HL Paper 1

Which functions are carried out by all unicellular organisms?

A.	growth	homeostasis	photosynthesis	response
B.	growth	homeostasis	metabolism	response
C.	metabolism	photosynthesis	reproduction	response
D.	growth	nutrition	reproduction	ventilation

Markscheme

B

Examiners report

N/A

What is an example of the therapeutic use of stem cells?

A. Sequencing the human genome
B. Forensic investigations of paternity
C. Production of genetically modified crops
D. Restoration of insulation tissue in neurons

Markscheme

D

Examiners report

N/A

What distinguishes prokaryotic cells from eukaryotic cells?

	Prokaryotic cells	Eukaryotic cells
A.	no plasma membrane	plasma membrane
B.	80S ribosomes	70S ribosomes
C.	Golgi apparatus	mitochondria
D.	no internal membrane compartments	internal membrane compartments

Markscheme

D

Examiners report

There is a comment in the G2s about the fact that there are some prokaryotic organisms that do have internal-bound compartments. This is true, but most prokaryotes do not have these compartments, and this is only an exception. In Biology there are many exceptions to the rule. In a multiple choice question one expects the best suited answer, in this case, all the other answers were incorrect, so the fact that prokaryotes do not have membrane bound compartments was the most suitable answer. In all, the question turned out to be an easy question and a good discriminator.

Which substance is used for structure in plants?

A. Amylopectin
B. Cellulose
C. Collagen
D. Starch

Markscheme

B

Examiners report

These questions proved to be too easy.

An unknown cell is observed using a microscope. A cell wall, ribosomes and DNA are identified. What can be concluded from these observations?

A. It can only be a prokaryotic cell.
B. It can only be a eukaryotic cell.
C. It could be a prokaryotic or eukaryotic cell.
D. It can only be a plant cell.

Markscheme

C

Examiners report

This question proved difficult. Many candidates answered the correct option C but many went for D. They seemed to equate the cell wall with only plant cells and did not consider that prokaryote cell walls exist as well.

A red blood cell is 8 μm in diameter. If drawn 100 times larger than its actual size, what diameter will the drawing be in mm?

A. 0.08 mm
B. 0.8 mm
C. 8 mm
D. 80 mm

Markscheme

B

Examiners report

Many candidates were not able to do this calculation correctly and convert μm to mm. Although the size of the drawing calculated was admittedly too small for a real drawing, there was no reason why the correct conversion could not be made. It did discriminate as the more able candidates got this correct while the others guessed between the other choices of answers.

What is proportional to a cell's surface area?

A. Rate of exchange of materials
B. Rate of heat production
C. Rate of waste production
D. Rate of oxygen consumption

Markscheme

A

Examiners report

N/A

What are stem cells?

A. Specialized cells that can be used therapeutically
B. Surplus cells taken from an embryo
C. Cells that retain their ability to divide and differentiate
D. Cells in the xylem and phloem tissues that support a plant

Markscheme

C

Examiners report

N/A

Which are functions of membrane proteins?

A. Hormone binding sites and DNA replication

B. Cell adhesion and translation

C. Cell to cell communication and protein pumps

D. Passive transport and glycosis

Markscheme

C

Examiners report

[N/A]

Where are proteins synthesized by free ribosomes used?

A. Outside the cell after secretion
B. Within the nucleus
C. Within the lysosomes
D. Within the cytoplasm

Markscheme

D

Examiners report

Some proteins synthesized in the free ribosomes will be used in the nucleus (for example polymerases), but these are only a few, most of them are used in the cytoplasm, therefore C is the best answer.

What describes nuclear division in stem cells?

A. Clonal selection

B. Mitosis

C. Cytokinesis

D. Meiosis

Markscheme

B

Examiners report

A high discrimination index and a high difficulty index shows this question proved to be difficult to many candidates but at the same time, good students answered well.

Which evidence falsifies the Davson–Danielli model?

I. The presence of globular proteins within the phospholipid bilayer

II. Non-polar amino acids cause proteins to remain embedded in membranes

III. Membrane proteins remain in a fixed position inside a membrane

A. I only

B. I and II only

C. II and III only

D. I, II and III

Markscheme

B

Examiners report

[N/A]

Which property makes stem cells suitable for therapeutic use?

A. They can divide by meiosis to form gametes.
B. They contain chemicals that can kill bacteria.
C. Their chromosomes are suitable for gene transfer and cloning.
D. They can differentiate into specialized cells.

Markscheme

D

Examiners report

N/A

What is a function of the plant cell wall?

A. Formation of vesicles for transport of large molecules
B. Prevention of excessive water uptake
C. Communication with other cells by means of glycoproteins
D. Active transport of ions

Markscheme

B

Examiners report

N/A

What features of a cell favour efficient removal of waste products?

