

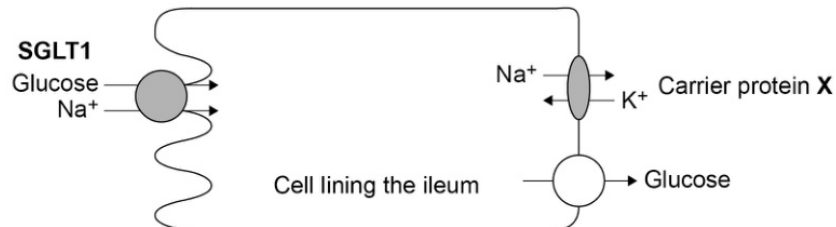
Question 1

0 1

Figure 1 shows a cell from the lining of the ileum specialised for absorption of products of digestion.

SGLT1 is a carrier protein found in the cell-surface membrane of this cell, it transports glucose and sodium ions (Na^+) into the cell.

Figure 1



0 1 . 1

The action of the carrier protein **X** in **Figure 1** is linked to a membrane-bound ATP hydrolase enzyme.

Explain the function of this ATP hydrolase.

[2 marks]

0 1 . 2

The movement of Na^+ **out** of the cell allows the absorption of glucose **into** the cell lining the ileum.

Explain how.

[2 marks]

0 1 . 3

Describe and explain **two** features you would expect to find in a cell specialised for absorption.

[2 marks]

1

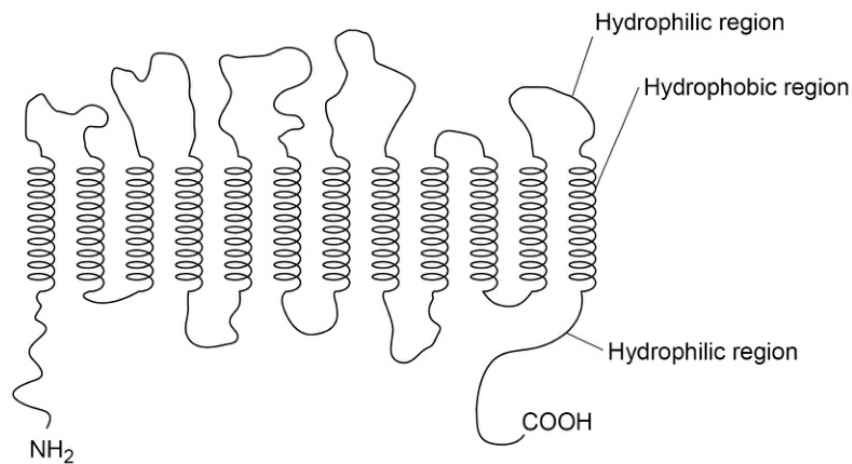
2

Figure 2 is a diagram of one SGLT1 carrier protein.

Figure 2

outside the box

box



0 1 . 4 Draw phospholipids on **Figure 2** to show how the carrier protein, SGLT1, would fit into the cell-surface membrane.

Do **not** draw more than eight phospholipids.

[2 marks]

0 1 . 5 **Figure 2** shows the SGLT1 polypeptide with NH_2 at one end and COOH at the other end.

box

Describe how amino acids join to form a polypeptide so there is always NH_2 at one end and COOH at the other end.

You may use a diagram in your answer.

[2 marks]

Space for diagram:

Question 2

0 2

To study lipid digestion, a scientist placed a tube into the gut of a healthy 20-year-old man. The end of the tube passed through the stomach but did not reach as far as the ileum.

The scientist fed the man a meal containing triglycerides through the tube. The scientist also used the tube to remove samples from the man's gut at intervals after the meal.

The scientist measured the type of lipid found in the samples. Some of her results are shown in **Table 1**.

Table 1

Sample	Time of collection after meal / min	Concentration of fatty acids / mg cm ⁻³	Concentration of triglycerides / mg cm ⁻³
A	45	2.7	0.6
B	75	3.3	0.0

0 2 . 1

Use your knowledge of lipid digestion to explain the differences in the results for samples **A** and **B** shown in **Table 1**.

You should assume that **no** absorption had occurred.

[3 marks]

0 2 . 2

After collecting the samples, the scientist immediately heated them to 70 °C for 10 minutes.

Explain why.

[2 marks]

0 2 . 3

Describe the role of micelles in the absorption of fats into the cells lining the ileum.

[3 marks]

box

box

Question 3

06.1

Particulate matter is solid particles and liquid particles suspended in air. Polluted air contains more particulate matter than clean air.

