PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 2: CELLS, VIRUSES AND REPRODUCTION OF LIVING THINGS

EUKARYOTIC AND PROKARYOTIC CELL STRUCTURE AND FUNCTION

SCORE	PERCENTAGE
/143	%

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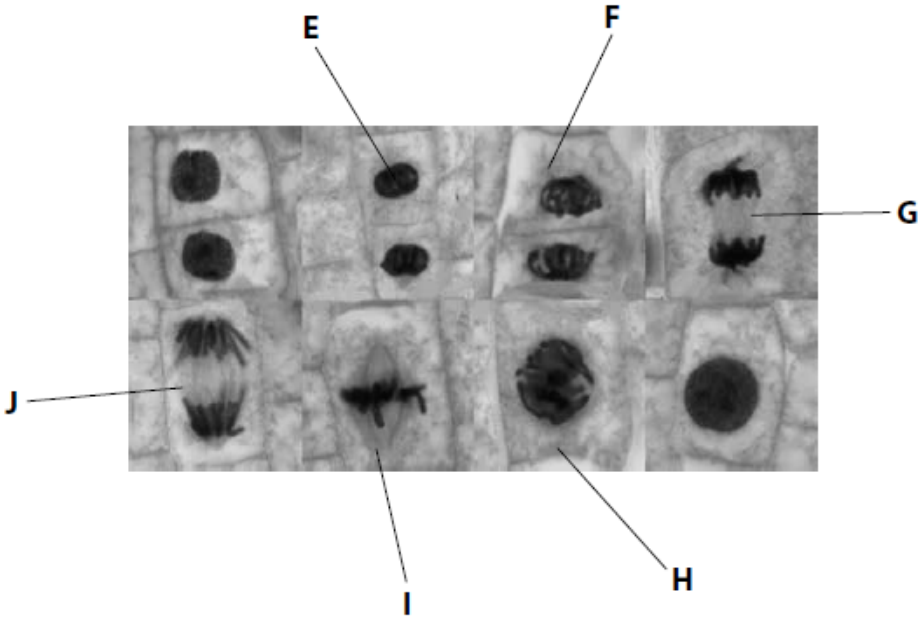
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Q1.

The photograph below shows cells dividing by mitosis.



© Steve Gschmeissner / Science Photo Library

(a) The actual length of cell **J** is 23.5 µm.

(i) Calculate the magnification of this photograph.

(3)

Answer .....

(ii) Describe what has happened in cell **J**.

(4)

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(b) (i) Which sequence of letters represent the cells in order of their appearance in the phases of mitosis?

(1)

☒ **A** E, F, G, H, I, J

☒ **B** G, F, H, I, J, E

☒ **C** H, I, J, G, F, E

☒ **D** J, I, H, G, F, E

(ii) Give a reason why there are differences in the appearance of cells **E** and **G**.

(1)

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(Total for question = 9 marks)

Q2. Bacteria and viruses can cause human diseases.

(a) Distinguish between the structure of bacteria and viruses

(3)

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(b) Infection with a bacterium can result in the development of active immunity to that bacterium. This results in the production of antibodies by plasma cells.

(i) Describe how infection with a bacterium results in the production of plasma cells.

(4)

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(ii) Explain how antibodies help a person to recover from an infection.

(2)

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(iii) A person who has had an organ transplant has to take immunosuppressive drugs. This prevents the immune system from destroying the organ transplant. Some of these drugs work by inhibiting the production of cytokines.

Suggest what effect these drugs could have on a person infected with a bacterium or a virus.

(4)

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(Total for Question = 13 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Photographs **P** and **Q** are electron micrographs of mitochondria.

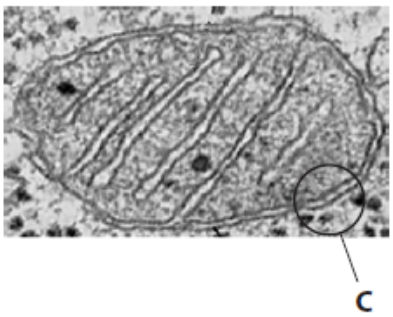
Each photograph was taken using a different electron microscope.

Photograph **P**



Sourced from: http://book.bionumbers.org/how-big-are-mitochondria/

Photograph **Q**



Source: Cellupedia

(i) What is the structure labelled **S**?

(1)

☒ **A** crista

☒ **B** matrix

☒ **C** stroma

☒ **D** thylakoid

(ii) Explain the difference in appearance of the parts labelled **C** using the two different electron microscopes.

(2)

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(Total for question = 3 marks)

Q4.

Mitochondria and chloroplasts in eukaryotic cells are thought to have originated millions of years ago by a process called endosymbiosis.

In endosymbiosis, free-living prokaryotic organisms were engulfed by their new host cells.

The table shows the lipid composition of the membranes of these two organelles.

Type of lipid	Percentage of total lipid composition of membranes (%)	
	In mitochondria	In chloroplasts
phosphatidyl A	43	0
phosphatidyl B	35	0
phosphatidyl C	6	1
phosphatidyl D	3	7
phosphatidyl E	13	0
monogalactosyldiacylglycerol F	0	55
digalactosyldiacylglycerol G	0	24
sulfolipid H	0	8

(i) Analyse the data and use your knowledge to explain why these two organelles are thought to have originated from different prokaryotic organisms.

(3)

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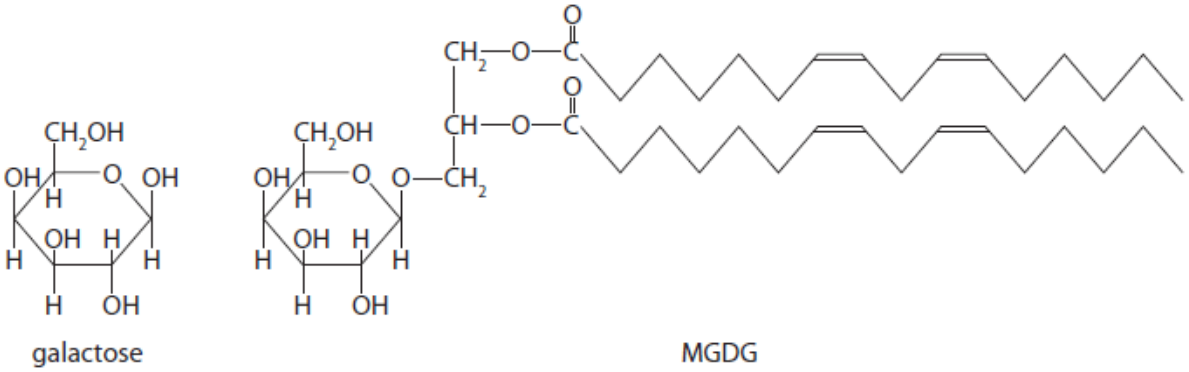
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(ii) Digalactosyldiacylglycerol (DGDG) is synthesised from galactose and monogalactosyldiacylglycerol (MGDG).

