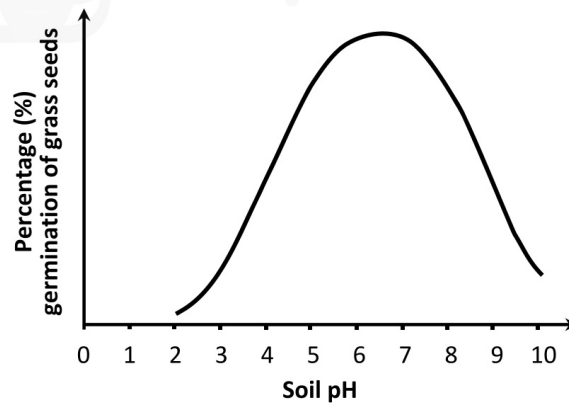


Question 1

2. A horticulturist was carrying out scientific research into germination. They proposed the following hypothesis: "If soil pH is changed, then germination of grass seeds is affected." They tested this hypothesis and the results of the investigation are shown in the graph below.



- (a) Draw a vertical line **on the graph above** that indicates a pH that would be *most* suitable for the germination of grass seeds.
- (b) Explain the term *hypothesis*.
- (c) State **one** variable from the investigation described above.
- (d) Controls are often used in investigations. What is the function of a control?
- (e) Where might the horticulturist first publish the results of their research?
- (f) Give **two** limitations of the scientific method.

1.

2.

Question 2

1. Answer any **five** of the following parts (a) to (f):

- (a) Name the **three** chemical elements that are present in **all** carbohydrates.

- (b) Give the general formula for carbohydrates.

- (c) Name the smallest unit of a carbohydrate.

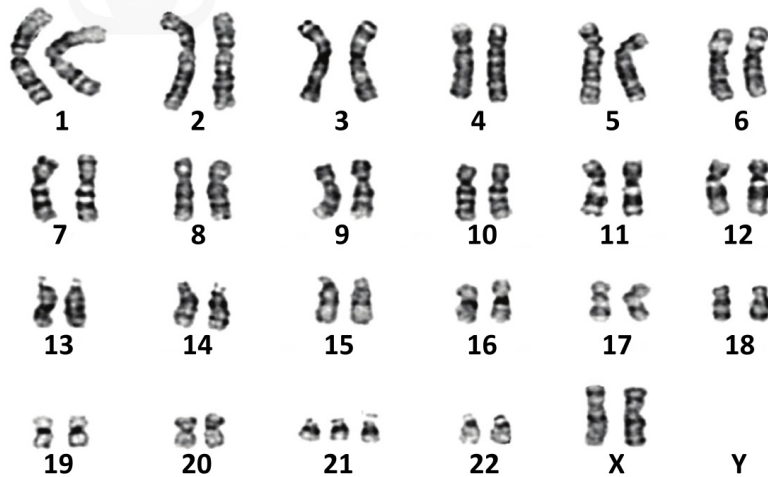
- (d) Name the type of carbohydrate formed when many of the smallest units of a carbohydrate bond together.

- (e) Give **one** structural role of carbohydrates in living organisms.

- (f) Carbohydrates are an important component of the diet.
State **one** dietary source of carbohydrates.

Question 3

3. Study the image below which shows a set of human chromosomes (karyotype). The chromosomes are arranged in homologous sets for analysis (i.e. there are two of chromosome number '1', two of chromosome number '2', and so on). The karyotype shown is from an individual with a genetic condition called Down's syndrome.



- (a) Name the **two** chemical components that make up chromosomes.

- 1.
- 2.

- (b) Is the karyotype shown above from a female or a male?

- (c) Justify the answer you have given at part (b) above.

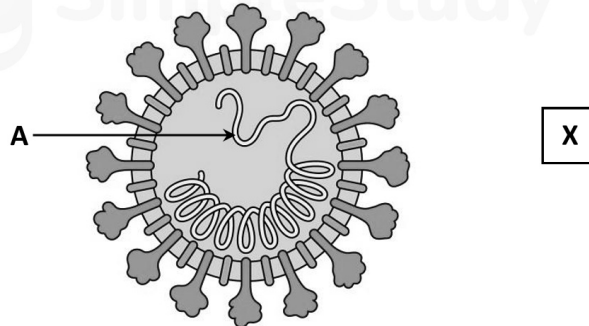
- (d) What evidence is shown in the karyotype that this person has the genetic condition Down's syndrome?

