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Leaving Certificate Biology
Higher Level Examination Paper

CONTENTS

SECTION A

Answer any five questions.

MARKS: In Q.1 the first two correct answers get 7 marks each; the remaining correct answers get 2 marks each.

1. (a) *Biosphere*: Part of the planet where life can exist
(b) *Niche*: Functional role of an organism
(c) *Biotic factor*: Living factor
(d) *Trophic level*: Feeding stage an organism occupies in a food chain
(e) *Competition*: Struggle between organisms for a resource in short supply
(f) *Symbiosis*: Close association between two organisms of different species where at least one benefits

TIP: There are often two questions on ecology on the biology paper – one in Section A and one in Section C. Statistically, ecology questions are **one of the best answered questions** every year by students. Do not be afraid to attempt them!

MARKS: In Q.2 the first correct answer gets 7 marks; the second correct answer gets 6 marks; and the remaining correct answers get 1 mark each.

2. (a) (i) Catabolism
(ii) *X*: Lipase
Y: Glycerol

(b) (i) *Phospholipid*: Two fatty acids and a phosphate group.
Fat: Three fatty acids.

TIP: A question on food/nutrition always appears in section A.

(ii) Vitamin A OR Vitamin D OR Vitamin E OR Vitamin K
(Marks: Any, 1 point)

TIP: Where space is tight give important key words and phrases rather than full definitions.

(iii) Vitamin A: Night blindness.
Vitamin D: Rickets in children.
Vitamin E: Hair loss, muscle weakness.
Vitamin K: Defective blood clotting.
(Marks: Any, 1 point. Must match answer given in b (ii))

(iv) 1. Formation of bone (magnesium and calcium).
2. Formation of haemoglobin (iron).

MARKS: In questions 3, 4, 5 and 6, the first correct answer gets 8 marks; the second correct answer gets 7 marks; and the remaining correct answers get 1 mark each.

3. (a) *C*: Lymph vessel

(b) *A*: Arteriole

(c) A has a thicker wall than B.

(d) 1. Collect excess tissue fluid and return it to the bloodstream.
2. Maturation of lymphocytes.

(e) Lymph does not have any red blood cells.

(f) Vena cava.

TIP: Questions in recent years have become more abstract, testing an understanding of the topic rather than an answer that can be learned off. Remember this in your study approach!

4. (a) (i) Fungi have cell walls made from chitin.
(ii) Plants have chloroplasts.
(iii) Animals have membrane-bound organelles.
(iv) Protistans have contractile vacuoles.

(b) (i) *Rhizopus*
(ii) Amoeba
(iii) *Escherichia coli*

5. (a) Single-celled organisms use meiosis for asexual reproduction. FALSE

(b) In telophase of mitosis, a cleavage furrow forms in plant cells. FALSE

(c) When a cell is not dividing, it is said to be in prophase. FALSE

(d) The nuclear membrane disappears in the early part of mitosis. TRUE

(e) Centromeres give rise to the nuclear spindle. FALSE

(f) Mitosis is a source of variation. FALSE

(g) In multicellular organisms, mitosis is primarily used for growth. TRUE

6. (a) High energy molecule.

(b) 1. Protein synthesis.
2. DNA replication.

(c) 1. Ethanol.
2. Lactic acid.

(d) Acetyl coenzyme A.

(e) Enters the Krebs cycle to join with a four-carbon compound and is then catabolised fully into carbon dioxide and water.

SECTION B

Answer any <u>two</u> questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) (i) Endosperm OR Cotyledon. **(3)**

(ii) 1. Water. **(1)**
2. Oxygen. **(1)**
3. Suitable temperature. **(1)**

TIP: Always qualify the word 'temperature' by using 'suitable' or 'correct' when naming it as one of the factors required for germination!

(b) (i) 1. To prevent the growth of microorganisms. **(3)**
2. Dipping in ethanol. **(3)**

(ii) Agar. **(3)**

(iii) Starch OR Milk OR Protein. **(3)**

(iv) Boiled seeds. **(3)**

TIP: If you run out of space, place an asterisk at the end and continue in your answer booklet.

(v)
- Added iodine to the dishes;
- Area underneath germinating seeds did not turn blue-black or stayed red-yellow;
- Demonstrating that the starch was digested by the germinating seeds.
OR
- Added Biuret reagent to the dishes;
- Area underneath germinating seeds did not turn purple;
- Demonstrating that the milk/protein was digested by the germinating seeds. **(3 × 3)**

8. (a) (i) Bring the image into focus using the coarse focus wheel. **(3)**

(ii) 0.8/400 = 0.002 mm. **(3)**

TIP: Calculation is required here. Don't forget to bring a calculator to the exam with you!

(b) (i) Swabbed the inside of mouth using a cotton wool bud. **(3)**

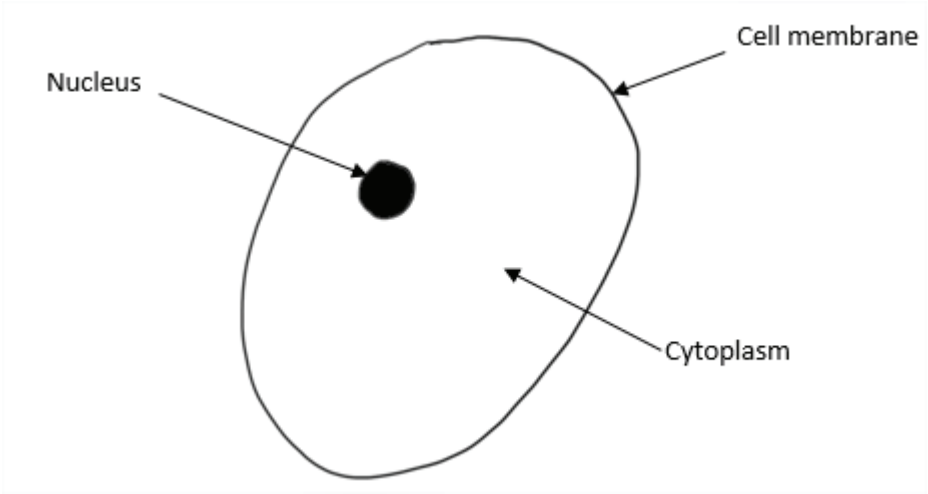
(ii) Methylene blue. **(3)**

(iii) Lowered the coverslip from a 45˚ angle using a mounted needle. **(2 × 3)**

(iv) Protect the lens. **(3)**

(v) • Microscope was set up with the lowest power objective lens in position and the image of the cells on the slide was focused using the coarse focus wheel and the low power lens. **(3)**
• The high power lens was carefully moved into position and the image was focused using the fine focus wheel and the high power lens. **(3)**

(vi)



TIP: Keep diagrams simple. Draw in pencil; colour is not necessary. Always make sure your arrows point to the exact structure you want to label!

Marks: Diagram **(3)**

9. (a) (i) Accidental discovery OR Extent of our basic knowledge. **(3)**
(ii) Scientific journal. **(3)**

(b) (i) 1. Between the right atrium and right ventricle. **(3)**
2. Using a scalpel, an incision was made into the right-hand side of the heart. **(2 x 3)**
3. At the base of the aorta/pulmonary artery. **(2 x 3)**

(ii) 1. Resting pulse OR breathing rate. **(3)**
2. *Measure pulse rate:*
• Felt for pulse on the wrist or neck using index and middle finger;
• Counted the number of pulses for one minute.
OR
Measure breathing rate:
• Observed the number of inhalations and exhalations (one breath);
• Counted the number of breaths in one minute. **(2 x 3)**

TIP: You only have to learn ONE of the experiments mentioned here: either the effect of exercise on pulse rate OR the effect on breathing rate.

SECTION C

Answer any <u>four</u> questions.

TIP: Learn definitions off by heart! Examiners look for key words and phrases in definitions.

10. (a) (i) *Species*: group of similar organisms capable of interbreeding to produce fertile offspring. **(2 x 3)**
(ii) *Gene expression*: using the code in a gene to produce a protein. **(3)**

(b) (i) Protein. **(3)**
(ii) Ribosome. **(3)**
(iii) mRNA. **(3)**
(iv) *Name:* DNA profiling. **(3)**
Procedure:
• Samples of DNA are cut using a restriction enzyme **(3)**
• Fragments of DNA are separated using gel electrophoresis **(3)**
• Pattern of DNA bands from samples are analysed and compared **(3)**

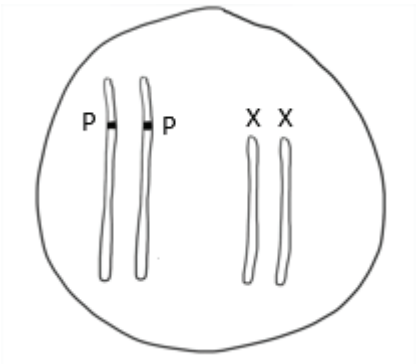
(v) No, pig DNA is different to horse DNA.
OR
Yes, not all the DNA is beef DNA. **(6)**

(c) (i) Heterozygous. **(3)**

(ii) No, because the alleles are not present on the sex chromosomes. **(2 x 3)**

(iii) Polled or hornless. **(3)**
Male. **(3)**

(iv)



(Marks: 2 × 3)

TIP: When drawing the loci of alleles make sure they are opposite one another on homologous chromosomes. Also, be careful when writing the letters, especially when uppercase is the same shape as lowercase.

(v) Birds OR Moths OR Butterflies OR Snakes. **(3)**

11. (a) (i) Hinge. **(3)**

(ii) Tendon. **(3)**

(iii) Muscles that have opposite effects. **(3)**

TIP: Do not get tendon and ligament mixed up! Tendons attach muscle to bone and ligaments attach bone to bone.

(b) (i) Ion. **(3)**

(ii) *How neurotransmitters work:*

- Secreted by pre-synaptic neuron when impulse arrives at synaptic terminal
- Travel across the synaptic cleft
- Received by receptors on the post-synaptic neuron
- Cause another impulse to be created in the post-synaptic neuron
- Broken down by enzymes and reabsorbed into the pre-synaptic neuron **(Any four points: 4 x 3)**

(iii) 1. Cerebellum: Located at the back of the brain.
Cerebrum: Located at the top of the brain. **(3)**

2. *Three functions:*
   - Intelligence. **(3)**
   - Memory. **(3)**
   - Emotion . . . **(3)**

TIP: There are many other functions of the cerebrum that are acceptable here.

(c) (i) Illness that gets worse. **(3)**

(ii) Many genes. **(3)**

(iii) Build-up of protein-based plaques in the brain. **(3)**

(iv) Memory loss. **(3)**

(v) Scans can examine the brain for early detection. **(3)**

(vi) Larger population OR ageing population. **(3)**

(vii) Parkinson's disease . . . **(3)**
Treatment: L-dopa administration OR physiotherapy . . . **(3)**

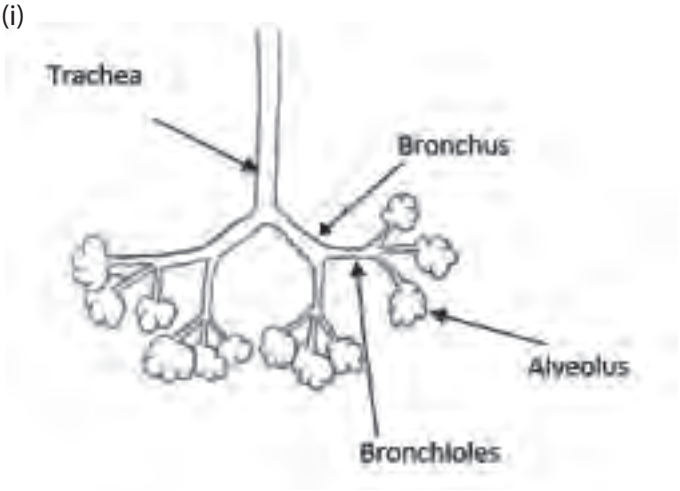
TIP: Read extracts very carefully – they contain many of the answers.

TIP: The nervous system disorder and treatment you give in your answer must match.

12. (a) (i) Lenticels. **(3)**

(ii) Carbon dioxide. **(3)**
Water. **(3)**

(b) (i)



TIP: The question asks for a '**labelled** diagram'. Label it fully! The question also only asks for the respiratory tract. Therefore, you only have to draw the tubes associated with the tract.

TIP: Keep your diagram simple. There is no need to use colour. Label as many structures as possible and ensure the arrow head is pointing exactly at the correct structure.

Marks: Diagram **(6)**
Labels **(3 × 1)**

(ii) *Inhalation:*

- Brain sends a signal to the intercostals and diaphragm
- Intercostals contract
- Rib cage moves upward and outward
- Diaphragm contracts
- Diaphragm moves downward
- Volume of thoracic cavity increases
- Air pressure in the thoracic cavity decreases
- Air rushes in

(Any six points: 6 × 3)

TIP: When describing the events of any biological process use bullet points. It will help you to remember everything and it will help the examiner in their marking!

(c) (i) Mitochondrion. **(3)**

(ii) Wall is one cell thick. **(3)**

(iii) Venous blood has collected carbon dioxide from the body cells that produce carbon dioxide as a result of respiration. **(2 × 3 marks)**

(iv) Pulmonary artery: carries blood high in carbon dioxide to the lungs to be excreted
OR
Pulmonary vein: carries blood from the lungs that has had carbon dioxide excreted **(2 x 3)**

(v) *Role of carbon dioxide:*

- Medulla oblongata senses the amount of carbon dioxide in the blood **(3)**
- High levels of carbon dioxide stimulates increased breathing rate **(3)**

TIP: This is an example of how building a good integrated knowledge of biology is important – the medulla oblongata sensing the levels of carbon dioxide in the blood.

13. (a) (i) Graph A: The rate of reaction decreases as the other factor (x-axis) increases. **(3)**

Graph B: The rate of reaction increases up to a point and then decreases as the other factor (x-axis) increases. **(3)**

TIP: It is very important to be able to read graphs and describe what is happening in them!

(ii) Temperature OR pH. **(3)**

(b) (i) *Enzyme function:*

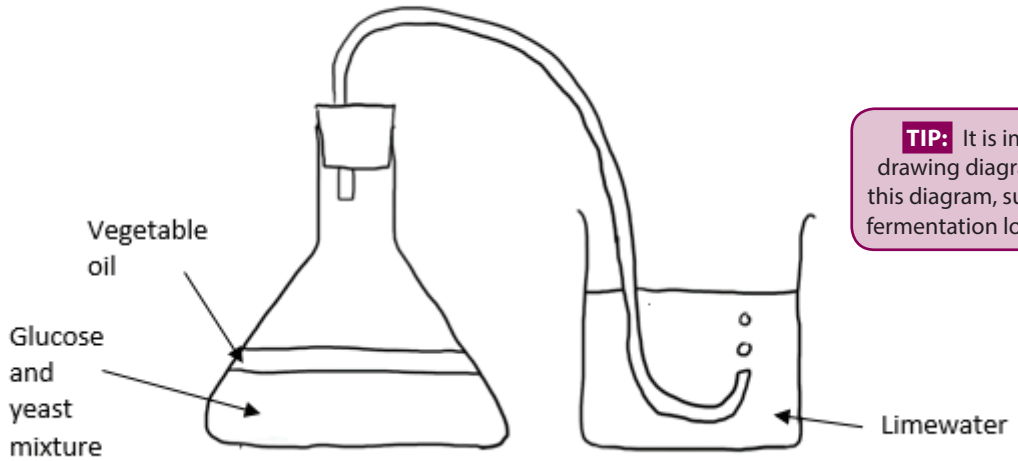
- Enzymes have an active site.
- Enzymes are specific – they bind with only one substrate.
- The enzyme changes the shape of its active site slightly – induced fit.
- An enzyme-substrate complex is formed.
- Product is formed.
- Enzyme and its active site remain unchanged.

(Any four points: 4 × 3)

(ii) Respiration **(3)**
Photosynthesis . . . **(3)**

(iii) 1. To digest and break down food-based stains. **(3)**
2. It is the optimum temperature. **(3)**
3. They would be denatured. **(3)**

(c) (i)



TIP: It is important to practise drawing diagrams. Other versions of this diagram, such as one containing a fermentation lock, are also acceptable.

Marks: Diagram **(3)**
Labels **(3 × 1)**

(ii) They can be reused. **(3)**
There is no contamination of the product by the enzyme. **(3)**

(iii) *Iodoform test:*

- Potassium iodide was added to the filtered product.
- Sodium hypochlorite was added.
- The mixture was heated in a hot water bath.
- Appearance of pale yellow crystals indicated alcohol.

OR

Dichromate test:

- Potassium dichromate was added to the filtered product.
- A few drops of concentrated sulphuric acid was added.
- The mixture was gently heated in a warm water bath.
- The colour change from orange to green indicated alcohol was present.

(Any four points: 4 × 3)

TIP: Spelling in biology is usually not that important, except in a few instances and this is one of them! Learn the correct spelling of the chemicals used in testing for alcohol.

14. (a) (i) 1. Anther. **(3)**
2. Stigma. **(3)**

(ii) Pollination by animals; e.g. by insects. **(3)**
Pollination by wind. **(3)**

(iii) Prevents inbreeding and enables variation amongst offspring. **(3)**

(iv) *Events following pollination:*

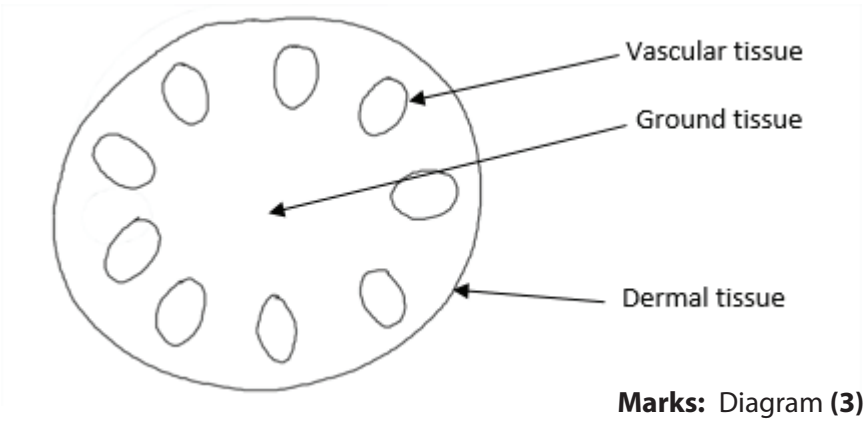
- Pollen tube is formed
- Pollen tube grows down through the style and enters the embryo sac
- Generative nucleus divides by mitosis
- Two male gametes (sperm nuclei) are formed
- One male gamete fertilises the egg cell
- Other male gamete fertilises the polar nuclei in the embryo sac

(Any four points: 4 × 3)

TIP: It is better to write too much than too little but make sure your key words and phrases are used in the correct context!