The galactose forms a 1,6 glycosidic bond with the MGDG.

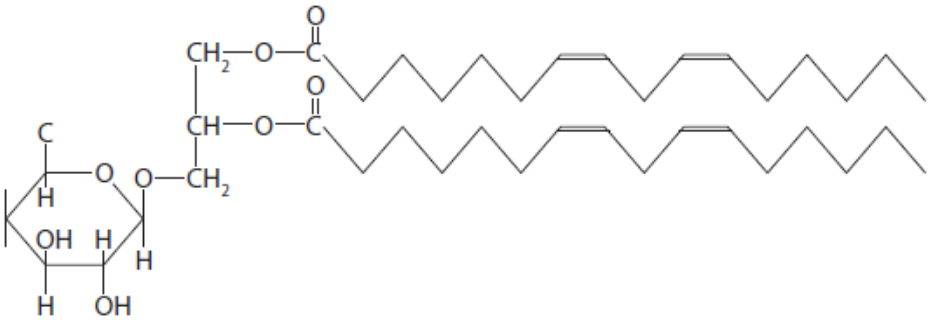
The diagram shows the structure of galactose and MGDG.



galactose MGDG

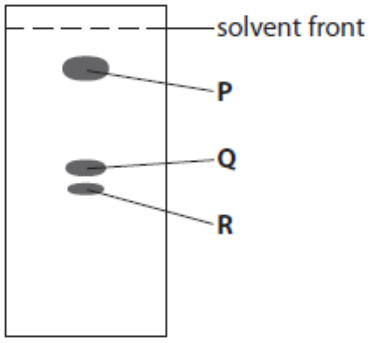
Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(3)



(iii) Chromatography can be used to separate MGDG, DGDG and sulfolipid extracted from chloroplasts.

The diagram shows the position of these three lipids, **P**, **Q** and **R**, on a chromatogram.



Which row in the table identifies the position of these three lipids in this chromatogram ?

(1)

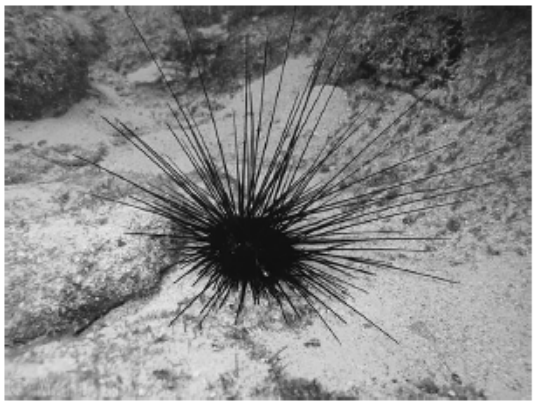
	Lipid in position P	Lipid in position Q	Lipid in position R
☒ A	DGDG	sulfolipid	MGDG
☒ B	MGDG	DGDG	sulfolipid
☒ C	sulfolipid	DGDG	MGDG
☒ D	sulfolipid	MGDG	DGDG

(Total for question = 7 marks)

Q5.

A sea urchin is an invertebrate animal that lives on the seabed.

The photograph shows a sea urchin.



Sea urchin embryos are often used to study embryonic development.
In the early stages of embryonic development, a sea urchin embryo is similar to a mammalian embryo.

A scientist carefully removed one of the 128 cells from the hollow structure and injected fluorescent dye into its cytoplasm

She replaced this cell in a new position on the opposite side of the hollow structure.

The embryo then developed normally. The repositioned cell formed healthy tissue, appropriate to its new position.

The tissue formed by an embryonic cell is called the 'fate' of the cell.

(i) Explain how the scientist could identify the fate of the repositioned cell.

(2)

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(ii) The scientist found that repositioning this cell changed its fate.

Explain the scientist's finding.

(4)

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Q6.

Leigh syndrome is a genetic disorder inherited from the mother. The mother carries genes for the disorder in her mitochondrial DNA.

Draw and label a mitochondrion.

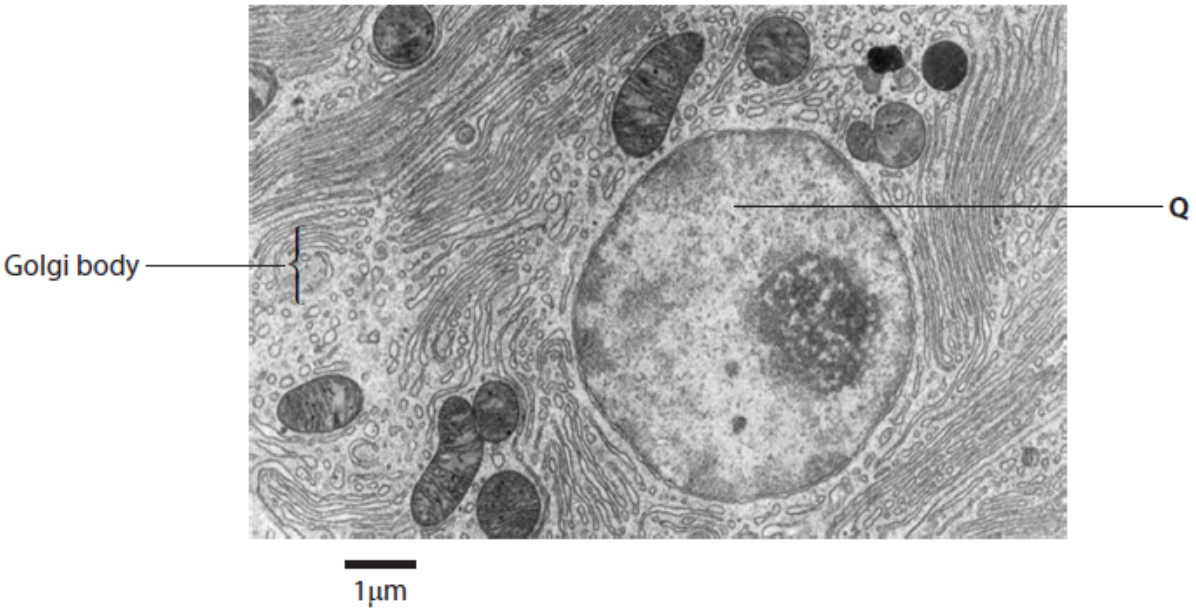
(4)

(Total for question = 4 marks)

Q7.

