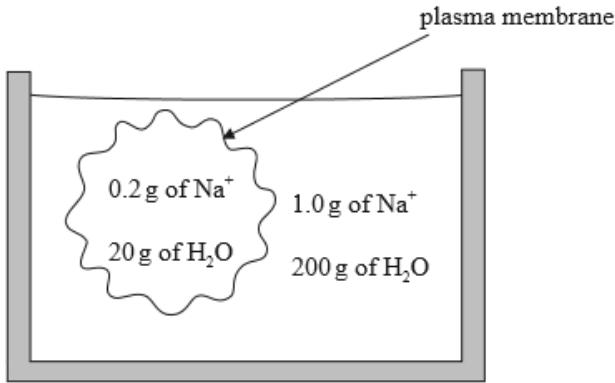


SL Paper 2

The diagram (not to scale) shows a cell which contains water and sodium ions. This cell is immersed in a salt solution of water and sodium ions.



a (i) State the mode of transport if water moves into the cell. [1]

a (ii) State the mode of transport if sodium ions move into the cell. [1]

b. Explain facilitated diffusion. [3]

c. State the name of the structures formed within a cell by endocytosis. [1]

a. State **two** differences in structure between plant and animal cells. [2]

b. Outline how molecules move across a membrane by simple diffusion. [2]

c. Explain the role of protein pumps in active transport. [2]

a. Draw a labelled diagram showing the ultrastructure of a typical prokaryote. [4]

b. Outline how **three** different environmental conditions can affect the rate of photosynthesis in plants. [6]

c. Explain how the emission of gases, both naturally and through human activity, can alter the surface temperature of the Earth. [8]

- a. State the property of stem cells that makes them useful in medical treatment. [1]
 - b. Explain how multicellular organisms develop specialized tissues. [2]
 - c. Outline some of the outcomes of the sequencing of the human genome. [3]
-

- a. Draw a labelled diagram showing the structure of three water molecules and how they interact. [5]
 - b. Aquatic and other environments are being affected by a global rise in temperature. Outline the consequences of this on arctic ecosystems [6]
 - c. Cell membranes separate aqueous environments in cells. Explain how the properties of phospholipids help to maintain the structure of cell membranes. [8]
-

- a. List **two** functions of membrane proteins. [2]
 - b. Explain why digestion of large food molecules is essential. [1]
 - c. Outline why antibiotics are effective against bacteria but not against viruses. [2]
 - d. Outline the use of polymerase chain reaction (PCR) to copy and amplify minute quantities of DNA. [2]
-

- a. State **three** processes occurring in a cell during interphase of the cell cycle but not in mitosis. [3]
 - 1.
 - 2.
 - 3.
 - c. Explain how sexual reproduction can allow evolution to occur. [3]
-

- a. Draw a labelled diagram to show the molecular structure of a membrane. [4]
 - b. Some proteins in membranes act as enzymes. Outline enzyme-substrate specificity. [6]
 - c. Membranes of pre-synaptic and post-synaptic neurons play an important role in transmission of nerve impulses. Explain the principles of synaptic transmission. [8]
-

- a. Draw a labelled diagram of a prokaryotic cell. [5]
- b. Bacteria are prokaryotes that sometimes act as pathogens. Describe how the body can defend itself against pathogens. [7]
- c. Explain the evolution of antibiotic resistance in bacteria. [6]
-

- a. Draw a labelled diagram to show the structure of membranes. [5]
- b. Explain the importance of surface area to volume ratio as a factor limiting cell size. [7]
-

- a. Outline the bonding between DNA nucleotides. [2]
- b. Explain how chemical bonding between water molecules makes water a valuable coolant in living organisms. [2]
- c. Describe the movement of water across membranes. [2]
- d. Outline the role of water in photosynthesis. [2]
-

- a. Explain why DNA must be replicated before mitosis and the role of helicase in DNA replication. [4]
- b. Explain how the base sequence of DNA is conserved during replication. [5]
- c. Describe the events that occur during mitosis. [9]
-

Reproduction in eukaryotes can be sexual or asexual.