	Surface area	Volume
A.	high	high
B.	high	low
C.	low	high
D.	low	low

Markscheme

B

Examiners report

N/A

Which is a difference between prokaryote and eukaryote cells?

	Prokaryote cell	Eukaryote cell
A.	no ribosomes	ribosomes
B.	no region containing DNA	nucleus containing DNA
C.	no flagella	flagella
D.	no mitochondria	mitochondria

Markscheme

D

Examiners report

Only two thirds of candidates answered this apparently easy question on the differences between prokaryote and eukaryote cell structure correctly. This was most likely due to candidates not reading B carefully enough and choosing it as their answer, even though they did know that prokaryotes contain DNA. If they had carried on and read D they would probably have chosen it.

What happens to the cell surface area to volume ratio as a cell grows?

A. It decreases, so production of waste material is reduced.
B. It increases, so mineral ion absorption is increased.
C. It increases, so osmosis is reduced.
D. It decreases, so rate of gas exchange is too low.

Markscheme

D

Examiners report

N/A

What is an example of binary fission?

A. Cell division in prokaryotes
B. Production of haploid gametes
C. Separation of chromatids in prokaryotic cells
D. Replication of prokaryotic DNA occurring simultaneously in two directions

Markscheme

A

Examiners report

N/A

Which of the following is **not** a function performed by a membrane protein?

A. Hormone binding sites
B. Cell adhesion
C. Enzyme synthesis
D. Pumps for active transport

Markscheme

C

Examiners report

N/A

Which process is possible due to the fluidity of cell membranes?

A. Endocytosis
B. Osmosis
C. ATP production
D. Cell recognition

Markscheme

A

Examiners report

N/A

Animal cells often secrete glycoproteins as extracellular components. What is a role of these glycoproteins?

A. Adhesion

B. Additional energy reserve

C. Membrane fluidity

D. Water uptake

Markscheme

A

Examiners report

This question was answered well by half the candidates and the discrimination index was very high, this means that capable candidates studied the extracellular function of glycoproteins well.

How do prokaryotic cells divide?

A. By mitosis
B. By meiosis
C. By budding
D. By binary fission

Markscheme

D

Examiners report

Some teachers believed that mitosis could be considered a correct answer for the prokaryotic cell division, but this mechanism only occurs in eukaryotes (it requires the presence of chromosomes). Most candidates did very well in this question and it was a very good discriminator.

What is the approximate thickness of the plasma membrane of a cell?

A. 10 nm

B. 50 nm

C. 10 μm

D. 50 μm

Markscheme

A

Examiners report

Only half of candidates knew that the thickness of a plasma membrane is about 10nm, with large numbers instead choosing the answer 10μm. More emphasis therefore needs to be given to the difference between micrometres and nanometres.

The following events occur in mitosis.

X: Attachment of spindle microtubules to centromeres
Y: Movement of sister chromatids to opposite poles
Z: Supercoiling of chromosomes

What is the correct sequence of events?

A. X → Z → Y
B. X → Y → Z
C. Z → X → Y
D. Z → Y → X

Markscheme

C

Examiners report

N/A

What causes cells to differentiate?

A. Sufficient nutrition
B. Full expression of all genes
C. Specialized functions at different stages of embryo development
D. Expression of some genes with suppression of other genes

Markscheme

D

Examiners report

N/A

During which phase of the cell cycle do chromosomes duplicate?

A. G1
B. S
C. G2
D. Mitosis

Markscheme

B

Examiners report

N/A

What is a difference between a cell in the G_1 phase and a cell in the G_2 phase of the cell cycle?

A. A cell in the G_2 phase would be smaller than a cell in the G_1 phase.
B. A cell in the G_2 phase would have more mitochondria than a cell in the G_1 phase.
C. A cell in the G_1 phase would have more DNA in its chromosomes than a cell in the G_2 phase.
D. DNA replication occurs in the G_1 phase but not in the G_2 phase.

Markscheme

B

Examiners report

This question required the candidates to know what occurs during the cell cycle. Good candidates were able to answer this question correctly.

What actions occur during interphase?

A. DNA replication and RNA synthesis
B. Spindle formation and DNA replication
C. Chromosome alignment at the metaphase plate
D. Growth and separation of sister chromatids

Markscheme

A

Examiners report

N/A

During which stage does the cell surface area to volume ratio decrease?

A. Interphase

B. Metaphase

C. Telophase

D. Cytokinesis

Markscheme

A

Examiners report

A high discrimination index and a high difficulty index shows this question proved to be difficult to many candidates but at the same time, good students answered it well.

