1.1 Cells: Theory

Question Paper

Course	DP IB Biology
Section	1. Cell Biology
Topic	1.1 Cells: Theory
Difficulty	Hard

Time allowed: 60

Score: /43

Percentage: /100

Question 1a

a)
Pseudonaja textilis (Eastern Brown Snake) has a group of specialised chemoreceptors located in the Jacobson's organ, which is on the roof of the snake's mouth. It also has venom glands that produce a neurotoxin.

These are essential in allowing the snake to detect and paralyse its prey.

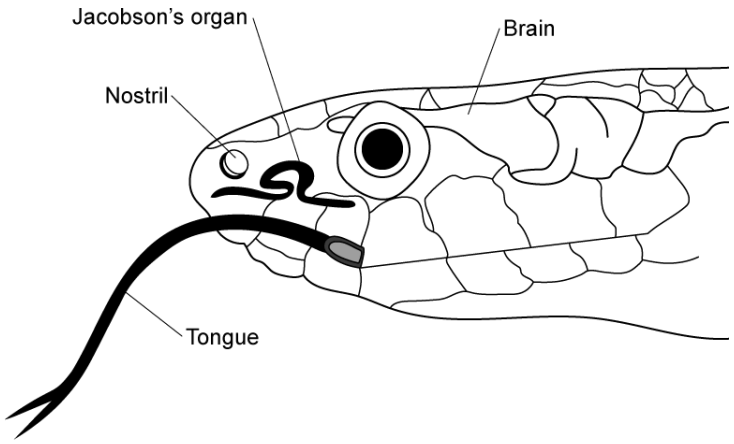
Explain the property described in this passage that allows multicellular organisms to function efficiently.

[2 marks]

[2 marks]

Question 1b

b)
The Jacobson's organ in *Pseudonaja textilis* (Eastern Brown Snake) is a pair of crescent-shaped chambers where odour molecules are deposited by the forked tongue when it retracts back into the mouth.



Suggest why Jacobson's organ is crescent-shaped.

[2 marks]

[2 marks]

Question 1c

c)
Scientists studying the expression of olfactory receptor (OR) genes in four snake species found that fewer than 3% were non-functional genes compared to humans who have up to 67% non-functioning OR genes. These genes code for olfactory receptor proteins located in the cilia of the nostrils.

Deduce why the expression of certain genes, like the OR gene in nostrils, is beneficial to multicellular organisms.

[2 marks]

[2 marks]

Question 2a

a)
Creutzfeldt-Jakob disease is a rare neurodegenerative disease caused by abnormally-folded proteins found in the brain. Proteins that trigger abnormal folding are called prions.

Suggest why scientists have not classified prions as living.

[2 marks]

[2 marks]

Question 2b

b)
Viruses and viroids are two other particles that are not considered to be living entities. These are considered exceptions to the cell theory.

Discuss two other discrepancies to cell theory that scientists have discovered.

[2 marks]

[2 marks]

Question 2c

c)
Euglena gracilis is a unicellular eukaryotic organism that inhabits moist soils and stagnant fresh water, often forming green scum on the surface of ponds and lakes.

E. gracilis are heterotrophic and autotrophic, and propel themselves using a flagellum. They have an eyespot which allows them to respond to sunlight and contractile vacuoles that regulate the composition of the cytoplasm.

Compare the functions of life of *E.gracilis* and a *Paramecium* species.

[3 marks]

[3 marks]

Question 3a

a)
A plant palisade mesophyll cell is 4 μm in width and depth, and 25 μm in length.

Its shape is approximately cuboid.

Calculate the surface area to volume ratio of this cell. Show your working.

[3 marks]

[3 marks]

Question 3b

b)
If the palisade cell in part (a) has a large central vacuole, so that the cytoplasm (not including the vacuole) extends inward 500 nm from the plasma membrane of the cell.

Calculate the surface area to cytoplasmic volume ratio. Show your working.

[3 marks]

[3 marks]

Question 3c

c)
From part (b) comment on what the function of the plant vacuole is.

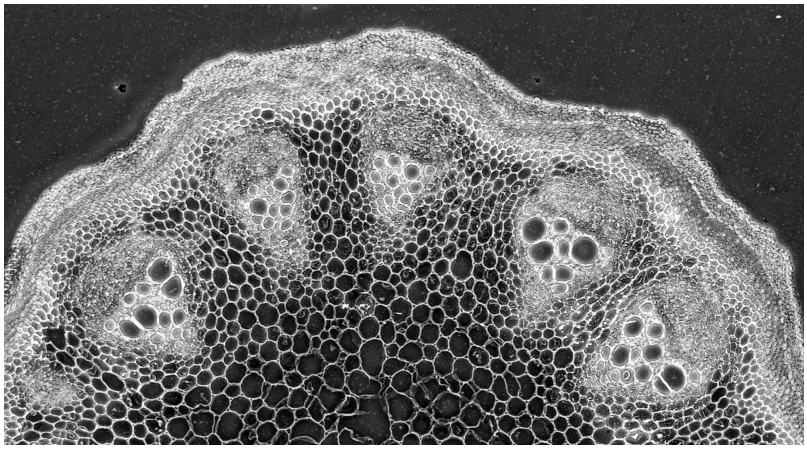
[2 marks]

[2 marks]

Question 4a

a)

The image below is a photomicrograph of a transverse section through part of a stem.



Doc. RNDr. Josef Reischig, CSc., CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons

Draw a large tissue plan diagram of this part of the stem.