- a. Describe the origin of eukaryotic cells according to the endosymbiotic theory. [4]
- b. Explain how hormones are used to control the human menstrual cycle. [8]
- c. Outline natural methods of cloning in some eukaryotes. [3]
-

- a. Describe the characteristics of stem cells that make them potentially useful in medicine. [5]

b. Outline the inheritance of a **named** sex-linked condition in humans. [5]

c. Explain the use of karyotyping in human genetics. [8]

a. Describe the genetic code and its relationship to polypeptides and proteins. [5]

b. Outline the role of proteins in active and passive transport of molecules through membranes. [5]

c. Many cell functions, like synthesis of macromolecules and transport, require energy in the form of ATP. Explain how ATP is generated in animal cells. [8]

a. Draw a labelled diagram to show the structure of a membrane. [5]

b. Outline how vesicles are used to transport materials secreted by a cell. [6]

c. Explain how the structure of a villus in the small intestine is related to its function. [7]

a. Draw a labelled diagram to show the structure of membranes. [6]

c. Explain passive transport and active transport across membranes. [8]

a. Explain how materials are moved across membranes of cells by active transport. [2]

b. Explain the effects of pH on enzyme catalysed reactions. [3]

c. Distinguish between the process of anaerobic respiration in yeast and humans. [2]

a. Outline the use of human embryonic stem cells (hESC) to treat Stargardt's disease. [2]

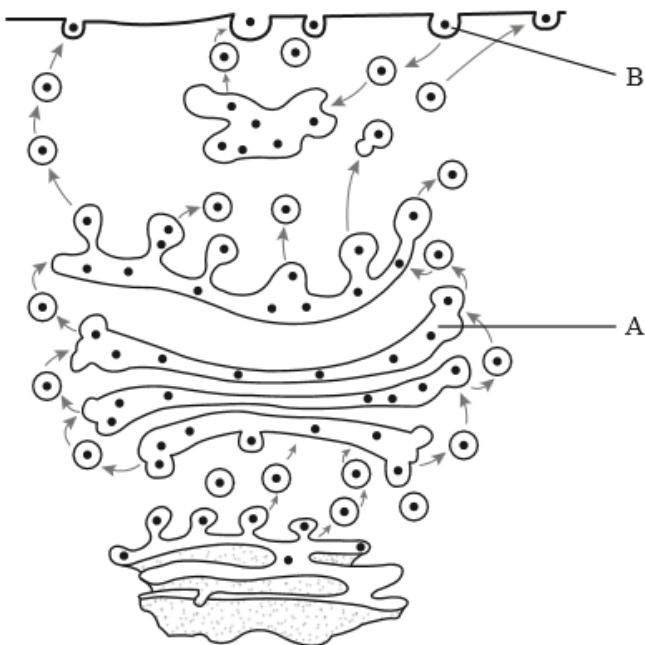
b. The most common form of Stargardt's disease is known to be autosomal recessive. Using a Punnett grid, deduce the probability of a child inheriting Stargardt's disease, if both of the parents are carriers of the disease but do not have the disease themselves. [3]

- a. Plants are a diverse group of eukaryotic organisms. Describe the different characteristics of the bryophyta, filicinophyta, coniferophyta and angiospermophyta. [9]
 - b. Plants store carbohydrate in the form of starch. Explain the reasons for starch being digested by the human digestive system. [4]
 - c. Compare the structure of prokaryotic and eukaryotic cells. [5]
-

- a. Compare simple diffusion with facilitated diffusion as mechanisms to transport solutes across membranes. [5]
 - b. Describe the process of endocytosis. [5]
 - c. Explain how an impulse passes along the membrane of a neuron. [8]
-

- a. State the functions of the following organelles of a eukaryotic animal cell: lysosome, Golgi apparatus, free ribosomes, plasma membrane, rough endoplasmic reticulum. [5]
 - b. Distinguish between anaerobic and aerobic cell respiration in eukaryotes. [4]
 - c. Explain the mechanism of ventilation in the lungs in order to promote gas exchange for cell respiration. [9]
-

The diagram shows how vesicles are used to transport materials in a cell.



- a (i) State the name of organelle A. [1]
- a (ii) State the process occurring at B. [1]
- b. Describe how the structure of the membrane allows the formation of vesicles. [2]
- c. Explain active transport across membranes. [3]

The diagram shows a human karyotype.



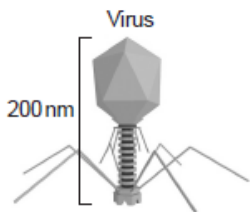
[Source: http://en.wikipedia.org/wiki/File:NHGRI_human_male_karyotype.png, courtesy of the National Human Genome Research Institute.]