Which of the following processes take place during interphase in animal cells?

I. Spindle formation
II. Transcription and translation
III. Increase in numbers of mitochondria

A. I only
B. I and II only
C. II and III only
D. I, II and III

Markscheme

C

Examiners report

[N/A]

How do cells in multicellular organisms differentiate?

A. Some cell types divide by mitosis more often than others.
B. They express some of their genes but not others.
C. Some of their proteins denature but not others.
D. Their DNA content changes with time.

Markscheme

B

Examiners report

N/A

What can be deduced about a striated muscle fibre from both of these statements?

"A eukaryotic cell has one nucleus."

"A striated muscle fibre has many nuclei."

A. It is prokaryotic.
B. It is an exception to cell theory.
C. It consists of aseptate hyphae.
D. It is preparing to divide.

Markscheme

B

Examiners report

Despite the complaints, this question is perfectly suitable for this test as in 1.1 of the guide there is an application that states that one should question the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae. This was a very good discriminator.

Which features are present in prokaryotic cells?

A. DNA, plasma membrane and mitochondria
B. DNA, cell wall and pili
C. ribosomes, chloroplasts and cell wall
D. cytoplasm, ribosomes and rough endoplasmic reticulum

Markscheme

B

Examiners report

In question 4, more candidates than was expected thought that prokaryotes have mitochondria and so chose answer A.

Which functions of life are carried out by **all** unicellular organisms?

A.	photosynthesis	nutrition	homeostasis
B.	nutrition	reproduction	response
C.	metabolism	photosynthesis	growth
D.	growth	reproduction	photosynthesis

Markscheme

B

Examiners report

N/A

The giant marine alga *Halicystis ovalis* is able to move sodium ions from vacuoles to the surrounding seawater through active transport. Which condition or feature is required for this mode of transport?

A. Movement from a region of higher sodium concentration to a region of lower sodium concentration
B. A partially permeable surface
C. Membrane fluidity
D. Transmembrane proteins

Markscheme

D

Examiners report

[N/A]

What structures are part of an *Escherichia coli* cell?

A. Ribosomes, nucleoid and Golgi apparatus

B. Ribosomes, mitochondria and pili

C. Cell wall, plasma membrane and nuclear membrane

D. Pili, flagella and cytoplasm

Markscheme

D

Examiners report

[N/A]

What is evidence for the endosymbiotic theory?

A. RNA can catalyse metabolic reactions.

B. Meteorites contain organic molecules.

C. Amino acids can be synthesized from inorganic compounds.

D. Mitochondria possess their own DNA.

Markscheme

D

Examiners report

[N/A]

Which of the following take(s) place during interphase and mitosis in animal cells?

I. Re-formation of nuclear membranes
II. Pairing of homologous chromosomes
III. DNA replication

A. I only
B. I and II only
C. II and III only
D. I and III only

Markscheme

D

Examiners report

This question discriminated well. Many candidates answered the correct option, but many went for C. This clearly showed they did not know the difference between mitosis and meiosis. The question may have been badly worded, as candidates might have been looking for a process that occurred in both the stages rather than either of them. In this case there would have been no correct answer.

Which pair of features is correct for both diffusion and osmosis?

	Diffusion	Osmosis
A.	net movement of particles from high to low concentration	active transport of water across a partially permeable membrane
B.	net movement of particles from low to high concentration	active transport of water across a partially permeable membrane
C.	net movement of particles from low to high concentration	passive movement of water across a partially permeable membrane
D.	net movement of particles from high to low concentration	passive movement of water across a partially permeable membrane

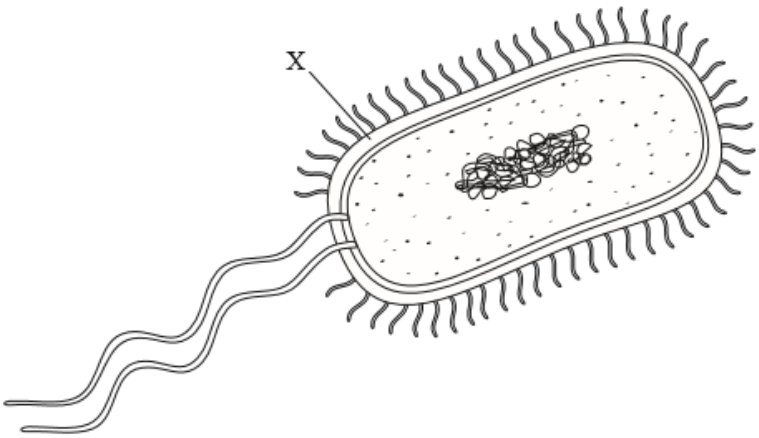
Markscheme

D

Examiners report

N/A

The diagram shows the structure of a bacterium.



