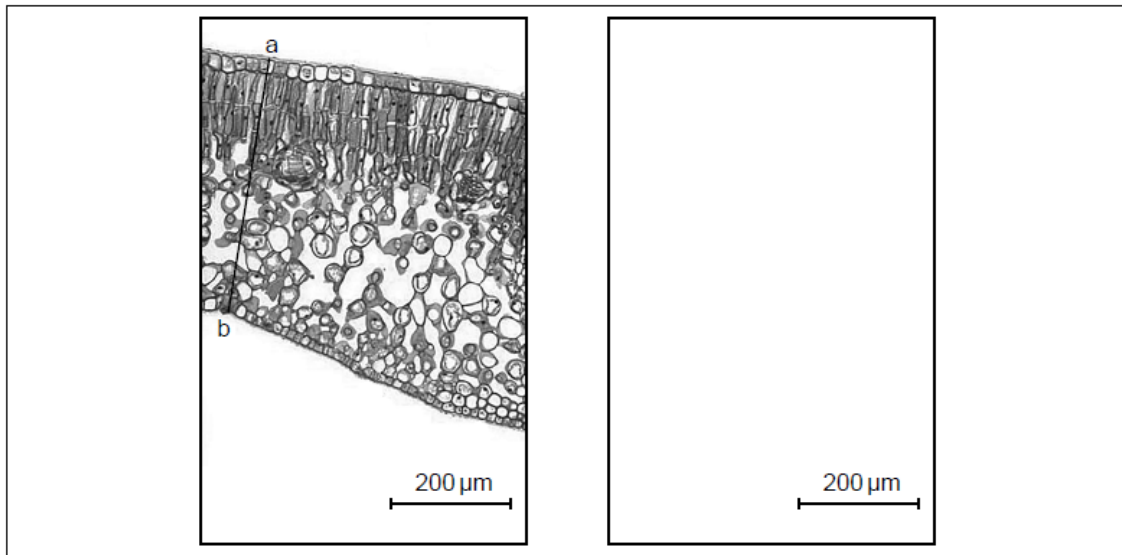


A2.2 Cell structure [71 marks]

1. [Maximum mark: 7]

The micrograph shows a transverse section of a leaf from a flowering plant.



[Source: Houseman, J. and Ford, M., 2014. *Dicot leaf L.* [image online] Available at: https://commons.wikimedia.org/wiki/File:Dicot_leaf_L.jpg Distributed under the terms of the Creative Commons Attribution License 4.0 (CC BY-SA 4.0). <https://creativecommons.org/licenses/by-sa/4.0/deed.en> Image cropped and re-coloured.]

- (a) Draw a plan diagram in the right-hand box with labels to show the distribution of tissues in this transverse section of a leaf. [3]
- (b) Calculate the actual thickness of the leaf, from upper to lower surface along the line a–b, showing your working. [2]
- (c) Suggest a reason for using a lower power objective lens when first focusing on a slide under the microscope. [1]

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(d) Identify **one** adaptation of the leaf for the absorption of light visible in this micrograph. [1]

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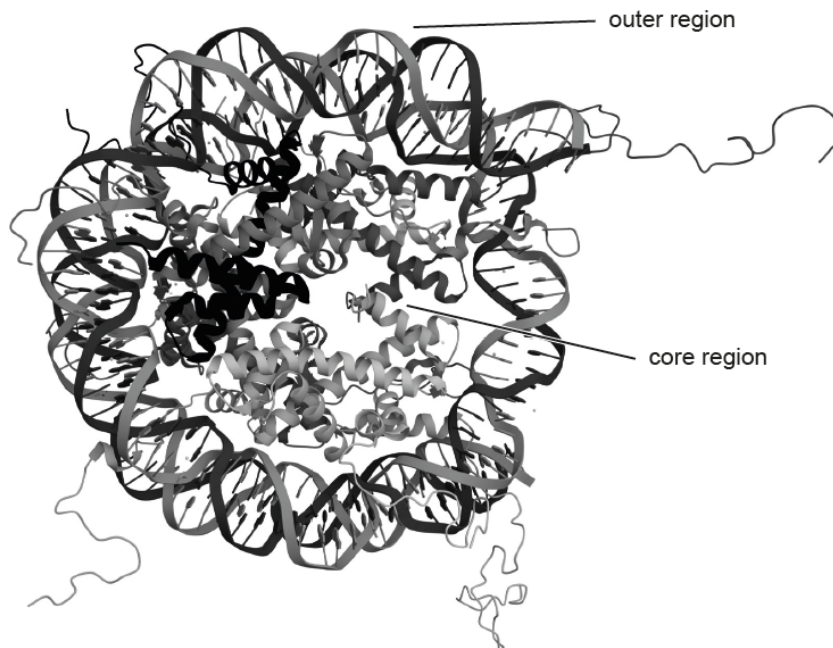
.....