- a. (i) State the technique used to collect cells for pre-natal testing. [3]
- (ii) State the method used to arrange the chromosomes in a karyotype.
- (iii) State at what stage in the cell cycle the cells would be when this photograph was taken.
- c. Albinism is inherited as a recessive trait; the alleles of the gene involved are A and a. An individual with albinism produces little or no pigment in the eyes, skin and hair. In a family, one sister has albinism while the parents and other sister have normal pigmentation. [3]
- (i) Determine, using a Punnett grid to show your reasoning, the possible genotypes of the sister with normal pigmentation.

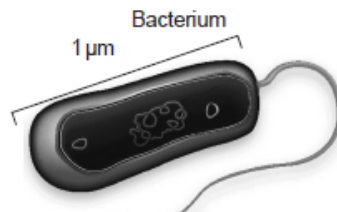
(ii) Deduce the probability that the next child of this couple will have albinism.

-
- a. Draw a labelled diagram to show the fluid mosaic structure of a plasma membrane, indicating the hydrophilic and hydrophobic regions. [5]
- b. Distinguish between active and passive movements of materials across plasma membranes, using **named** examples. [4]
- c. Explain how the properties of water are significant to living organisms. [9]
-

The diagrams show a virus and a bacterium.



[Source: adapted from <http://cronodon.com>]



[Source: adapted from www.microbiologyonline.org.uk]

- a. Calculate the magnification of the bacterium. [1]
- b. State the method that bacteria use to divide. [1]
- c. Outline the effectiveness of antibiotics against viruses and bacteria. [1]

d(i) Saprotrophic organisms, such as *Mucor* species, are abundant in soils. [1]

Define *saprotrophic organisms*.

d(ii) State **one** role of saprotrophic organisms in the ecosystem. [1]

a. Draw a labelled diagram of a motor neuron. [5]

b. Explain how an impulse passes along the membrane of a neuron. [8]

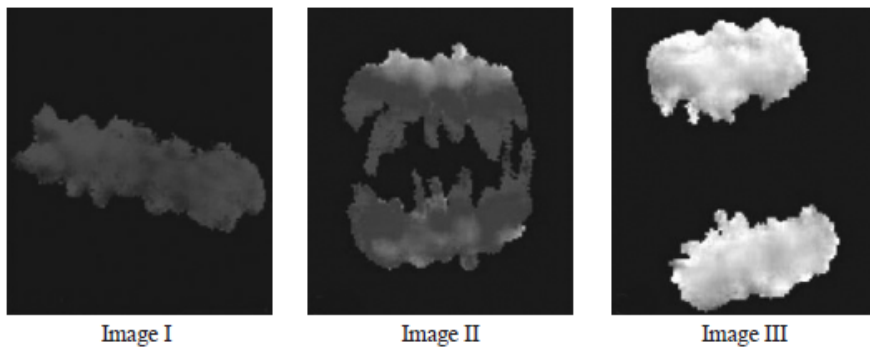
c. Describe the process of endocytosis. [5]

a. Outline the stages of the cell cycle. [5]

b. Explain the process of translation in cells. [8]

c. Outline the production of a dipeptide by a condensation reaction, showing the structure of a generalized dipeptide. [5]

The following sequence of pictures, made using an electronic imaging technique, shows a cell undergoing division.



[Midzone activation of aurora B in anaphase produces an intracellular phosphorylation gradient, Brian G. Fuller, Michael A. Lampson, Emily A. Foley, Sara Rosasco-Nitche, Kim V. Le et al. Nature, vol 453, issue 7198, 2008 Nature Publishing Group. Reproduced with permission.]

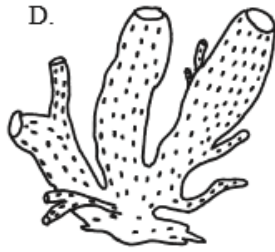
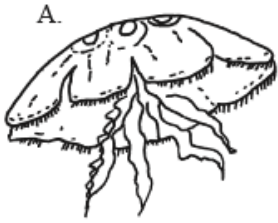
a. State the stage of mitosis typified by image II. [1]

b. List **two** processes that involve mitosis. [2]

c. State the process that results in tumour (cancer) formation or development. [1]

d. Explain, using **one** example, how non-disjunction in meiosis can lead to changes in chromosome number. [2]

a. Parts of a dichotomous key to organisms A, B, C and D are shown. Design missing parts of the key using features visible in the following diagrams. [2]



© International Baccalaureate Organization, 2013

1.

Body with tentaclesA

Body without tentacles go to 2

2.

.....B

.....go to 3

3

.....C

.....D

b. All of these organisms belong to the animal kingdom. State **two** structural differences between animal cells and plant cells [2]

The electron micrographs show mitosis in a cell at an early stage and an intermediate stage.