(v) Ovary. **(3)**

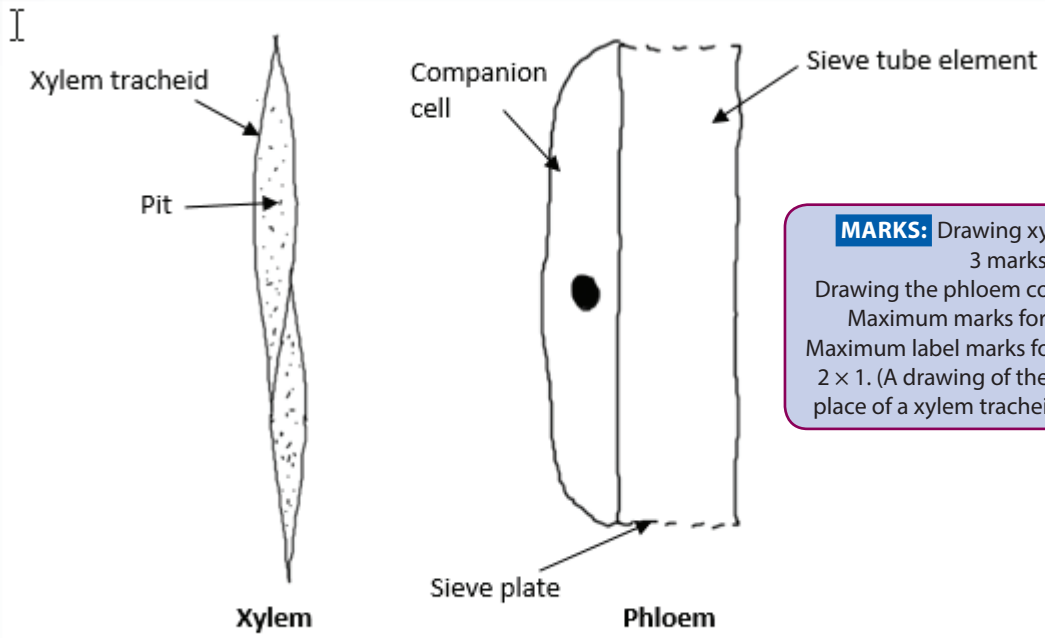
(b) (i)



Marks: Diagram **(3)**
Labels **(1, 1, 1)**

(ii) 1. Vascular tissue. **(3)**
2. Centre of the root. **(3)**
3. Support OR Photosynthesis OR Storage. **(3)**

(iii)



MARKS: Drawing xylem correctly: 3 marks.
Drawing the phloem correctly: 3 marks.
Maximum marks for labels: 3 × 1.
Maximum label marks for either diagram: 2 × 1. (A drawing of the xylem vessel in place of a xylem tracheid is acceptable.)

(iv) Phloem. **(3)**

(v) Growth OR Mitosis. **(3)**

(c) (i) *Water absorption into roots:*

- Water enters root hairs by osmosis **(3)**
- The water concentration outside the root hair (soil) is higher than the water concentration inside the root hair **(3)**
- Water moves cell to cell across the ground tissue of the root into the vascular tissue in the centre of the root **(3)**

(ii) Xylem **(3)**

(iii) *Features:*

- Narrow tubes
- Presence of pits
- Hollow, continuous tube
- Thick wall
- Presence of lignin

(Any two points: 2 × 3)

TIP: There are usually plenty of questions on plant biology so it is worth putting the effort into studying these topics.

(iv) *Names:*

- Root pressure
- Transpiration
- Adhesion
- Cohesion

(Any two points: 2 × 3)

Explanations:

- *Root pressure:* Water absorption into the roots pushes water up the xylem vessels/tracheids.
- *Transpiration:* Water evaporation from the aerial parts of the plant pulls water up the xylem vessels/tracheids.
- *Adhesion:* Water molecules are attracted to the walls of the xylem vessels/tracheids.
- *Cohesion:* Water molecules are attracted to each other, creating a continuous stream of water molecules.

(Any two explanations: 2 × 3)

15. (a) (i) Phytoplankton population:

- Decreases and is low in winter
- Increases and is high in spring
- Fluctuates during the summer
- Increases at the beginning of the autumn and decreases at the end of autumn

(Any three points: 3 × 2)

TIP: When asked to describe a graph, simply state what you see! There is no need to give an explanation as to why it is happening unless you are asked to.

(ii) Nutrient levels are high in winter because plankton numbers are low. **(2)**
Nutrient levels drop sharply in spring because plankton numbers are high. **(2)**
Plankton are absorbing and using the nutrients in spring. **(2)**

(iii) Nitrates . . . **(2)**

TIP: There are a lot of other inorganic nutrients that could be given here as well.

(iv)

TIP: Do what the question asks and draw the zooplankton curve in a dashed line.

TIP: Remember, in a predator-prey relationship such as this one the number of predators is always lower than the number of prey.

- Zooplankton population is lower than phytoplankton population. **(2)**
- Zooplankton population curve matches the phytoplankton population curve. **(2)**
- Zooplankton spring population peak shifted to the right. **(2)**
- Zooplankton autumn population peak shifted to the right. **(2)**

Explanation of the curve drawn:

- Zooplankton prey on and consume phytoplankton.
- Predator population numbers are always smaller than prey population numbers.
- There is a time lag required for predator population numbers to increase after prey population numbers have increased.

(Any two points from explanations: 2 × 2)

(v) Low temperature or Low light intensity. **(4)**

(b) (i) *Capture-recapture technique:*

- Rabbits were captured using mammal traps and the number captured noted
- Rabbits were tagged using a metal band attached to their legs
- Tagging is inconspicuous and does not hinder the movement of the rabbits
- Rabbits were released into the same habitat in which they were caught
- A week later, mammal traps were reset and rabbits were recaptured
- The number of rabbits recaptured and the total number caught was noted
- The following formula was used to calculate the number of rabbits living in the habitat:

$$\frac{\text{Number caught on Day 1 x Number caught on Day 2}}{\text{Number caught on Day 2 that were tagged}} \times 100$$

(Any six points: 6 × 2)

TIP: Learn off this formula. Using it in your practical study of ecology will help you remember it. You don't have to have mammal traps to carry out a capture-recapture study; you can conduct a similar study using snails that you will find quite easily in trees of a woodland or in the long grass of a grassland.

(ii) No predators OR Plenty of food OR Warm climate. **(3)**

(iii) Effects of extinction of a plant species:

- Soil erosion
- Fewer nutrients present
- Siltation
- Decrease in consumer numbers
- Increase in numbers of other plant species **(Any two points: 2 × 3)**

(iv) *Advantage*: No harmful chemicals are used. **(3)**
Disadvantage: Balance of nature is upset. **(3)**

(v) Rabbits developed immunity. **(3)**

(c) (i) *Factors affecting human population:*

- War
- Famine
- Disease
- Contraception
- Birth/death rates
- Natural disasters

(Any three points: 3 × 2)

MARKS: The marking in questions 14 and 15 can be different to other questions. Notice in Question 15 (a) and (c) there are 2 marks for each correct answer, some even have just 1 mark!

(ii) *Increase in human population:*

- Better nutrition OR Better food distribution.
- New technologies OR Better living conditions.
- Advancement of medicine OR Improved hygiene.

(Any two points: 2 × 2)

(iii) Decreases. **(1)**

(iv) Reduce, reuse and recycle. **(3 × 1)**

(v) *Pollution*: Any harmful addition to the environment. **(2)**

(vi) Decomposition. **(2)**

TIP: In part keep (vii) your answer specific to animals and plants. There are no additional marks for naming other organisms involved.

(vii) 1. *Plants:*

- Absorb nitrates from soil
- Synthesise proteins
- Absorbs carbon dioxide
- Synthesises carbohydrates through photosynthesis
- Excrete carbon dioxide via respiration
- Die, releasing carbon and nitrogen-containing nutrients into the soil

(Any three points: 3 × 2)

2. *Animals:*

- Consume plants
- Assimilate amino acids received from plants into animal protein
- Assimilate carbohydrates received from plants
- Produce nitrogenous waste such as urea
- Excrete carbon dioxide via respiration
- Die, releasing carbon and nitrogen-containing nutrients into the soil

(Any three points: 3 × 2)

SECTION A

Answer any five questions.

1. (a) *Starch:* Highly branched polysaccharide made up of repeating units of glucose **(2)**
Glucose: Monosaccharide with the formula $C_6H_{12}O_6$ **(2)**

(b) *Amino acids:* Nitrogen-containing monomers of which there are 20 different types and they are the building block of proteins. **(2)**
Proteins: Folded biomolecules composed of up to 20 different types of amino acids. **(2)**

(c) *Cellulose:* Unbranched polysaccharide composed of repeating units of glucose. **(2)**
Keratin: Fibrous protein that contributes to the structure of skin, hair and nails. **(2)**

(d) *Enzymes:* Folded, globular, protein catalysts. **(2)**
Hormones: Chemical Messenger. **(2)**

(e) *Biuret test:* A test for protein. **(2)**
Benedict's test: A test for reducing sugar. **(2)**

(f) *Fats:* Solid lipids at room temperature. **(2)**
Oils: Liquid lipids at room temperature. **(2)**

TIP: The amount of space provided is insufficient for a full definition. Hence, all that is required here is important key words and phrases rather than full definitions.

MARKS: There are a maximum of 20 marks available for Question 1. Marks will be awarded to the best five answers.

2. (a) Beginning. **(3)**

(b) Primary consumers. **(3)**

(c) Because only 10% of the energy is transferred between trophic levels of food chains. **(3)**

(d) That the organisms at the start are larger. **(3)**

(e) (i) No. **(3)**
(ii) Parasites live on other organisms. They are not producers. **(3)**

(f) Heat. **(2)**

TIP: There are often two questions on ecology on the biology paper – one in Section A and one in Section C. Statistically, they are often the best answered questions every year by students. Do not be afraid to attempt them!

3. (a) X **(3)**
Because the temperature remains the same despite a change in environmental temperature. **(3)**

(b) Endotherms. **(3)**

(c) Respiration OR Metabolism. **(3)**

(d) The dog's activity is independent from the environmental temperature. **(3)**

(e) Ectotherms. **(3)**

(f) Environmental heat OR the Sun **(2)**

TIP: Always read any graphs very carefully before answering the questions. Graphs very often confuse students!

4. (a) 1. As the 'runner' has a leaf. **(3)**
2. Presence of many vascular bundles. **(3)**

(b) Vegetative propagation. **(3)**

(c) Diploid. **(3)**
As the new plant forms directly by mitosis from the parent plant. **(3)**

(d) Presence of the strawberry fruit. **(3)**

(e) Grafting OR Layering OR Cuttings OR Micropropagation. **(2)**

TIP: Questions in recent years have become more abstract, requiring an understanding of the topic rather than an answer that can be learned off by heart. Remember this when you are doing your revision!

5. (a) (i) *Selective permeability:* the ability of a membrane to allow some substances to pass through whilst preventing others.

(ii) The cell can allow required substances in and prevents substances that are not required from entering.

(iii) Oxygen and water.

(b) (i) Pressure of the contents of the cell against the cell wall.

(ii) Large central vacuole.

(iii) Turgor gives the plant support, allowing it to stand upright.

MARKS: The first two questions answered correctly are worth 1 mark each. The third correct answer is worth 8 marks. The fourth correct answer is worth 6 marks. Further correct answers are worth 1 mark each.

6. (a) (i) Complementary means one base matches with another specific nitrogenous base.

(ii) 1. Uracil.
2. Guanine.

(iii) Ribose.

(iv) Phosphate.

MARKS: The first two questions answered correctly are worth 1 mark each. The third correct answer is worth 8 marks. The fourth correct answer is worth 6 marks. Further correct answers are worth 1 mark each.

(b) (i) Messenger.

(ii) RNA is single stranded; DNA is double stranded OR RNA has the sugar ribose; DNA has the sugar deoxyribose.

(iii) RNA polymerase synthesises RNA.

SECTION B

Answer any <u>two</u> questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

TIP: Notice how part (a) of all questions in Section B asks for definitions or is related to definitions.

7. (a) (i) *Habitat:* the place where an organism lives. **(3)**

(ii) *Ecosystem:* a community of organisms that interact with their environment. **(3)**

(b) *Ecosystem:* Woodland OR Rocky seashore.

(i) *Abiotic factor:* Wind speed. **(3)**
Measured at a number of different locations in the habitat using an anemometer. **(3)**

(ii) Animal identification key. **(3)**

(iii) By throwing a pencil over the shoulder and then placing the quadrat down at the location the pencil landed. This was repeated a number of times. **(3)**

(iv) *Animal:* Snail.
Adaptation: Shell for protection. **(3)**
Plant: Nettle.
Adaptation: Stinging hairs to protect from herbivores. **(3)**

TIP: In part (b) there are other possible correct answers.

(v) Fox. **(3)**

(vi) Hare OR Rabbit. **(3)**

8. (a) (i) Product. **(3)**

(ii) The conditions under which an enzyme works best. **(3)**

(b) (i) *Enzyme:* Catalase. **(3)**
Substrate: Hydrogen peroxide. **(3)**

TIP: The solution given here for (b) (ii) describes the experiment in full detail. However, you will not be expected to give this much detail in the exam. If you run out of space on the paper, simply place an asterisk at the end and carry on in your answer booklet.

MARKS: In (b) (ii) there is a maximum of 5x3 marks. This means that 5 key pieces of information need to be provided in your answer. You must supply as many key points as possible to ensure you get the full 15 marks!

(ii)
- Celery (containing the enzyme catalase) was finely chopped.
- Equal amounts were put into two graduated cylinders along with equal amounts of pH 7 buffer to maintain the pH at 7.
- One of the graduated cylinders was placed in a boiling water bath for 20 minutes to denature the enzyme.
- The other was not exposed to any heat (control).
- The graduated cylinder that was heated was then allowed to cool so that both cylinders were at the same temperature.
- One drop of washing up liquid was placed into each graduated cylinder.
- Equal amounts of hydrogen peroxide were added to both graduated cylinders and a stop watch was started.
- Froth was produced in the unboiled cylinder whereas no froth was produced in the boiled cylinder.
- The activity of the enzyme was measured by recording the volume of froth produced after 1 minute and again after 2 minutes.
- The difference between these two values was taken as the activity of the enzyme.

(iii)

MARKS: Drawing the graph correctly **(3)**. Note that there are other ways in which the data from the experiment can be expressed graphically.

9. (a) (i) Double-blind testing enables the experimenter to ensure that there is no bias on the part of the medical practitioner administering a particular drug to a patient.

OR

Double-blind testing allows for fair testing. **(3)**

(ii) A hypothesis is an educated guess based on an observation; a theory is a hypothesis supported by experiments. **(3)**

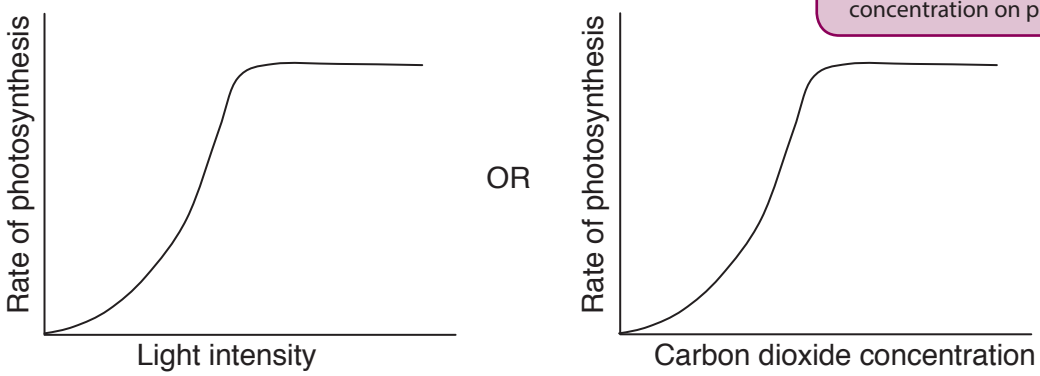
(b) (i) 1. *Light intensity:* varied by moving the light nearer to the pondweed

OR

Carbon dioxide concentration: varied by dissolving various amounts of sodium hydrogen carbonate (sodium bicarbonate) in pond water. **(3)**

TIP: You only have to learn ONE of the experiments mentioned here – either the effect of light intensity on photosynthesis OR the effect of CO_2 concentration on photosynthesis.

2.



(3)

(ii) 1. Visking tubing was used as it is a selectively permeable membrane. **(3)**

2. Osmosis was shown to have occurred by measuring the masses of each Visking tube. The control stayed the same mass. The tubing with a concentration gradient showed an increase in mass due to water moving into the tube by osmosis. **(3)**

(iii) 1. Iodine; yellow. **(3)**

2. Using a dropper. **(3)**

(iv) 1. By dissolving starch in nutrient agar. **(3)**

2. By boiling the seeds for the control plate. **(3)**

SECTION C

Answer any four questions.

10. (a) (i) Endocrine gland. **(3)**

(ii) They are ductless. **(3)**

(iii) Because the pancreas is both an endocrine and an exocrine gland. **(3)**

(b) (i) Protein. **(3)**

(ii) Named hormones: Thyroxine **(2)** and Growth hormone **(2)**
Thyroxine is secreted by the thyroid gland which is located in the neck. **(2)**
Growth hormone is secreted by the pituitary which is located at the base of the brain. **(2)**
Thyroxine functions in controlling the rate of metabolism. **(2)**
Growth hormone functions in causing an increase in length and size of bones and muscles. **(2)**

(iii) 1. *Thyroxine:* deficiency symptom is goitre (swelling in the neck) and weight gain.
OR
Growth hormone: deficiency symptom is short stature. **(2)**

2. *Thyroxine:* symptom of excess secretion is weight loss and irritability.
OR
Growth hormone: symptom of excess secretion is large hands and feet along with being extremely tall. **(2)**

3. *Thyroxine:* example of a corrective measure for deficiency is to take iodine tablets OR thyroxine tablets.
OR
Growth hormone: example of a corrective measure for deficiency is growth hormone injections.
OR
Thyroxine: example of a corrective measure for excess secretion is surgery to remove part of the thyroid gland.
OR
Growth hormone: example of a corrective measure for excess secretion is surgery to remove part of the pituitary gland. **(2)**

TIP: Thyroxine and growth hormone are the two hormones described here; however, there are many other hormones that you could describe.