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Name organelle **Q**.

(1)

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(Total for question = 1 mark)

Q8.

Food poisoning can be caused by food that is contaminated with pathogenic microorganisms.

A number of different viruses can cause food poisoning.

One virus that can cause food poisoning is the Norovirus.

Noroviruses are RNA viruses.

(i) The following four statements are features of viruses:

1. have envelopes

2. contain reverse transcriptase

3. surrounded by a protein coat

4. have a helical structure

Which of the following is correct for all RNA viruses?

(1)

☒ **A** statement 1, statement 2 and statement 3

☒ **B** statement 2 only

☒ **C** statement 3 only

☒ **D** statement 1 and statement 4

(ii) Which of the following groups of viruses are also RNA viruses?

(1)

☒ **A** Ebola virus, human immunodeficiency virus and tobacco mosaic virus

☒ **B** Ebola virus, λ phage and tobacco mosaic virus

☒ **C** Human immunodeficiency virus, λ phage and tobacco mosaic virus

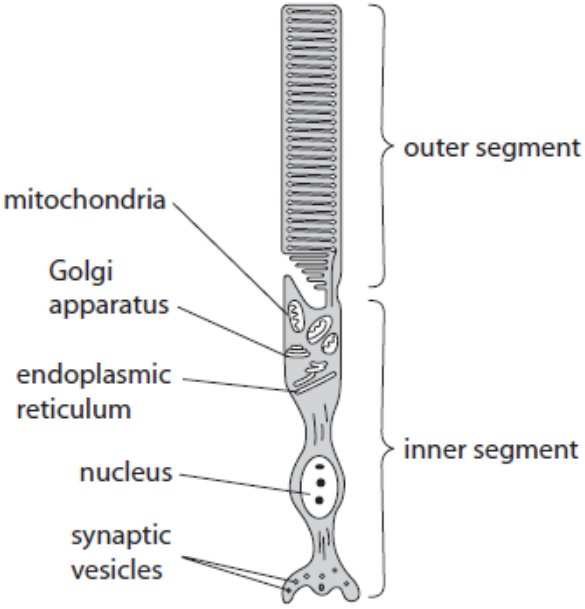
☒ **D** λ phage and tobacco mosaic virus

(Total for question = 2 marks)

Q9.

Answer the question with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows the structure of a rod cell.



(i) How many of the labelled organelles have a double membrane?

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(ii) Which of the following statements about the effect of light on rod cells are correct?

(1)

1. rhodopsin breaks down into opsin and trans-retinal
2. voltage-gated sodium channels open in the membrane
3. more neurotransmitter is released from the presynaptic terminal

☒ **A** 1 only

☒ **B** 1 and 2

☒ **C** 1 and 3

☒ **D** 2 and 3

(Total for question = 2 marks)

Q10.

Fungi break down dead plant and animal material in ecosystems.

Some types of fungi produce cellulase enzymes. These enzymes break down cellulose.

The breakdown of cellulose can be detected using Benedict's solution.
This solution turns red if monomers from the breakdown of cellulose are present.

Give a reason why more cellulose is found in dead plant material than in dead animal material.

(1)

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Q11.

The retina contains rod cells and bipolar neurones.

Rod cells contain large numbers of mitochondria.

Explain the role of mitochondria in the functioning of rod cells.

(2)

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(Total for question = 2 marks)

Q12.

Salmonella are Gram negative bacteria found in the large intestine of humans.

Which is the correct statement about *Salmonella*?

(1)

☒ **A** *Salmonella* has a thick peptidoglycan cell wall and produces endotoxins

☒ **B** *Salmonella* has a thick peptidoglycan cell wall and produces exotoxins

☒ **C** *Salmonella* has a thin peptidoglycan cell wall and produces endotoxins

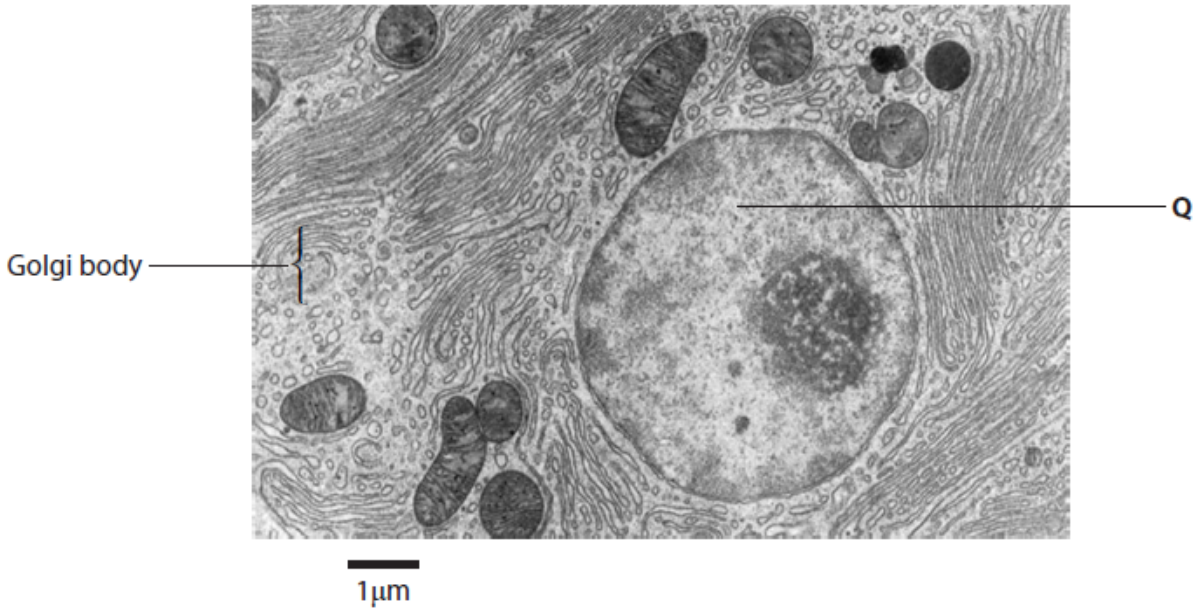
☒ **D** *Salmonella* has a thin peptidoglycan cell wall and produces exotoxins

(Total for question = 1 mark)

Q13.

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Describe the role of the Golgi body in producing secreted enzymes.