[4 marks]

[4 marks]

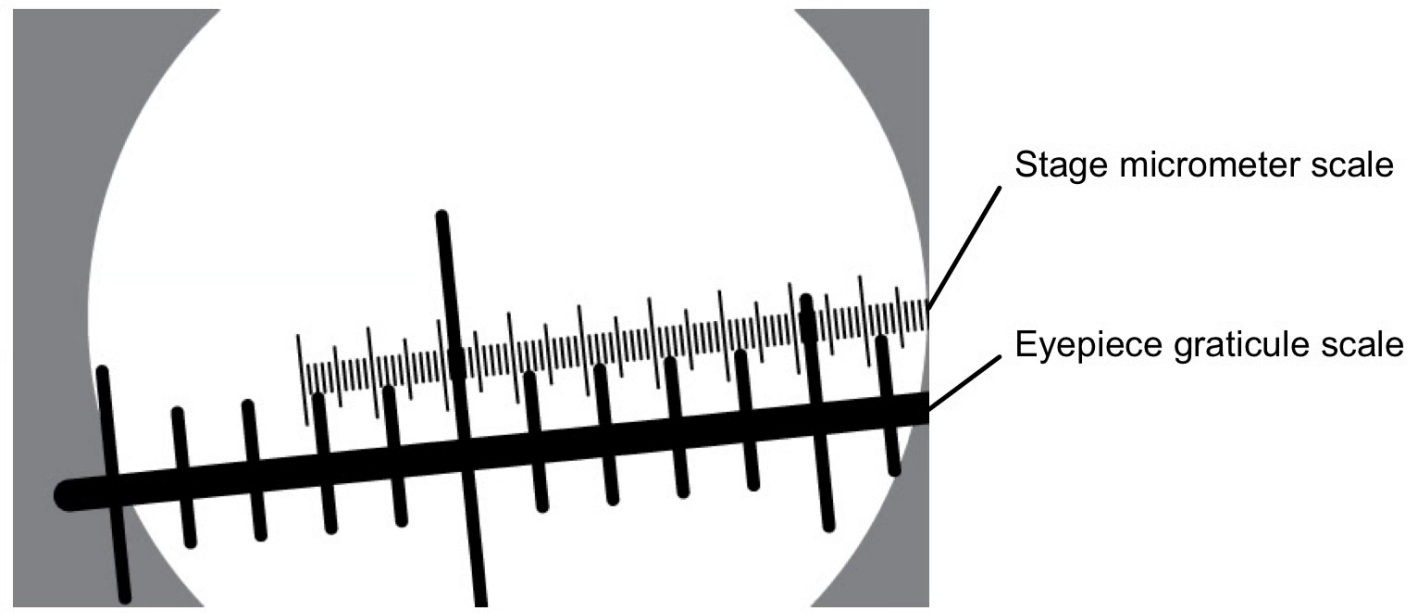
Question 4b

b)

A student used a light microscope to study the plant stem pictured in part (a). The diagram below shows the stage micrometer scale that was used to calibrate an eyepiece graticule.

One division, on either the stage micrometer scale or the eyepiece graticule, is the distance between two adjacent lines.

The length of one division on this stage micrometer is **0.01 mm**.



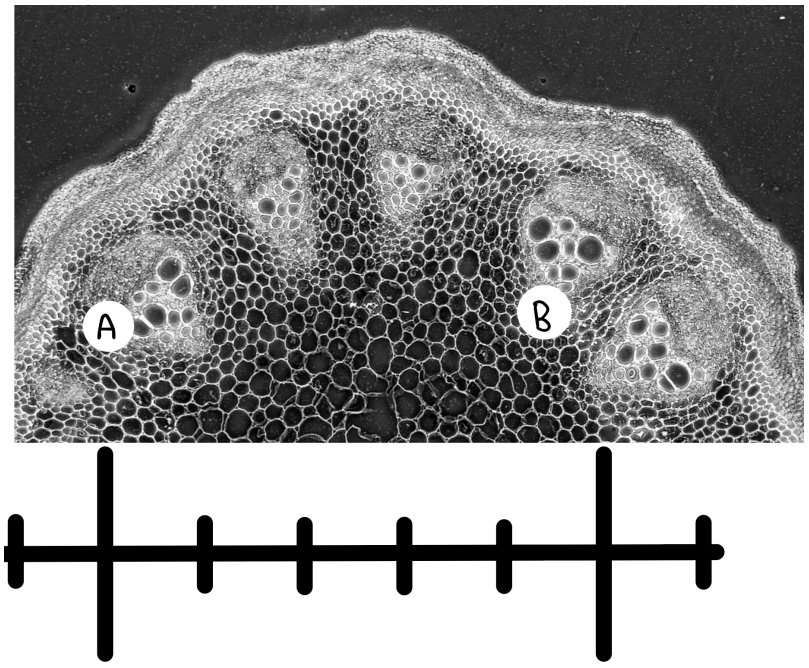
Using this stage micrometer, calculate the actual length of one eyepiece graticule division. Show your working.

[2 marks]

[2 marks]

Question 4c

c)
The photomicrograph below was taken using the same microscope with the same lenses as part (b).
The same eyepiece graticule was also used; a section of that graticule is shown under the image below.



Use the calibration of the eyepiece graticule unit from part (b) and the information in the photomicrograph to estimate the actual length **in μm** of the plant tissue from **A** to **B**.

[1 mark]

[1 mark]

Question 5a

One mark is available for clarity of communication throughout this question.

a)
Explain the importance of the surface area to volume ratio to a growing bacterial cell.

[3 marks]

[3 marks]

Question 5b

b)
Evaluate **two named** therapeutic uses of stem cells.

[7 marks]

[7 marks]

Question 5c

c)
Compare and contrast the functions of life in a *Paramecium* with a **named** photosynthesising organism.

[5 marks]

[5 marks]