Phase A

Phase B



[Source: Phase A from: <http://upload.wikimedia.org/wikipedia/commons/f/f5/Anaphase.jpg>
Phase B from: <http://upload.wikimedia.org/wikipedia/commons/d/db/Prophase.jpg>]

a (i) State the name of each phase shown, recording whether each phase has taken place at an early or intermediate stage of mitosis. [2]

Phase A:occurs at an..... stage

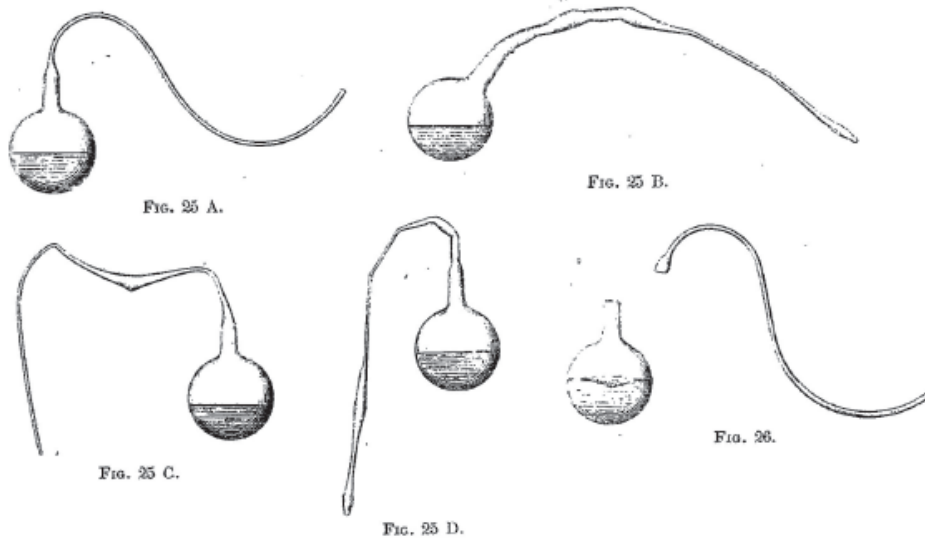
Phase B:occurs at an..... stage

a (ii) Outline the events occurring in phase A. [2]

b. State what results when there is an uncontrolled division of cells in living organisms. [1]

c. DNA in chromosomes undergoes replication before mitosis. Outline how complementary base pairing is important in this process. [2]

a. Pictured below are Louis Pasteur's original drawings of swan-necked flasks. [3]



[Source: L Pasteur and L Pasteur Vallery-Radot, (1922), *Œuvres de Pasteur, Vol II Fermentations et générations dites spontanées*, pages 260–261]

Describe how Pasteur's experiments provided convincing evidence to falsify the concept of spontaneous generation.

b.i.State the function of life in *Paramecium* that is carried out by: [1]

cilia.

b.ii.State the function of life in *Paramecium* that is carried out by:

[1]

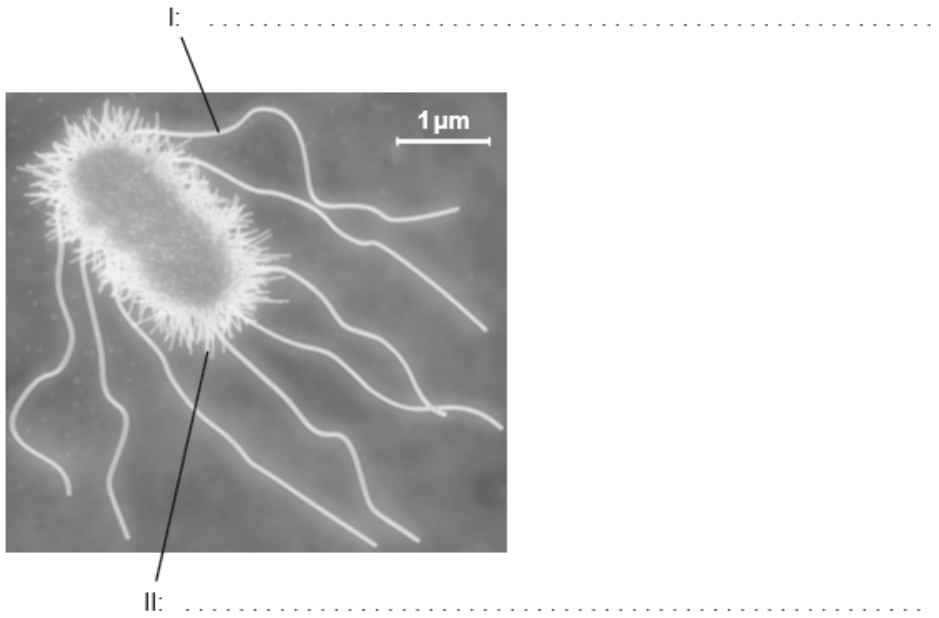
the contractile vacuole.

c. Discuss the advantages and disadvantages of the use of adult stem cells.

