 %

0 5 . 3 Tick (✓) the name given to the division of cytoplasm during the cell cycle.

[1 mark]

Binary fission	
Cytokinesis	✓
Phagocytosis	
Segregation	

0 5 . 4 Describe and explain what the student should have done when counting cells to make sure that the mitotic index he obtained for this root tip was accurate.

[2 marks]

The student should look at a number of areas to ensure a representative sample is obtained and repeat counting cells to ensure that the numbers are correct.

0 8 . 1 Describe a biochemical test to confirm the presence of protein in a solution.

[2 marks]

Biuret test can be used to test for the presence of peptide bonds in a solution. Add equal volume of NaOH into a test tube containing the sample followed by a few drops of dilute copper (II) sulfate and mix gently. If proteins are present, the sample will turn from blue to purple.

0 8 . 2 A dipeptide consists of two amino acids joined by a peptide bond. Dipeptides may differ in the type of amino acids they contain.

Describe **two other** ways in which all dipeptides are similar and **one** way in which they might differ.

[3 marks]

Similarities

1 formed through condensation reactions

2 contain carbon, hydrogen, oxygen and nitrogen

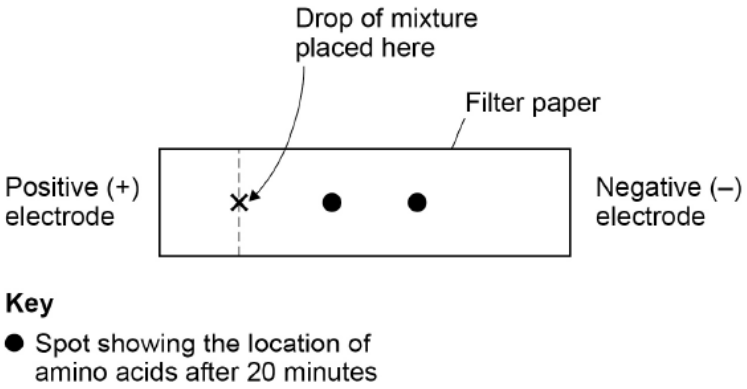
Difference they may have different physical and chemical properties

A solution contained a mixture of **three** different amino acids. A scientist passed an electric current through the solution to separate the amino acids.

She placed a drop of the mixture at one end of a piece of filter paper, attached an electrode to each end of the paper and switched on the current. She switched off the current after 20 minutes and stained the paper to show spots of the amino acids at new positions.

Her results are shown in **Figure 6**.

Figure 6



0 8 . 3 Explain what the positions of the spots in **Figure 6** show about these amino acids.

[3 marks]

Both amino acids are positively charges as they are moving towards the negative electrode. The spot further to the right contains amino acids with a higher charge/mass ratio.

0 5 . 1 A student investigated starch hydrolysis using the enzyme amylase.

During the procedure, the student:

- treated the starch to make it soluble
- prepared 10 cm^3 of different concentrations (mg dm^{-3}) of starch solution
- added an identical concentration of amylase to each starch solution
- measured the time in minutes to completely hydrolyse starch.

He repeated the procedure and calculated the mean time to completely hydrolyse starch in each concentration of starch solution.

Draw a table the student could use to record all of his results.

You only need to show completed column headings.

[2 marks]

Concentration of starch solution (mg dm-3)	Concentration of amylase (mg dm-3)	Time taken to hydrolyse starch (mins)		Mean time taken to hydrolyse starch (mins)
		1	2	

0 5 . 2 Describe the results you would expect the student to obtain.

Mean time taken for starch to be hydrolysed increases as concentration starch solution increases

[1 mark]

0 5 . 3 A competitive inhibitor decreases the rate of an enzyme-controlled reaction. Explain how.

[3 marks]

A competitive inhibitor has a shape similar to the subtrate, which is complementary to the shape of the active site on the enzyme. Competitive inhibitors bind to the active site, preventing subtrate from binding to the enzyme and forming enzyme-substrate complexes. This is a reversible inhibition as it can be overcome by increasing substrate concentration.

0 1 . 1 Structures **A** to **E** are parts of a plant cell.