(iv) Hormonal responses are slower than nervous responses because hormonal responses are chemical messages that have to travel in the bloodstream to reach their target. **(3)**
Nervous responses are electrical messages that travel directly to an effector through a neuron at very high speeds. **(3)**

(c) (i) 1. Plant regulators are chemical messengers that travel around the plant in the vascular system. **(3)**
2. Plant regulators are produced in one area of the plant and act in another area. **(3)**

(ii) Auxin **(3)**
Meristems of plants **(3)**

(iii) Vascular bundles **(3)**

(iv) 1. Auxins used in producing seedless fruits. **(3)**
2. NAA (naphthalene acetic acid) is used as a rooting powder in the process of growing cuttings. **(3)**

(v) Abscisic acid OR Ethene. **(3)**

11. (a) (i) Palaeontology. **(3)**

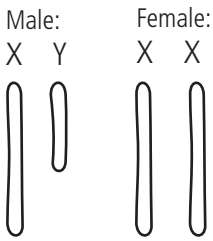
(ii) Fossil records show a detailed history of the timeline of evolution and how organisms have adapted and changed over millions of years. **(2 × 3)**

TIP: There are other correct answers for part (a). Make sure your outline of the evidence in part (ii) matches your answer to part (i).

(b) (i) Sex chromosomes. **(3)**

TIP: Remember the Y chromosome is shorter than the X chromosome!

(ii) **(2 × 3)**



(iii) *Punnett square:*

Male parent (XY)

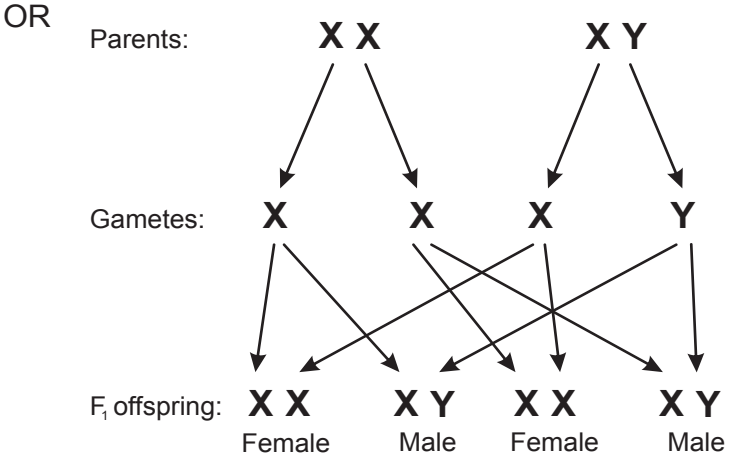
Gametes:	X	Y
X	X X	X Y
X	X X	X Y

Female parent (XX)

MARKS:
Available Marks: **(9)**
Genotypes: **(3)**
Arrows/Punnet Square 'Cross': **(3)**
Genotypes of offspring: **(3)**

F_1 offspring are in the ratio of 1:1. That is, there is an equal chance that the child will be male or female.

OR



TIP: The phrase '…or otherwise' means you can answer the question without a Punnett square if you prefer.

F_1 offspring are in the ratio of 1:1. That is, there is an equal chance that the child will be male or female.

(iv) 1. Sex linkage is where genes are present on a sex chromosome. **(3)**

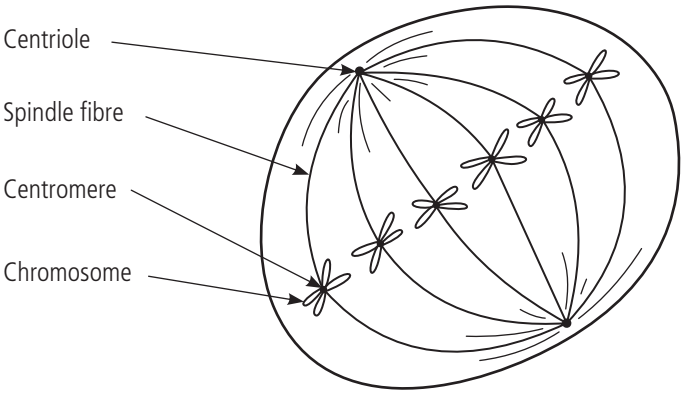
2. Colour blindness. **(3)**
Haemophilia. **(3)**

(c) (i) Interphase. **(3)**

(ii) Gene expression OR Protein synthesis OR Respiration. **(3)**

TIP: Note that the question asked for a 'labelled diagram'. Label it fully!

(iii)



TIP: Questions that involve drawing chromosome diagrams can be confusing. To remember how many chromosomes to draw at metaphase or anaphase of mitosis just double the diploid number and draw them in pairs! So here, 2n = 6. Therefore, you have to draw 6 pairs of chromosomes.

MARKS:
Diagram: **(6)**
Labels: **(3 × 1)**

(iv) 1. Spindle fibres: pull the chromosomes to the poles of the cell during anaphase. **(3)**

2. Spindles fibres are composed of contractile proteins that contract and shorten, thereby pulling on the chromosomes. **(3)**

(v) Cancer. **(3)**

12. (a) (i) Viruses are composed of a piece of nucleic acid (DNA or RNA) and a protein coat.
OR
Many viruses have a lipid bilayer surrounding their protein coat. **(3)**

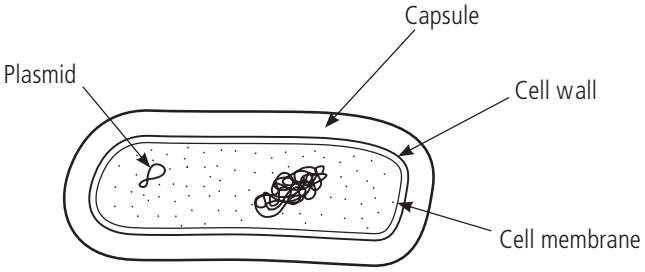
(ii) Because they can only replicate themselves with the help of a host cell. **(3)**

(iii) Viruses are used in genetic engineering. **(3)**

(b) (i) Monera. **(3)**

TIP: Remember that bacteria belong to Kingdom Monera. Many students get confused between Kingdom Monera and Kingdom Protista!

(ii)



TIP: Keep your diagram simple. There is no need to use colour. Make sure you label each of the structures asked for and ensure the arrow head is pointing exactly at the correct structure.

MARKS: Diagram: **(5)**
Labels: **(4 × 1)**

(iii) 1. Harsh conditions OR Unfavourable conditions OR Lack of water OR Lack of nutrients. **(3)**

2. Endospore formation: **(6)**
- Asymmetrical binary fission occurs without the cell splitting in two
- The larger cell engulfs the smaller cell
- The cytoplasm shrinks
- A cortex (thick wall) forms around the cell
- An outer coat forms around the cortex – it is then called an endospore
- Endospore is released.

TIP: A total of 6 marks is available **(2 × 3)**. Therefore, two pieces of information are required. However, write down as many key points as possible.

(iv) 1. Parasitic. **(3)**
2. Saprophytic. **(3)**

(c) (i) *Antibodies:* proteins produced by lymphocytes in response to the presence of an antigen.
Antibiotics: chemicals produced by microorganisms that prevent the growth of, or kill, other microorganisms. **(4 × 3)**

MARKS: In c (i) a total of 12 marks are available for both definitions. You could have 9 from one definition and 3 from the other or simply 6 from each.

(ii) *Active immunity:* the production of antibodies by lymphocytes in response to a specific antigen. **(3)**
Passive immunity: the transfer of antibodies from one organism to another. **(3)**

TIP: Learn off definitions!

(iii) Antibiotics are used frequently in hospitals. Antibiotic-resistant bacteria are more likely to be found within the hospital environment. **(3)**
Patients in hospital generally have weaker immune systems and are therefore more likely to pick up a bacterial infection in hospital. **(3)**

13. (a) (i) Secondary sexual characteristics. **(3)**
(ii) Puberty. **(3)**
(iii) Testosterone. **(3)**

(b) (i) A: Vagina **(1)**
B: Uterus/Womb **(1)**
C: Endometrium **(1)**
D: Fallopian tube/Oviduct **(1)**
E: Ovary **(1)**
F: Cervix **(1)**

TIP: Practise drawing diagrams regularly as it will help you to remember all the various structures for questions such as this.

(ii) 1. Meiosis occurs: E **(3)**
2. Zygote formation: D **(3)**
3. Implantation: C **(3)**

(iii) *Oestrogen:* Repairs the endometrium
Inhibits FSH
Stimulates LH **(Any two: 2 × 3)**
Progesterone: Maintains the endometrium
Inhibits FSH
Inhibits LH **(Any two: 2 × 3)**

(c) (i) Mitosis. **(3)**
(ii) Blastocyst. **(3)**
(iii)
- Transfer nutrients and antibodies from mother to foetus.
- Secrete progesterone.
- Acts as a barrier against entry of bacteria, viruses and many toxins. **(Any two: 2 × 3)**

(iv) Breaking of the waters OR Uterine contractions. **(3)**
(v) The birth process is divided into three stages:
1. Labour: the uterus begins to contract (caused by the hormone oxytocin). Uterine contractions cause the amniotic sac to break releasing the amniotic fluid ('breaking of the waters'). The contractions also cause the cervix to widen to allow for the next stage. **(3)**
2. Parturition: involves the baby being passed out of the birth canal head first. Once the baby has been born, the umbilical cord is clamped and cut. **(3)**
3. Afterbirth: the final stage of labour involves further contractions of the uterus to expel the placenta. **(3)**

14. (a) (i) Light stage **(3)**

(ii) 1. A photosystem (collection of chlorophyll molecules) is energised by sunlight and high energy electrons are released. They pass along a series of electron acceptors releasing energy and finally go back to chlorophyll. **(2 × 3)**

2. A photosystem is energised by sunlight and high energy electrons are released. They pass along a series of electron acceptors releasing energy with ATP being formed using this energy. The electrons are passed onto another photosystem where they are re-energised by sunlight and captured by the electron acceptor, $NADP^+$, which becomes $NADP^-$. Protons are attracted to this electron acceptor. NADPH is formed as a result. The chlorophyll that lost its electrons splits water. Electrons released by the splitting of water are taken up by the first photosystem. Oxygen gas and protons are also released through the splitting of water. Oxygen is released into the atmosphere. Protons are stored in the proton pool of the chloroplast. **(2 × 3)**

TIP: This question involves a lot of writing. In general, it is better to write too much than too little but keep it relevant and ensure you include as many key words and phrases in the correct contexts!

(iii) Dark stage OR Calvin cycle OR light independent stage. **(3)**

(iv) Because it does not require the direct input of sunlight. **(3)**

(v) Because the products of the light stage (NADPH and ATP) are used in the dark stage. **(3)**

(vi) NADPH and ATP enter the stroma of the chloroplast where they are used to convert carbon dioxide to glucose. **(3)**

NADPH supplies the protons and electrons necessary to reduce the carbon dioxide. Energy is supplied by ATP. **(3)**

(b) (i)
- Metabolism is the sum of all chemical reactions in an organism.
- Metabolism is controlled by enzymes.
- Anabolism is the building up of large molecules from smaller molecules using energy (e.g. protein synthesis).
- Catabolism is the breaking down of large molecules into smaller molecules with the release of energy (e.g. respiration). **(4, 3, 3)**

MARKS: In each part of (b) the first correct piece of information obtains 4 marks with the second and third pieces of information getting 3 marks each.

(ii)
- Krebs cycle is part of the second stage of respiration.
- It occurs in the matrix of the mitochondrion and is oxygen-dependent.
- It involves a cycle of chemical reactions beginning with acetyl-CoA that is converted to a six-carbon molecule.
- This is broken down in a series of catabolic reactions producing ATP, carbon dioxide and high energy protons and electrons. **(4, 3, 3)**

(iii)
- ADP: stands for adenosine diphosphate.
- It is a low energy molecule.
- It is converted to ATP by the addition of energy and an inorganic phosphate. **(4, 3, 3)**

(c) (i) Fermentation is anaerobic respiration. **(3)**

(ii) Yeast. **(3)**

(iii) Fungi. **(3)**

(iv) Glucose. **(3)**

TIP: Practise drawing diagrams regularly as it will help you to remember all the various structures for questions such as this.

(v) 1. *Bioprocessing:* use of living cells, or their components (such as enzymes), to make useful products or carry out useful procedures. **(3, 3)**

Immobilised: a cell or cell component that is attached to or trapped in a gel or similar insoluble material. **(3)**

2. Advantage: cells do not contaminate or become mixed in the product OR can be reused. **(3)**
3. Sodium alginate. **(3)**
4. Bioreactor. **(3)**

15. (a) (i) Finches OR Sparrows.
Blood-sucking mites. **(3)**

TIP: 'Ectoparasite' is not mentioned anywhere in the biology syllabus, but it is still possible to deduce what it is from reading the passage. Please be aware that these type of questions can be and are asked at Higher Level!

(ii) *Ectoparasite:* organism that lives on the outside of an organism (host) causing that organism harm. **(3, 3)**

(iii) Infection OR death. **(3)**

(iv) Act as bedding for the birds and chicks OR Act as a good insulator from environmental conditions. **(3)**

(v) Attracts pollinators OR Warns off herbivores. **(3)**

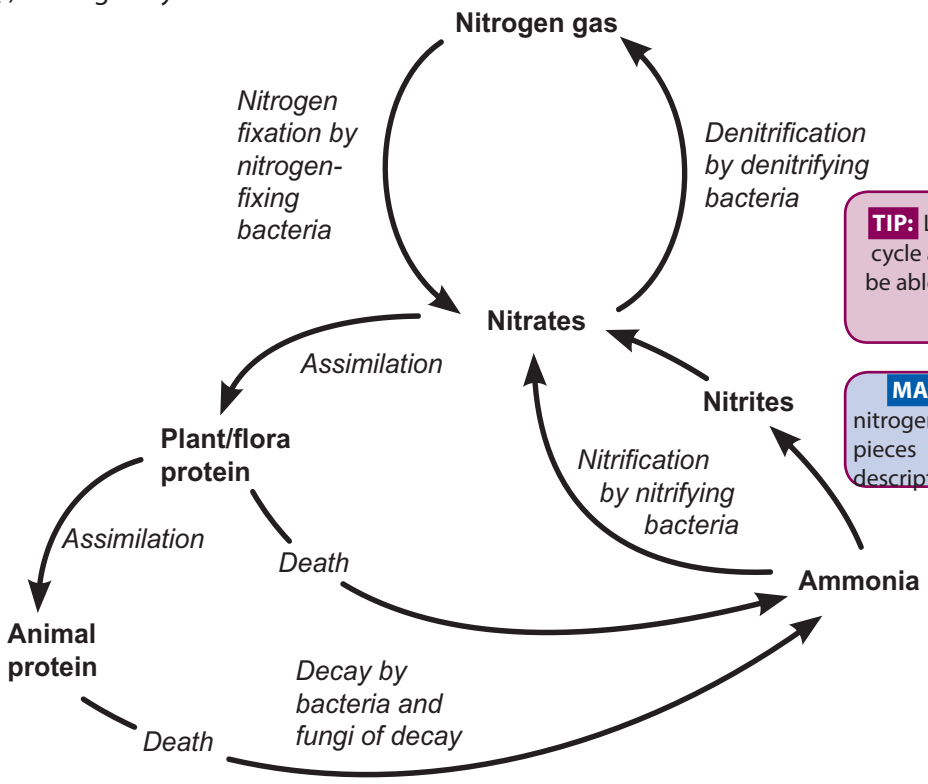
(vi) Nicotine OR Tar. **(3)**

(vii) Remove the fibre and measures its mass using digital scales. **(3)**

(viii) To act as a control to see if it was used cigarette filters that were keeping mites away or just the cigarette filter fibres. **(3)**

(ix) Because they did not contain nicotine, which keeps mites away. **(3)**

(b) (i) Nitrogen cycle



TIP: Learn off the diagrams of the carbon cycle and nitrogen cycle. You should then be able to answer any individual questions asked about either cycle.

MARKS: There are 6 x 2 marks for the nitrogen cycle. You must include six key pieces of information in your diagram/description.

(ii) 1. Both cycles involve death and bacteria and fungi of decay. **(2)**
2. Both cycles involve assimilation of biomolecules into the bodies of organisms from other organisms. **(2)**

TIP: This question asked for 'biological similarities' so make sure your examples involve biological rather than chemical similarities.

(iii) It allows for observation of changes in our environment and ways in which we can remedy changes. **(2)**

(iv) 1. *Contest competition* is a direct fight between two organisms for a resource that is in short supply with one organism obtaining all of the resource. **(2)**

Scramble competition is the struggle amongst a number of organisms for a resource with each organism obtaining a small amount of the resource. **(2)**

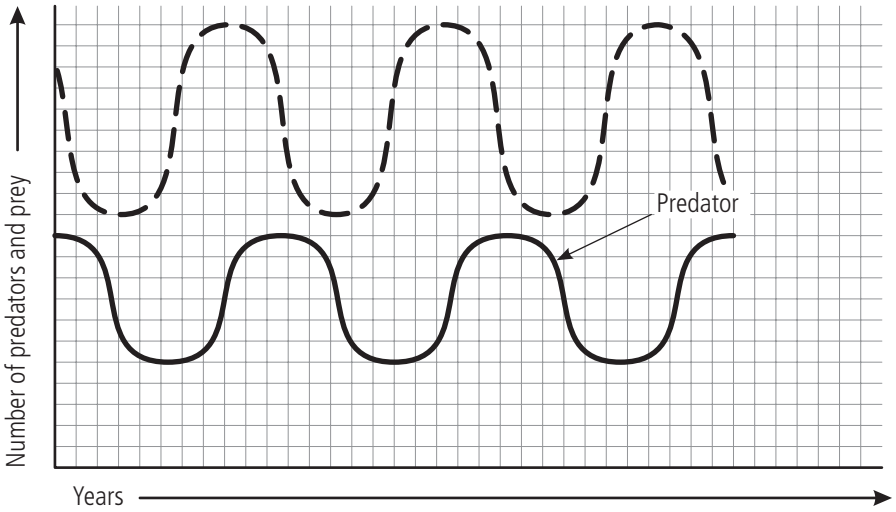
2. *Edaphic:* factors associated with the soil or the geology of the land. **(2)**

Aquatic: factors associated with water environments. **(2)**

3. *Climate:* long-term environmental conditions. **(2)**

Weather: short-term atmospheric conditions. **(2)**

(c) (i)



MARKS: There are 3 marks for placing the 'prey' graph above the 'predator' graph; and another 3 marks for drawing the two graphs out of sync.