- (e) Sickle-cell anaemia is a condition caused by a different type of mutation than the one responsible for Down's syndrome. Name this other type of mutation.

- (f) Scientific analysis of chromosome karyotypes is an application of tissue culture. Give **one** other application (or use) of tissue culture.

Question 4

7. The diagram below shows the structure of a typical virus, such as SARS-CoV-2 (a type of coronavirus). It is one example of a harmful virus and it causes COVID-19 in humans.



- (a) Name molecule **A**.

--

- (b) Antigens are present in viruses. **On the diagram above**, draw an arrow from 'X' to accurately show the location of an antigen.

- (c) Explain why viruses are described as obligate parasites.

- (d) Vaccination has proved to be very effective in combatting COVID-19. Explain in detail the term *vaccination*.

- (e) Name **one** harmful virus, other than SARS-CoV-2 (coronavirus).

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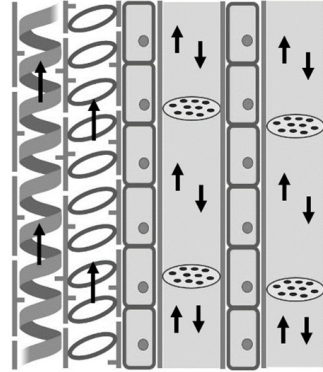
- (f) Give **one** example of a beneficial application of a virus.

Question 5

4. The diagram shows a longitudinal view of xylem vessels **and** phloem in plants.

- (a) Label any **one** structure **on the diagram below** by writing in the box provided **and** draw an arrow from the box to the named structure.

Label:



- (b) To which type of plant tissue do xylem and phloem belong?

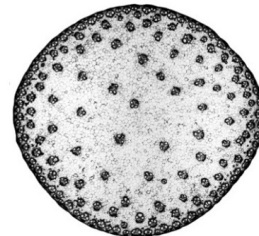
- (c) Give **one** function of xylem.

- (d) Give **one** function of phloem.

- (e) The image shows how the tissue containing xylem and phloem is arranged in a transverse section (TS) of a stem.

- (i) Is this stem a monocotyledonous (monocot) stem or a dicotyledonous (dicot) stem?

- (ii) Justify your answer above.



- (f) State the location of the tissue containing xylem and phloem in a transverse section of a root.

Question 6

Section B

Answer any one question.

Write your answers in the spaces provided.

Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

8. (a) Distinguish clearly between a eukaryotic cell **and** a prokaryotic cell, by writing a brief sentence on **each**.

Eukaryotic:
Prokaryotic:

- (b) A student observed the following images when examining stained cells using a light microscope. Image **A** was observed at x400 and image **B** at x100.

- (i) Which image, **A** or **B**, represents plant tissue?

--

- (ii) Give a reason for your answer at part (b) (i) above.

- (iii) Identify structure **Z**.

--

- (iv) When examining cells with a microscope:

1. Name a stain that can be used.

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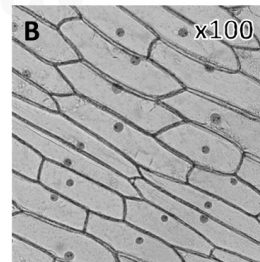
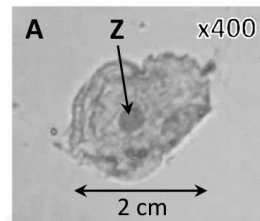
2. Give **one** benefit of using a stain.

--

- (v) The image of the cell in **A** was 2 cm wide. What is the actual width of this cell?

- (vi) Image **B** shows cells at x100.

Describe the steps taken to view these cells at x400.



Question 7

Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

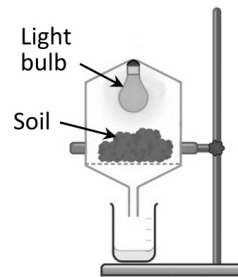
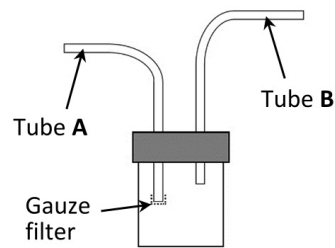
8. (a) Write down the terms that describe each of the following:

(i) The parts of the Earth where life can exist.

(ii) Living factors that have an effect on an ecosystem.

(b) Answer the following questions based on your study of an ecosystem.

(i) Identify the following animal collection apparatus **and** describe how they would be used to collect animals.

