A-Level Biology

Edexcel A (Salters Nuffield)

2025 Predicted Paper

Paper 2

Energy, Exercise and Co-ordination

Primrose Kitten
YouTube tutorials for GCSE and A-Level

Name:.....

Date:.....

2 hours allowed

You may use a calculator

Rough Grade Boundaries

These do not guarantee you the same mark in the exam.

A* - 70%
A - 60%
B - 50%
C - 45%
D - 35%
E- 30%

Question	Possible Marks	Marks Gained
1	9	
2	11	
3	7	
4	10	
5	10	
6	10	
7	13	
8	11	
9	8	
10	11	
Total	**100**	

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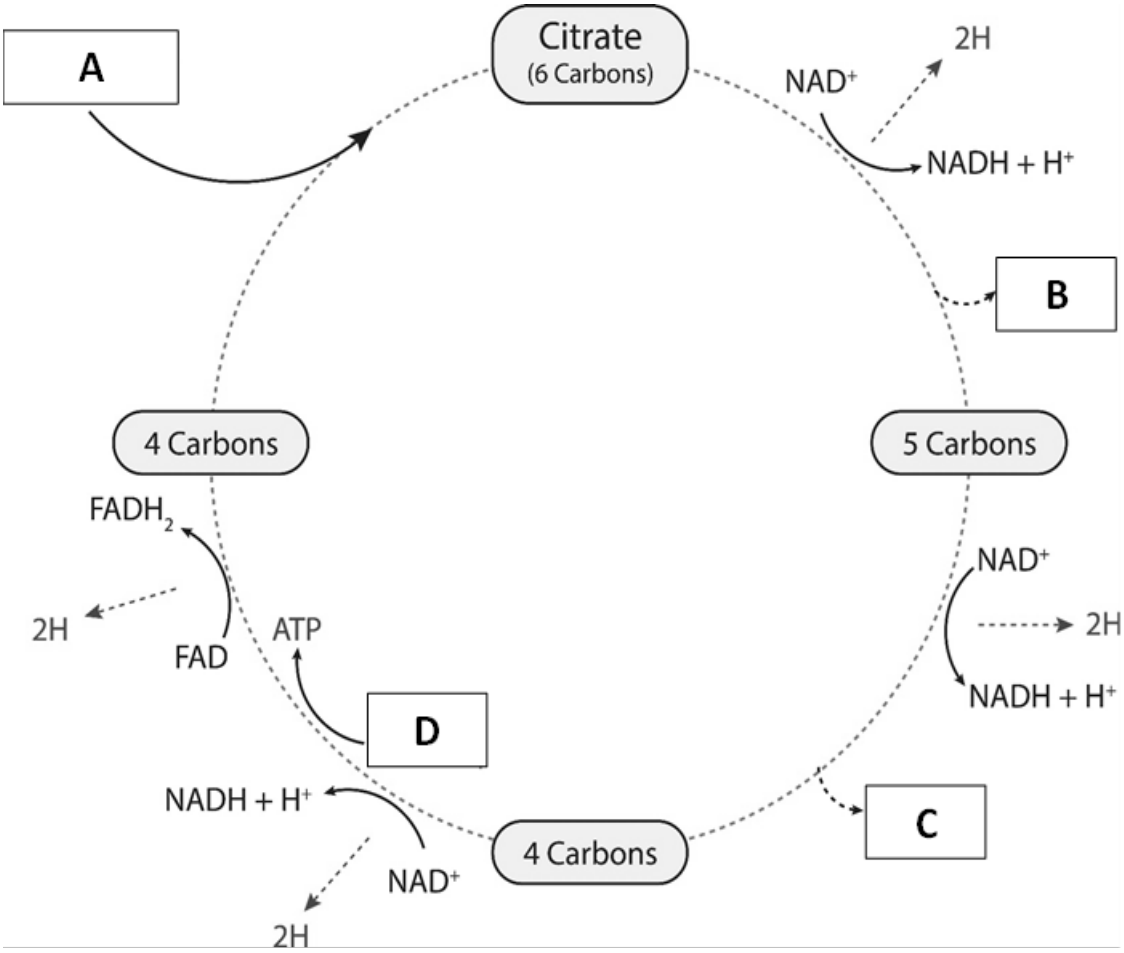
01 ATP is a source of energy in cells.

a) The Krebs cycle produces the largest amount of ATP.



i) State where the Krebs cycle occurs.