(3)

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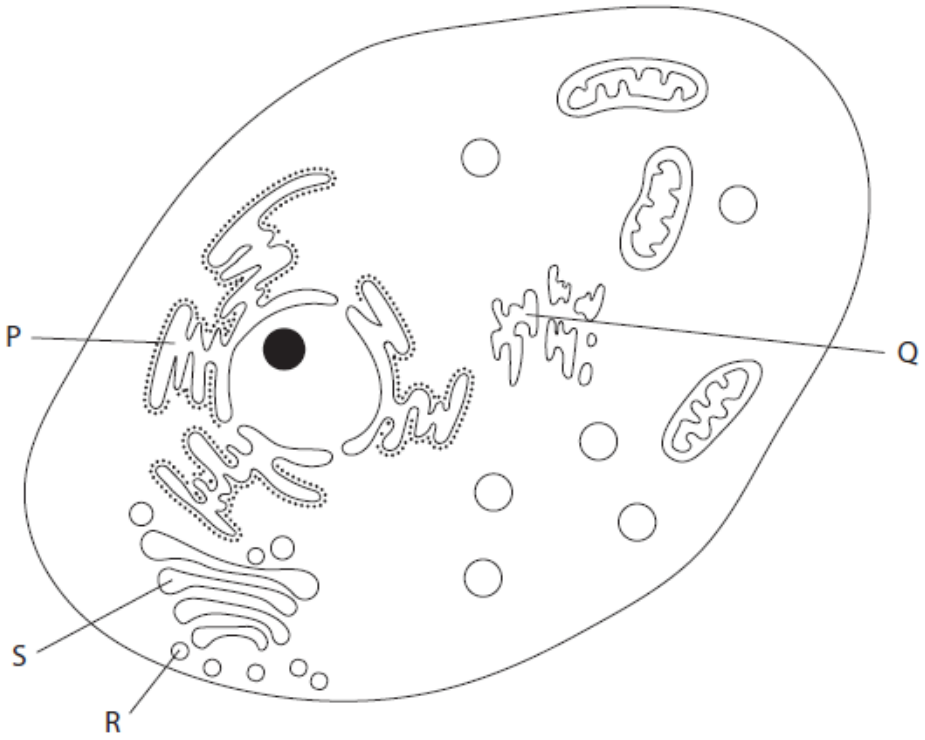
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(Total for question = 3 marks)

Q14.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows the structure of an animal cell.



(i) Which of the following is the name of the structure labelled Q?

(1)

☒ **A** centriole

☒ **B** nucleus

☒ **C** rough endoplasmic reticulum

☒ **D** smooth endoplasmic reticulum

(ii) These cells were cultured in radioactively-labelled amino acids.

In which sequence would the cell structures in the diagram become radioactive during protein synthesis?

(1)

☒ **A** Q S R

☒ **B** S P R

☒ **C** P R Q

☒ **D** P S R

(iii) Explain one function of lysosomes.

(2)

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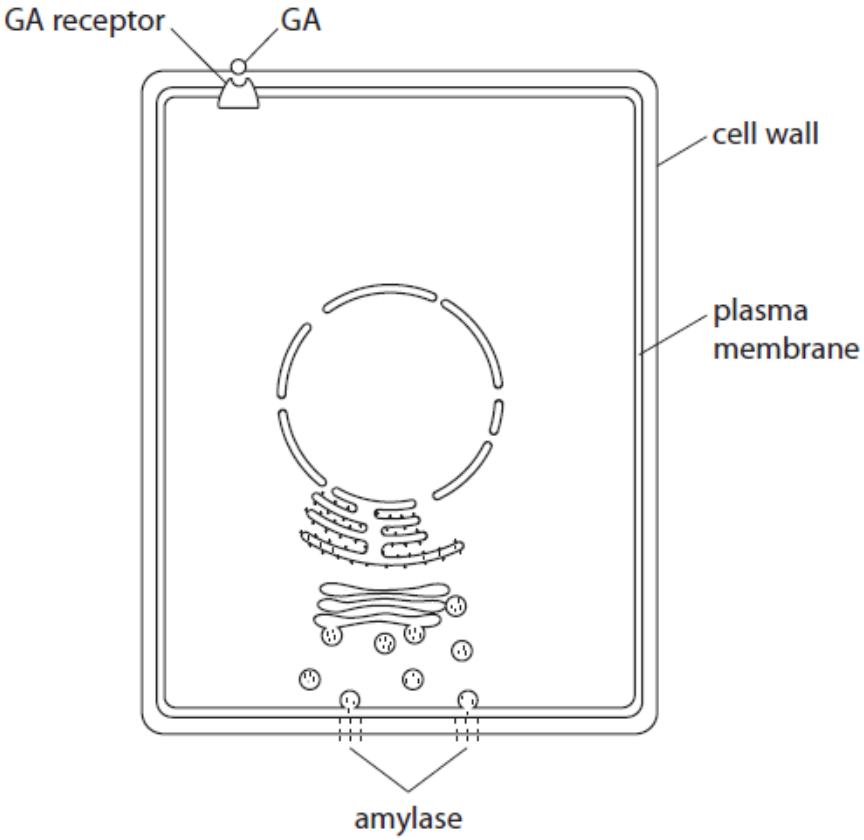
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(Total for question = 4 marks)

Q15.

Gibberellin stimulates cells in the aleurone layer of cereal grains, such as barley, to produce the enzyme amylase.

The diagram shows a cell from the aleurone layer with some of the structures involved in the production of amylase.



Gibberellin binds to a protein receptor in the cell surface membrane and this stimulates transcription in the nucleus.

(i) Describe the process of transcription in the nucleus of this cell.

(2)

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(ii) Describe the processes occurring after transcription that result in the release of amylase from the cell shown in the diagram.

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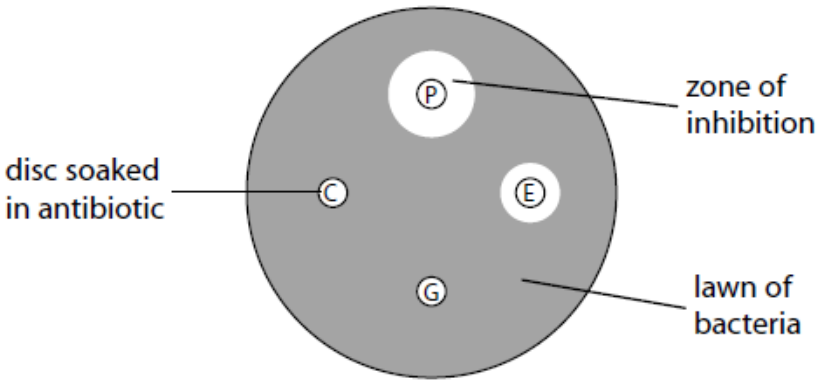
(Total for question = 7 marks)

Q1.