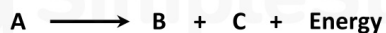


Apparatus:	Apparatus:
How used:	How used:

(ii) As part of your study of an ecosystem, you carried out a quantitative survey of plants. Describe how you carried this out using the percentage cover technique.

Question 8

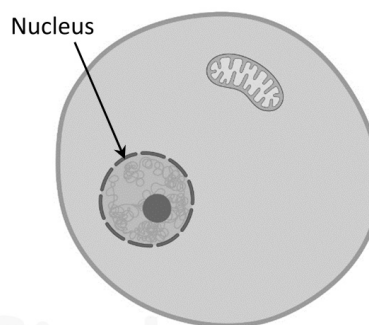
12. (a) (i) Explain the term *metabolism*.
 (ii) Is the reaction shown below an anabolic reaction or a catabolic reaction? Explain your answer.



(9)

- (b) Aerobic respiration is a metabolic reaction that occurs in two stages in living cells.

- (i) Copy the diagram of the cell **into your answerbook** and indicate clearly the specific locations of stage 1 and stage 2.



- (ii) What is the name given to stage 1?
 (iii) Stage 1 ends with the formation of a three-carbon compound. Name this compound.
 (iv) This three-carbon compound is converted into acetyl coenzyme A, which passes into a series of reactions called Krebs cycle where electrons are removed. Describe in detail what happens to these electrons after they are removed.
 (v) ATP is produced during respiration. Copy the following word equation **into your answerbook** and complete the missing parts of the equation.



(27)

- (c) Enzymes are important in all metabolic reactions.

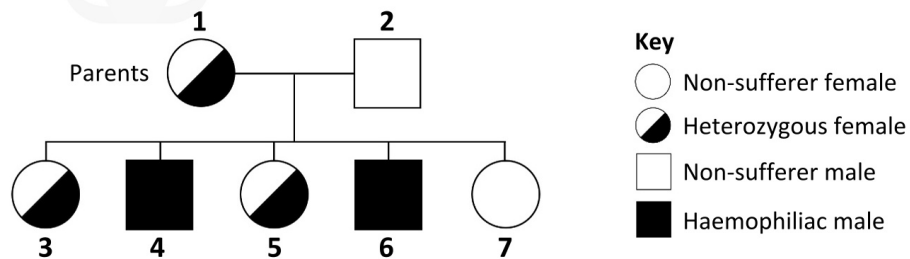
- (i) What is an *enzyme*?
 (ii) Describe in detail the active site theory of enzyme action.
 (iii) Describe what happens to an enzyme if it is overheated.
 (iv) Give **one** example of a catabolic enzyme **and one** example of an anabolic enzyme.

(24)

Question 9

13. (a) (i) Which famous scientist is regarded as the father genetics? (9)
 (ii) State the Law of Segregation.
- (b) Haemochromatosis is an inherited condition where iron levels in the body slowly build up over many years. Classic hereditary haemochromatosis is caused by a gene mutation whereby two recessive alleles are inherited.
- (i) Explain **each** of the underlined terms.
 (ii) Give **one** possible cause of gene mutations.
 (iii) Name another type of mutation **and** give a condition caused by this type of mutation.
 (iv) The letter **H** can be used to represent the dominant allele and the letter **h** can be used to represent the recessive haemochromatosis allele. Using a Punnett square, or a genetic cross, explain how it is possible for two parents, both without haemochromatosis, to have a child who suffers from the condition.
 (v) If the parents have a child without haemochromatosis, how might they check to see if their child was a carrier? (27)