[1 mark]

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ii) Explain what happens to the reduced coenzymes after the cycle is complete.

[2 marks]

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iii) Give the name of the molecule or molecules represented by the following letters in the diagram.

[2 marks]

B and C: .....

D: .....

ATP is needed for DNA replication.

b) One role of ATP in DNA replication is to activate enzymes including DNA helicase.

Describe the role of DNA helicase in DNA replication.

[1 mark]

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c) During DNA replication, the two template strands are exposed.

Describe how a new DNA strand is built from a template strand during DNA replication.

[3 marks]

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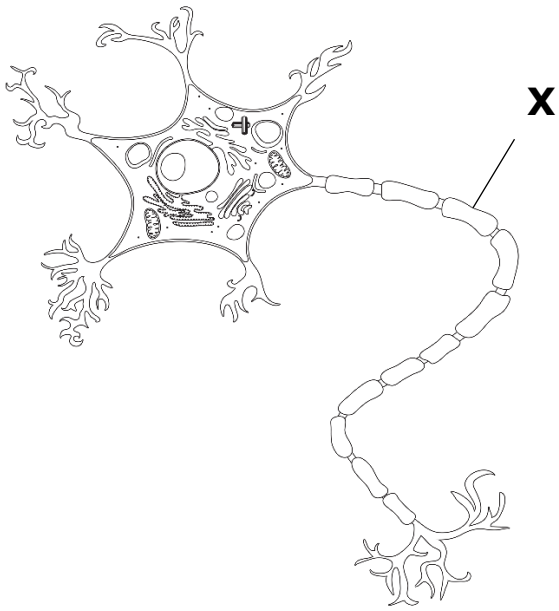
02 The diagram shows a neurone.



a) Give the name of the cell that forms part X and explain how it helps the neurone to carry out its function.

[3 marks]

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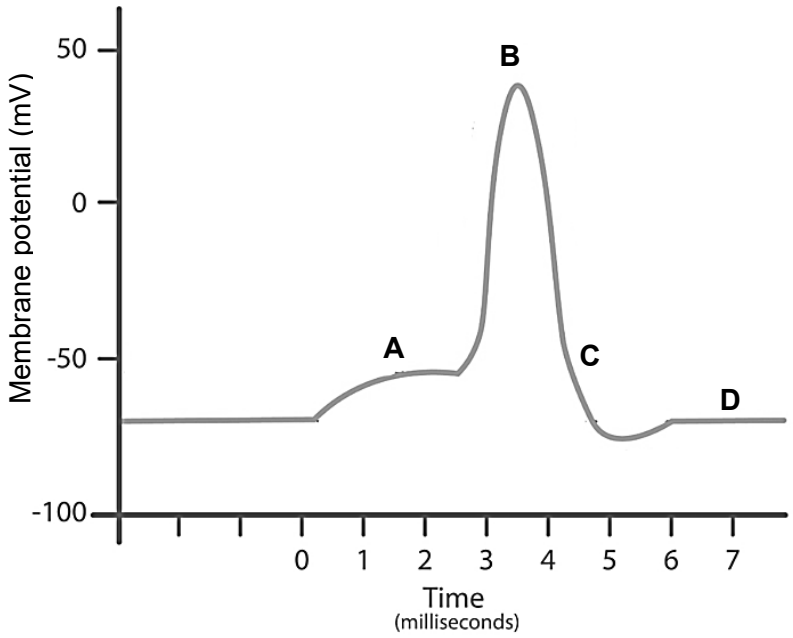
The diagram shows the changes in membrane potential during an action potential.



b) The changes are due to the movement of ions across the membrane of the axon.

Explain what causes the change in membrane potential between points A and B.

[2 marks]

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When an action potential reaches the end of one neurone, it must cross the synapse.