[3]

d. Explain the role of decomposers in an ecosystem.

[2]



a. Outline the cell theory

[2]

b (i)Annotate the electron micrograph of the *Escherichia coli* cell with the function of the structures labelled I and II.

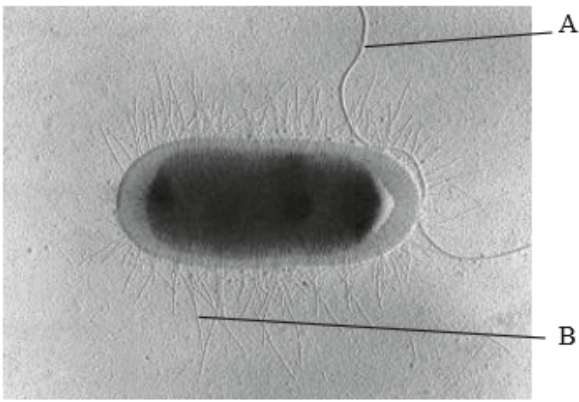
[2]

b (ii)Calculate the magnification of the electron micrograph.

[1]

a. The electron micrograph below shows an *E. coli* cell.

[2]



[Source: www.microbiology.umaryland.edu/images/bact_em.jpg]

Identify the structures labelled A and B in the electron micrograph above and state **one** function of each.

A: Name

Function

B: Name:

Function:

b. Compare prokaryotic and eukaryotic cells.

[3]

a. The electron micrograph is of a spore of a fungus (*Tilletia controversa*) which affects wheat.

[2]



[www.padil.gov.au/pbt/index.php?q=node/15&pbtID=163]

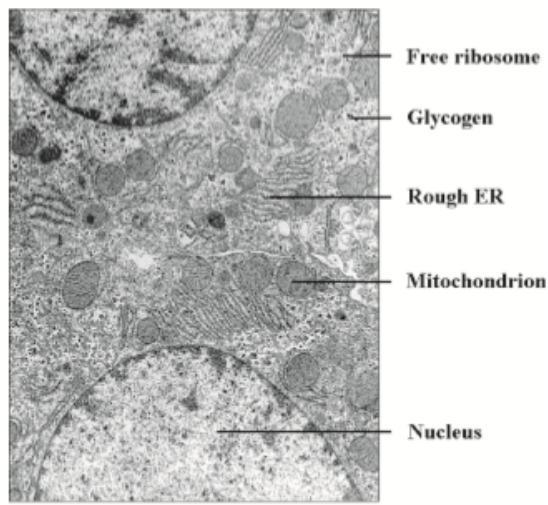
Determine the magnification of the spore in the electron micrograph. The scale bar represents 1 μm . Show your working.

b. Explain the importance of surface area to volume ratio as a limit to cell size.

[2]

a. The image is an electron micrograph.

[1]



[Source: <http://image.wikifoundry.com/image/2/H1jghtjAjTutprovXh4VCA200205/GW720H652>]

Determine, with a reason, whether the image is of a prokaryotic cell **or** eukaryotic cell.

b. (i) State the process that divides one nucleus into two genetically identical nuclei.

[5]

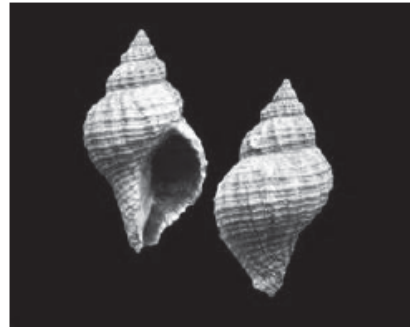
(ii) Explain how the cell cycle is controlled.

Native oyster populations are decreasing where rivers meet the ocean along the northwest coast of North America. These oyster populations are being attacked by a gastropod.