The resistance of one type of bacteria to a range of different antibiotics was investigated.

A lawn of bacteria was prepared by spreading a suspension of the bacteria over the surface of agar. Paper discs that had been soaked previously in different antibiotics were placed on top of the bacteria. The antibiotics were all the same concentration. The culture was incubated for 48 hours.

The diagram below shows the appearance of the culture after incubation.



Key:

C = chloramphenicol

E = erythromycin

G = gentamycin

P = penicillin

Explain why these results indicate that the bacteria must be Gram positive.

(3)

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(Total for question = 3 marks)

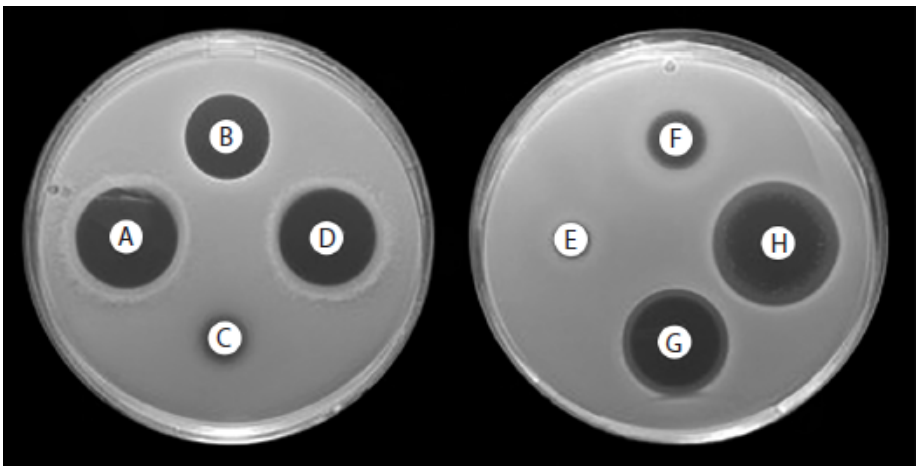
Q2.

A student read that more than half of raw chickens on sale in supermarkets are contaminated with bacteria from the genus *Campylobacter*.

Some species of *Campylobacter* cause food poisoning in humans.

The student carried out an experiment to test the effectiveness of various antibiotics against *Campylobacter*.

The photograph shows the student's agar plates at the end of the experiment.



The white circles labelled A–H are filter paper discs. These discs were soaked in different antibiotics then placed on the surface of the agar.

One of the antibiotics the student used was penicillin.
Describe the effect of penicillin on bacterial cells.

(3)

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Q3.

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

(i) Name the antibiotic that affects Gram positive bacteria only.

(1)

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(ii) Give one reason why these antibiotics will not affect human cells.

(1)

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(Total for question = 2 marks)

Q4.

The photograph shows part of a bacterial cell surrounded by viruses, as seen using an electron microscope.



(i) Which of these structures would be present in a bacterial cell but absent in a palisade mesophyll cell?

(1)

☒ **A** cellulose cell wall and nucleoid

☒ **B** cellulose cell wall and nucleolus

☒ **C** peptidoglycan cell wall and nucleoid

☒ **D** peptidoglycan cell wall and nucleolus

(ii) Which virus contains DNA?

(1)

☒ **A** Ebola

☒ **B** HIV

☒ **C** *λ* (lambda) phage

☒ **D** tobacco mosaic

(iii) Explain why an electron microscope, rather than a light microscope, was used to produce this photograph.

(2)

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(Total for question = 4 marks)

Q5. Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

(2)

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(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis*, are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

(2)

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(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

(2)

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(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

(3)

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(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

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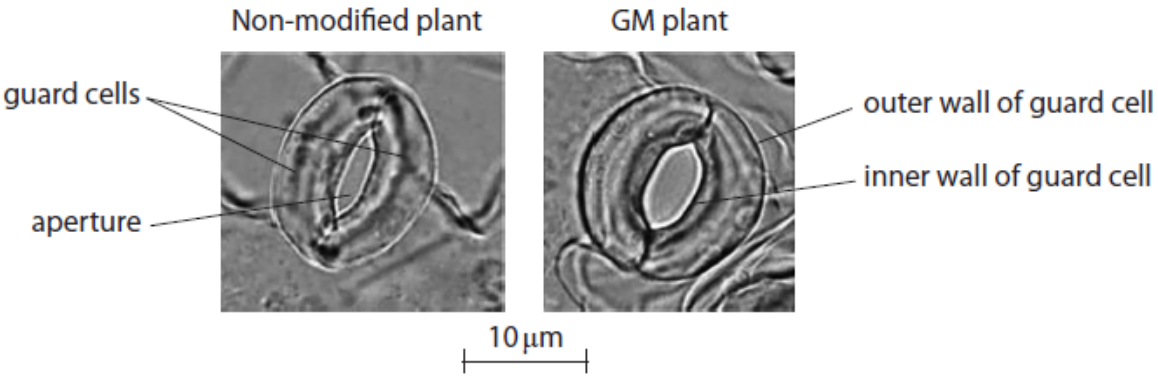
(Total for Question = 13 marks)

Q6.

Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.



Sourced from: http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg

(i) Calculate the magnification of the GM plant photograph using the scale bar.

Give the answer in standard form.

(2)

Answer .....

(ii) Calculate how many times wider the aperture of the stoma of the GM plant is

compared with the stoma of the non-modified plant.

(1)