2. [Maximum mark: 1]
Which cell organelle is common to all prokaryotic and eukaryotic cells?

- A. Nucleus
- B. Cell wall
- C. Vesicle
- D. Ribosome

[1]

3. [Maximum mark: 8]
Molecular visualization software was used to produce the representation of a human nucleosome.



[Source: RCSB Protein Data Bank, n.d. *X-Ray Structure of the Nucleosome Core Particle, NCP147, at 1.9 Å Resolution*. [image online] Available at: <https://www.rcsb.org/3d-sequence/1KX5?assembly1> [Accessed 18 June 2024]. Source adapted.]

(a) Using the image,

(a.i) identify, giving a reason, the molecule found in the outer region.

[1]

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(a.ii) describe the structure of the core region.

[2]

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(b) Suggest a reason that nucleosomes are absent in bacterial DNA.

[1]

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(c) Explain how DNA can be used in cladistics.

[4]

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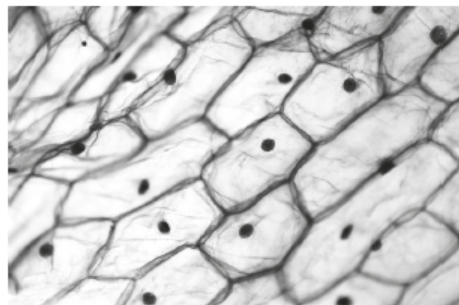
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4. [Maximum mark: 5]

The image shows epidermis tissue from a bulb of the onion plant (*Allium cepa*) viewed using a light microscope.

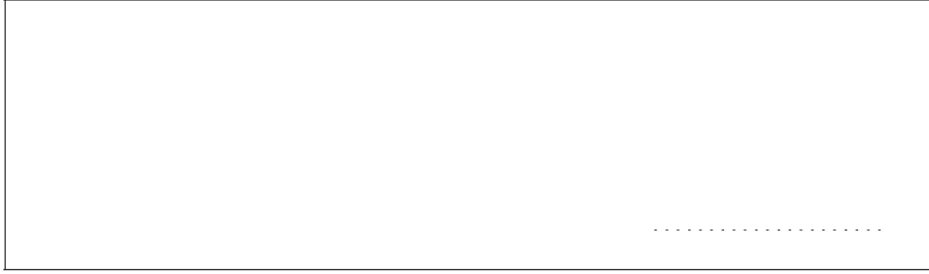


50 μ m

[Source: PeterHermesFurian, 2017. *Onion epidermis with large cells under light microscope*. [image online]

Available at: <https://www.gettyimages.co.uk/detail/photo/onion-epidermis-with-large-cells-under-light-royalty-freeimage/655178448> [Accessed 29 April 2024]. Source adapted.]

- (a) Calculate the magnification of the image.



[1]

- (b) State the item of equipment that a student could use to accurately measure the length of an onion cell viewed using a light microscope.

[1]

-
- (c) Draw a labelled diagram of a nucleus from a eukaryotic cell, such as an onion epidermis cell, as seen using an **electron** microscope.

[3]

5. [Maximum mark: 15]

Eukaryotes are a diverse group of organisms, including animals and plants.

- (a) Distinguish between structures in animal and plant cells.

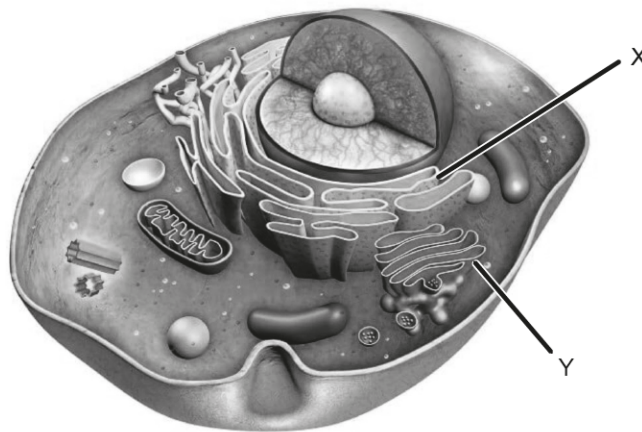
[3]

- (b) Outline adaptations of animals to herbivory and ways in which plants are adapted to resist herbivores.