The average gap between two neurones is 32 nanometres and the average time it takes for the impulse to pass between neurones is $1.6x10^{-7}$ s.

c) Calculate the speed of the impulse crossing the gap between two neurones in m/s.

[2 marks]

..... m/s

d) Parkinson's disease is a neurodegenerative disorder in which patients have information processing, attention, movement, and memory difficulties. In patients with Parkinson's disease the speed of transmission of impulses across certain synapses is reduced. L-Dopa is a drug used to treat some patients with Parkinson's disease.

Explain why Parkinson's can be treated with L-Dopa.

[4 marks]

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03

a) State what is meant by the term species.

[1 mark]

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A population of 1000 squirrels lives in a forest. Coat colour in squirrels is determined by a single gene with two alleles: B (brown) and b (white). Over time, researchers have observed changes in the frequency of white squirrels in the population.

The current population has 160 white squirrels.

b) Use the Hardy–Weinberg equations to calculate the percentage of heterozygous individuals in the squirrel population.

[2 marks]

..... %

c) State **two** reasons that might cause the changes in the frequency of the white squirrels in the population.

[2 marks]

1:

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2:

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d) Explain how measuring the allele frequencies of wild populations can help conservationists to maintain biodiversity.

[2 marks]

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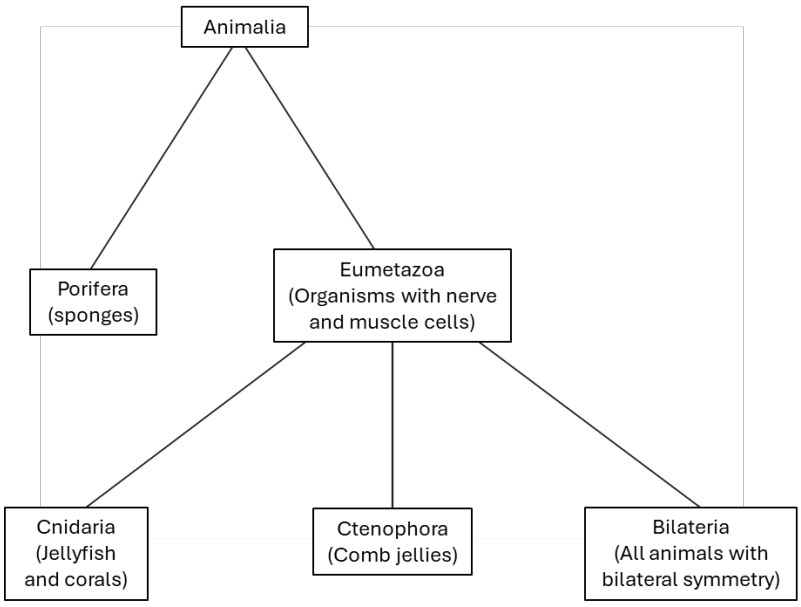
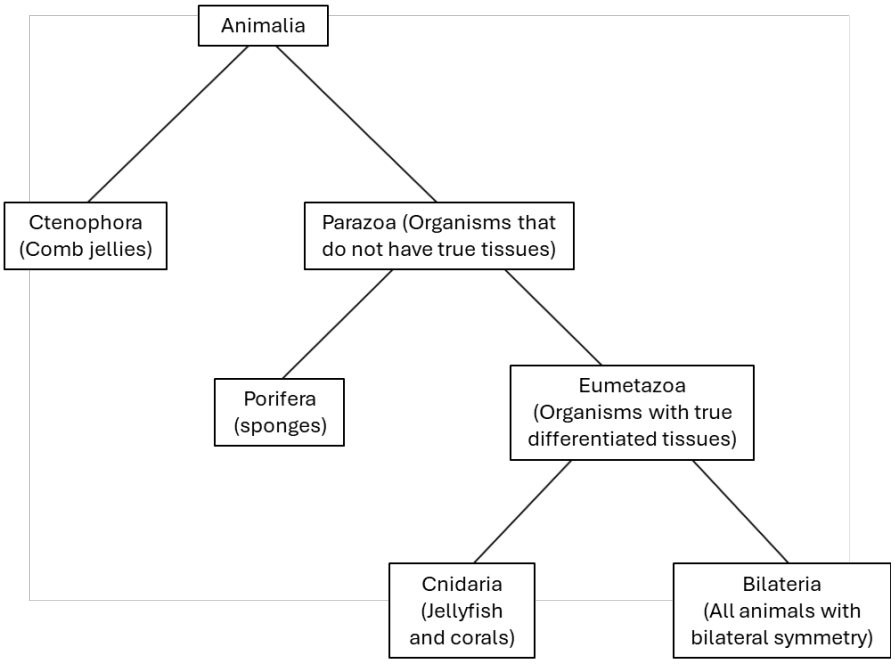
04 The diagrams show the phylogenetic tree for some early animal phyla. The tree has been recently updated after some molecular analysis comparing the differences in mitochondrial DNA between cnidarians, ctenophores and poriferans with other higher animals.