What is the structure labelled X?

A. Pilus
B. Cell wall
C. Cytoplasm
D. Cell membrane

Markscheme

B

Examiners report

N/A

What is the process shown in this image?

[Source: http://www.slideshare.net/sciencepowerpointcom/bacterial-reproduction-biology-lesson-powerpoint-binary-fission]

A. Binary fission of a prokaryotic cell
B. Telophase II in a eukaryotic cell
C. End of mitosis in a prokaryotic cell
D. Cytokinesis of a eukaryotic cell

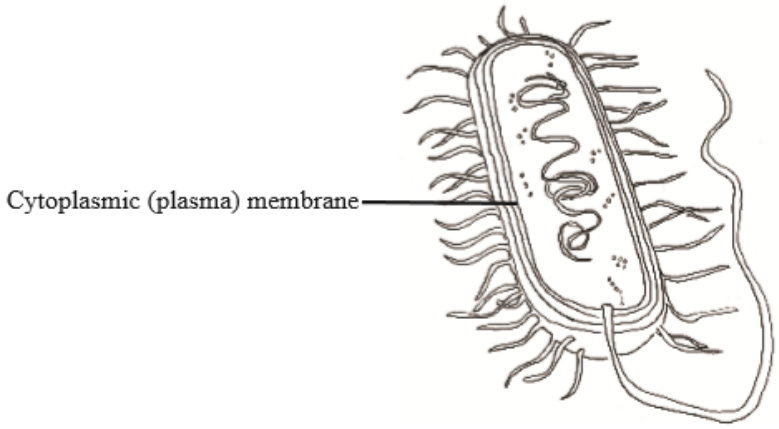
Markscheme

A

Examiners report

This was a very good discriminator. Good candidates were able to see a prokaryotic cell carrying out binary fission. It would have been better to have a scale bar next to the diagram.

What is the function of the cytoplasmic (plasma) membrane of this bacterium?



A. To produce ADP
B. To form the only protective layer preventing damage from outside
C. To control entry and exit of substances
D. To synthesize proteins

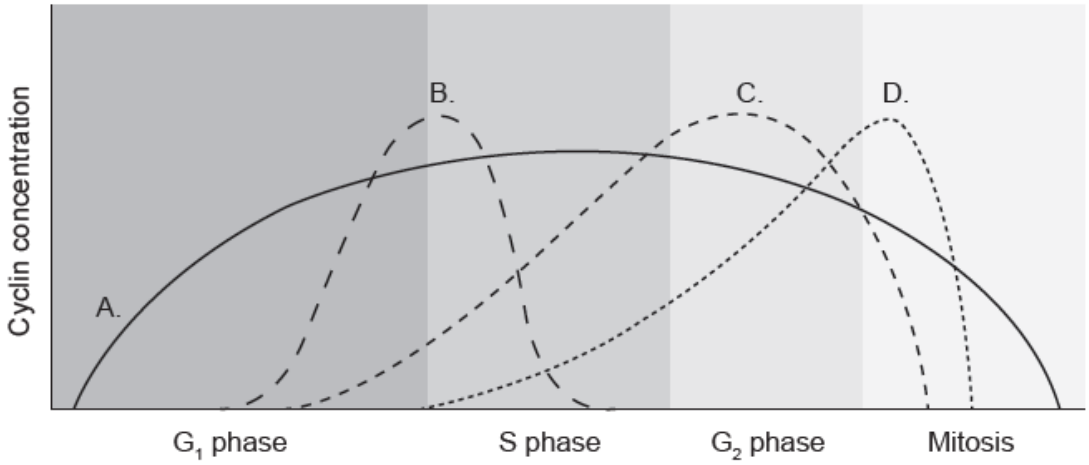
Markscheme

C

Examiners report

N/A

The diagram shows the concentration of four cyclins during the cell cycle. Which curve represents the cyclin that promotes the assembly of the mitotic spindle?



[Source: http://upload.wikimedia.org/wikipedia/commons/thumb/c/ce/Cyclin_Expression.svg/400px-Cyclin_Expression.svg.png]

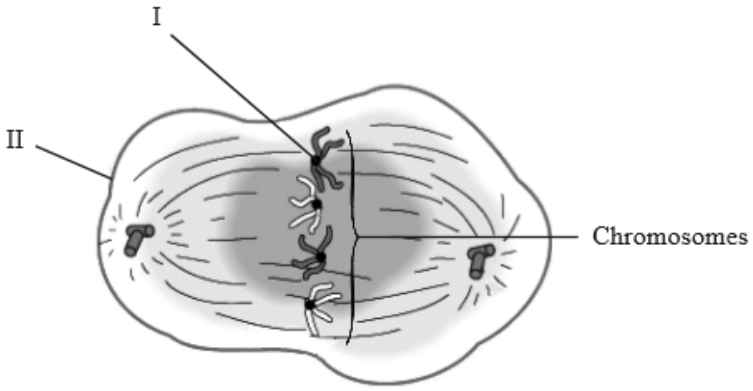
Markscheme

D

Examiners report

[N/A]

The diagram below shows a cell during mitosis.