[4]

(c) Compare and contrast the processes of mitosis and cytokinesis in animal and plant cells. [8]

6. [Maximum mark: 6]
Eukaryotic cells have certain characteristics in common.



[Source: Adobe Stock / Andrea Danti.]

(a) State a function for structures X and Y labelled in the cell diagram.

X:	
Y:	

[2]

(b) Describe **three** different processes that allow molecules to pass through the lipid bilayer of a cell.

[3]

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(c) Outline **one** difference between the structure of prokaryotic and eukaryotic cells.

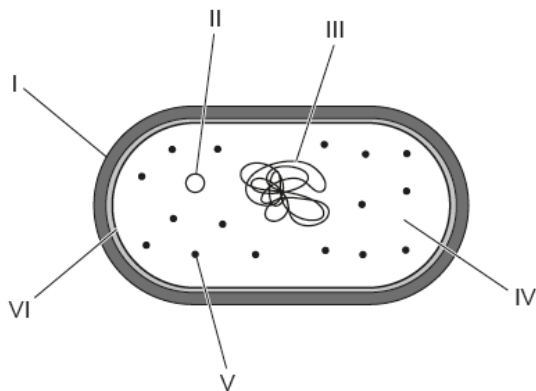
[1]

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7. [Maximum mark: 1]
The diagram shows a prokaryotic cell.

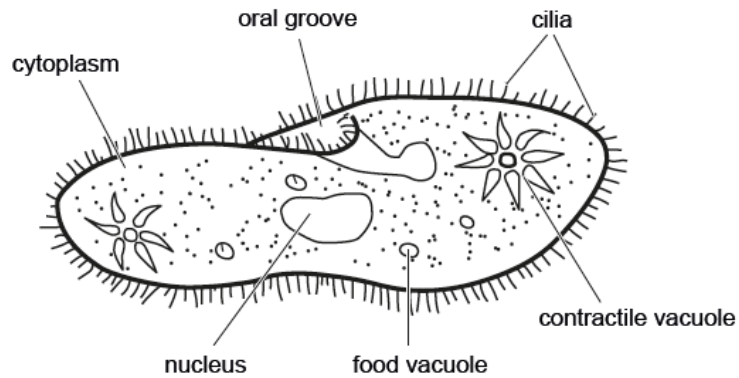


Which two structures are correctly identified?

- A. I is the cell wall and II is a vesicle.
- B. III is a chromosome and IV is the matrix.
- C. V is a ribosome and VI is the plasma membrane.
- D. III is the nucleus and V is a vesicle.

[1]

8. [Maximum mark: 1]
Single-celled organisms of the genus *Paramecium* carry out all functions of life.



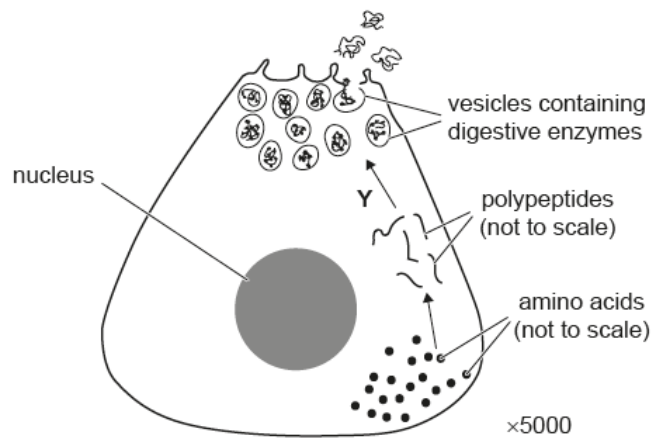
[1]

Which functions of life are performed by the contractile vacuole?

- A. Nutrition
- B. Reproduction
- C. Homeostasis
- D. Metabolism

9. [Maximum mark: 1]

The diagram summarizes the production and secretion of digestive enzymes in an exocrine gland cell of the pancreas.

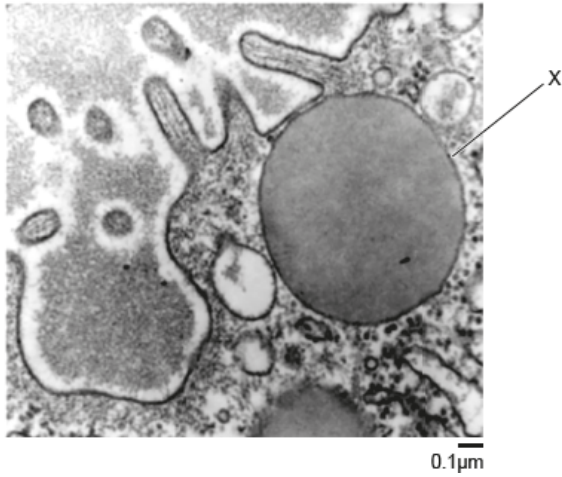


Which cell organelle is involved at Y?