Before Molecular Analysis



After Molecular Analysis



a) Give the taxonomic group to which animalia belongs.

[1 mark]

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b) Explain what the differences in the updated phylogenetic tree suggest about the evolutionary relationship of comb jellies and sponges.

[3 marks]

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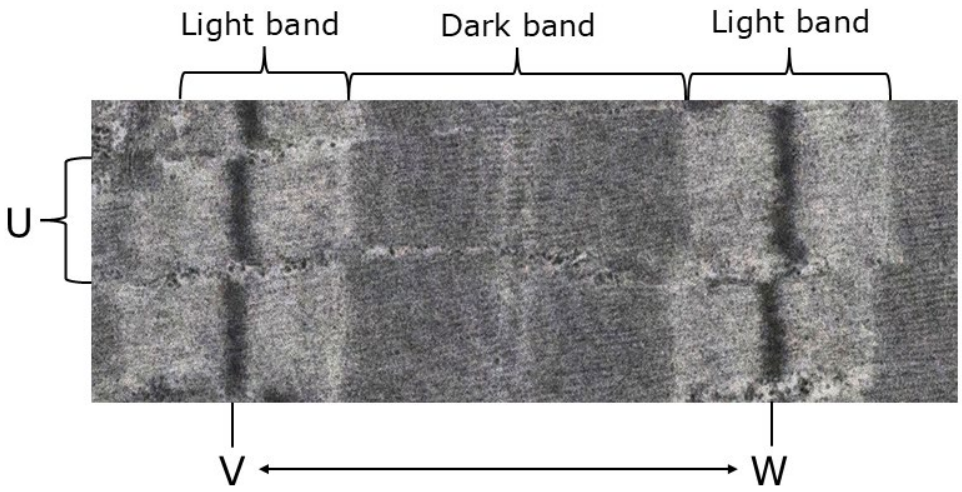
c) The whole classification system of organisms has also been updated following molecular analysis to now include domain as the highest level.

Describe the new classification system and explain how this new theory was accepted by the scientific community.

[6 marks]

05 The image below shows a transmission electron micrograph of a longitudinal section of skeletal muscle viewed at x40,000 magnification.



a) Name the following:

i) The section U.

[1 mark]

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ii) The structure between points V and W.

[1 mark]

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b) Explain what causes the banding pattern seen.

[2 marks]

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c) During a contraction, muscle fibres shorten on average by around 28%.

Estimate the distance between points V and W, in μm, if this muscle was contracted.

[3 marks]

..... μm

d) Explain why calcium ions are needed for muscle contraction to occur.

[3 marks]