What are the structures and stage of mitosis?

	Stage of mitosis	Structure I	Structure II
A.	metaphase	chromatid	nuclear membrane
B.	anaphase	centromere	plasma membrane
C.	anaphase	chromatid	nuclear membrane
D.	metaphase	centromere	plasma membrane

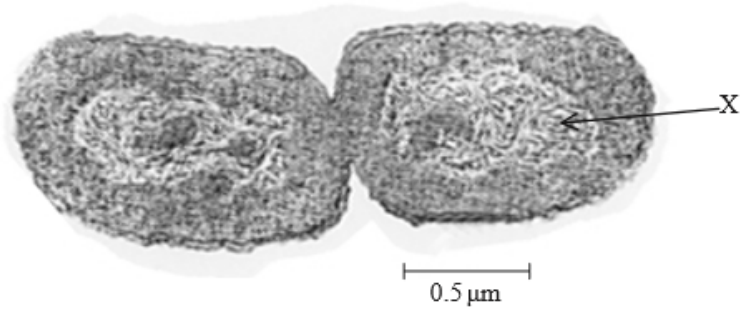
Markscheme

D

Examiners report

N/A

Questions 3 and 4 refer to the following micrograph of an E.coli bacterium undergoing reproduction.



[Source: www.bio.mtu.edu/campbell/prokaryo.htm]

In the diagram what does label X identify?

A. Nucleoid region
B. Chromatin
C. Histones
D. Endoplasmic reticulum

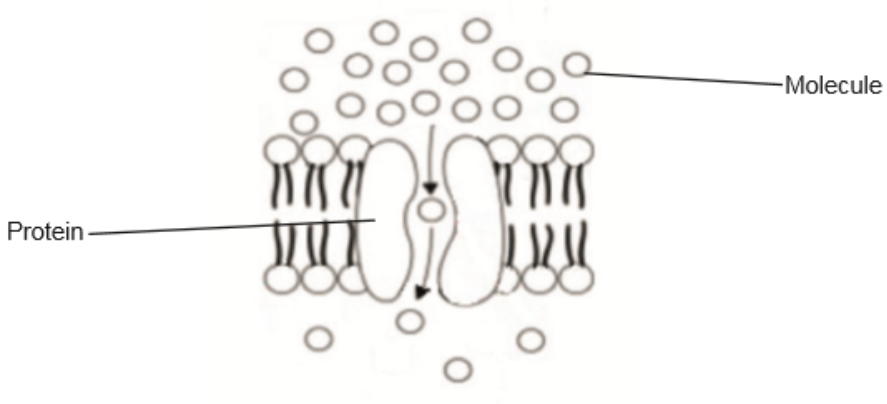
Markscheme

A

Examiners report

The quality of the micrograph was not good; nevertheless this did not affect the performance of the candidates.

The diagram is a model of one type of movement across a membrane.



[Source: CAMPBELL, NEIL A.; REECE, JANE B., *BIOLOGY*, 7th, ©2005, p. 134.
Reprinted by permission of Pearson Education, Inc., New York, New York.]

What is this type of movement?

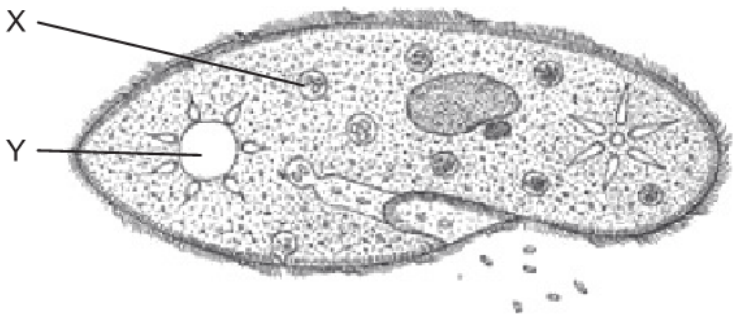
A. Simple diffusion
B. Facilitated diffusion
C. Osmosis
D. Active transport

Markscheme

B

Examiners report

This question brought many comments. The IB has agreed with many teachers that the diagram is not appropriate, as facilitated diffusion was meant to be shown, but the change in the shape of the protein could have implied the use of energy through active transport. Therefore both answers A and D were accepted.