A Cell Wall
B Chloroplast
C Nucleus
D Mitochondrion
E Golgi apparatus

Complete **Table 1** by putting the correct letter, **A**, **B**, **C**, **D** or **E** in the box next to each statement.

[3 marks]

Table 1

Statement	Letter
Has stacked membranes arranged in parallel and contains DNA.	B
Is made of polysaccharide.	A
Is an organelle and is **not** surrounded by two membranes.	E

0 1 . 2 Human breast milk is produced and secreted by gland cells. These gland cells have adaptations that include many mitochondria and many Golgi vesicles. The milk contains a high concentration of protein.

Explain the role of these cell adaptations in the production and secretion of breast milk.

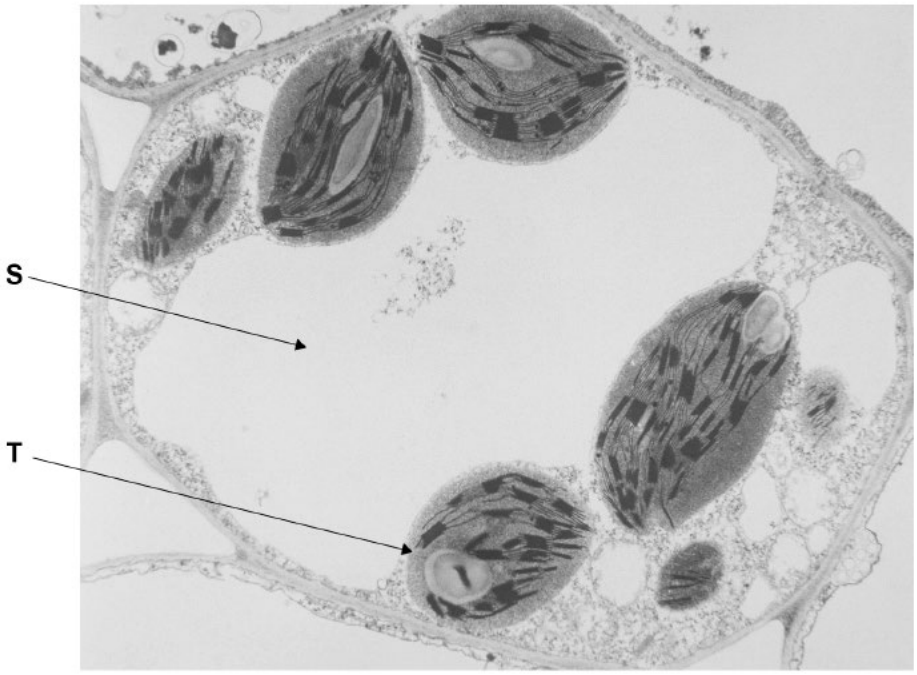
[2 marks]

Many mitochondria produces more ATP which is needed for protein synthesis and the transport of proteins.

Many Golgi vesicles are needed for the vesicular transport of proteins out of the cell.

Figure 3 is a transmission electron micrograph of a plant cell.

Figure 3



0 4 . 2 Suggest why a nucleus is **not** visible in **Figure 3**.

The cell is not stained to show the nucleus

[1 mark]

0 4 . 3 Name the organelles labelled **S** and **T** in **Figure 3**.

[1 mark]

Organelle **S** large vacuole

Organelle **T** chloroplast

0 4 . 4 Give **one** advantage of viewing a biological specimen using a transmission electron microscope compared with using a scanning electron microscope.

[1 mark]

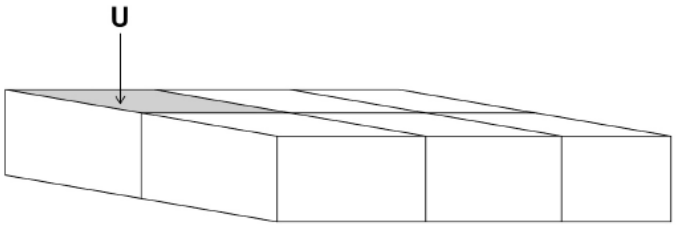
Transmission electron microscopes can be used to observe samples at higher magnification.