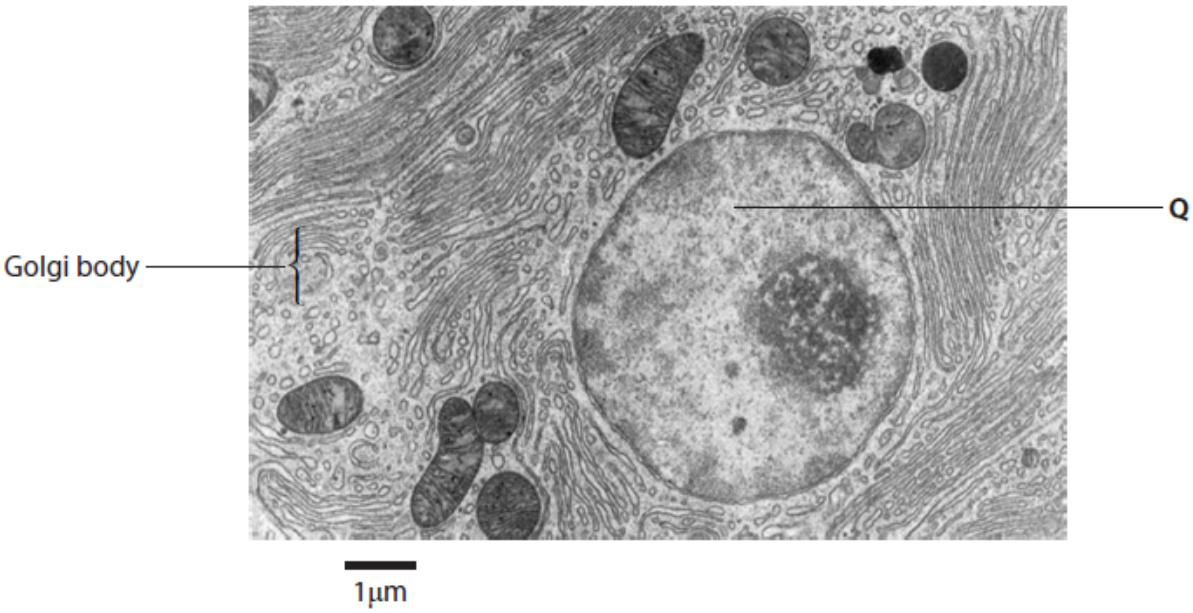
Answer .....

(Total for question = 3 marks)

Q7.

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Calculate the maximum diameter of organelle **Q**.

(2)

Answer .....

(Total for question = 2 marks)

Q8.

Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

The effectiveness of UV radiation was investigated, using three species of pathogenic bacteria.

The table provides information about the bacteria used in this investigation.

Bacteria	Gram staining	Infected part of body
P. aeruginosa	negative	blood
S. aureus	positive	lung
E. coli	negative	intestine

(i) Compare and contrast the structure of the wall of Gram positive bacteria and Gram negative bacteria.

(3)

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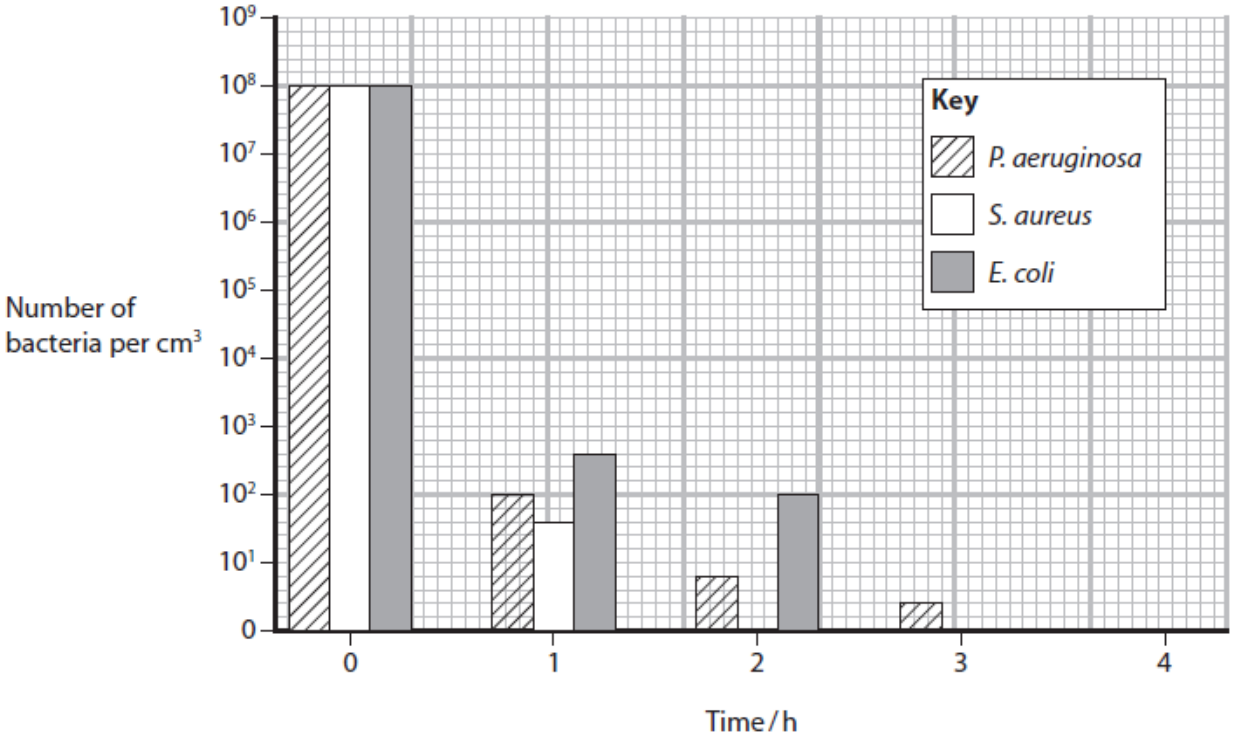
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(ii) In this investigation, living bacteria of each species were exposed to UV radiation for four hours.

The numbers of living bacteria were counted each hour during the four-hour period.

The graph shows the results of this investigation.



Calculate the percentage change in numbers of living *E. coli* after two hours of exposure to UV radiation.

(2)

Answer ..... %

(iii) A student concluded from this investigation that if food is exposed to UV radiation, it would remove all risk of food poisoning.

Criticise the validity of this conclusion.

(4)

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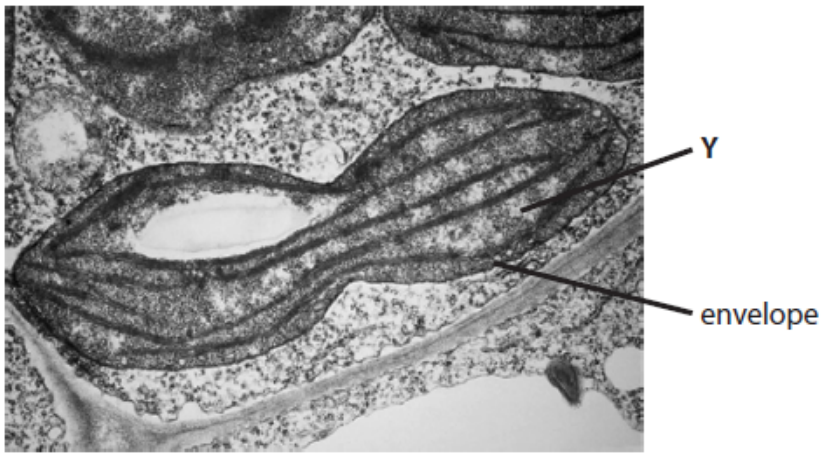
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(Total for question = 9 marks)

Q9.