[Source: Adapted from www.biology-resources.com. Copyright 2004–2017 D G Mackean & Ian Mackean. All rights reserved.]

Which function is accomplished by structures X and Y in the *Paramecium*?

	X	Y
A.	digestion	homeostasis
B.	feeding	metabolism
C.	food storage	movement
D.	DNA replication	respiration

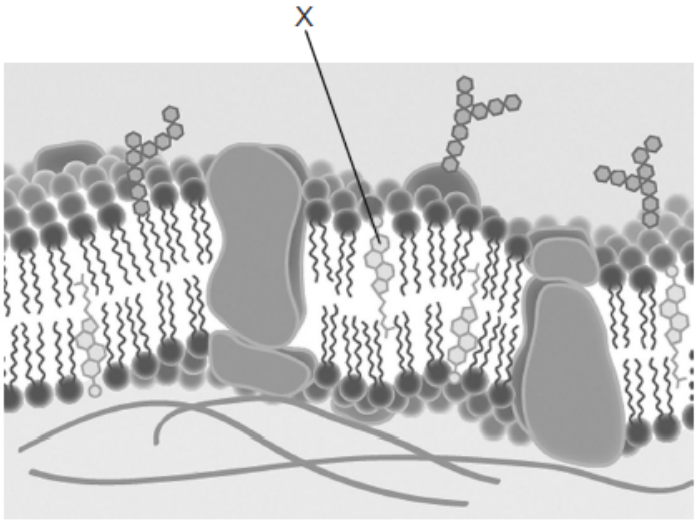
Markscheme

A

Examiners report

[N/A]

The diagram shows a plasma membrane.



[Source: adapted from http://shmoop.com]

Which molecule is labelled X?

A. Cholesterol

B. Glycoprotein

C. Phospholipid

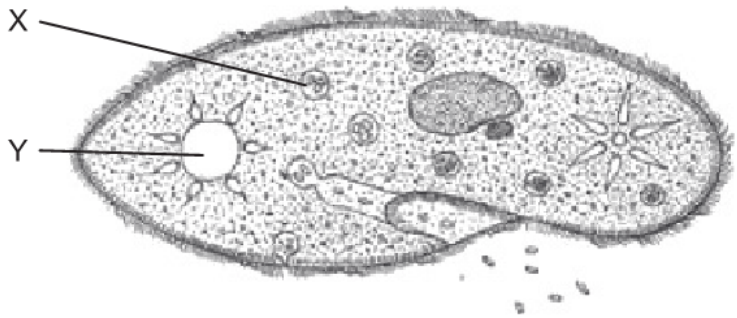
D. Amylase

Markscheme

A

Examiners report

This question was too easy so did not discriminate well.



[Source: Adapted from www.biology-resources.com. Copyright 2004–2017 D G Mackean & Ian Mackean. All rights reserved.]

The salt concentration inside the *Paramecium* is 1.8 %. The salt concentration in the surrounding medium suddenly drops to 0.2 %. What will be the likely response?

A. The cell will lose salt to the medium.

B. The contractile vacuole will expel more water.

C. The cell will swell and eventually burst.

D. The membrane will become more permeable to salt.

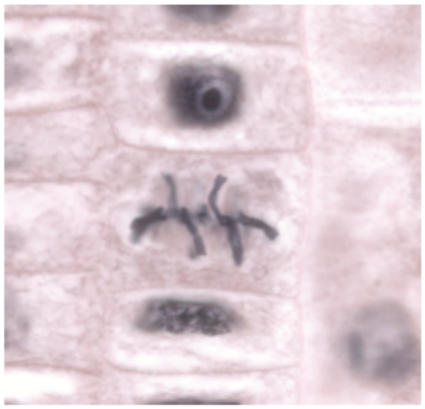
Markscheme

B

Examiners report

[N/A]

Which phase of mitosis is shown in the photomicrograph?



[Source: http://commons.wikimedia.org/wiki/File:Allium-Mitose03-DM100x_BL28.jpg]