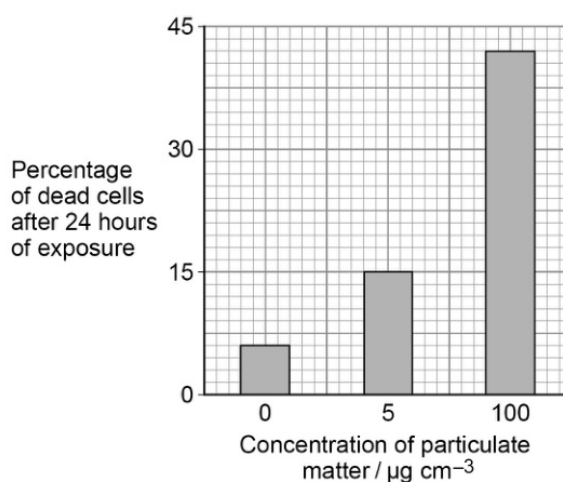
A high concentration of particulate matter results in the death of some alveolar epithelium cells. If alveolar epithelium cells die inside the human body they are replaced by non-specialised, thickened tissue.

Explain why death of alveolar epithelium cells reduces gas exchange in human lungs.

[3 marks]

Scientists grew alveolar epithelium cells and exposed the epithelium cells to different concentrations of particulate matter. They calculated the percentage of these alveolar epithelium cells that died after 24 hours of exposure to particulate matter. Their results are shown in **Figure 6**.

Figure 6



06.2

Do the data in **Figure 6** show a linear relationship between concentration of particulate matter and percentage of dead cells?

Use suitable calculations to justify your answer.

[2 marks]

Space for your calculations:

Question 4

0 1 . 1 Describe the structure and function of the nucleus.

[4 marks]

0 1 . 2 Name the main polymer that forms the following cell walls.

[1 mark]

Plant cell wall _____

Fungal cell wall _____

Scientists investigated the effect of the number of fungal species in soil on the diversity of plant species.

Table 1 shows their raw data for soil containing 14 fungal species.

Table 1

Plant species	Total shoot biomass / g m ⁻²
<i>Poa compressa</i>	2
<i>Achillea millefolium</i>	4
<i>Aster cordifolius</i>	5
<i>Aster novae-angliae</i>	7
<i>Chrysanthemum leucanthemum</i>	15
<i>Daucus carota</i>	36
<i>Fragaria virginiana</i>	51

0 1 . 3 Suggest **one** reason the scientists used biomass instead of the number of individuals of each plant species when collecting data to measure diversity.

[1 mark]

0 1 . 4 The scientists used this equation to calculate the plant species index of diversity.

$$d = 1 - \sum \left(\frac{n}{N} \right)^2$$

where n = shoot biomass of each plant species
and N = total shoot biomass of all plant species

Use this equation to calculate the index of diversity for the data in **Table 1**.

[2 marks]

Index of diversity

Figure 1 shows the plant species index of diversity the scientists calculated when the soil contained 0, 1, 2, 4 and 8 fungal species.

box

Figure 1

Figure 1 not reproduced here due to third-party copyright restrictions

0 1 . 5

Sometimes farmers stop growing crops on an area of land to allow the natural ecosystem to recover. The plant species index of diversity of these areas previously used to grow crops is different from nearby land that has never been used to grow crops.

Suggest and explain how the plant species index of diversity would be different in these areas previously used to grow crops.

Use **Figure 1** and your knowledge of the effect of farming on biodiversity in your answer.

[2 marks]

Question 5

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 _____

0 8 . 2

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.

Using all the information, what can you conclude about aorta diameter and the risk of developing an aneurysm?

[3 marks]

0 8 . 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:

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

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

Question 6

0 1 . 1

Give the **three** structural features found in **all** virus particles **and** describe the function of **one** of these features.

[2 marks]

1 _____

2 _____

3 _____

Function of **one** named feature _____

0 1 . 2

Explain why viruses are described as acellular and non-living.

[2 marks]

0 1 . 3

Give **one** reason why antibiotics are **not** effective against viruses.

[1 mark]

Question 7

1 0 . 1 Describe how mRNA is formed by transcription in eukaryotes.

[5 marks]

box

1 0 . 2 Describe how a polypeptide is formed by translation of mRNA.

[6 marks]

outside the
box

1 0 . 3 Define 'gene mutation' and explain how a gene mutation can have:

- no effect on an individual
- a positive effect on an individual.

[4 marks]

outside the
box

Question 8

1 0 . 1

Describe and explain how you would use cell fractionation **and** ultracentrifugation to obtain a sample of nuclei from muscle tissue.

[6 marks]

*Do not write
outside the
box*

1 0 . 2

Describe the role of organelles in the production and release of enzymes by animal cells.

Do **not** include details of transcription in your answer.

[5 marks]

*Do not write
outside the
box*

1 0 . 3

Describe the structure of ATP.

Outline how named enzymes break down and resynthesise ATP.

[4 marks]

*Do not write
outside the
box*

Question 9

1 0 . 1

Describe how a quaternary protein is formed from its monomers.

Do not include the process of translation in your answer.

[5 marks]

*Do not write
outside the
box*

1 0 . 2

Describe the structure of DNA and the structure of a chromosome.

[6 marks]

*Do not write
outside the
box*

1 0 . 3

Mutation can result in an increase in genetic variation within a species.

Describe and explain the **other** processes that result in increases in genetic variation within a species.

[4 marks]

*Do not write
outside the
box*