6. Give a brief biological explanation for **each** of the following:

(a) Food chains are limited in length.

(b) There is always competition between members of a species.

(c) Fruit formation by plants.

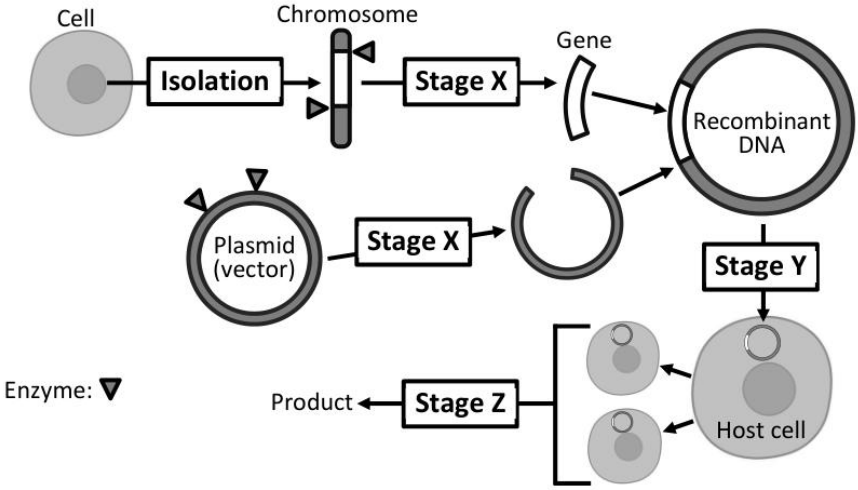
(d) Urine volume will be low if a person does not regularly drink fluids.

(e) Doctors do not prescribe antibiotics for viral infections.

(f) Meiosis halves the number of chromosomes in cells.

(g) The septum separates the two sides of the human heart.

7. Isolation of DNA is the first stage of genetic engineering.
Three of the **other** stages are labelled Stage **X**, Stage **Y** and Stage **Z** in the diagram.



(a) Explain the term *genetic engineering*.

(b) Name **each** stage **X**, **Y** and **Z**.

Stage X:
Stage Y:
Stage Z:

(c) Give **one** application of genetic engineering for **each** of the following:

(i) Plant

(ii) Animal

(iii) Micro-organism

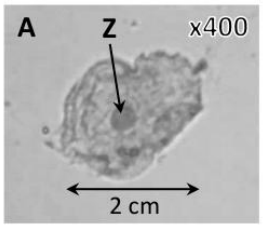
Section B

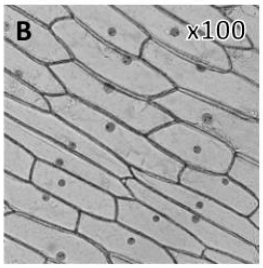
Answer any one question.
Write your answers in the spaces provided.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

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.

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.

11. (a) (i) Distinguish between a food chain and a food web.
Include a clear reference to each in your answer.

(ii) What do ecologists mean by a *pyramid of numbers*? **(9)**

(b) Organisms that are introduced into new environments outside their natural ranges are referred to as exotic species. In some cases these introductions have been deliberate and in other cases accidental e.g. when a species kept in captivity in a new country escapes and gives rise to a wild population. Worldwide, the great majority of deliberate attempted introductions have been unsuccessful.

(i) Suggest a reason for attempting to establish an exotic species in a new country.

(ii) Suggest **two** reasons why the great majority of attempted introductions have been unsuccessful.

(iii) Use your knowledge of the life cycle of flowering plants to suggest how an exotic plant may escape from captivity.

(iv) Use the knowledge that you have gained in your studies of ecology to suggest how the introduction of an exotic species may:
1. impact negatively on an existing community.
2. impact positively on an existing community.

(v) It has been stated that an exotic species has a good chance of becoming established in a new environment if there is a vacant niche.
1. Explain the term *niche* in this context.
2. Do you agree with the above statement?
3. Explain your answer. **(27)**

(c) **Name the ecosystem** which you investigated during your study of ecology.

(i) Explain the terms
1. *Flora,*
2. *Fauna.*

(ii) Name **one** animal from your named ecosystem **and** describe how you carried out a quantitative study of that animal.

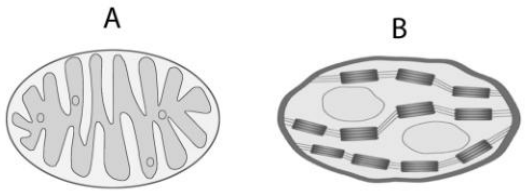
(iii) Suggest **one** way in which marking an animal might endanger it.