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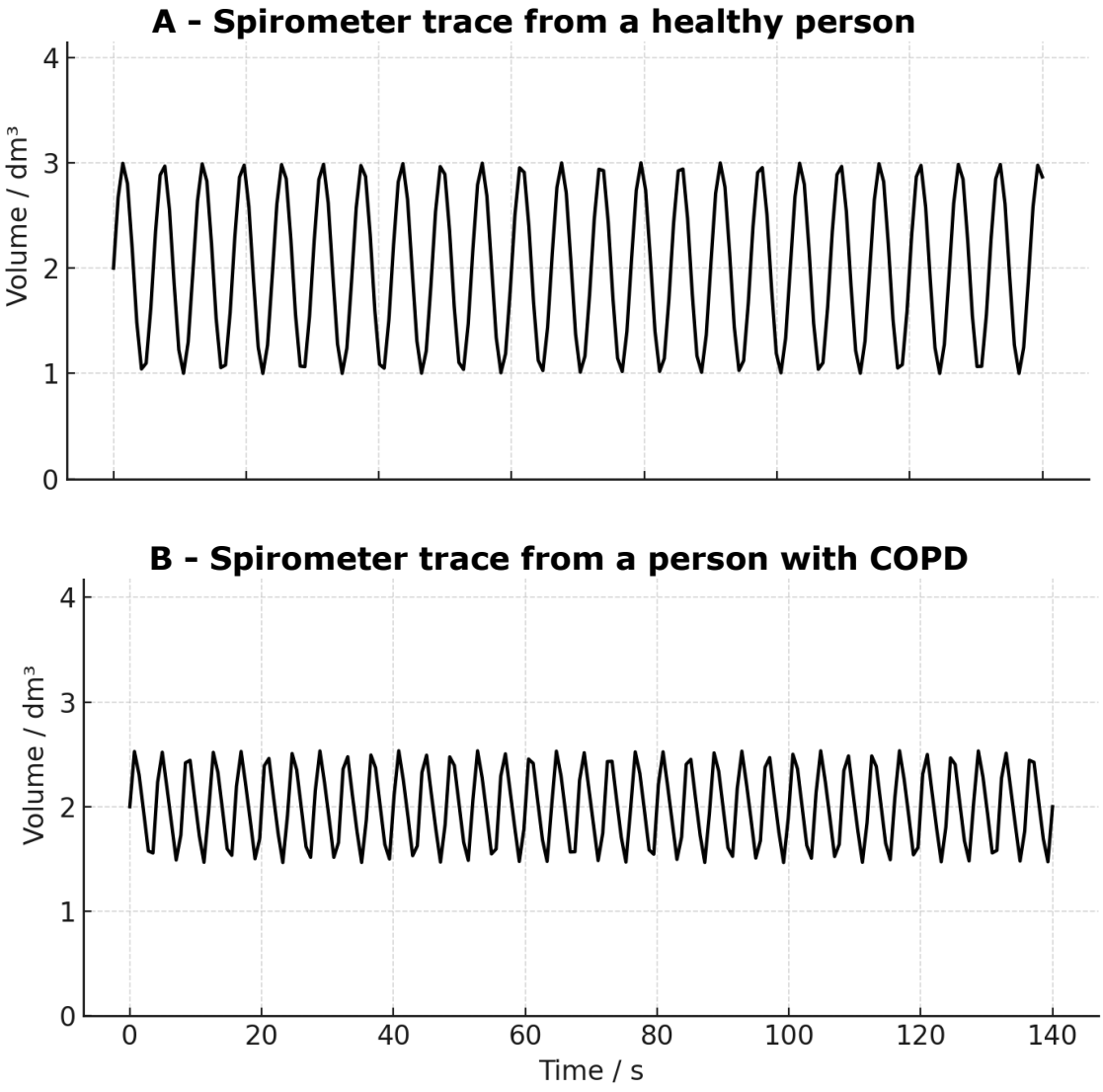
06 The graphs below show the results of two spirometer traces where the volume of inhaled and exhaled air was measured in a healthy person and a person with Chronic Obstructive Pulmonary Disease (COPD) over time.



a) Describe what the graphs show about the effect of COPD on ventilation.

[2 marks]

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b) The pulmonary ventilation rate (PVR) can be calculated using the following equation:

$$PVR = \text{tidal volume } (dm^3) \times \text{breathing rate } (min^{-1})$$

The PVR of the person with COPD is 15. Use the graph to calculate the PVR of the healthy person.

[1 mark]

..... dm^3min^{-1}

c) Suggest and explain how COPD affects the exchange of gases between the blood and the alveoli.

[3 marks]

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d) One cause of COPD is long-term inflammation of the airways caused by chronic bronchitis. The drug theophylline that can be used to treat COPD is found in trace amounts in coffee and tea plants and has similar effects to caffeine.