TIP: When copying a graph from the paper into your answer book, use a pencil so that you can erase any mistakes rather than having to write it out numerous times.

(ii)
- Prey numbers increase whilst predator numbers are at their lowest or decreasing.
- There is also always more prey than predators.
- Numbers of prey will also change to a greater extent than the numbers of predators.

(Any two: 2 × 3)

(iii) No.

Explanation: The graph of the number of parasites would be above the graph representing the number of host organisms. This is because there will be more parasites than hosts. As the numbers of hosts increase, the numbers of parasites will also increase very quickly. **(3)**

(iv) Parasites control host population sizes. **(3)**

(v) 1. *Song Thrush.* **(3)**
Fox. **(3)**

2. *Song Thrush:* picks up snails and smashes them against rocks to get at the body of the snail (behavioural adaptation). **(3)**
Fox: nocturnal – only searches for prey at night (behavioural adaptation). **(3)**

TIP: The final question asks you to give 'one adaptive technique'. This refers to behavioural adaptations so make sure you do not give physical adaptations. Ensure your adaptations match your answers for predators.

SECTION A

Answer any five questions.

1. (a) Glucose OR Fructose OR Galactose

(b) $C_6H_{12}O_6$

(c) Starch OR Amylose (if answer to (a) is *glucose*)
OR
Fructan (if answer to (a) is *fructose*)
OR
Galactan (if answer to (a) is *galactose*)

(d) Amino acids contain nitrogen OR Amino acids contain an amine ($–NH_2$) group OR Amino acids contain a carboxyl (–COOH) group.

(e) Carbohydrates and fats both contain the elements carbon, hydrogen and oxygen.

(f) Different fats contain different fatty acids OR Some fats are phosphorylated.

TIP: Question 1 has always been on Food & Nutrition!

TIP: Always try to write down the most obvious answer! It generally makes the subsequent questions easier if they are linked to the original question!

TIP: Your answer in part (d) must match and be relevant to your answer in part (c).

MARKS: The first two correct answers are worth 7 marks each, further correct answers are worth 2 marks each to a maximum of 20 marks.

2. (a) (i) A tissue is a group of similar cells that carry out the same or similar function.

(ii) Muscle OR Connective OR Nervous OR Epithelial

(iii) Movement (if answer to (ii) is *muscle*)
OR
Support OR Movement OR Transport (if answer to (ii) is *connective*)
OR
Carry/generate electrical impulses (if answer to (ii) is *nervous*)
OR
Protection OR absorption of nutrient (if answer to (ii) is *epithelial*)

(iv) Contractile proteins are present (if answer to (ii) is *muscle*)
OR
Contain strong, fibrous collagen fibres (if answer to (ii) is *connective*)
OR
Very long cells OR Possess axons and dendrites OR Ability to transfer electrical impulses to other cells at synapses (if answer to (ii) is *nervous*)
OR
Water proof OR Thin layer (if answer to (ii) is *epithelial*)

TIP: Your answers in parts (iii) and (iv) of this question must match and be relevant to your answer in part (ii).

(b) (i) Tissue culture is the growing of tissue and/or cells outside an organism.

(ii) 1. Cancer research.
2. Skin grafting.

MARKS: The first question you answer correctly is worth 8 marks, the second question you answer correctly is worth 7 marks, further correct answers are worth 1 mark each, to a maximum of 20.

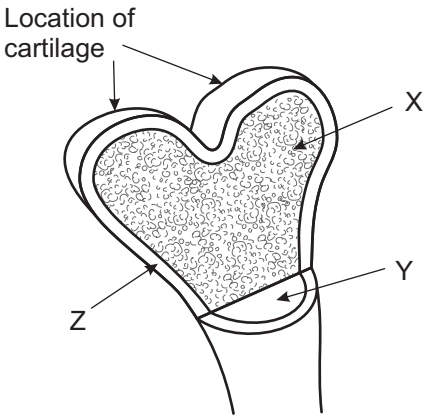
3. (a) (i) Femur OR Humerus OR Ulna OR Radius OR Tibia OR Fibula.

(ii) X: Spongy bone
Y: Bone marrow
Z: Compact bone

(iii) Strength OR Lowers the density of the long bone.

(iv) Production of blood cells OR Stores fat.

(b) (i)



TIP: Do NOT forget to answer questions that involve writing something onto a diagram!

(ii) Friction free movement OR Shock absorption

MARKS: The first two questions answered correctly are worth 7 marks each, any further correct answers are worth 1 mark each.

4. (a) (i) Conservation is wise management of our existing natural resources (habitats and endangered species).

(ii) To allow species to reproduce and develop OR To prevent species from becoming extinct.

(b) (i) Pollution is any harmful addition to the environment.

(ii) *Pollutant*: Methane OR Mercury OR Carbon dioxide released as a result of combustion OR Sulfur dioxide.

Effect: Global warming (if answer above is either *Mercury* or *Carbon dioxide*) OR Toxic to living organisms (if answer above is *Mercury*) OR Acid rain (if answer above is *Sulfur dioxide*).

TIP: Don't forget - the '*Effect*' must match the '*Pollutant*'

(iii)
- Methane collection system (if answer to b (ii) is *Methane*) OR
- Burn less fossil fuels (if answer to b (ii) is either *Carbon dioxide* or *Sulfur dioxide*) OR
- Do not put batteries into general waste (if answer to b (ii) is *Mercury*)

(c) (i) *Advantage*: Reduces waste OR Reduces reliance on landfill OR Used to produce electricity.

(ii) *Disadvantage*: Produces harmful aerosols such as dioxins and sulfur dioxide.

MARKS: The first two questions answered correctly are worth 7 marks each. Further correct answers are worth 1 mark each.

5. (a) Monocotyledonous means one seed leaf.

(b) Grass OR Wheat OR Maize OR Palm tree OR Bamboo OR Lilly OR Tulip.

(c) Vascular bundles.

(d) (i) It is a stem as there are many vascular bundles present.

(ii) It is a monocot as the vascular bundles are scattered throughout the stem.

(e) Parallel.

(f) The veins in a dicot are arranged in a net or reticulate formation.

MARKS: The first question answered correctly is worth 8 marks, the second question answered correctly is worth 7 marks. Any further correct answers are worth 1 mark each to a maximum of 20.

6. (a) Variation refers to differences amongst members of the same species.

(b) Sexual reproduction.

(c) (i) Point OR Gene mutation.
(ii) Chromosome mutation.

(d) (i) UV radiation.
(ii) Cigarette smoke.

(e) Mutations lead to new genotypes and hence new phenotypes. Most of these new phenotypes will be disadvantageous to organisms. However, occasionally a new phenotype occurs that gives an organism an advantage over the rest of the population. Therefore, this organism will be more likely to survive and pass on the new phenotype to its offspring. In this way mutations are important to natural selection.

TIP: If it is unclear how many marks are prescribed for each part, try to write a passage with as many key words and phrases as possible, making sure they are described in the correct context!

MARKS: The first two questions answered correctly are worth 7 marks each.
Further correct answers are worth 1 mark each to a maximum of 20.

SECTION B

Answer any <u>two</u> questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) (i) *Data*: Information or observations or results collected in the course of an experiment. **(3)**
(ii) *Replicates*: Repeats of an experiment. **(3)**

TIP: Part (a) of each question in section B often asks for definitions or requires answers based on definitions.

(b) (i) Semi-lunar valves were exposed by cutting into the walls of the aorta and pulmonary artery. **(3)**
(ii) Iodoform test: the addition of potassium iodide (KI) and sodium hypochlorite (NaOCl) to the solution to be tested and then gently heated. The appearance of pale yellow crystals indicates the presence of alcohol. **(3)**
(iii) Starch agar plates. **(3)**
(iv) Iodine solution added to plates. Digestive activity had occurred if there was a negative result (iodine remained yellow) where the seed had been placed. **(3)**
(v) Placed seeds in a tube with cool boiled water (no oxygen present) and with a layer of oil on top (to prevent oxygen dissolving back into the water) and compared the germination of these seeds to the control (seeds exposed to oxygen).
OR
Placed seeds in an aerobic jar (no oxygen present) and compared the germination of these seeds to the control (seeds exposed to oxygen). **(3)**
(vi) Visking tubing. **(3)**
(vii) IAA (indole acetic acid). **(3)**
(viii) x200 **(3)**

TIP: Always learn off what the acronyms in the course stand for.

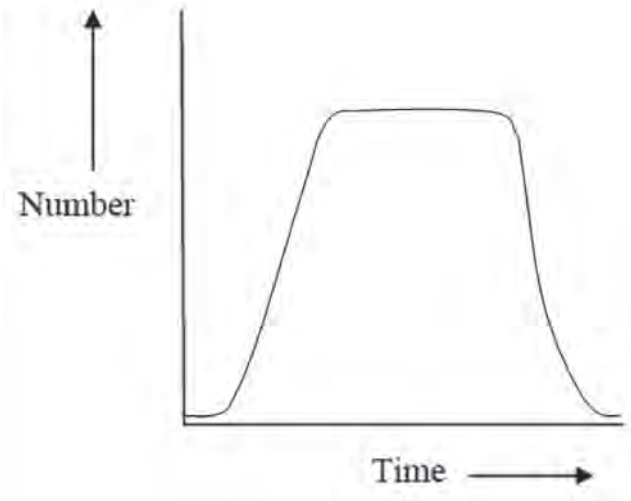
8. (a) (i) Eukaryotic. **(3)**
(ii) Chloroplast. **(3)**
(b) (i) Agar acts as a source of nutrients for growth of microorganisms. It also acts as a medium upon which the microorganisms can attach themselves. **(3)**
(ii) There are more leaves present on trees in July. There is also a more suitable temperature in July for growth of leaf yeast. **(3)**
(iii) Leaves are attached to the lid of the Petri dish using petroleum jelly with the underside of the leaf facing the agar. **(3)**

(iv) The control acts as a comparison in order to show that the leaf yeast came from the leaf and not from the agar. **(3)**

(v) The leaf yeast formed small round pink colonies. **(3)**

(vi) The plates were immersed in disinfectant for 24 hours and then disposed of in general waste.
OR
The plates were autoclaved at a temperature of 121˚C for 15 minutes, allowed to cool and then disposed of in general waste. **(3)**

(vii)



MARKS: Lag phase **(3)**
Log and stationary phase **(3)**

(6)

9. (a) (i) Protein. **(3)**

(ii) Folded OR Globular. **(3)**

TIP: Other enzymes can be used. Make sure your substrate matches your enzyme!

(b) (i) Catalase. **(3)**

(ii) Hydrogen peroxide. **(3)**

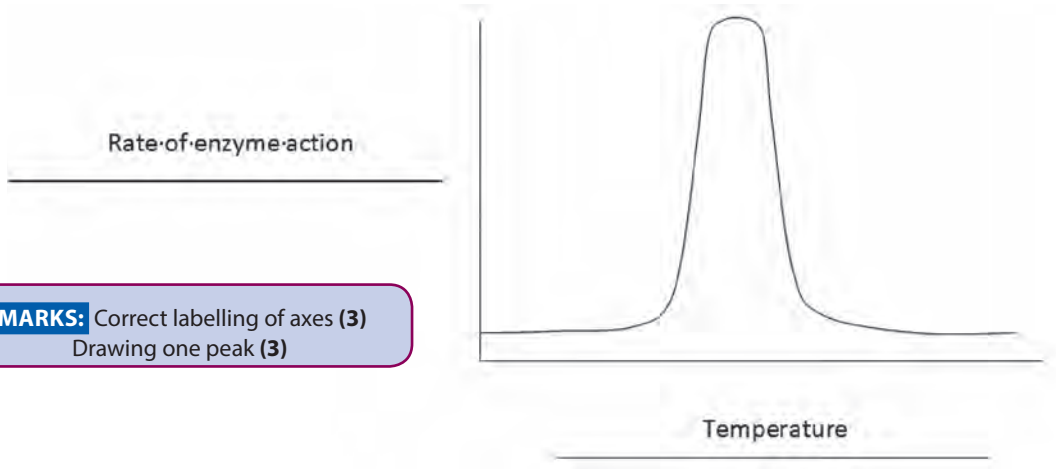
(iii) In order to have only one variable (i.e. temperature). **(3)**

(iv) Using pH buffer. **(3)**

(v) Using water baths OR Using a water bath at different temperatures. **(3)**

(vi) Production of froth. **(3)**

(vii)



MARKS: Correct labelling of axes **(3)**
Drawing one peak **(3)**

(6)

SECTION C

Answer any four questions.

10. (a) (i) Purines, pyrimidines. **(3, 3)**

(ii) Adenine = Thymine and Cytosine ≡ Guanine **(3)**

> **TIP:** Learn off definitions! Otherwise you will be throwing away a lot of marks needlessly!

(b) (i) *Law of Segregation:* Each cell contains two factors governing each trait, **(3)**
with these factors separating at gamete formation. **(3)**

Law of Independent Assortment: Members of one pair of factors can combine with either member of another pair of factors during gamete formation. **(3)**

> **TIP:** Mendel's first law definition came up in 2009 as well. However, in 2009, it was only worth 3 marks and only required the answer "Two factors that separate at gamete formation". However, for the full 6 marks here, a longer definition is required. Always learn off definitions IN FULL and answer them IN FULL.

(ii) 1. SSYy OR ssYy **(3)**

2. Smooth and yellow (if answer above is *SSYy*) OR Wrinkled and yellow (if answer above is *ssYy*) **(3)**

(iii) SsYy = Smooth and yellow **(3)**

SSYY OR SsYY OR SSYy (if answer in *(ii) 1* above is ssYy) **(3)**

(iv) Sy, sY **(3, 3)**

(c) (i) Genetic engineering is the artificial manipulation of genes. **(3)**

(ii)

Isolation:	The removal of DNA from the cells of interest. **(3)**
Cutting (restriction):	The removal or cutting of a gene from a piece of DNA using a restriction enzyme. **(3)**
Transformation (ligation):	The uptake of recombinant DNA by a cell (transformation) OR The joining together of two different pieces of DNA (ligation) **(3)**
Introduction of base sequence changes:	The sequences of bases in the new piece of DNA is different in the cell that has been transformed. **(3)**
Expression:	Activation of the inserted gene and production of its product. **(3)**

(iii) 1. Mice have been genetically modified to glow fluorescent green under UV light.
2. Maize has been genetically modified to be resistant to weed killers.
3. *E. coli* bacteria have been genetically modified to produce human insulin. **(Any two: 3, 3)**

> **TIP:** In (c) (iii) you only have to give one application for genetic engineering for two organisms from animals, plants and microorganisms. All three are given here.

11. (a) (i) *Food chain*: sequence of organisms in which one organism is eaten by the next organism in the sequence. **(3)**
Food web: two or more interconnected food chains. **(3)**

> **TIP:** Ecology questions are nearly always the best answered questions by students! Do not be afraid to attempt them!

(ii) *Pyramid of numbers:* a diagram showing the number of organisms at each trophic level. **(3)**

(b) (i) To control a certain indigenous species. **(3)**

(ii) 1. The organisms fail to adapt to their new surroundings. **(3)**

2. The organisms are killed by predators. **(3)**

(iii) An exotic plant may escape from captivity through dispersal of its seeds either via wind, water, animal or self dispersal. **(3)**

(iv) 1. *Negative impact*: The organism may have no predators in its new habitat and plenty of prey thereby reproducing itself to a very large population and affecting the natural, balanced numbers of prey that were originally present. This can then have knock-on effects on other species in the habitat. **(3)**

2. *Positive impact*: The organism may control a nuisance species present in a habitat. **(3)**

(v) 1. *Niche*: Functional role of an organism in a habitat. **(3)**

2. Yes OR No

3. *Explanation*: Because it has a certain adaptation that enables it to fulfil the vacant niche (if answer to *(v) 2* is *Yes*)
OR
Because the organism would not have the necessary adaptations to survive (if answer to *(v) 2* is *No*) **(6)**

TIP: To get marks for V (2) you must give an explanation in part 3.

(c) Woodland OR Rocky seashore

(i) *Flora*: Photosynthetic organisms, such as plants. **(2)**
Fauna: Animals, such as insects. **(2)**

(ii) *Snail* OR *Woodlouse* OR *Hare* OR *Squirrel* (if answer to *(c) (i)* is Woodland)
OR
Limpet OR *Barnacle* OR *Periwinkle* (if answer to *(c) (i)* is Rocky seashore) **(2)**
Method of quantification: Capture-recapture method **(6 × 2)**

- Count the number of a particular organism (e.g. snails) in a particular habitat.
- Mark each organism with a dot or an X using a black permanent marker or, in the case of mammals caught using a mammal trap, tag them or mark their fur in a way that does not harm the mammal or make it more visible to predators.
- Black will not make it visible to predators but will still be visible to the experimenter.
- Release organisms back into their habitat (if they were collected).
- A period of time later (e.g. one month), revisit the habitat.
- Count the number of organisms present and, of those counted, record the number that had the mark.
- Calculate the approximate population of the organism in the habitat using the formula:

$$\text{Number of organisms} = \frac{\text{No. caught 1}^{st}\text{ visit} \times \text{No. caught 2}^{nd}\text{ visit}}{\text{No. marked 2}^{nd}\text{ visit}}$$

(iii) It may make it more visible to predators. **(2)**

(iv) *Natural change*: Flooding OR Migration of species, such as birds. **(2)**
Artificial change: Building by humans OR Deforestation. **(2)**

12. (a) (i) Autotrophic **(3)**

(ii) A: Mitochondrion; B: Chloroplast **(3, 3)**

(b) (i) 1. Chlorophyll a: Violet, red **(3, 3)**
2. Chlorophyll b: Blue **(3)**

(ii) Yellow is reflected OR Yellow is not absorbed OR Yellow is only slightly absorbed. **(3)**

(iii) More light can be absorbed for photosynthesis OR Increased photosynthesis can occur. **(3)**

(iv) Use violet light. **(3)**

(v) 1. Atmosphere OR Respiration. **(3)**

2. *NADP*: carries high energy electrons and protons to the site of reduction of carbon dioxide. **(3)**
ATP: supplies the energy for the reduction of carbon dioxide. **(3)**

(c) (i) Glycolysis:

- It is the first stage of respiration
- Occurs in the cytosol
- Oxygen independent (anaerobic)
- Glucose is broken down into two pyruvic acid molecules
- Forms a small amount of energy in the form of the energy carriers ATP and NADH **(Any two: 2 × 3)**

TIP: This is a 24 mark question. Each brief note is worth 6 marks and therefore requires two pieces of information. However, list three if you can, to cover yourself.