A. Anaphase
B. Metaphase
C. Prophase
D. Telophase

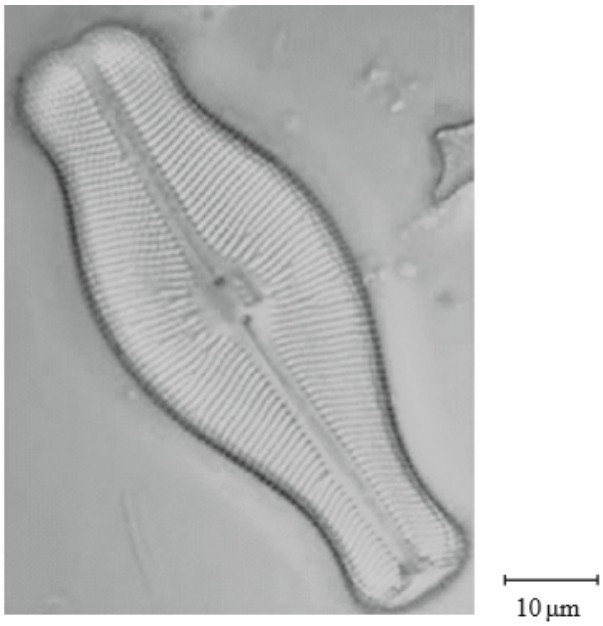
Markscheme

B

Examiners report

N/A

The diatom *Didymosphenia geminata* is a species of single-celled alga that lives in warm, shallow water. In the light microscope image below, the scale bar is equal to 10 micrometres (10 μm). What is the actual length of the cell?



[Source: United States Environmental Protection Agency
http://www.epa.gov/region8/water/didymosphenia/White%20Paper%20Jan%202007.pdf
EPA white paper]

A. 0.007 mm
B. 0.07 mm
C. 0.7 mm
D. 7.0 mm

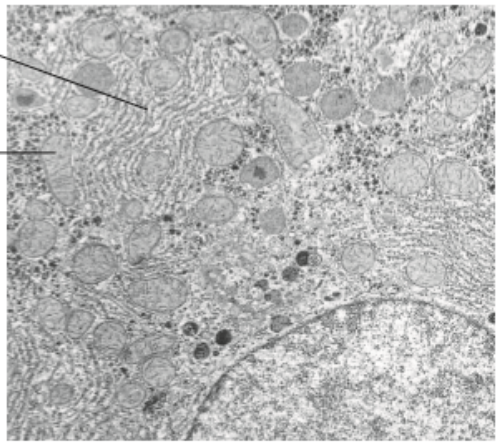
Markscheme

B

Examiners report

Question 3 was answered much less successfully than expected. Some teachers reported on G2 forms that it was too difficult without calculators, but the math was in fact very easy. A large number of candidates were unable to convert 70μm into 0.07mm by moving the decimal point three places to left. Students should be taught that S.I. units are increased by a factor of 1000 so conversion from micrometres to millimetres is accomplished by dividing the length by 1000.

In the electron micrograph of a rat liver cell below, what are the structures labelled X and Y?



[Source: ©Principia Cybernetica. Used with permission.]

	X	Y
A.	rough endoplasmic reticulum	mitochondrion
B.	smooth endoplasmic reticulum	nucleus
C.	Golgi apparatus	vesicle
D.	chromosome	vacuole

Markscheme

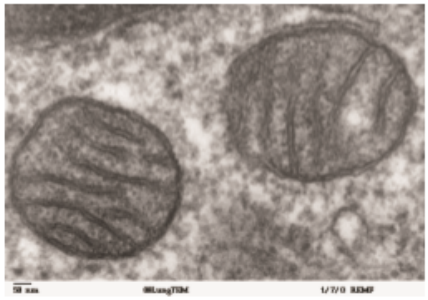
A

Examiners report

Question 4 had a very low discrimination index which sometimes indicates a problem with a question. In this case it merely showed that a high proportion of candidates answered the question correctly, despite the fears expressed by some teachers in G2 forms that the micrograph was not clear enough.

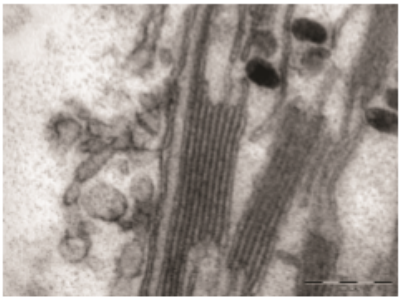
In the electron photomicrographs which organelle is involved in vesicle formation?

A.



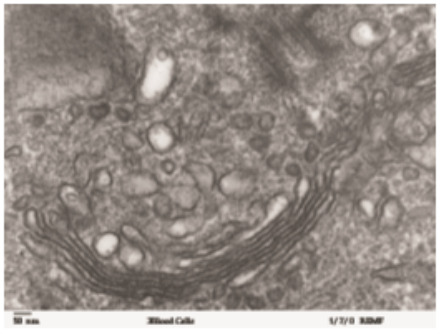
http://en.wikipedia.org/wiki/File:Mitochondria,_mammalian_lung_-_TEM.jpg

B.