- A. Rough endoplasmic reticulum
- B. Golgi apparatus
- C. Lysosome

10. [Maximum mark: 5]

The electron micrograph shows part of a pancreas cell that secretes digestive enzymes.



[Source: Rothman, J.E. (2014), The Principle of Membrane Fusion in the Cell (Nobel Lecture). *Angew. Chem. Int. Ed.*, 53: 12676–12694.

<https://doi.org/10.1002/anie.201402380>. Source adapted.]

(a) Calculate the magnification of the micrograph.

[1]

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(b) Identify the organelle labelled X.

[1]

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(c) State the organelle where digestive enzymes are synthesised.

[1]

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(d) Identify the process by which digestive enzymes are secreted.

[1]

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(e) The pancreas secretes other chemicals as well as enzymes. State an example of a chemical **and** the type of pancreatic cell that secretes it.

[1]

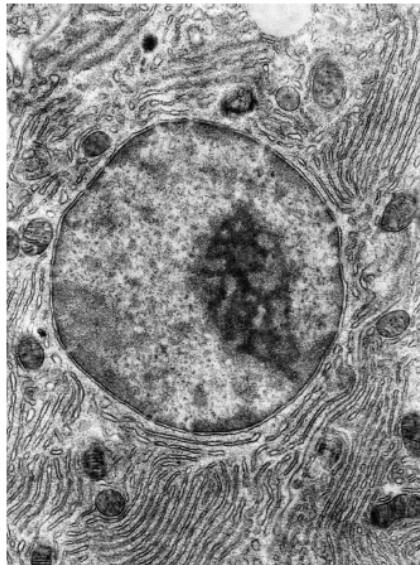
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11. [Maximum mark: 1]

The image shows the nucleus of a cell from the pancreas that is surrounded by endoplasmic reticulum.



[Source: Fawcett, D.W., n.d. [Micrograph of *Myotis lucifugus*]. Available at: <https://www.sciencephoto.com/media/214818/view/pancreatic-cell-nucleus-tem> [Accessed 27 May 2024].]

What describes this nucleus?

- A. It is composed of highly folded internal membranes and a liquid matrix.
- B. It contains ribosomes and is the main site of protein synthesis in a cell.
- C. It contains membrane-bound organelles.

D. It contains chromatin and is surrounded by a double membrane.

[1]

12. [Maximum mark: 1]

The image shows a single *Paramecium* with food vacuoles that contain ingested cells of the unicellular green alga *Chlorella*.



[Source: Summerer, M., Sonntag, B. and Sommaruga, R., 2007. An experimental test of the symbiosis specificity between the ciliate *Paramecium bursaria* and strains of the unicellular green alga *Chlorella*. *Environ Microbiol.* 9(8), 2117–22. [e-journal] Available at: <https://pubmed.ncbi.nlm.nih.gov/17635555/> [Accessed 11 April 2023]. Source adapted.]

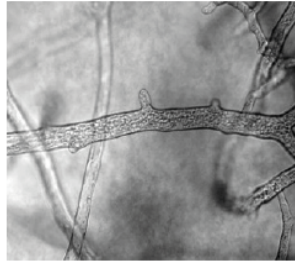
What can be deduced about *Paramecium*?

- A. It is an autotroph.
- B. It cannot perform all of the functions of life.
- C. It carries out heterotrophic nutrition.
- D. It is a prokaryote.

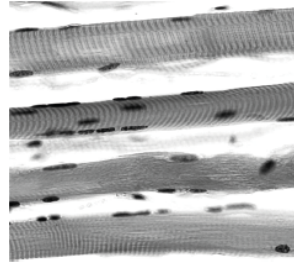
[1]

13. [Maximum mark: 1]

The micrographs show two examples of atypical cells.