Adult oyster, *Ostrea lurida*

[Source: © International Baccalaureate Organization 2017]



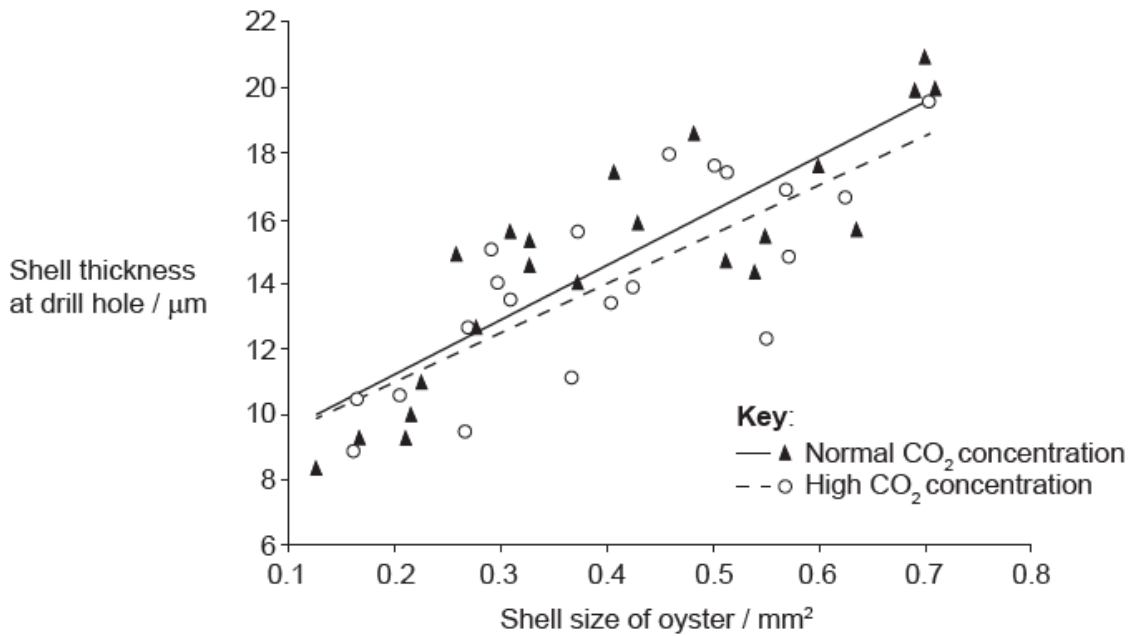
Adult gastropod shell, *Urosalpinx cinerea*

[Source: © International Baccalaureate Organization 2017]

It is known that oysters and gastropods have hard parts composed of calcium carbonate and that ocean acidification is increasing. Studies were carried out using juvenile oysters and gastropods to investigate the effects of acidification on the decrease in the population of oysters.

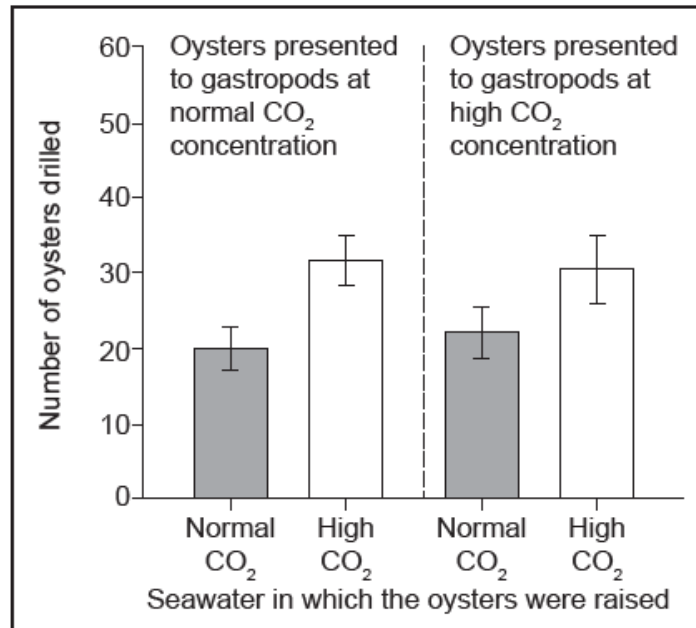
The first step was to raise oysters in two different mesocosms. One had seawater at a normal concentration of CO₂ and the other had sea water with a high concentration of CO₂. Gastropods were raised in two further mesocosms with normal and high CO₂ concentrations respectively.