When a photosynthetic plant cell grows, the number of chloroplasts in the cell increases. This increase in the number of chloroplasts can result from the division of chloroplasts already present in the cell.

The electron micrograph shows a chloroplast dividing.



The envelope consists of two membranes. These membranes are separated by a gap of 10 × 10^{-3} to 20 × 10^{-3} µm.

The magnification of this electron micrograph is ×12 000.

(i) Calculate the maximum width of this gap in this electron micrograph.

(2)

Answer .....

(ii) Explain why the envelope in this electron micrograph cannot be seen as two separate membranes.

(2)

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(Total for question = 4 marks)

Q10.

The pathogenic effects of bacteria can be due to the toxins they release.

Endotoxins are released by Gram negative bacteria.

(i) Name **one** type of Gram negative bacteria that releases endotoxins.

(1)

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(ii) Give **one** difference between the structure of Gram negative bacteria and Gram positive bacteria.

(1)

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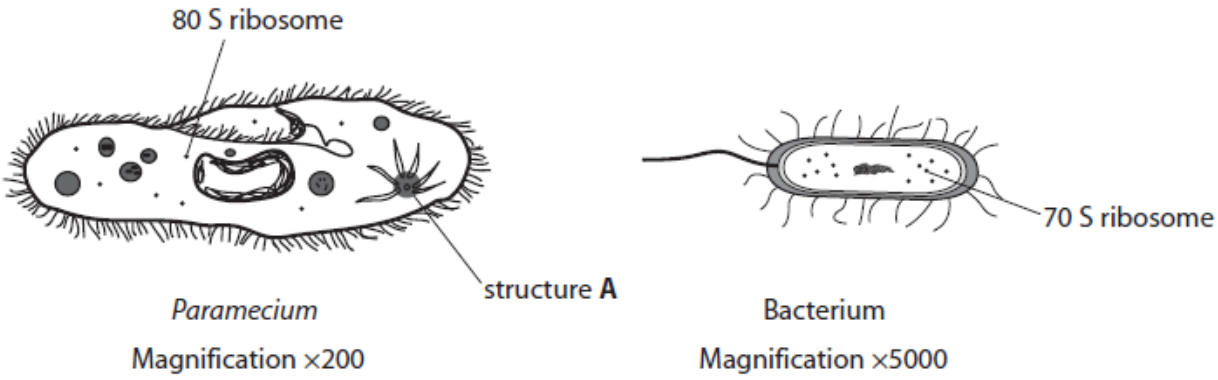
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(Total for question = 2 marks)

Q11.

The drawings show two single-celled organisms that live in ponds, *Paramecium* and a bacterium.



Paramecium
Magnification ×200

Bacterium
Magnification ×5000

Which of the following statements is correct?

(1)

☒ **A** Both *Paramecium* and the bacterium are eukaryotes

☒ **B** Both *Paramecium* and the bacterium are prokaryotes

☒ **C** *Paramecium* is a eukaryote and the bacterium is a prokaryote

☒ **D** *Paramecium* is a prokaryote and the bacterium is a eukaryote

Q12.

Plant stems contain xylem and phloem, tissues specialised for transport.

The photomicrograph shows a longitudinal section of phloem tissue.



State why stains, such as methylene blue, are sometimes used when preparing a microscope slide.

(1)

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(Total for question = 1 mark)

Q13.

Cysteine proteases are enzymes found in fruits such as pineapples.

When a protease enzyme is added to fat-free skimmed milk, the milk turns from cloudy to clear.

Cysteine proteases are also found in the predatory bacterium *Bdellovibrio bacteriovorus* (BvB).

These bacteria are harmless to humans but prey on Gram negative bacteria.

(i) Give two differences between Gram negative and Gram positive bacteria.

(2)

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(ii) The cell of the predatory BvB is 1µm in length and can swim 100 times its length per second.

Calculate the swimming speed of this bacterial cell in mm s^{-1}.

(2)

Answer .....

(iii) The BvB bacteria have been described as 'living antibiotics'.

Explain why the BvB bacteria might be useful in the future for treating bacterial infections.

(2)

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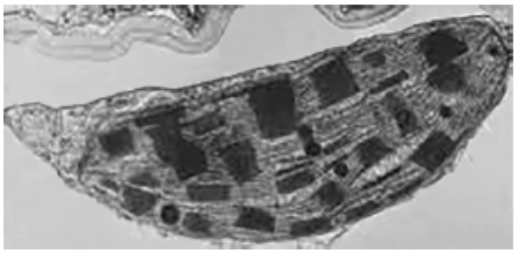
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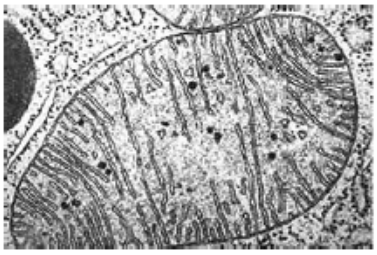
(Total for question = 6 marks)

Q14.

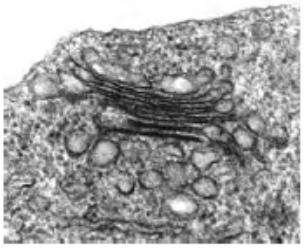
The electron micrographs show four different organelles.



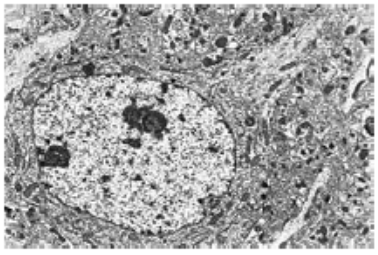
A



B



C



D

Which of these organelles contains the photosynthetic pigments?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

Q15.

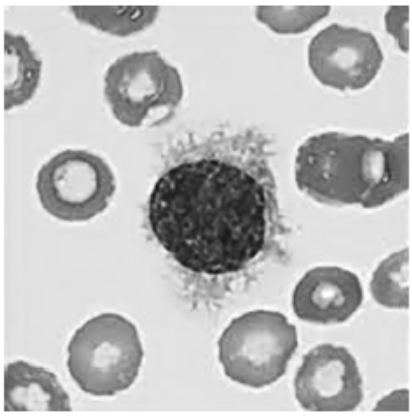
Leukaemia is a type of cancer involving abnormal white blood cells.

In 2015, scientists announced that 1 in 5 people aged 90 or over had mutations linked to leukaemia.