0 4 . 5 The cells in **Figure 4** are part of a continuous layer of cells forming the upper surface of a leaf.

The shaded area of cell **U** is 150 μm^2

The total area of the upper surface of the leaf is 70.65 cm^2

Figure 4



Calculate the number of cells in the upper surface of the leaf.

Give the answer in standard form.

Assume that all these cells are identical in size.

Show your working.

[2 marks]

$70.65\ cm^3 = 70.65 \times 10^4 \times 10^4\ \mu m^2$

$= 706500000\ \mu m$

$\frac{7065\,000\,000}{150} = 47100000$

$= 4.71 \times 10^7$ cells

0 3 . 1 Name the **two** scientists who proposed models of the chemical structure of DNA and of DNA replication.

[1 mark]

James Watson & Francis Crick

A scientist replicated DNA in a test tube. To do this, he mixed an enzyme with identical single-stranded DNA fragments and a solution containing DNA nucleotides.

0 3 . 2 Name the enzyme used in this DNA replication.

[1 mark]

DNA polymerase

0 3 . 3 Use your knowledge of semi-conservative replication of DNA to suggest:

[3 marks]

1. the role of the single-stranded DNA fragments to act as the template for DNA nucleotides to bind to their bases through complementary base pairing

2. the role of the DNA nucleotides. monomers which form the daughter strand, their bases form hydrogen bonds with the template strand through complementary base pairing

0 4 . 1 Give **two** similarities in the movement of substances by diffusion and by osmosis.

[2 marks]

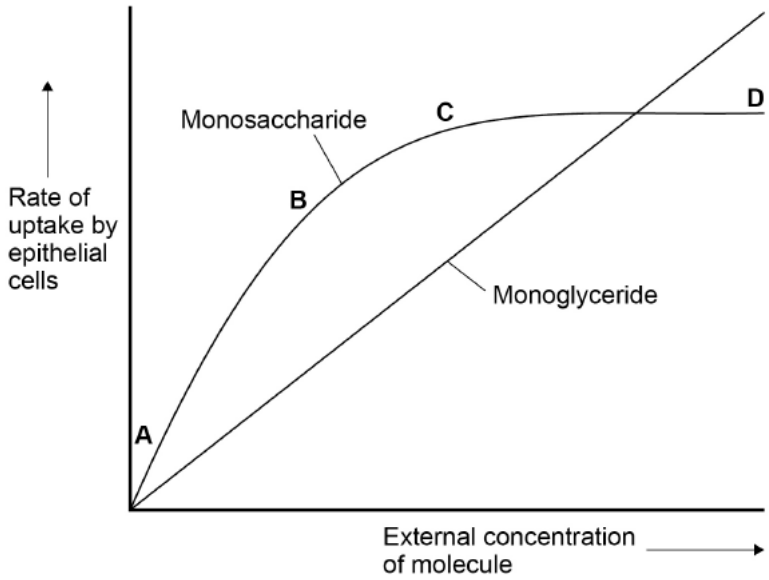
1 substances move from an area of high concentration to an area of low concentration gradient, down their concentration/water potential gradient

2 no energy required

A scientist measured the rate of uptake of a monoglyceride and a monosaccharide by epithelial cells of the small intestine of mice. A monoglyceride is a molecule of glycerol with one fatty acid attached. She did this for different concentrations of monoglyceride and monosaccharide.

Her results are shown in **Figure 1**.

Figure 1



0 4 . 2 Use your knowledge of transport across membranes to explain the shape of the curve in **Figure 1** for uptake of monosaccharides between concentrations:

[3 marks]

A and B Monosaccharides are transported into cells via facilitated diffusion, using transporters. Between A and B, as the external concentration of monosaccharides increase, more monosaccharides bind to transporters, causing a conformational change which moves the monosaccharide into the cell, so the rate of uptake increases

C and D most transporters are saturated with monosaccharides. There is little change in the rate of uptake as there are few transporters available to transport monosaccharides even if external concentration increases. The graph has reached a plateau.