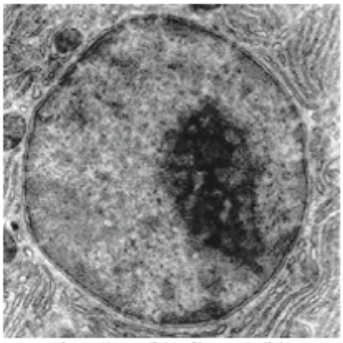
http://en.wikipedia.org/wiki/File:Chloroplast_in_leaf_of_Anemone_sp_TEM_85000x.png

C.



http://en.wikipedia.org/wiki/File:Human_leukocyte,_showing_golgi_-_TEM.jpg

D.



http://en.wikipedia.org/wiki/File:Micrograph_of_a_cell_nucleus.png

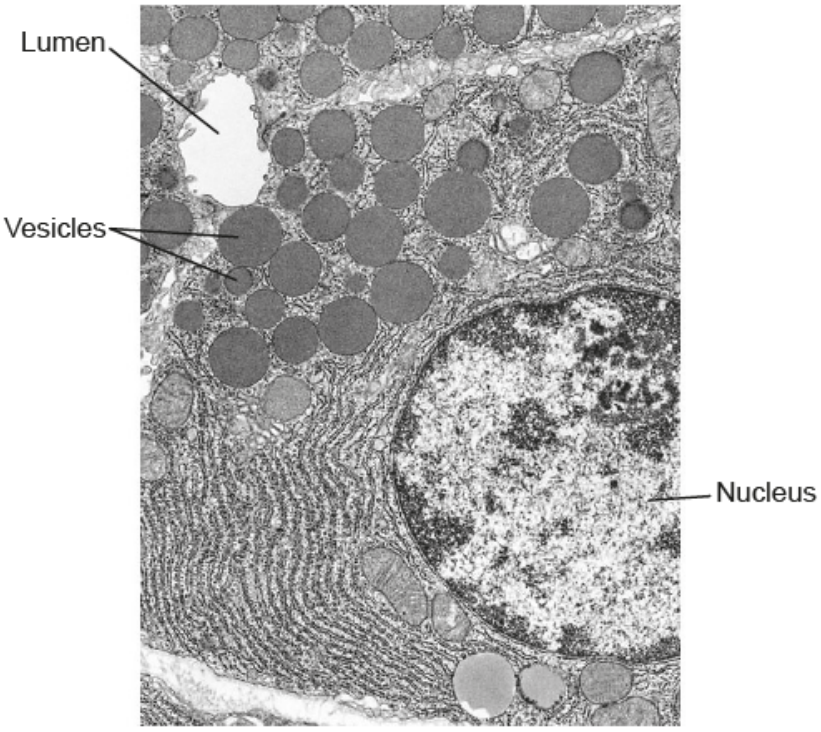
Markscheme

C

Examiners report

N/A

The image shows an electron micrograph of pancreatic exocrine cells.



[Source: Meschner AL, *Junqueira's Basic Histology: Text and Atlas*, 12th edition. Copyright McGrawHill Education.]

What is the role of the vesicles shown in the micrograph?

A. To transport hormones between the rough endoplasmic reticulum and the Golgi apparatus

B. To store glycogen when blood glucose levels are high

C. To move enzymes out of the cell by exocytosis

D. To digest cellulose

Markscheme

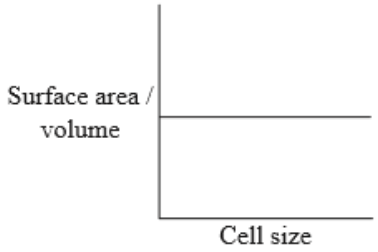
C

Examiners report

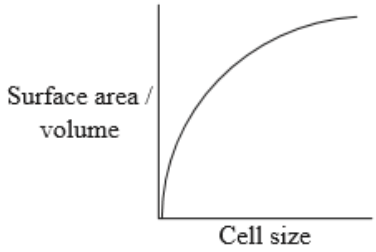
[N/A]

How does the surface area to volume ratio change with an increase in cell size?

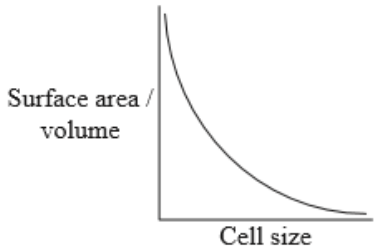
A.



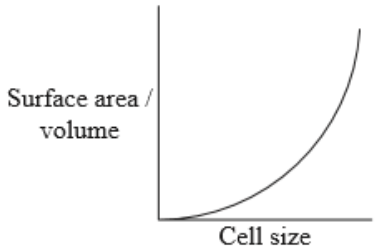
B.



C.



D.



Markscheme

C

Examiners report

N/A