(ii) Acetyl Coenzyme A:

- It is a two-carbon molecule
- Produced in the mitochondrion from the breakdown of pyruvic acid
- Produced only when sufficient oxygen is present (i.e. aerobic)
- Enters the Krebs cycle where it takes part in reactions that produce ATP and NADH **(Any two: 2 × 3)**

(iii) Adenosine triphosphate:

- Energy carrier
- Composed of the nitrogenous base, adenine, the sugar ribose and three phosphates
- Releases energy in powering metabolic reactions forming ADP in the process
- Produced during respiration with most being produced during stage 2 of respiration

(Any two: 2 × 3)

(iv) Electron transport chain:

- Part of stage 2 of respiration
- Oxygen dependent (aerobic)
- Occurs in the mitochondria (cristae)
- High energy electrons from NADH are transferred along a series of electron acceptors
- Releases a large amount of energy in the form of ATP
- Water is formed at the end of the chain when the electrons have lost all of their energy and combine with protons and oxygen gas

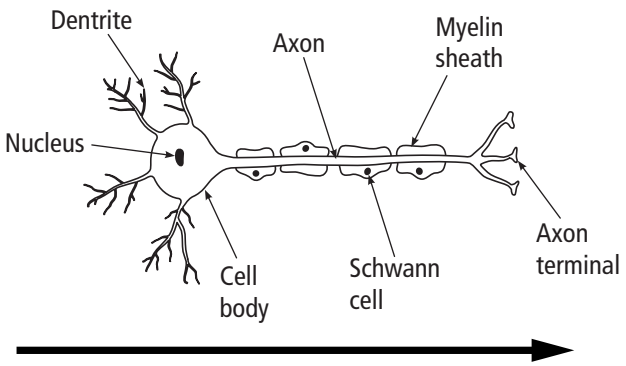
(Any two: 2 × 3)

13. (a) (i) *CNS:* Brain and spinal cord. **(3)**
PNS: nerves outside of the CNS. **(3)**

(ii) Nervous responses are fast; hormonal responses are slow. **(3)**

TIP: Keep diagrams simple and labelled clearly with the arrow pointing to exactly where the structure is located.

(b) (i)



MARKS: Correct diagram: **(6)**
One structure missing: **(3)**
Two or more structures missing: **(0)**
Labels: **(1 each to a max. of 6)**

(ii) *Dendrite*: Receives impulses from other neurons.
Cell body: Directs impulse towards axon.
Axon: Carries impulse towards axon terminals.
Myelin sheath: Fatty substances responsible for insulating against loss of impulse strength.
Schwann cell: Responsible for producing myelin sheath.
Axon terminal: Contains neurotransmitter used to transfer impulse to another neuron or to an effector (e.g. muscle). **(Any two: 2 × 3)**

(iii) [Arrow shown on diagram] **(3)**

(iv) *Sensory neuron:* Carries impulses towards the CNS. **(3)**
Interneuron: Carries impulses from sensory neurons to motor neurons
OR Carry impulses within the CNS. **(3)**

(c) (i) *Cerebrum*: Reasoning OR Language OR Hearing OR Sight OR Emotion… **(3)**
Hypothalamus: Water homeostasis OR Control of thirst OR Control of hunger OR Homeostasis. **(3)**
Cerebellum: Control of balance OR Control of muscle coordination. **(3)**
Medulla oblongata: Controls breathing OR Controls heart rate OR Controls digestion OR Controls blood vessels. **(3)**

(ii) *Grey matter*: Contains mostly cell bodies of neurons. **(3)**
White matter: Contains mostly axons and myelin sheath of neurons. **(3)**

(iii) In the case of **paralysis**:
Cause: Damage to the spinal cord OR Motor neuron disease OR Multiple sclerosis. **(3)**
Treatment: Physiotherapy. **(3)**
OR
In the case of **Parkinson's disease**:
Cause: Lack of dopamine in the brain OR Exposure to toxic chemicals. **(3)**
Treatment: Levodopa treatment OR Physiotherapy OR Deep brain stimulation OR Exercise. **(3)**

TIP: Make sure your answers for '*Cause*' and '*Treatment*' match the condition!

14. (a) (i) 1. *Petal*: attracts insects. **(3)**
2. *Anther*: produces the male gamete, pollen. **(3)**
3. *Stigma*: this is where the pollen lands during pollination. **(3)**

(ii) Style OR Stigma OR Ovary OR Micropyle. **(3)**

(iii) 1. Mitosis. **(3)**
2. First male gamete fuses with the egg cell. **(3)**
Second male gamete fuses with the polar nuclei. **(3)**
3. Product of first fusion is a diploid zygote. **(3)**
Product of second fusion is triploid endosperm. **(3)**

(iv) Endosperm OR Cotyledon. **(3)**

(b) (i) 1. Endoderm and mesoderm and ectoderm. **(3, 3, 3)**
2. *Endoderm*: internal lining of the digestive system. **(3)**
Mesoderm: bone. **(3)**
Ectoderm: brain. **(3)**

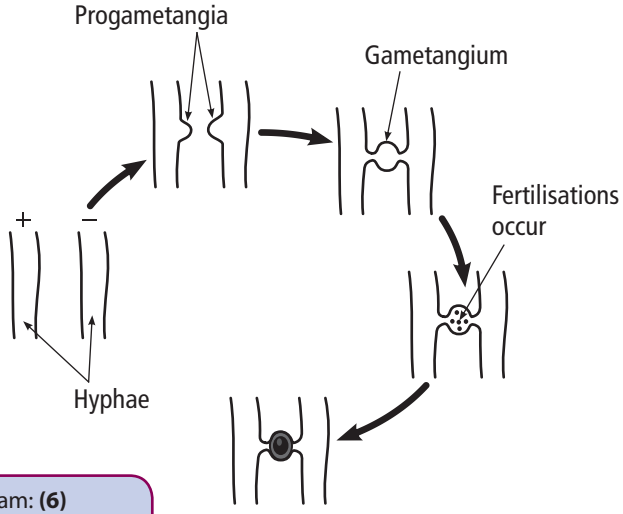
TIP: For (b) (i) 2 there are many other correct structures in the human body for each germ layer.

(ii) Embryonic tissue. **(3)**
Uterine tissue. **(3)**

(iii) 1. Amnion is a protective sac surrounding the developing foetus. **(3)**
2. The amnion protects the foetus by secreting amniotic fluid that acts as a shock absorber. **(3)**

(c) (i) 1. Lack of water OR Lack of substrate OR Build up of toxins. **(3)**

2.



TIP: Keep diagrams simple and labelled clearly with the arrow pointing to exactly where the structure is located.

TIP: Notice how the zygospore is not labelled because the question asked you to label three structures other than the zygospore.

MARKS: Complete diagram: **(6)**
One structure missing: **(3)**
Two or more structures missing: **(0)**
Labels: **(2 each to a maximum of 6)**

3. Enables *Rhizopus* to survive lack of water or substrate. **(3)**
   Dispersal of the zygospore to colonise a new habitat. **(3)**

TIP: "Variation" is not an advantage of zygospore formation

(ii) 1. Budding. **(3)**

2. New cells break away from the parent cell OR New cells form a colony of yeast cells. **(3)**

3. Asexual reproduction in *Rhizopus* is by means of spores. **(3)**

15. (a) (i) X: Villus; Y: Lacteal **(3, 3)**

(ii) Peristalsis. **(3)**

(iii) Alkaline. **(3)**

(iv) Pancreas and liver. **(3, 3)**

(v) 1. Symbiotic bacteria are bacteria that live in or on another organism and at least one of the organisms benefits from the association. **(3)**

2. Vitamin K production **(3)**
   AND
   Compete with pathogenic bacteria (thereby limiting their growth). **(3)**

(vi) Colon OR Large intestine. **(3)**

(b) (i) Red blood cells do not have a nucleus; white blood do have a nucleus. **(3)**
Red blood cells are biconcave in shape; white blood cells have no fixed shape. **(3)**

(ii) Monocytes OR Macrophages OR Phagocytes OR Dendritic cells. **(3)**

(iii) 1. Antibodies inactivate pathogens by binding to antigens on their surface. **(3)**

2. Killer T-cells and Memory T-cells and Helper T-cells and Suppressor (Regulatory) T-cells.
(Any three: 3 × 3)

3. *Killer*: Produce perforins which bind to an infected cell and cause it to burst.
Memory: Remember antigens and offer long-term immunity against a particular pathogen.
Helper: Recognise antigens and hence stimulate other T-cells and B-cells to act against a pathogen.
Suppressor: Stop an immune reaction once a pathogen has been eliminated. **(Any three: 3 × 3)**

(c) (i) Homeostasis is the maintenance of a constant internal environment. **(3)**

(ii) *Diffusion:* is the movement of a substance from a region where it is in high concentration to a region where it is in low concentration. **(3)**

Osmosis: is the movement of water molecules from a region of high water concentration to a region of low water concentration across a semi-permeable membrane. **(3)**

Active transport: is the movement of a substance from a region where it is in low concentration to a region where it is in high concentration using energy in the form of ATP. **(3)**

(iii) 1. The liver releases heat OR The liver deaminates excess amino acids OR The liver absorbs glucose from the blood stream and stores it as glycogen. **(3)**

2. The lungs excrete excess carbon dioxide OR The lungs absorb oxygen needed for respiration OR The lungs excrete excess water vapour. **(3)**

3. The nephron excretes excess water OR The nephron excretes urea OR The nephron excretes excess salts. **(3)**

(iv) *When the body is too hot:*

- The skin excretes water onto its surface via the sweat glands which evaporates and has a cooling effect.
- The skin's blood vessels dilate which enables heat to be released more easily from the body.

When the body is too cold:

- The skin has hairs that stand erect (when the piloerector muscle contracts) which traps a layer of air close to the skin. The air acts as an insulator reducing heat loss.
- The skin's blood vessels constrict which enables heat to be conserved as blood is prevented from getting close to the surface of the body. **(Any three: 3 × 3)**

SECTION A

Answer any five questions.

1. (a) Lipid. **(4)**

(b) *Named mineral:* calcium; *Function*: makes up the middle lamella between cell walls. **(4)**

(c) Brick red. **(4)**

(d) Component of cell membrane. **(4)**

(e) Transport of substances around organism. **(4)**

(f) 20 **(4)**

TIP: Question 1 is always on food and nutrition.

2. (a) Asexual reproduction. **(3)**

(b) Cancer. **(3)**

(c) UV light. **(3)**

(d) Metaphase. **(3)**

(e) Spindle fibres. **(3)**

(f) Plant cell. **(3)**

(g) Mitosis produces two daughter cells; meiosis produces four daughter cells. **(2)**

TIP: In part (e) remember to use the word 'spindle' when answering higher level questions on what chromosomes attach to.

MARKS: In questions 2 to 6 the first six correct answers are worth 3 marks each. The maximum marks for each question is 20 so if you get the first six correct, the last part is worth only 2 marks.

3. (a) Parasitism. **(3)**

(b) Producers. **(3)**

(c) Population. **(3)**

(d) Decomposers. **(3)**

(e) Symbiosis. **(3)**

(f) Competition. **(3)**

(g) Predation. **(2)**

4. (a) (i) Animal that produces its own heat. **(3)**

(ii) Ectotherms. **(3)**

(iii) Activity levels of endotherms are independent of the environment. **(3)**

(b) (i) 35.7˚C to 36.7˚C **(3)**

(ii) 6 a.m. **(3)**

(iii) Lower metabolism during sleeping. **(3)**

(iv) Children have higher metabolic rates due to rapid growth. **(2)**

TIP: This is an example of an abstract question, which is becoming more common in HL papers. These types of questions require more than a 'learned-off' answer. You will need to spend some time thinking about the question before answering.

TIP: Read graphs carefully before answering and always double check your answer!

5. (a) (i) The mechanical and chemical breakdown of food. **(3)**

(ii) In order for nutrients to be absorbed into the bloodstream. **(3)**

(iii) *Mechanical*: physical breakdown of food by chewing using teeth and churning of the stomach;
Chemical: breakdown of food using enzymes and stomach acid. **(3)**

(b) (i) W: Duodenum. **(3)**

(ii) X: Liver. **(3)**

(iii) Stomach. **(3)**

(iv) Produces the digestive enzymes lipase and amylase. **(2)**

TIP: You can mention 'emulsification of fats' here, but remember that emulsification is a type of mechanical digestion!

6. (a) (i) Stage 1 is oxygen independent; stage 2 is oxygen dependent. **(3)**
(ii) Stage 1 produces a small amount of energy; stage 2 produces a large amount of energy. **(3)**
(b) Cytosol. **(3)**
(c) Anaerobic respiration. **(3)**
(d) Lactic acid OR Ethanol. **(3)**
(e) ATP. **(3)**
(f) Oxygen OR Protons. **(2)**

SECTION B

Answer any <u>two</u> questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

TIP: In recent years the questions in Section B have been more miscellaneous – covering many different experiments on the course. To do well in Section B it is important to have a good knowledge of all experiments on the course!

7. (a) (i) *Experiment*: a test of a hypothesis. **(3)**
(ii) *Theory*: a supported hypothesis. **(3)**

(b) (i) To minimise variation. **(3)**
(ii) 1. Heated the soil to a high temperature (e.g. 120˚C) for 15 minutes. **(3)**
2. To ensure there were no other organisms to compete with the wheat. **(3)**
(iii) To set up a control. **(3)**
(iv) So that there is only one variable. **(3)**
(v) 1. Temperature. **(3)**
2. Soil pH. **(3)**
(vi) To ensure reliability of results. **(3)**

8. (a) (i) *Buffer*: to maintain a constant pH. **(3)**
(ii) *Biuret test*: to test for protein. **(3)**

(b) (i) *Use 1*: to test for starch. **(3)**
Use 2: to stain plant cells. **(3)**
(ii) *Use 1*: to maintain a temperature for optimal enzyme activity. **(3)**
Use 2: to denature an enzyme for the demonstration of enzyme denaturation. **(3)**
(iii)
- More energy is required.
- More oxygen is required for respiration.
- More carbon dioxide is produced which needs to be excreted. **(Any two: 2 x 3)**

(iv) Cut a thin section using a blade. **(3)**
Using a paintbrush the section was placed onto a glass slide with a drop of water. **(3)**

9. (a) (i) Hydrogen bonds. **(3)**
(ii) Non-coding DNA. **(3)**

(b) (i) 1. Finely chop the onion. **(3)**
2. To increase the surface area for obtaining plant DNA. **(3)**
(ii) To break the cell membranes. **(3)**
(iii) To clump the DNA. **(3)**
(iv) 1. An enzyme that digests proteins. **(3)**
2. Because the DNA is combined with protein. **(3)**
(v) 1. Added slowly down the side of the test tube using a dropper. **(3)**
2. To precipitate the plant DNA out of solution. **(3)**

SECTION C

Answer any four questions.

10. (a) (i) *Contest competition* is a direct fight between two organisms for a resource with one organism obtaining all of the resource. **(3)**

Scramble competition is the struggle amongst a number of organisms for a resource with each organism obtaining a small amount of the resource. **(3)**

(ii) Disease OR Predation. **(3)**

(b) (i) The predators were able to find different prey

(ii) Organism develops immunity to the virus.

(iii) Hazardous conditions are experienced by migratory organisms.

(iv) Grazing by rabbits results in reduced competition between plants allowing for a greater variety of plant life.

(v) The female ducks may have to conserve energy for egg-laying in the spring.

MARKS: In part (b) the first three correct answers get 7 marks each, the final two correct answers get 3 marks each.

(c) (i) *Qualitative*: what is present. **(3)**

Quantitative: how many are present. **(3)**

(ii) Using a plant identification key. **(3)**

(iii)
- Pencil thrown over shoulder to ensure random selection
- Quadrat placed where pencil lands
- Percentage cover of each plant species within quadrat estimated
- This procedure was repeated at least 10 times
- An average was calculated. **(Any three: 3 × 3)**

TIP: Use bullet points instead of paragraphs wherever possible. It reduces the risk of forgetting important points in a description.

(iv)
- Incorrect identification from key
- Lack of random selection
- Inadequate sample size (not enough quadrat throws)
- Incorrect estimation or counting of plant species. **(Any two: 2 × 3)**

11. (a) (i) Surroundings that are harmful to organisms. **(3)**

(ii)
- Possession of a thick cuticle
- Abscission (leaf fall)
- Possession of thorns
- Possession of stinging hairs
- Production of heat shock proteins
- Being able to become dormant. **(Any two: 2 × 3)**

TIP: Part (a) (ii) only asks for two ways in which plants protect themselves. If you know of more or if you are unsure of the correct answers, put in a couple of extra points. This will maximise your chances of getting all the available marks.

(b) (i) Growth regulators. **(3)**

(ii) 1. Meristems. **(3)**

2. • Root tip
   • Shoot tip
   • Bud
   • Embryo
   • Vascular bundle. **(Any two: 2 × 3)**

(iii) Growth towards light. **(3)**

(iv) Increased photosynthesis. **(3)**

(v) *Named external stimulus*: Light

Mechanism of response:
- Growth regulator (IAA) is produced in the meristem of a shoot tip
- It diffuses down the shaded side of the stem
- It causes cell elongation
- Shaded side of the stem grows more rapidly than the side exposed to light
- This causes the stem to bend towards the light. **(Any three: 3 × 3)**

(c) (i) A hormone is a chemical messenger secreted by an endocrine gland directly into the bloodstream where it travels to a target organ and exerts a specific effect. **(3)**

TIP: Even though the marking scheme only required the use of the term 'chemical messenger', it is always good practice to write in the full definition!