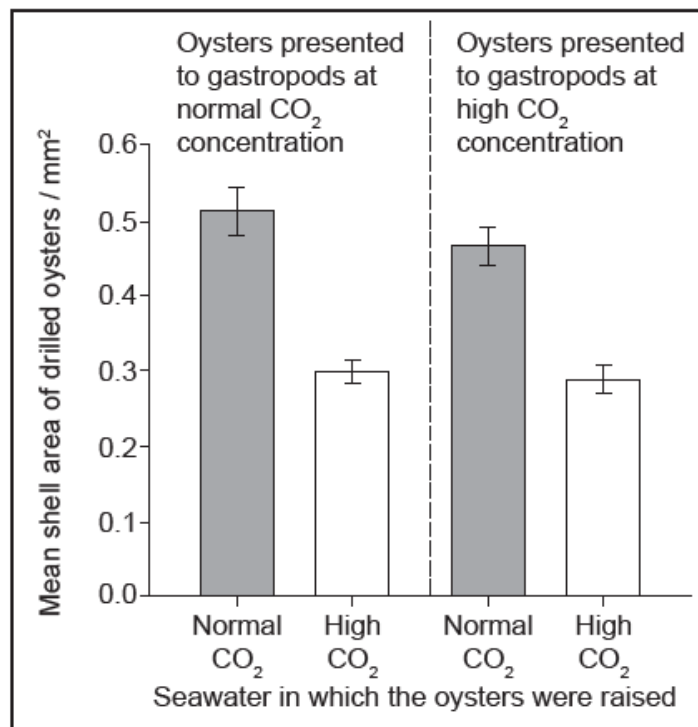
A juvenile gastropod will attack a juvenile oyster by using its tongue-like structure (radula) to drill a hole through the oyster shell. Once the hole has been drilled, the gastropod sucks out the soft flesh. Researchers investigated the shell thickness at the site of the drill hole in relation to the size of the oyster. The results are seen in this graph.



[Source: E Sanford *et al.* (2014) *Proceedings of the Royal Society B*, 281, by permission of the Royal Society.]

Equal numbers of oysters raised in seawater with a normal CO₂ concentration and in seawater with a high CO₂ concentration were then presented together to the gastropod predators in seawater with a normal CO₂ concentration. The same numbers of oysters from the two groups were also presented together to the gastropods in seawater with a high CO₂ concentration. The bar charts show how many of the oysters were drilled by the gastropods and the mean size of drilled oysters.

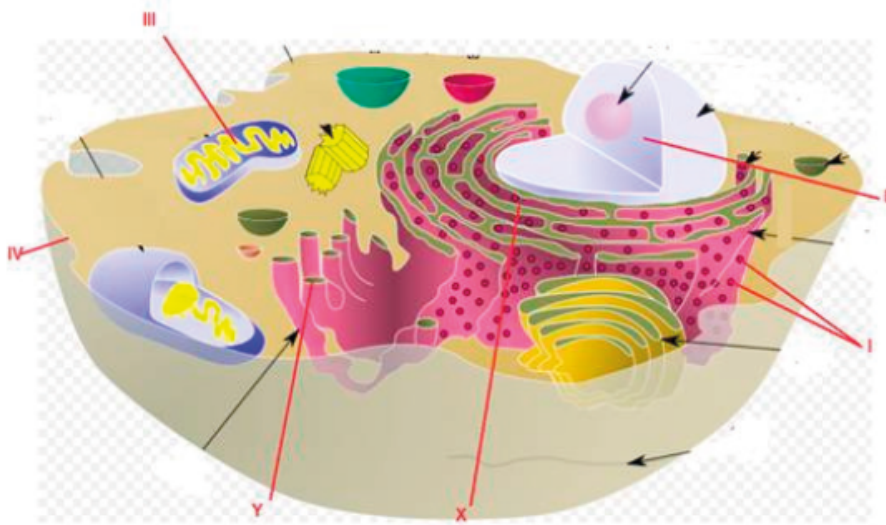




[Source: © International Baccalaureate Organization 2017]

- a. Outline how acidified sea water could affect the shells of the oyster. [1]
- b. Outline the trends shown in the data in the graph. [2]
- c. Estimate how much smaller drilled oysters raised in seawater at a high CO₂ concentration were than drilled oysters raised in seawater at a normal CO₂ concentration. [1]
- d.i. Deduce from the data in the bar charts which factors were and were not correlated significantly with the number of oysters drilled by the gastropods. [2]
- d.ii. Suggest reasons for the differences in the numbers of oysters drilled, as shown in the bar charts. [2]
- d.iii. The radula in a gastropod is hard but not made of calcium carbonate. Outline how this statement is supported by the drilling success of the gastropods in seawater with normal or high CO₂ concentrations. [2]
- e. Using all the data, evaluate how CO₂ concentrations affect the development of oysters and their predation by gastropods. [2]

The diagram shows some of the structures in an animal cell.