(iv) Ecosystems are subject to changes, both natural and artificial.
Mention **one** of **each** type of change as it applies to your named ecosystem. **(24)**

12. (a) (i) From the following list, **write into your answer book** any term that describes the nutrition of a typical plant:

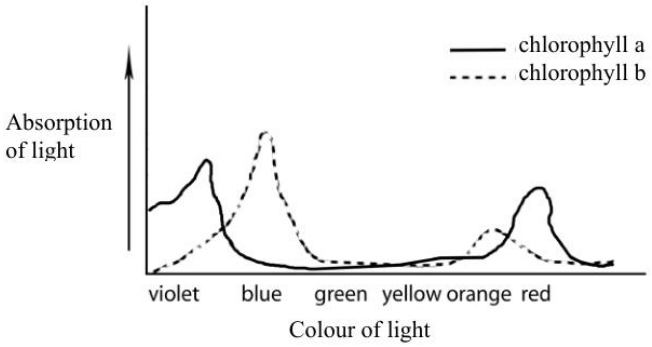
parasitic; heterotrophic; saprophytic; autotrophic.

(ii) Identify, **in your answer book**, the cell organelles A and B.



(9)

(b) Chlorophyll is composed of various pigments.
Two of these pigments are **chlorophyll a** and **chlorophyll b**.
The graph below shows the amount of light of different colours absorbed by chlorophyll a and chlorophyll b.



(i) 1. What **colours** of light are absorbed most by chlorophyll a?
2. What **colour** of light is absorbed most by chlorophyll b?

(ii) What happens to yellow light when it strikes a leaf?

(iii) Suggest **one** possible benefit to plants of having more than one chlorophyll pigment.

(iv) From the information provided by the graph suggest how a commercial grower might try to increase crop yield in his glasshouses or tunnels.

(v) 1. What is the main source of carbon dioxide used by plants in the dark stage of photosynthesis?
2. State **one** role of NADP **and one** role of ATP in the dark stage of photosynthesis.

(27)

(c) Write a brief note on **each** of the following items in relation to respiration.

(i) Glycolysis.
(ii) Acetyl Co-enzyme A.
(iii) Adenosine triphosphate.
(iv) Electron transport chain. **(24)**

5. (a) (i) What is meant by the term *digestion*? _____

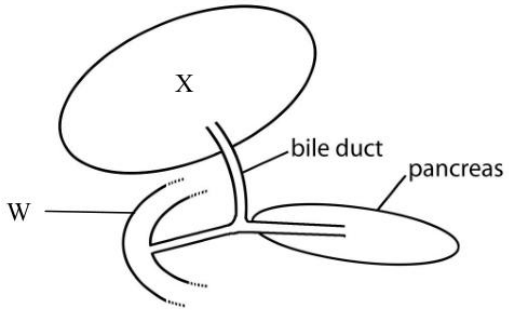
(ii) Why is digestion necessary? _____

(iii) Distinguish between mechanical and chemical digestion by writing a sentence about each.

_____

_____

(b) The diagram shows part of the human alimentary canal and associated structures.



(i) What part of the alimentary canal is labelled W? _____

(ii) The bile duct is connected to X. Name X. _____

(iii) From which part of the alimentary canal does food arrive into W? _____

(iv) State **one** digestive function of the pancreas. _____

2. In relation to the principles of experimentation:

(a) What is meant by the term *hypothesis*?

(b) Explain what is meant by *double-blind testing*.

(c) Explain the necessity for random selection.

(d) Give two other features of good experimental design.

1.

2.

(e) Where are the results of scientific research usually first published?

(f) Why is it important that scientists publish the results of their research?

15. Answer any **two** of (a), (b), (c). **(30, 30)**

(a) (i) Give **one** example of a beneficial effect of bacteria, other than the production of antibiotics, and **one** example of a harmful effect of bacteria.

(ii) Bacteria reproduce asexually.

1. Name the specific method of asexual reproduction used by bacteria.

2. Describe this process of asexual reproduction.

(iii) Penicillin is an example of an antibiotic produced in large quantities using the batch processing method.

1. Describe batch processing.

2. Explain why overuse of antibiotics is potentially dangerous.

(iv) How do certain bacteria survive when environmental conditions become unfavourable?

(b) Give a detailed biological explanation for each of the following.

(i) Bile contains bile salts e.g. sodium hydrogencarbonate ($NaHCO_3$).

(ii) Active immunity results in long-lasting immunity.

(iii) Humans sweat during exercise.

(iv) Antibiotics should not be prescribed to directly treat influenza.

(v) High sugar or high salt concentrations are used in the preservation of food.

(c) (i) In relation to the human eye, name **and** explain the role of each of the following:

1. The fluid that fills the rear chamber.

2. The **two** types of light receptor cells.

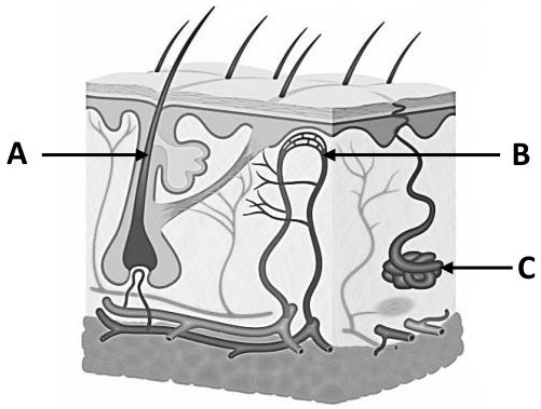
3. The transparent covering in front of the cornea.