- It relaxes smooth muscle
- It can increase the force of heart muscle contractions
- It can increase the heart rate

i) Theophylline can be used by athletes as a performance-enhancing drug. Explain why.

[3 marks]

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ii) Give **one** ethical reason why performance-enhancing drugs like theophylline are banned from use in professional sport.

[1 mark]

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07 Betalains are water-soluble pigments present in vacuoles of plants. The most common is betanin which can be found in red beetroots.

A student carried out an investigation into the effect of ethanol on the permeability of plasma membranes in beetroot cells. They used the following method:

1. Used a cork borer to cut out cylinders of beetroot.
2. Rinsed the cylinders in distilled water.
3. Used the serial dilution method to produce different concentrations of ethanol.
4. Place a beetroot cylinder in 100 ml of each concentration of ethanol in test tubes in a water bath for 20 minutes.
5. Transfer the solution from each test tube into a cuvette and measure the absorbance using a colorimeter.

a) State **two other** variables the student should have controlled in this experiment that are not mentioned in the method.

[2 marks]

1:

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2:

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b) The student is provided with a stock solution of 95% ethanol.

Using calculations, show how they would produce the 100 ml of the 20% ethanol solution needed for the investigation.

[2 marks]

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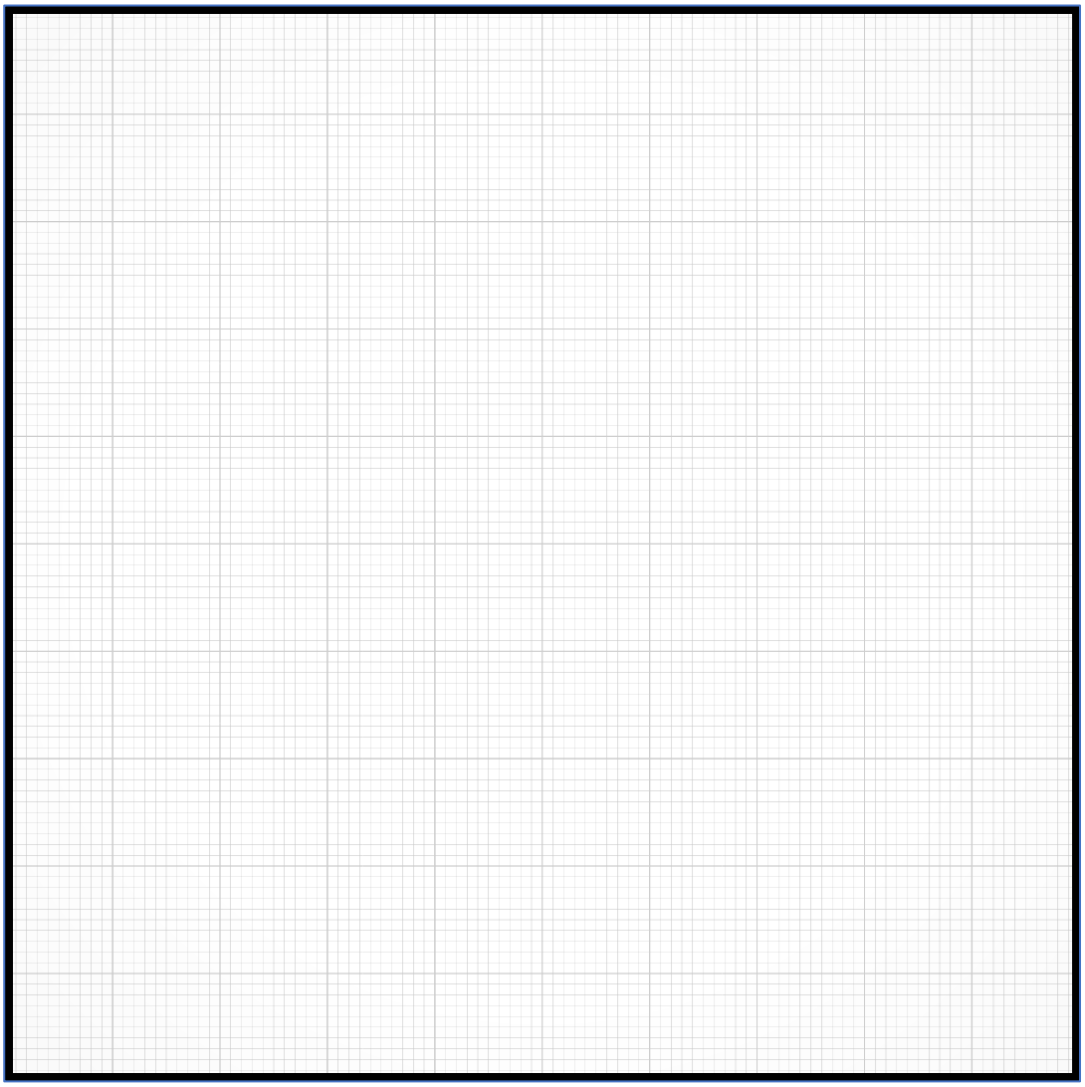
c) The table below shows the results the students obtained.