(ii) Both are produced in one location.
Both act in a different location to which they are produced.
Both have long lasting effects. **(Any two: 2 × 3)**

(iii) 1. A certain level of a hormone inhibits the secretion of another hormone or its own secretion. **(2 × 3)**

2. *Named hormone*: Thyroxine. **(3)**
Feedback mechanism: Thyroxine inhibits the secretion of thyroid-stimulating hormone (TSH) from the pituitary. **(3)**

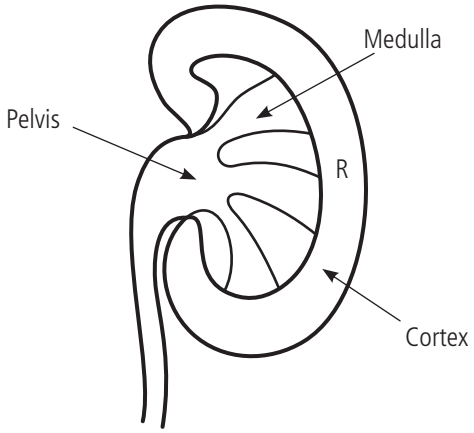
(iv) *Named hormone*: Thyroxine.
Deficiency symptom: Swelling of the neck (goitre). **(3)**

12. (a) (i) *Excretion*: getting rid of the waste products of metabolism made in the body. **(2 × 3)**

TIP: The available marks for this definition are 2 x 3 which means that two pieces of information are required. Always write definitions out in full!

(ii) Transpiration OR Diffusion of carbon dioxide through stomata and lenticels. **(3)**

(b) (i)



TIP: Draw diagrams clearly without colour and ensure the label is pointing exactly to the structure.

MARKS: Diagram: **(3)**
Labels: **(3 × 1)**

(ii) Indicated on diagram by the letter 'R' **(3)**

TIP: Do not forget to answer questions like this. Many students make this error!

(iii) 1. Renal artery **(3)**
2. Aorta **(3)**

(iv) Abdomen **(3)**

(v) Urea **(3)**

(vi) Has ducts **(3)**

TIP: Notice how a good knowledge of the circulatory system is required here in a question on the human excretory system!

(c) (i) 1. 1 = Bowman's capsule **(1)**
2 = Glomerulus **(1)**
3 = Afferent arteriole **(1)**
4 = Efferent arteriole **(1)**
5 = Proximal convoluted tubule **(1)**
6 = Distal convoluted tubule **(1)**

2. 1 and 2 **(3)**

3. Anti-diuretic hormone (ADH) **(3)**

(ii) 1. No. **(3)**
2. Protein molecules are too big to get through the glomerulus and Bowman's capsule. **(3)**

(iii) 1. No. **(3)**
2. Glucose is normally reabsorbed in the proximal convoluted tubule. **(3)**

13. (a) (i) *Evolution*: inheritable changes within a species over a long period of time to produce new species in response to environmental stresses. **(2 × 3)**

(ii) Charles Darwin OR Alfred Russel Wallace. **(3)**

TIP: Even though they are stated here, you do not need to know the first names of famous scientists.

(b) (i) Independent assortment can occur resulting in more variation in the offspring. **(3)**

(ii) Parents: RrTt x rrtt

Gametes:	*rt*	**F_1 phenotypes**
RT	RrTt **(3)**	Pink flower, tall stem **(3)**
Rt	Rrtt **(3)**	Pink flower, short stem **(3)**
rT	rrTt **(3)**	White flower, tall stem **(3)**
rt	rrtt **(3)**	White flower, short stem **(3)**

(c) (i) *Gene:* section of DNA that codes for a protein. **(3)**
Allele: alternative form of a gene, where a number of different forms can exist. **(3)**

(ii) *Homozygous*: two alleles are the same. **(3)**
Heterozygous: two alleles are different. **(3)**

(iii) *Genotype*: genetic make-up. **(3)**
Phenotype: physical make-up. **(3)**

TIP: Learn off definitions by heart! There are 27 marks in total within Question 13 for definitions. This is 6.25% of the entire paper!

(iv) *Linkage*: genes are present on the same chromosome. **(3)**
Sex linkage: gene is present on a X or Y chromosome. **(3)**

14. (a) (i) Elodea. **(3)**

(ii) By counting the number of bubbles produced per minute. **(2 × 3)**

(iii) Temperature OR Carbon dioxide concentration. **(3)**

(iv) *Temperature*: water bath.
OR
Carbon dioxide concentration: excess sodium bicarbonate dissolved in pond water. **(3)**

(v) To ensure that any changes in the rate of photosynthesis was not due to temperature or carbon dioxide concentration. **(3)**

(vi) 1. A. Levels off. **(3)**
B. Continues to increase. **(3)**
2. A. Temperature is the limiting factor meaning the rate of photosynthesis cannot go any faster. **(3)**
B. An increase in temperature allows a faster rate of photosynthesis. **(3)**

(b) (i) *Metabolism*: sum of all the chemical reactions occurring in an organism. **(3)**

(ii) Because enzymes are biological catalysts that control the rate of metabolic reactions in cells. **(2 × 3)**

(iii) 1. *Protein synthesis*: anabolic. **(3)**
2. *ADP to ATP*: anabolic. **(3)**
3. *Product larger than substrate*: anabolic. **(3)**

(iv) High temperature OR Agitation OR High pH OR Low pH. **(3)**

(v) Changed shape/structure. **(3)**
Loss of function. **(3)**

(vi) Nitrogen. **(3)**

(c) (i) Immediately inside the cell wall. **(3)**

(ii) Eukaryotic. **(3)**

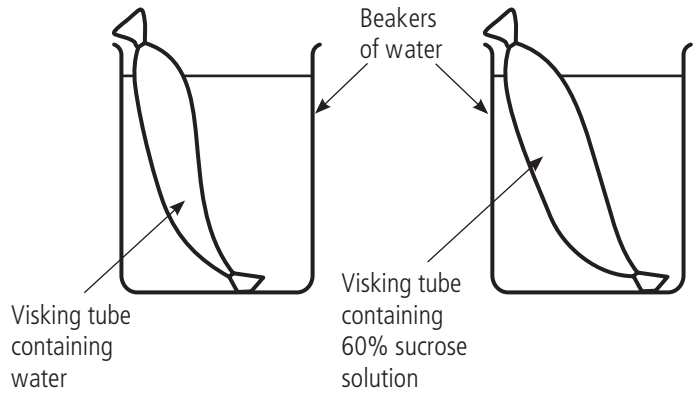
(iii) Prokaryotic. **(3)**

(iv) It allows certain substances through while preventing other substances. **(3)**

(v) Energy is not required. **(3)**

(vi) Because it is the movement of water molecules across a semi-permeable membrane from a region of high water concentration to a region of low water concentration. **(3)**

(vii) *Osmosis demonstration*:
- Two Visking tubes were set up, one filled with water and another filled with a 60% sucrose solution
- Both tubes were weighed using digital scales
- Both tubes were put in beakers of water and left for one hour
- Both tubes were reweighed
- The tube with the 60% sucrose solution had increased in mass.



TIP: Draw diagrams clearly and without colour. Ensure the labels are pointing exactly to the structure to be labelled.

MARKS:
Diagram: **(3)**
Labels: **(3 × 1)**
Result indicated/stated: **(3)**

(viii) Contractile vacuole. **(3)**

15. (a) (i) 1. A: Cochlea **(2)**
B: Eardrum **(2)**
C: Auditory nerve **(2)**

2. D: Balance **(3)**
E: Equalise pressure between the middle ear and atmosphere **(3)**

3. A **(3)**
D **(3)**

(ii) Retina **(3)**

(iii) Skull **(3)**

(iv) *Named defect*: Short-sightedness
Corrective measure: Concave lens in front of the eye
OR
Named defect: Long-sightedness
Corrective measure: Convex lens in front of the eye
OR
Named defect: Glue ear
Corrective measure: Insertion of a grommet into the eardrum **(2 × 3)**

TIP: Remember, you only have to learn about either a disorder of the ear or a disorder of the eye. You do not have to learn both.

(b) (i) Xylem. **(3)**

(ii) Narrow OR Contains lignin. **(3)**

(iii) In vascular bundles. **(3)**

(iv) Provides strength and support to the plant. **(3)**

(v) Gravity. **(3)**

(vi) *Cohesion-tension model:*
- Water molecules are held together by hydrogen bonding (cohesion)
- There is a continuous chain of water molecules from the roots to the aerial parts of the plant
- Water molecules adhere to the walls of the xylem vessels (adhesion)
- Transpiration pulls on the chain of water molecules creating a tension. **(Any three: 3 × 3)**

(vii) Henry Dixon **(3)**
John Joly **(3)**

TIP: Even though they are stated here, you do not need to know the first names of famous scientists.

(c) (i) A: Rhizoids **(3)**
Function: Anchorage OR Absorption of nutrients OR Secretion of enzymes. **(3)**

(ii) B: Sporangium **(3)**
Asexual: because it produces spores from one parent. **(3)**

(iii) 1. *Saprophytic*: feeding on dead organic matter. **(3)**
2. Breakdown of dead organisms so that nutrients can be recycled. **(3)**

(iv) *Heterotrophic*: obtaining food from other living organisms. **(3)**

(v) Parasitic. **(3)**

(vi) Death Cap (Amanita phalloides). **(3)**
Destroying Angel (Amanita bisporigera). **(3)**

TIP: Even though they are stated here, you do not need to know the Latin names of harmful fungi. Also, please be aware that there are many other correct answers for harmful fungi.

SECTION A

Answer any five questions.

MARKS: There are a maximum of 20 marks available for question 1. Marks will be awarded to the best five answers only.

1. (a) An element that is needed by the body in only small amounts. **(4)**
(b) Iron OR Copper OR Zinc **(4)**
(c) Oils are liquid at room temperature; fats are solid at room temperature. **(4)**
(d) Fat-soluble
Water-soluble **(4)**
(e) A unit of fat OR Glycerol and three fatty acids. **(4)**
(f) Respiration **(4)**

TIP: Question 1 is always on food and nutrition!

TIP: In part (f), 'digestion' was allowed. However, the question referred to a catabolic reaction '…in a cell.' Therefore you should answer this question with a reaction that occurs within a cell. Remember, digestion occurs in the lumen of the small intestine, which is outside cells.

2. (a) 100% **(5)**
(b) 50% **(5)**
(c) 75% **(5)**
(d) 50% **(5)**

TIP: Do not try to do these in your head. Working them out – preferably in your answer booklet – will make errors less likely.

3. (a) A: Pseudopods **(1)**
B: Contractile vacuole **(1)**
C: Food vacuole **(1)**
(b) Protista **(3)**
(c) Eukaryotic **(3)**
(d) Because it possesses membrane-bound organelles. **(3)**
(e) Feeding OR Movement **(3)**
(f) (i) Osmoregulation **(3)**
(ii) There is a larger concentration difference between the cytoplasm of freshwater amoebae and the freshwater than between marine amoebae and seawater. **(2)**

TIP: The diagram in question 3 could be easily mistaken for a bacterium! Practise your diagrams so that you are familiar with all diagrams in the exam paper.

4. (a) Group of similar cells with a common function. **(3)**
(b) Dermal OR Ground OR Vascular OR Meristematic **(3)**
(c) *Dermal*: protection
Ground: photosynthesis OR storage
Vascular: transport of substances around the plant
Meristematic: growth **(3)**
(d) Muscle OR Nervous OR Epithelial OR Connective **(3)**
(e) *Muscle*: movement
Nervous: generation and conduction of electrical impulses
Epithelial: protection OR absorption OR secretion
Connective: movement OR support **(3)**
(f) *Tissue culture*: cells grown in or on a nutrient medium **(3)**
(g) Cancer research **(2)**

TIP: The functions you give MUST match the named tissue!

5. (a) *Biosphere*: part of the Earth that supports life. **(3)**
(b) *Ecosystem*: organisms and their environment. **(3)**
(c) *Habitat*: where an organism lives. **(3)**
(d) *Symbiosis*: where two organisms live in close association with at least one of the organisms benefitting. **(3)**
(e) *Biotic factor*: anything that is living and has an effect on organisms in a habitat. **(3)**
(f) *Food web*: two or more interconnected food chains. **(3)**
(g) *Fauna*: animals. **(2)**

TIP: Spend time learning off definitions! Almost the whole of question 5 is definitions. That is 20 marks or 5% of the entire exam!

6. (a) (i) A: Protein **(3)**
(ii) B: Nucleic acid **(3)**

TIP: Notice 6 (c) is a question that requires a good understanding of the immune system. When learning new material, try to understand it, as well as learning it off. This will enable you to answer these types of questions.

(b)
- Virus attaches to host cell
- Virus and/or nucleic acid enters host cell
- Host's nucleus and ribosomes are used to create new viral components
- Viral components are assembled
- New viruses are released from host cell. **(Any three: 3 × 3)**

(c) Older people have likely had a previous exposure to the virus and possess antibodies and memory cells capable of recognising the virus. **(3+2)**

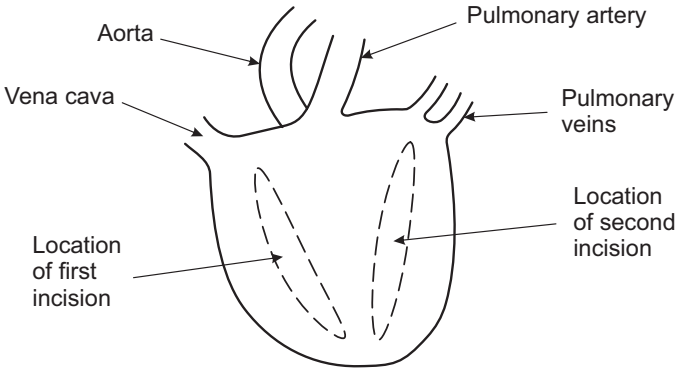
SECTION B

Answer any <u>two</u> questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) (i) Thoracic cavity **(3)**
(ii) Slow to tire **(3)**

MARKS: The marks in part (b) can also be gained from an appropriately labelled diagram.

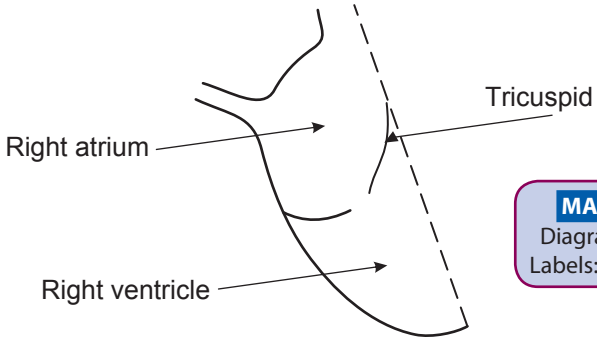
(b) (i)
- Wash heart and place in a dissection tray
- Identify the front and back of the heart by finding the flat back surface of the heart
- Using a scalpel, make two incisions down either side of the front of the heart
- Locate the internal structures of the heart using pins and small pieces of paper. **(4 × 3)**



TIP: Draw diagrams clearly and point the labels exactly at the structure. Although you did not have to draw a diagram of the heart for this question, it is always a good idea to use diagrams as they can help you to gain full marks if you left something out of your description!

(ii) Cut open aorta or pulmonary artery **(3)**

(iii)



MARKS:
Diagram: **(3)**
Labels: **(3 × 2)**

TIP: Only draw and label what was asked of you in the question. Don't waste time drawing too much. Also, try to keep diagrams simple where possible.

8. (a) (i) *Hypothesis*: Educated guess **(3)**

(ii) *Control*: To act as a comparison upon which the results of the experiment can be compared **(3)**

(b) (i) *Methylene blue*: stain the nucleus of cells
OR
Iodine: stain plant cells **(3)**

(ii) So that the rate of photosynthesis can be measured by counting the bubbles of oxygen gas produced **(3)**

(iii) 1. Break cell membranes **(3)**
2. Ice-cold ethanol brings DNA out of solution **(3)**

(iv) 1. To prevent contamination by bacteria and other fungi **(3)**
2. To attach the leaves to the lid of the Petri dishes **(3)**

(v) 1. To test for protein **(3)**
2. To test for fat **(3)**

TIP: In recent years the questions in Section B have been more miscellaneous – covering many different experiments on the course. To do well in Section B it is important to have a good knowledge of all experiments on the course!

9. (a) (i) *Tropism*: growth of a plant in response to a stimulus **(3)**

(ii) *Growth regulator*: chemical that controls the growth of a plant **(3)**

(b) (i) Seed OR Ground tissue **(3)**

(ii)
- IAA solutions of different concentrations prepared and transferred to a number of Petri dishes
- Control set up with no IAA (water replaced the IAA solution)
- Five seeds placed in the lids of each Petri dish held in place with filter paper
- IAA solution transferred to each corresponding lid
- Petri dishes packed out with cotton wool and all connected together with tape
- Petri dishes left in an incubator for one week
- Lengths of roots and shoots from seeds of each Petri dish measured. **(Any four: 4 × 3)**

TIP: Note the use of bullet points. You should use these wherever possible, rather than using paragraphs. It reduces the risk of forgetting important points in a description.

(iii) Water with no IAA. **(3)**

(iv) Low IAA levels stimulated growth when compared to the control.
High IAA levels inhibited growth when compared to the control. **(3, 3)**

SECTION C

Answer any <u>four</u> questions.

10. (a) (i) Guanine **(3)**

(ii) DNA double helix is opened or unzipped. **(3)**
A new strand is made by new nucleotides attaching to complementary nucleotides on the old strand. **(3)**

(b) (i) *Transcription*: the making of mRNA using a DNA template **(3)**
Translation: the making of protein using the code in mRNA **(3)**

(ii) Ribosomes **(3)**

(iii) Three **(3)**

(iv) Start **(3)**
Adding an amino acid **(3)**
Stop **(3)**

(v) Transfer **(3)**

(vi) Amino acid **(3)**

(c) (i) *Haploid*: one set of chromosomes **(3)**
Diploid: two sets of chromosomes **(3)**

TIP: Once again, definitions are regularly asked. Spend time learning them off by heart. The whole of question 10 (c) is definitions. That is 24 marks or 6% of the entire exam!