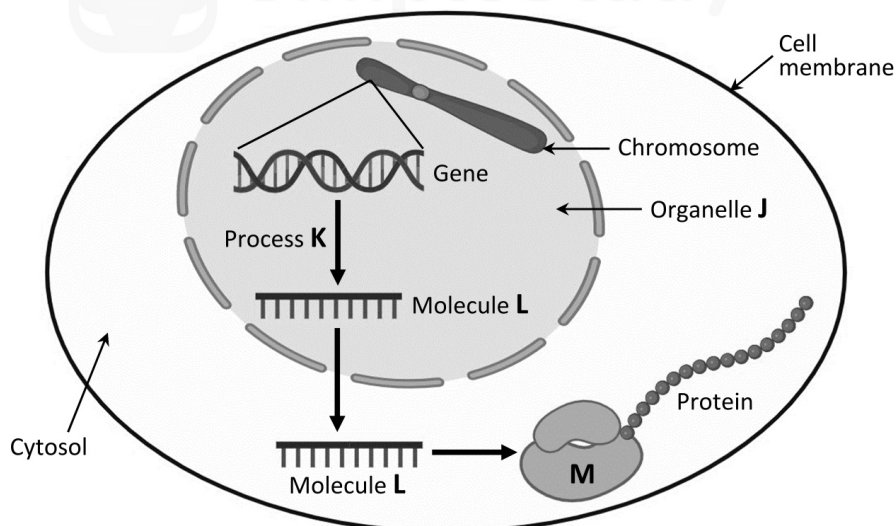
- (c) Haemophilia is caused by a recessive allele (gene mutation) that inhibits the blood's ability to clot. This allele is only found on the X chromosome. The following pedigree chart shows an example of the inheritance of this condition between parents and children.



- (i) What term is used to describe an allele present on the X chromosome?
 (ii) The letter **N** can be used to represent the dominant allele and the letter **n** can be used to represent the recessive haemophilia allele. Draw **two** fully labelled chromosome diagrams (one for each parent) showing the positions of **each** allele. Indicate clearly which is female and which is male.
 (iii) The pedigree chart above shows that two of their male children (persons 4 and 6) suffer from haemophilia. Show, using a Punnett square or otherwise, how it is possible for the parents to have a male child who does **not** suffer from haemophilia.
 (iv) Explain clearly why it would be almost impossible for person 7 to be the parent of a child with haemophilia. (24)

Question 10

13. (a) Nucleic acids are composed of subunits called nucleotides.
Draw **and** label the structure of any **one** nucleotide. (9)
- (b) The diagram illustrates some of the events of protein synthesis.



- (i) What is the name of process **K** that results in the formation of molecule **L**?
 - (ii) Name molecule **L**.
 - (iii) Part of the sequence of nitrogenous bases in the gene is as follows:
Base sequence: **A C G T G C T G A**
Using this sequence, write out in order the complementary sequence of bases found in molecule **L**.
 - (iv) Give the name of the opening through which molecule **L** leaves organelle **J**.
 - (v) Molecule **L** arrives at structure **M** in the cytosol as shown.
 1. Identify structure **M**.
 2. Name the main molecule from which structure **M** is made.
 - (vi) Describe the events that occur at structure **M**, which allow the production of a functioning protein. (27)
- (c) In squash plants, the allele for white fruit (**F**) is dominant to the allele for yellow fruit (**f**). The allele for disc-shaped fruit (**D**) is dominant to the allele for spherical-shaped fruit (**d**). The genes that control fruit colour and fruit shape are located on different chromosomes.
A squash plant, homozygous dominant for both fruit colour and shape, was crossed with a squash plant homozygous recessive for both.
- (i) Explain the underlined terms.
 - (ii) Draw **two** chromosome diagrams (one for each parent) showing the position of **each** allele on homologous chromosomes. Clearly indicate which is homozygous dominant and which is homozygous recessive.
 - (iii) Using a Punnet square, or otherwise, describe the result of this cross. (24)

Question 11

Section C

Answer any three questions.

Write your answers in the answerbook containing Sections A and B.

11. (a) (i) Give **one** precaution scientists use when working with microorganisms in the laboratory.
- (ii) Explain the terms *asepsis* **and** *sterility* as applied to living organisms.
- (9)
- (b) (i) Draw a large labelled diagram of a typical bacterial cell.
- (ii) Many species of bacteria can form endospores.
Describe the main events of endospore formation.
- (iii) Harmful bacteria can cause disease in humans.
1. Give any **two** examples of harmful bacteria.
2. Bacterial infections can be treated with antibiotics.
What is an antibiotic?
3. State **one** possible reason why antibiotic resistance has arisen in bacteria.
- (27)
- (c) Food processing is carried out in a bioreactor using microorganisms, such as bacteria and some fungi.
It can be carried out as batch or continuous flow food processing.
- (i) Give **two** factors that affect the growth of microorganisms, such as bacteria.
- (ii) Explain how either of the factors you named at part (c) (i) above affects growth.
- (iii) Distinguish between batch and continuous flow food processing by writing a brief sentence on **each** type.
- (iv) Sketch a plot of a microorganism growth curve.
Label the axes **and** label the curve with the five phases shown below.
- Note:** the list below is not in the correct order.
- stationary survival log decline lag

(24)