Ethanol concentration (%)	Repeat 1	Repeat 2	Repeat 3	Average Absorbance (au)
20	0.03	0.01	0.04	0.02
40	0.04	0.02	0.05	0.03
60	0.07	0.05	0.08	0.06
80	0.67	0.65	0.68	0.66
100	0.68	0.66	0.69	0.67

i) In the space provided plot a graph using the data in the table.

[4 marks]



ii) Explain the pattern shown by the graph.

[2 marks]

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iii) Hand sanitiser gels work because they contain ethanol. Effective hand sanitisers should contain a minimum of 60% ethanol, but most contain concentrations higher than 80%.

Use the data from the table to explain why.

[3 marks]

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08 Von Willebrand disease is the most common inherited blood-clotting disorder in humans. It affects the quality or quantity of the VWF protein released in the blood which helps blood clots to form.

a) Von Willebrand disease is caused by a mutation. Explain how a mutation can change the primary structure of the VWF protein.

[3 marks]

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b) Describe how the release of clotting factors leads to a blood clot forming.

[3 marks]

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c) Transgenic goats have been genetically modified to produce the human VWF protein in their milk. The VWF proteins can then be extracted from the milk and used to treat patients with Von Willebrand disease.

i) Describe how the goats could have been genetically modified to produce the human VWF protein.

[4 marks]

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ii) Give a reason why some people may be concerned about taking VWF protein from genetically modified goats.

[1 mark]

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09 Many organisms display adaptations to their environment, and sometimes organisms that depend on each other have evolved adaptations together over time. One example is the peccary and cactuses in desert habitats.

a) The table below shows some different adaptations of both animals.

Tick the box to show the correct type for each adaptation.

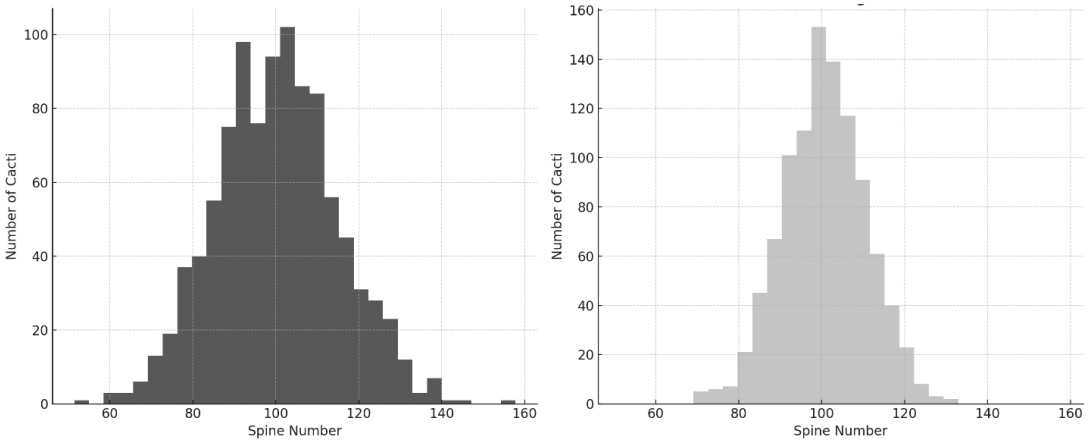
[3 marks]