Aseptate fungal hyphae



Striated muscle fibres

[Source: Left: Clayton, Michael W, n.d., University of Wisconsin Libraries. Coenocytic hyphae of Rhizopus. [image online] Available at: <https://search.library.wisc.edu/digital/APHT7CUN235E5D8M#dci-item-details> [Accessed 31 May 2024]. Source adapted. Right: Berkshire Community College Bioscience Image Library. [image online] Available at: [https://commons.wikimedia.org/wiki/File:Muscle_Tissue_Skeletal_Muscle_Fibers_\(40153601630\).jpg](https://commons.wikimedia.org/wiki/File:Muscle_Tissue_Skeletal_Muscle_Fibers_(40153601630).jpg) Licensed under the CC0 1.0 Universal Public Domain Dedication [Accessed 1 September 2022]. Source adapted.]

Which feature shared by both types of cells makes them atypical?

[1]

- A. Both have cell walls.
- B. Both have several nuclei.
- C. Both lack membrane-bound organelles.
- D. Both are divided into compartments.

14. [Maximum mark: 1]

How does the endosymbiotic theory explain the origin of mitochondria in eukaryotes?

- A. Autotrophic eukaryotes fused with photosynthetic bacteria.
- B. Small aerobic bacteria survived inside anaerobic prokaryotes.
- C. Anaerobic prokaryotes were engulfed by small aerobic bacteria.
- D. Invaginations occurred in large prokaryotes to increase surface area for gas exchange.

[1]

15. [Maximum mark: 1]

How is a prokaryotic cell different from a eukaryotic cell?

- A. Eukaryotic cells are compartmentalized, whereas prokaryotic cells are not.
- B. Prokaryotic cells do not contain ribosomes, whereas eukaryotic cells do.

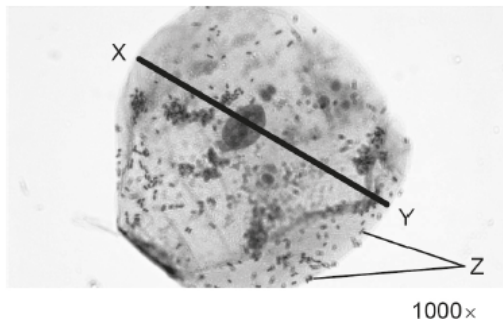
C. Eukaryotic cells contain DNA, whereas prokaryotic cells do not.

D. Prokaryotic cells have a cell wall, whereas eukaryotic cells do not.

[1]

16. [Maximum mark: 5]

The micrograph shows a human cheek cell magnified with a light microscope.



[Source: Fox, E. (2022, February 12). Micrograph human cheek epithelial cells methylene blue 1000X p000018. OER Commons.

<https://oercommons.org/courseware/lesson/89980>.]

(a) Calculate the width of the cheek cell from X to Y.

[1]

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(b) Explain what causes the irregular shape of the cheek cells rather than the uniform shape of plant cells.

[2]

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(c) Describe what would happen to the cheek cell if it was placed in a hypertonic salt solution.

[1]

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(d) In addition to the cheek cell, the micrograph shows smaller single cells. Two of these cells are labelled Z. Predict with a reason what the single cells could be.

[1]

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17. [Maximum mark: 3]

Draw the internal structures of a prokaryotic cell within the diagram.



[3]

18. [Maximum mark: 7]

The electron micrograph shows parts of two cells.



[Source: Howard, Louisa. https://commons.wikimedia.org/wiki/File:Pancreatic_cells_-_TEM.jpg. Public domain.]

(a) Identify organelles I to III.

I:

II:

III:

[3]

(b) Using evidence from the micrograph, deduce whether the cells are prokaryotic or eukaryotic.

[2]

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(c) State the function of flagella and ribosomes in prokaryotic cells.

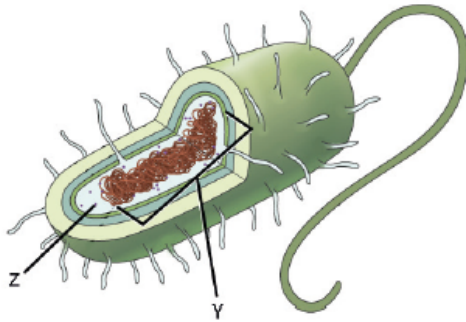
Flagella:

Ribosomes:

[2]

19. [Maximum mark: 1]

The diagram shows a prokaryotic cell.



[Source: © Rice University. 1999–2023 *Figure 4.5 Prokaryotic cell*. [image online] Available at: <https://openstax.org/apps/archive/20220815.182343/resources/50163f8ff80f335574f41bfc10cc49a1e87cf9df> [Accessed 13 January 2023].]

What are the structures labelled Y and Z?

	Y	Z
A.	Nucleus	70S ribosome
B.	Nucleoid	80S ribosome
C.	Nucleus	80S ribosome
D.	Nucleoid	70S ribosome

[1]

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