(ii) Suggest an advantage to humans of having two eyes.

(iii) Name a disorder of the eye **or** of the ear **and** give a corrective measure for the disorder referred to.

16. Answer any **two** of (a), (b), (c), (d). **(30, 30)**

(a) The diagram shows some parts of the longitudinal section (L.S.) of human skin. The skin is important in excretion and temperature regulation.



(i) Which labelled structure is involved in vasoconstriction?
(ii) Describe in detail the role of vasoconstriction in temperature regulation.
(iii) Which labelled structure is involved in piloerection?
(iv) Which labelled structure is involved in **both** excretion and temperature regulation?
(v) Name the excretory product produced by the structure stated at part (iv) above.
(vi) Humans can generate their own heat and regulate their own body temperature. What name is given to such organisms?
(vii) Name **two** other systems in which the skin has a role.

(b) (i) Draw a large diagram of the reproductive system of the human male.
Label the following parts:

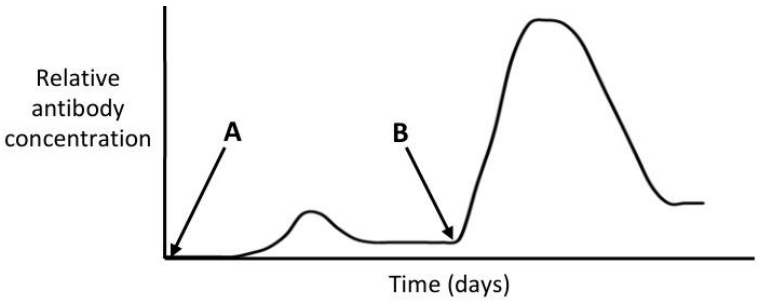
Testis	**Sperm duct**	**Prostate gland**	**Urethra**	**Penis**	**Scrotum**

(ii) Describe the differences between the human male **and** female type of gamete using the following headings:
1. Relative numbers of each produced
2. Frequency of production of gametes
3. Relative size.

(iii) What is meant by secondary sexual characteristics?
(iv) Name the hormone responsible for the development of male secondary sexual characteristics.
(v) Give **one** cause of male infertility.

(c) SARS-CoV-2 is a novel coronavirus which led to a global COVID-19 pandemic in 2020. A race to produce a vaccine began. The vaccine causes an immune response where antibodies are produced.

(i) Mucous membrane linings produce mucus which can help as a physical barrier against the entry of viruses.
Name **two** places in the body where mucus membrane linings are found.
(ii) Give the precise location in the body where lymphocytes are produced.
(iii) Identify the specific type of lymphocyte that produces antibodies.
(iv) Identify **one** type of white blood cell, other than lymphocytes, that is involved in an immune response.
(v) The graph below shows the antibody production after a person receives a vaccine **(A)** and after the same person becomes infected with the virus (**B**).



1. Using the information from the graph, compare the antibody response after receiving the vaccine at **A** with the antibody response after becoming infected with the virus at **B**.
2. Suggest a reason for your answer at part 1. above.

(vi) Identify the part of the virus that is recognised by antibodies.

(vii) Explain why antibiotics are not prescribed to cure COVID-19.

(d) (i) Name the structures located at the end of the breathing tract involved in gaseous exchange.

(ii) State **two** adaptations of the structures named at part (i) above, to increase the efficiency of gaseous exchange.

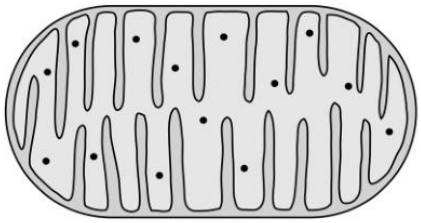
(iii) Identify the gas, soluble in blood plasma, which controls the rate of breathing.

(iv) Identify the region of the human brain which detects the gas you have named at part (iii) above.

(v) How does the breathing system respond to a high level of the gas named at part (iii) above?

(vi) Describe in detail the process of inhalation.

3. Aerobic respiration is a two-stage process.
Stage 2 occurs in the cell organelle shown.



(a) Name the cell organelle shown.

(b) Name the cycle of reactions that occurs in stage 2 of aerobic respiration.

(c) ATP is produced in large quantities by aerobic respiration.
What does ATP stand for?

(d) NAD^+ is an important molecule in respiration.
Give the function of NAD^+.

Anaerobic respiration may occur under certain conditions.

(e) Suggest a condition under which anaerobic respiration might occur.

(f) State where anaerobic respiration occurs in a cell.

(g) Name **one main** product of anaerobic respiration.

10. **(a)** **(i)** To which kingdom of living organisms do yeast belong?

(ii) Working with microorganisms often involves sterility. Explain the term *sterility*.

(b) Answer the following questions in relation to an investigation you carried out to grow leaf yeast.

(i) Describe how you set up the investigation. Include **one** safety precaution. You may include a labelled diagram if you wish.

Describe:

Labelled diagram:

(ii) Describe the result of the investigation, assuming the leaf yeast grew successfully.