(ii) *Homozygous*: two alleles are the same **(3)**
Heterozygous: two alleles are different **(3)**

(iii) *Genotype*: genetic make-up **(3)**
Phenotype: physical make-up **(3)**

(iv) *Segregation*: one member of a pair of alleles enter a gamete **(3)**
Independent assortment: either member of a pair of alleles can combine with either member of another pair during gamete formation **(3)**

11. (a) (i) Parkinson's disease **(3)**

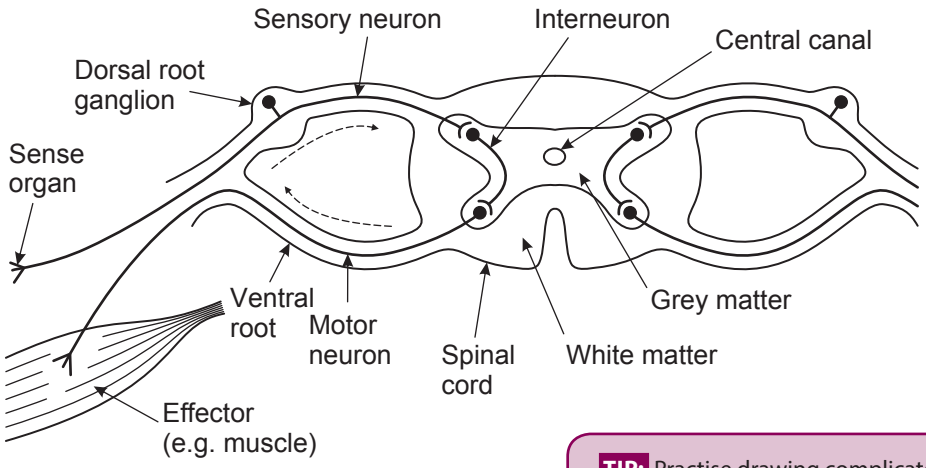
(ii) *Possible cause*: death of dopaminergic neurons in the brain **(3)**
Treatment: administration of levodopa **(3)**

(b) (i) Automatic, involuntary response to a stimulus. **(3,3)**

(ii) Coughing OR Sneezing OR Vomiting OR Gagging OR Startle. **(3)**

(iii) Protection from a harmful factor. **(3)**

(iv) 1. Reflex arc



MARKS:
Diagram: **(6)**
Labels: **(2, 2, 2)**

TIP: Practise drawing complicated diagrams such as this one. Label the structures accurately.

2. Arrows (dashed) indicated on diagram **(3)**

(c) (i) Endocrine **(3)**

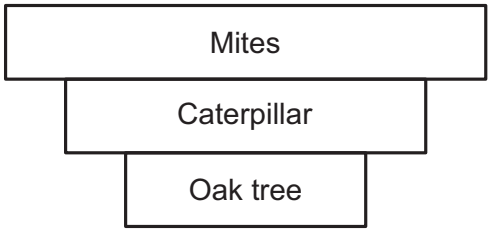
TIP: Make sure the hormone matches the named endocrine gland!

(ii) 1. Pituitary **(3)**
2. Base of brain **(3)**
3. Growth hormone **(3)**
4. Enlargement of tissues in the body (e.g. muscle and bone) **(3)**
5. Dwarfism (small stature) **(3)**

(iii) 1. Insulin injections: used in the treatment of type I diabetes **(3)**
2. Progesterone and oestrogen: used in the contraceptive pill **(3)**

12. (a) (i) Bottom **(3)**

(ii)



(3, 3)

(b) (i) Monera **(3)**

(ii) High availability of nutrients from the organic effluent **(3)**

(iii) Lower availability of nutrients **(3)**

(iv) Oxygen demand increases as the number of bacteria increases **(3)**
Oxygen demand decreases as the number of bacteria decreases **(3)**

(v) More bacteria require more oxygen **(3)**

(vi) Fish require oxygen for respiration **(3)**

(vii)
- Dissolving into the water via agitation (at waterfalls and/or fast-moving water)
- Photosynthesis **(3,3)**

TIP: Read graphs carefully before answering and always double check your answer!

(c) (i) True **(3)** Energy is lost at each trophic level **(3)**

(ii) False **(3)** Usually eaten by secondary consumers **(3)**

(iii) True **(3)** It has no economic value **(3)**

(iv) True **(3)** Due to premature death of infected parents **(3)**

13. (a) *Sepal*: protect flower **(3)**
Anther: produce pollen **(3)**
Stigma: traps pollen **(3)**

TIP: For the function of the stigma, make sure you state that the stigma 'traps pollen', rather than 'where pollen lands'.

(b) (i)
- Microspore mother cells undergo meiosis to form a tetrad of haploid cells
- The nucleus of each cell undergoes mitosis
- This mitotic division forms two nuclei: the tube nucleus and generative nucleus
- The cells then mature by forming a hard outer coat made up of two layers: an intine and exine

(3, 3, 3, 3)

TIP: Note the use of bullet points.

(ii) *Fertilisation*: fusion of haploid gametes to form a diploid zygote **(3)**

(iii)
- The generative nucleus enters the pollen tube and divides by mitosis
- Two sperm nuclei are formed which enter the embryo sac
- One fuses with the egg cell to produce a diploid zygote
- The other fuses with the polar nuclei to form triploid endosperm **(3, 3, 3, 3)**

(c) (i) *Dormancy*: a resting period when the seed undergoes no growth **(3)**

(ii) Allows the plant to survive the harsh conditions of winter **(3)**

(iii) Allows farmers to optimise the growing season **(3)**

(iv) *Water*: acts as a solvent in which enzyme-controlled metabolic reactions occur **(3)**
Oxygen: required for aerobic respiration **(3)**
Suitable temperature: required for optimal enzyme activity **(3)**

(v) 1. Radicle **(3)**
2. Plumule **(3)**

14. (a) (i) Chloroplast **(3)**

(ii) Light stage **(3)**

(iii) 1. Chlorophyll **(3)**

2. *Pathway 1:*

- Energised electrons from chlorophyll are captured by an electron acceptor
- They are passed from one electron acceptor to another
- The electrons lose energy as they are transferred
- The energy lost is used to make ATP from ADP and a phosphate
- The electron returns to chlorophyll **(Any two: 3, 3)**

TIP: Notice once again in this question, the use of bullet points to make answer more structured.

Pathway 2:

- Energised electrons from chlorophyll are captured by $NADP^+$ to produce $NADP^-$
- Protons are attracted to $NADP^-$ which becomes NADPH
- Water is the split into protons, high-energy electrons and oxygen gas
- The electrons from the splitting of water are transferred to electron acceptors
- As they are transferred, they lose energy
- The energy lost is used to make ATP from ADP and a phosphate
- The electron that came from the splitting of water is given to chlorophyll **(Any two: 3, 3)**

(iv) 1. Carbohydrates **(3)**

2. Water **(3)**

(v) Adenosine triphosphate **(3)**

(b) (i) *Enzyme*: protein catalyst that speeds up chemical reactions without being used up **(3)**

(ii) *Specificity*: an enzyme acts on only one substrate **(3)**

(iii) *Active site theory*:

- The substrate matches the active site of the enzyme
- The shape of the active site changes slightly to accommodate the substrate
- Enzyme-substrate complex is formed
- The enzyme acts on the substrate to form product(s) **(Any three: 3 × 3)**

(iv) 1. *Immobilisation*: enzyme is attached to an insoluble support or attached to one another **(3)**

2. *Bioreactor*: vessel in which products are made by cells or by cell components such as enzymes **(3)**

(v) Enzyme: Glucose isomerase **(3)**
Substrate: Glucose **(3)**
Product: Fructose **(3)**

TIP: In (b) (v) there are many other enzymes you could include. Make sure your substrate and product match the enzyme!

(c) (i) *Selective permeability*: where a cell membrane allows some substances to pass through while preventing other substances **(3)**

(ii)

- Cell membrane
- Nucleus
- Chloroplast
- Vacuole **(Any two: 3, 3)**

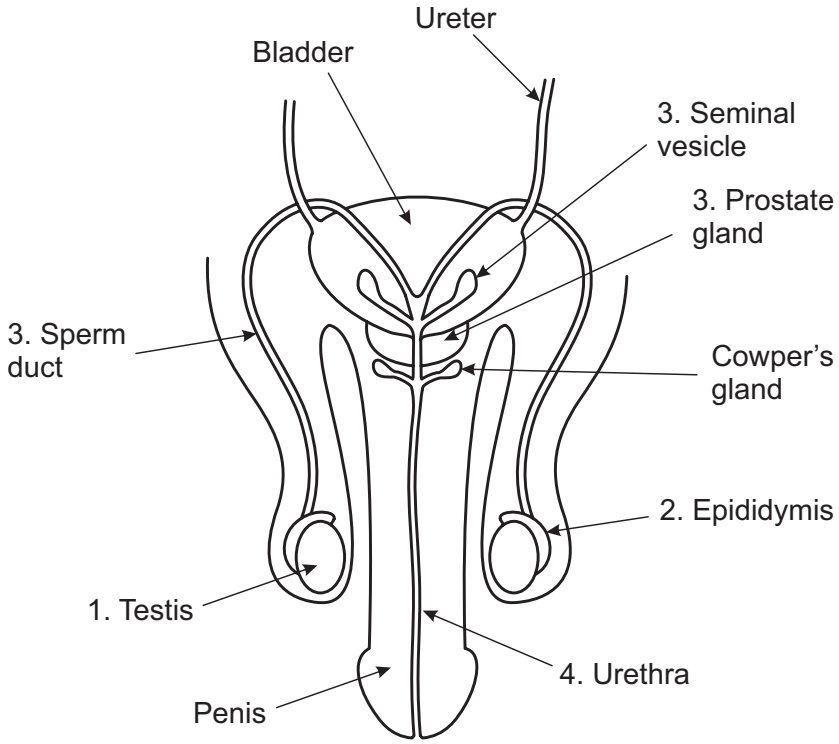
(iii) 1. *Diffusion*: the movement of particles from a region of high concentration to a region of low concentration **(3, 3)**

2. Oxygen
Diffuses between the alveolus and the bloodstream **(6)**

(iv) Kills microorganisms by causing the cell to lose water by osmosis. The cell will shrivel up and die. **(3, 3, 3)**

15. (a) (i) *Semen*: sperm and seminal fluid **(3)**

(ii)



TIP: Practise drawing complicated diagrams such as this one. Label the structures accurately.

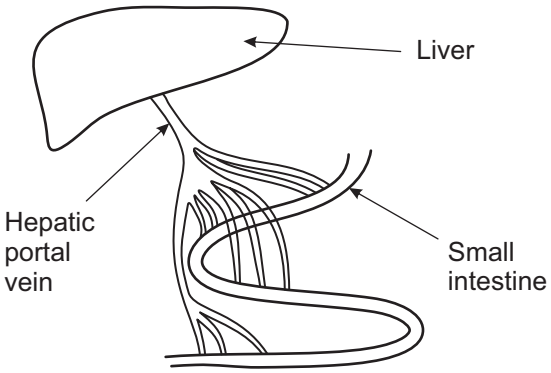
MARKS: Diagram: **(6)**
Four located and named parts: **(3, 3, 3, 3)**

(iii)
- Enlarged larynx
- Enlargement of testes
- Body and facial hair
- Enlargement of penis **(Any two: 3, 3)**

(iv) Testosterone **(3)**

TIP: Notice how all the blood vessels from the intestines join together to form the hepatic portal vein. It carries blood rich in nutrients.

(b) (i)



MARKS:
Diagram: **(3)**
Labels: **(2, 2, 2)**

(ii) Glucose OR Amino acids OR Fatty acids and glycerol **(Any one point: 3)**

(iii) Hepatic artery **(3)**

(iv) To the right of the stomach **(3)**

(v) Gall bladder **(3)**

(vi) Emulsify fats **(3)**

(vii)
- Stores fat-soluble vitamins
- Stores glycogen
- Deamination of excess amino acids
- Generation of heat
- Detoxification of alcohol
- Production of cholesterol **(Any two: 3, 3)**

TIP: Notice how questions asking you to demonstrate your knowledge of the location of various organs in the human body are asked regularly. It is essential to have a good knowledge of human anatomy to do well in biology. A model of the human body, with removable parts will help you learn the locations of the various organs.

(c) (i) Suckling by the baby stimulates the secretion of the hormone prolactin, which in turn stimulates milk production. **(3, 3)**

(ii) The common cold is caused by a virus. Viruses are unaffected by antibiotics. Over-prescription of antibiotics can lead to antibiotic-resistant strains of bacteria. **(3, 3)**

(iii) Wholegrain cereal contains fibre, which helps to prevent constipation by stimulating peristalsis within the gut. **(3, 3)**

(iv) Exercise causes loss of water from the body through sweating and exhalation. There is less water in the blood, causing ADH to be secreted from the pituitary gland. ADH causes the walls of the distal convoluted tubule and collecting ducts of the nephron to become more permeable to water. Water is reabsorbed from the glomerular filtrate, causing a low volume and concentrated urine. **(3, 3)**

(v) Arterioles in the fingers constrict, meaning less blood flows to the fingers. This minimises heat loss from the extremities. **(3, 3)**

SECTION A

Answer any five questions.

1. (a) Hydrogen and Oxygen **(4)**
(b) *Polysaccharide*: Carbohydrate made of many sugar units **(4)**
(c) Starch OR Glycogen **(4)**
(d) Cell wall **(4)**
(e) Benedict's test **(4)**
(f) 2. Heat but do not boil **(4)**

TIP: Remember Question 1 is always on food and nutrition!

MARKS: There are a maximum of 20 marks available for Question 1. Marks will be awarded to the best five answers.

2. (a) Radicle **(3)**
(b) Hydrotropism **(3)**
(c) Phototropism **(3)**
(d) Photosynthesis **(3)**
(e) Ethene OR Abscisic acid **(3)**
(f)
- Rooting powder OR
- Selective weedkiller OR
- Fruit ripening OR
- Seedless fruit OR
- Tissue culture **(Any two: 3, 2)**

3. (a) *Predation*: catching, killing and eating another organism. **(3)**
(b) *Predator*: Fox **(3)**
Prey: Rabbit **(3)**
(c) *Niche*: functional role an organism plays in its ecosystem. **(3)**
(d) Photosynthesis OR Protein synthesis **(3)**
(e) *Edaphic*: factor to do with soil or geology of the land **(3)**
(f) Particle size OR Soil type OR pH OR Air content OR Water content OR Mineral content OR Soil temperature OR Humus content **(2)**

TIP: Ensure the prey is an organism eaten by the predator you named!

4. (a) (i) *A*: Head OR Epiphysis **(2)**
B: Shaft OR Diaphysis **(2)**
C: Spongy bone **(2)**
D: Compact bone **(2)**
(ii) Between the vertebrae **(3)**
(iii) Shock absorption OR Friction-free movement **(3)**

(b) (i) Fat storage **(3)**
(ii) Blood cell formation **(3)**

5. (a) Anaphase **(3)**
(b) Chromosomes are being pulled apart **(3)**
(c) *A*: Spindle fibre **(3)**
B: Chromosome **(3)**
(d) Asexual reproduction **(3)**
(e) Growth **(3)**
(f) Meristems **(2)**

6. (a) *Genetic engineering*: the manipulation or alteration of genes. **(3)**

(b) 1. Isolation
2. Cutting
3. Transformation
4. Introduction of base sequence changes
5. Expression **(Any three: 3, 3, 3)**

(c) 1. *Microorganisms*: *E. coli* bacteria have been genetically modified to produce human insulin. **(3)**
2. *Animals*: mice have been genetically modified to glow green when UV light is shone on them. **(3)**
3. *Plants*: corn has been genetically modified to be resistant to herbicide and insects. **(2)**

SECTION B

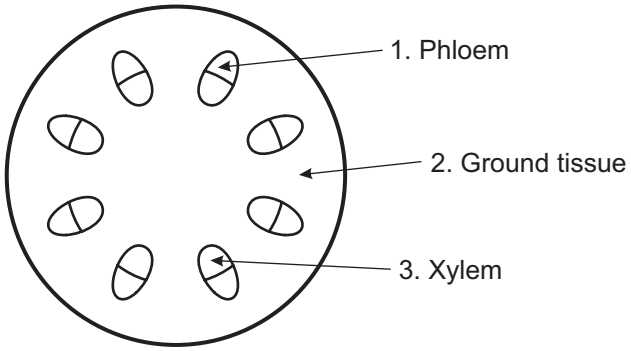
Answer <u>any</u> two questions.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) (i) Because it has two seed leaves. **(3)**
(ii) Rose bush. **(3)**

(b) (i)
- A thin section of a dicot stem was cut using a blade.
- Sections were transferred to a clock glass of water using a paintbrush. This prevented the sections from drying out.
- Section was transferred to a slide using paintbrush.
- Drop of water placed on section to prevent drying out.
- Coverslip applied. **(Any three: 3, 3, 3)**

(ii)
- Low power lens was placed in position.
- Lamp turned on, or mirror adjusted so that light could be seen through eyepiece.
- Slide containing specimen placed on slide of microscope.
- Image focused using coarse and fine focus wheels. **(Any three: 3, 3, 3)**

(c)



TIP: Practise drawing diagrams regularly. Keep diagrams simple: do not use colour; label structures accurately by pointing arrows exactly to where the structure is located.