[Source: http://commons.wikimedia.org/wiki/File:Biological_cell.svg]

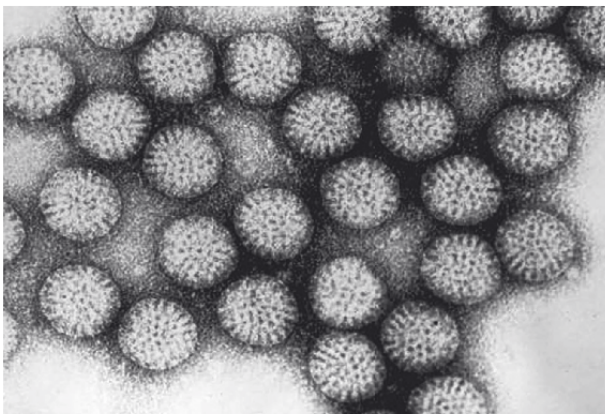
a. (i) Label structures I, II, III and IV. [3]

- I.
- II.
- III.
- IV.

(ii) State one function of structure III.

b. Explain how materials are transported within a cell between structures X and Y. [2]

The figure shows a transmission electron micrograph of rotavirus particles. Each rotavirus is about 70 nanometres in diameter.

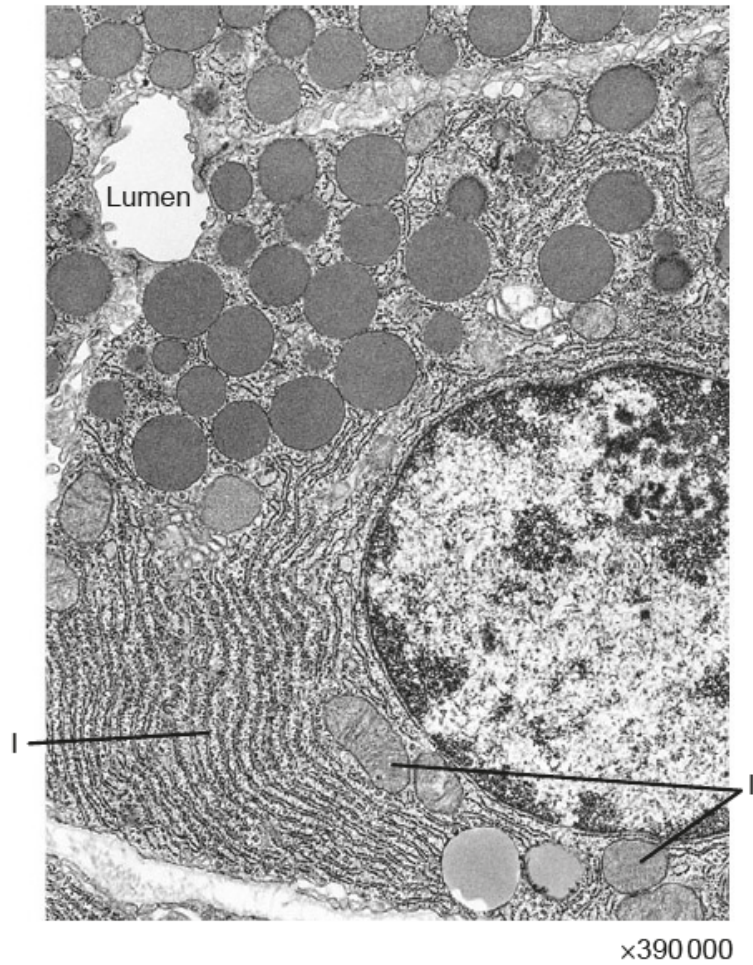


[Source: CDC / Dr. Erskine L. Palmer]

a. State a reason for using an electron microscope to view this virus rather than a light microscope. [1]

b. Rotavirus causes diarrhea and vomiting. Explain why viral diseases cannot be treated using antibiotics. [2]

The electron micrograph shows the structures in an exocrine gland cell of the pancreas.



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

a. Glands are organs that secrete and release particular chemical substances. Melatonin is an important hormone secreted in the pineal gland in the brain. Describe its role in mammals. [2]

b.i.State the principal product of this cell. [1]

b.ii.Using the table, identify the organelles labelled I and II on the electron micrograph with their principal role. [2]

Organelle	Name	Principal role
I		
II		