Adaptation	Behavioural	Physiological	Anatomical
Cactuses covered in spines			
Peccaries eating cactuses with fewer spines			
Catus producing oxalic acid which can cause diarrhoea			
Peccaries having a specialised digestive system			

As a response to increasing herbivory by peccaries, cactus spine number has increased. However, there is also a parasitic insect that is more likely to lay its eggs in the spines of cacti that have more densely packed spines.

b) The graphs show how the frequency of cactuses with different spine numbers in the population has changed over time.

A Original Population **B New Population**



Explain what the graphs show about how these factors have affected the cactus population.

[5 marks]

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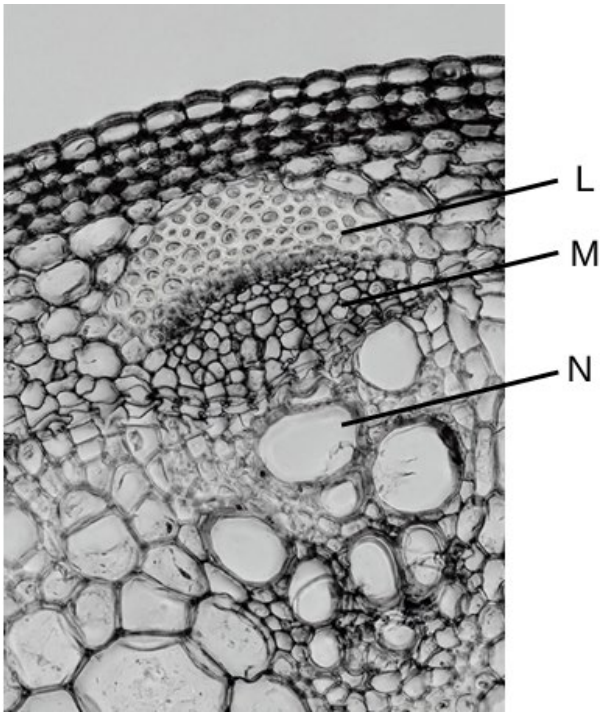
10 The image shows a transverse section of a Dahlia stem.



a) Identify the name of the tissue labelled M.

[1 mark]

- X **A** Xylem
- X **B** Phloem
- X **C** Parenchyma
- X **D** Sclerenchyma

b) Identify which tissues contain lignin.

[1 mark]

- [X] **A** L an M
- [X] **B** M and N
- [X] **C** N only
- [X] **D** L and N

c) Identify the function of the vessels in tissue L.

[1 mark]

- [X] **A** Transporting water and mineral ions
- [X] **B** Packing tissue that contains stem cells
- [X] **C** Structural support
- [X] **D** Transporting sugar and amino acids

Plant fibres have been used by humans to make materials for thousands of years.

Plant fibres are now being considered for use in composite building and construction materials to make the industry more sustainable.

d) Give **two** reasons why plant fibre based composite materials would be more sustainable than using synthetic fibres made from fossil fuels.

[2 marks]

1:

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2:

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e) Three types of plant fibre were tested to compare their suitability as potential replacements for synthetic fibres in building materials. The chemical properties of the vessel walls as well as their tensile strength was measured.

The data is presented in the table below.

Fibre	Pineapple	Jute	Sisal
Source	Leaf	Stem	Leaf
Lignin (%)	4.2	9.5	9.0
Hemi-cellulose content (%)	19.5	16.0	12.0
Cellulose content (%)	66.2	67.5	67.5
Number of vessels	12	26	144
Mean Tensile Strength (MPa)	513	583	484
Cost (US dollars per ton)	455	950	650

Student A analysed the data and concluded that Jute was the most suitable replacement due to it having the highest lignin content and therefore strength.

Student B analysed the same data but concluded that pineapple would be the most suitable replacement as it is more cost effective.

Evaluate these conclusions using your own knowledge and the data in the table.

[6 marks]

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END OF QUESTIONS