The current UK population is about 64 million, of which 0.8% are aged 90 or over.

Hairy cell leukaemia is a rare form of the disease in which there is an increase in the number of abnormal B lymphocytes.

The photomicrograph shows one of these B lymphocytes.



The hairy cell lymphocytes have an unusually large nucleolus.

State the function of the nucleolus in this hairy cell lymphocyte.

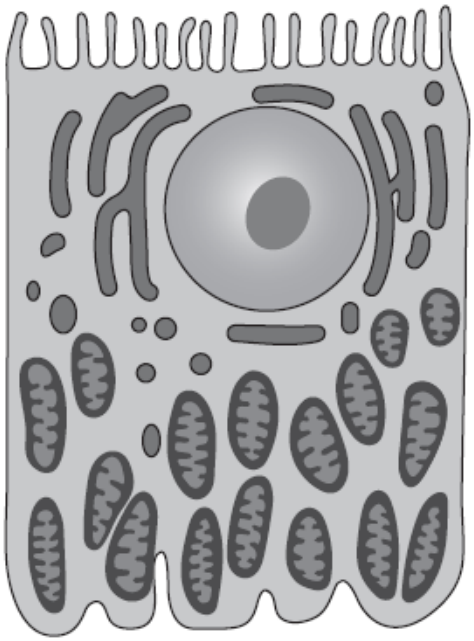
(1)

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Q16.

The diagram shows a cell from the proximal convoluted tubule of the nephron.



Explain how the features shown in the diagram enable this cell to carry out its function.

(4)

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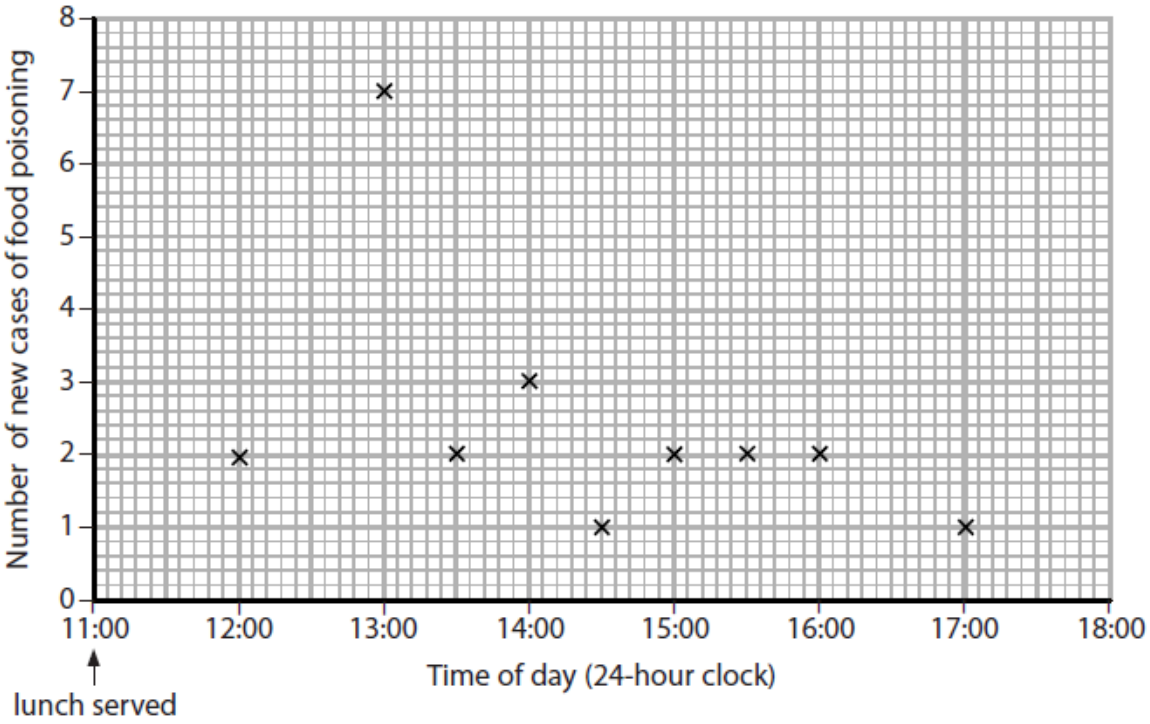
(Total for question = 4 marks)

Q17.

Food poisoning can be caused by food that is contaminated with pathogenic microorganisms.

A number of different bacteria can cause food poisoning.

The graph shows the number of new cases of food poisoning after a lunch party.



(i) Explain why it is likely that this food poisoning resulted from food contaminated with *Staphylococcus* rather than with *Salmonella*.

(3)

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(ii) Describe the techniques microbiologists could use to confirm that this food poisoning was caused by *Staphylococcus*.

(4)

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(Total for question = 7 marks)

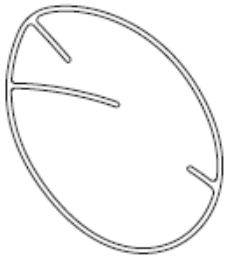
Q18.

Some antibiotics work by inhibiting the production of ribosomes in bacteria.

The structure of ribosomes in bacteria is similar to the structure of ribosomes in mitochondria.

These antibiotics can destroy cancer cells in humans.

The diagram shows the membranes of a mitochondrion from a cancer cell treated with these antibiotics.



(i) Give one difference in the membranes of this mitochondrion compared with the membranes of a mitochondrion from an untreated cancer cell.

(1)

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(ii) Some cancer cells depend on oxidative phosphorylation for ATP production.

Explain why the antibiotics that inhibit the production of ribosomes prevent oxidative phosphorylation when used to treat cancer cells.

(2)

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(iii) Some scientists suggested that inhibiting both glycolysis and mitochondrial respiration may be an effective way of treating cancer cells.

Explain why this suggestion may be an effective way of treating cancer cells.

(2)

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(Total for question = 5 marks)

Q19.

Infections caused by *Chlamydia* and human papillomavirus (HPV) are sexually transmitted.

The HPV is a non-enveloped DNA virus.

Chlamydia infection is caused by the bacterium, *Chlamydia trachomatis*.

Compare and contrast the structure of a bacterial cell with the structure of HPV.

(3)

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(Total for question = 3 marks)

Q20.

Some antibiotics work by inhibiting the production of ribosomes in bacteria.

The structure of ribosomes in bacteria is similar to the structure of ribosomes in mitochondria.

(i) Describe the structure of a ribosome.

(2)

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(ii) Describe the role of ribosomes in protein synthesis.

(2)

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(Total for question = 4 marks)