MARKS:
Diagram: **(3)**
Labels: **(3 × 1)**

8. (a) (i) *Germination*: Regrowth of the embryo in a seed after a period of dormancy **(3)**
(ii) To mobilise food within the seed so that it can be transported to where it is needed **(3)**

(b) (i) Petri dish containing a solid medium **(3)**
(ii) Starch OR Milk **(3)**
(iii)
- Broad bean seeds were soaked for 24 hours to start the germination process.
- The germinating seeds were cut in two using a blade.
- Half of the split seeds were boiled to kill them – denaturing the enzymes.
- Three unboiled seeds were placed cut-side down on a sterile agar plate.
- Three boiled seeds (control) were placed cut-side down on another sterile agar plate.
- The agar plates were placed in a 25˚C incubator for 2 days. **(Any two: 3, 3)**

(iv) Boiled seeds. **(3)**

(v) Iodine test (if starch agar was used) OR Biuret test (if milk agar was used). **(3)**

(vi) 1. *The experiment*: No blue-black underneath seeds (if starch agar was used).
OR
No purple underneath seeds (if milk agar was used). **(3)**

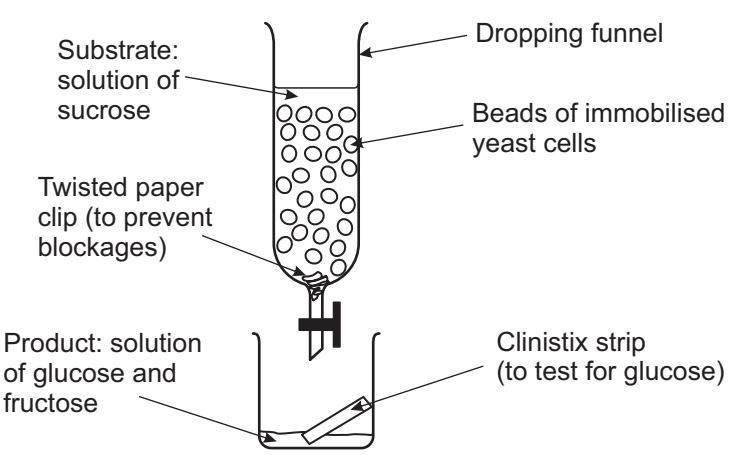
2. *The control*: Blue-black underneath seeds (if starch agar was used).
OR
Purple underneath seeds (if milk agar was used). **(3)**

9. (a) (i) Proteins **(3)**

(ii) Temperature OR pH **(3)**

(b) (i)
- Yeast (containing the enzyme invertase) was mixed with alginate.
- This viscous solution was then dropped into a solution of calcium chloride, using a syringe.
- Beads of calcium alginate with immobilise yeast cells were allowed to harden for 15 minutes. **(3, 3, 3)**

(ii)



MARKS:
Diagram: **(2)**
Labels: **(Any two: 2, 2)**

(iii)
- Twisted paper clip was placed at the bottom of the dropping funnel to prevent the beads blocking the funnel.
- Beads of immobilised yeast cells were placed in a dropping funnel.
- A solution of sucrose was added to the dropping funnel and allowed to run through the funnel slowly.
- The product was collected and tested at 1 minute intervals using Clinistix strips.
- If glucose was present the strips turned purple. **(3, 3, 3)**

SECTION C

Answer any <u>four</u> questions.

10. (a) (i) *Mendel's Law of Segregation*: Each cell contains two factors for each trait. These factors separate at gamete formation, so that each gamete contains only one factor for each pair of factors. At fertilisation, the new organism will have two factors for each trait, one from each parent. **(3)**

TIP: The definition given here for Mendel's first law of definition is a lot more than required by the marking scheme. However, it is very important to ALWAYS write out the definition in full.

(ii) Mitochondrion. **(3)**
Chloroplast. **(3)**

(b) (i) *Allele*: different forms of a gene. **(3)**
Dominant: an allele masks the effects of another allele. **(3)**

(ii) Linked. **(3)**

(iii) Independent assortment can occur OR More variation present in the offspring. **(6)**

(iv) *Brown hair, heterozygous short hair* x *Heterozygous black hair, long hair*
Parental genotypes: bbSs x Bbss

Gametes:	*Bs*	*bs*
bS	*BbSs* **(2)** Black hair, Short hair **(1)**	*bbSs* **(2)** Brown hair, Short hair **(1)**
bs	*Bbss* **(2)** Black hair, Long hair **(1)**	*bbss* **(2)** Brown hair, Long hair **(1)**

MARKS: In this genetic cross each excess incorrect answer cancels a correct answer!

(c) (i) *Species*: a group of similar organisms that is capable of interbreeding to produce fertile offspring. **(3, 3)**

(ii) 1. Variation: differences among members of the same species. **(3)**
2. Sexual reproduction. **(3)**
Mutation. **(3)**

(iii) New genotypes can be produced that may enable the organism to be better adapted to their environment. **(3)**

(iv)
- Fossils **(3)**
- Embryos **(3)**

TIP: There are five definitions in question 10 worth 15 marks in total or 4.75% of the final grade! Learn off definitions!

11. (a) (i) *Conservation*: management of our existing natural resources. **(3)**

(ii) *Agriculture*: slurry is stored in slurry pits to prevent run-off into rivers and lakes.
OR
Fisheries: waste parts of fish are pulped so that they can be used as pig feed.
OR
Forestry: branches, twigs, and excess cuttings are converted to wood chippings and made into chip board.
(Any two: 3, 3)

(b) 1.
- Occupying territory
- Defending territory
- Marking territory boundaries
- Hunting in groups **(Any two: 3, 3)**

2. With scent and urine. **(3)**
3. By accompanying the parents on hunts. **(3)**
4. They make waste food harder to obtain. **(3)**
5. Omnivore: an organism that eats both animal and plant material. **(3)**
6. Enables the fox to avoid competition with other predators. **(3)**
7. Rural foxes as there is more food available due to less human activity in rural settings. **(6)**

TIP: In (b) 7 any reasoned valid argument is allowed.

(c) (i) 1. *Qualitative*: types of organisms present. **(3)**
2. *Quantitative*: numbers of organisms present. **(3)**

(ii) Woodland **(3)**
Quantitative survey: **(3, 3, 3)**
- Pencil was thrown over shoulder in marked out habitat.
- Quadrat placed where pencil landed.
- The numbers of each plant species found within the quadrat was recorded by the percentage cover method.
- The percentage cover method involved using the squares within the quadrat to estimate the percentage of the square that was occupied by the particular plant species.
- The procedure was repeated a number of times.

(iii) Table OR Graph. **(3)**

(iv) Not enough samples taken OR Error in estimating the percentages. **(3)**

TIP: Any three points are sufficient in the quantitative survey, but always try to include as many as possible to cover yourself!

12. (a) (i) ADP **(3)**

(ii) Energy **(3)**

(iii) Capturing of high energy electrons and protons **(3)**

TIP: The diagram in 12 (a) requires an understanding of energy carriers. It is important in your study of biology to try to understand the detailed roles of various substances in the human body.

(b) (i) Glycolysis **(3)**

(ii) 1. Lactic acid **(3)**
2. Ethanol and carbon dioxide **(3)**

(iii) Mitochondrion **(3)**

(iv) Acetyl Coenzyme A **(3)**

(v) Krebs cycle **(3)**
Carbon dioxide OR ATP OR Protons **(3)**

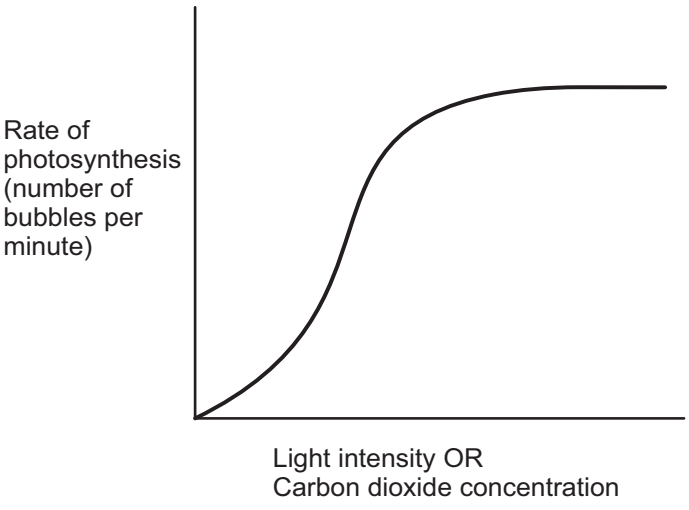
(vi) 1. Forming ATP **(3)**
2. They are combined with oxygen and protons to form water **(3)**

(c) (i) Counting the number of bubbles released by Elodea per minute **(3)**

(ii) Changed the distance between the light source and Elodea (if studying the effect of varying light intensity)
OR
Changed the amount of sodium hydrogen carbonate in pond water (if studying the effect of varying carbon dioxide concentration) **(3)**

(iii) *Named factor*: Temperature **(3)**
Kept constant using a water bath **(3)**

(iv) **(3, 3)**



TIP: There are other ways to draw this graph. If you are unsure ask your teacher!

(v) As the light intensity increases so does the rate of photosynthesis. However, the rate levels off when the plant is light saturated. **(3, 3)**

13. (a) (i) Pulmonary circuit **(3)**
Systemic circuit **(3)**

(ii) Systemic **(3)**

MARKS: Questions that require a structure to be named are often only given 2 marks; whereas other required pieces of information usually get 3 marks.

(b) (i) 1. *Pulse*: alternate contraction and expansion of an artery wall caused by the heart beating. **(3)**
2. *Blood pressure*: force of blood against the walls of blood vessels. **(3)**

(ii) 1. *Diet*: salt increases blood pressure OR cholesterol contributes to atherosclerosis. **(3)**
2. *Exercise*: stresses muscles of the heart making them stronger. **(3)**

(iii)
- Red blood cells have a biconcave shape.
- Red blood cells do not have a nucleus.
- Red blood cells contain haemoglobin. **(Any two: 3, 3)**

(iv) *SA node*: generates electrical impulses to cause cardiac muscle contraction and acts as a pacemaker.
AV node: passes the electrical impulses onto the heart muscle, causing contraction. **(3)**

(v) *SA node*: top of right atrium. **(3)**
AV node: between the right atrium and right ventricle. **(3)**

(c) (i) *A*: Bronchiole **(2)**
B: Alveolus **(2)**
C: Arteriole OR Capillary **(2)**

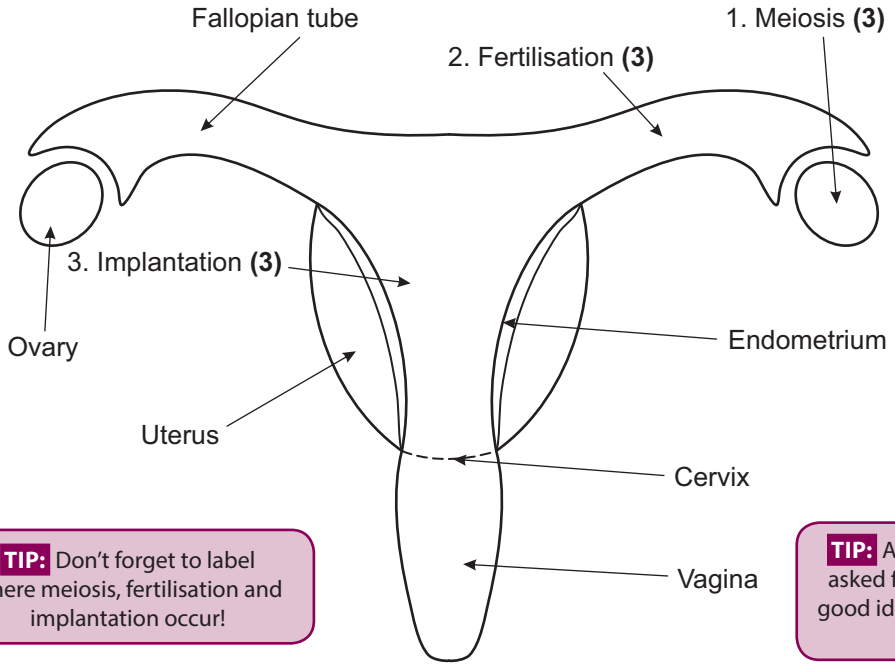
(ii)
- Thin-walled.
- Moist surfaces.
- Large surface area.
- Good blood supply.
- Large numbers of alveoli. **(Any two: 3, 3)**

(iii) *Named disorder*: Bronchitis. **(3)**
1. Cause: viral or bacterial infection. **(2)**
2. Prevention: wash hands well after sneezing; use hand sanitiser. **(2)**
3. Treatment: anti-inflammatory drugs; antibiotics (if caused by bacteria). **(2)**
OR
Named disorder: Asthma **(3)**
1. Cause: dust or exercise. **(2)**
2. Prevention: avoid breathing in dust or use an inhaler. **(2)**
3. Treatment: use an inhaler. **(2)**

MARKS: You only have to write about either bronchitis OR asthma. Therefore, the maximum marks here are 9.

(iv) Carbon dioxide. **(3)**

14. (a) (i) **(6)**



MARKS: Diagram: **(6)**

TIP: Don't forget to label where meiosis, fertilisation and implantation occur!

TIP: Although the question only asked for a diagram, it is always a good idea to label all diagrams you draw.

(ii) *Oestrogen*:
- Repairs endometrium
- Inhibits FSH
- Stimulates LH **(Any two: 3, 3)**

OR

Progesterone:
- Maintains the endometrium
- Inhibits FSH
- Inhibits LH **(Any two: 3, 3)**

MARKS: You only have to write about either oestrogen OR progesterone. Therefore, the maximum marks here are 6.

(iii) Named disorder: Fibroids **(3)**

1. *Cause*: growth of uterine muscle tissue. **(3)**
2. *Treatment*: anti-inflammatory medication, contraceptive pills or surgery for very large painful fibroids. **(3)**

OR

Named disorder: Endometriosis **(3)**

1. *Cause*: growth of endometrial cells outside the uterus, within the body cavity. **(3)**
2. *Treatment*: pain killers and hormone treatment or surgery in severe cases of endometriosis. **(3)**

MARKS: You only have to write about either fibroids OR endometriosis. Therefore, the maximum marks here are 9.

(b) (i) *Placenta*:
- Transports nutrients to foetus and wastes away.
- Acts as a barrier, preventing entry of harmful chemicals and pathogens.
- Produces progesterone, maintaining the pregnancy. **(Any two: 3, 3)**

(ii) Uterine and embryonic **(3)**

(iii) *Birth*:
1. Labour: progesterone levels drop, oxytocin levels increase, causing the uterus to contract. The 'waters break' when the amniotic sac bursts. **(3)**
2. Parturition: further contractions of the uterus force the baby out of the body via the birth canal. **(3)**
3. Afterbirth: the umbilical cord is cut. Further uterus contractions force the placenta out of the body. **(3)**

(iv) *In vitro fertilisation*: the fusion of a sperm and egg outside the body. **(3, 3)**

(v) *Morula*: solid ball of cells. **(3)**
Blastocyst: fluid-filled ball of cells. **(3)**

(c) (i) Rhizopus **(3)**

(ii) Fungi **(3)**

(iii) *A*: Sporangiophore **(2)**
B: Sporangium **(2)**
C: Spore **(2)**

TIP: Many students get mixed up between 'sporangiophore' and 'sporangium'. Learn these structures off by heart!

(iv) 1. Take in nutrients and transport them to other areas of the fungus. **(3)**
2. Secrete enzymes into substrate causing them to be broken down and then absorb the digested nutrients. **(3)**

(v) Saprophytic **(3)**

(vi) Nucleus **(3)**
Membrane-bound organelles **(3)**

(vii) Prokaryotic **(3)**

15. (a) (i) *Vegetative propagation*: new plant produced by asexual reproduction **(3)**

(ii) Fast OR Preserves desirable plant characteristics OR Cheaper OR More reliable **(3)**

(iii)
- Cutting
- Layering
- Grafting
- Micropropagation **(Any two: 3, 3)**

(iv) *Vegetative propagation*:
1. No gametes involved
2. Identical plants produced

Sexual propagation:
1. Gametes are involved
2. Non-identical plants produced **(3, 3)**

(v) 1. *Methods of dispersal*:
- Wind
- Animal
- Self
- Water **(Any two: 3, 3)**

2. *Advantages*:
- Colonise new habitats
- Reduce competition between parents and offspring **(3, 3)**

(b) (i) *V*: Iris **(2)**
W: Pupil **(2)**
X: Choroid **(2)**

(ii) *Function of Y*: Focus light rays onto the retina **(3)**
Function of Z: To produce nerve impulses based on light signals **(3)**

(iii) 1. Hold lens in place
2. Detects colours
3. Carries impulses from retina to brain
4. Interprets nerve impulses received from retina **(Any three: 3, 3, 3)**

(iv) The iris contracts to make the pupil smaller preventing too much light entering the eye. The iris relaxes making the pupil larger to let more light in. **(3, 3)**

(v)
- Increases the size of the visual field.
- Enables an animal to judge depth better. **(Any one: 3)**

(c) (i) *Role of lymphocytes*:
- There are two main groups of lymphocytes: B lymphocytes and T lymphocytes.
- B cells produce antibodies in response to an antigen.
- There are four subtypes of T lymphocytes: Helper T cells; Killer T cells; Suppressor T cells; and Memory T cells.
- Helper T cells stimulate other T cells and B cells.
- Killer T cells cause virus-infected cells to burst.
- Suppressor T cells inhibit the immune response once the antigen has been eliminated.
- Memory T cells remain in the immune system long after the antigen has been eliminated. **(4, 3, 3)**

(ii) *Neurotransmitters*:
- Chemical substances that are secreted by the synaptic terminals of presynaptic neurons in response to an electrical impulse.
- Chemicals that travel across a synaptic cleft, bind to receptors on another neuron (post-synaptic neuron) and cause a new electrical impulse.
- Can be reabsorbed back into the presynaptic neuron or are broken down by enzymes. **(4, 3, 3)**

(iii) *Homeostasis*:
- Maintenance of a constant internal environment.
- Important for enzymes to work at their optimal rate.
- For example, animal blood pH = 7.4; internal body temperature of the human = 37˚C. **(4, 3, 3)**

(iv) *Adaptations of wind-pollinated flowers*:
- Small, green petals.
- Long stamens with anthers that hang outside the flower to catch the wind.
- Long feathery stigmas that hang outside the flower to increase the chance of catching pollen grains.
- Large amount of pollen is produced.
- Pollen is small, smooth and light. **(4, 3, 3)**

(v) *Economic and medical importance of viruses*:
- Economic: Viruses cause illnesses and disease (such as foot and mouth disease in cattle and sheep).
- Economic: Viruses cause crop damage (such as tomato mosaic virus).
- Medical: Viruses cause human illnesses such as the common cold and influenza.
- Medical: Viruses cause human diseases such as AIDS.
- Medical: Viruses are used in scientific and medical research, as vectors for genetic engineering.

(4, 3, 3)

TIP: In part (v) your answer has to include at least one point from the economic category and one point from the medical categories. The third point can come from either category.

TIP: Question C (v) requires notes on only three of the topics listed. However, it is always a good idea to write notes on all topics and to write as much as you know about the specific topics. Use bullet points.