2022.M44

2022L025A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2022

Biology

Sections A and B and Answerbook

Higher Level

Tuesday 14 June Afternoon 2:00 - 5:00

290 marks

Examination Number

Day and Month of Birth

For example, 3rd February is entered as 0302

Centre Stamp

Instructions

Write your Examination Number and your Day and Month of Birth in the boxes on the front cover.

Write your answers to all parts of the examination into this answerbook. This answerbook will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write your answers in blue or black pen. You may use a pencil for sketches, graphs and diagrams only.

There are three sections in this examination. Questions for Section **C** are supplied separately but your answers must be written in this answerbook.

It is recommended that you spend not more than 30 minutes on Section **A** and 30 minutes on Section **B**, leaving 120 minutes for Section **C**.

Section **A**	Answer any **four** questions from this section. Each question carries 20 marks.
Section **B**	Answer any **one** question from this section. Each question carries 30 marks.
Section **C**	Answer any **three** questions from this section. Each question carries 60 marks.

Section A

Answer any four questions.
Write your answers in the spaces provided.

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

(a) Name the **four** elements found in **all** proteins.

(b) Name an element that is only sometimes found in proteins.

(c) How many common amino acids are found in proteins?

(d) Fibrous proteins have structural roles in living organisms.
Name any **one** fibrous protein.

(e) Give **one** metabolic role of proteins in living organisms.

(f) Give **one** good source of protein in the diet.

2. Write a brief sentence explaining **each** of the following terms.

(a) Ecology

(b) Food chain

(c) Edaphic factor

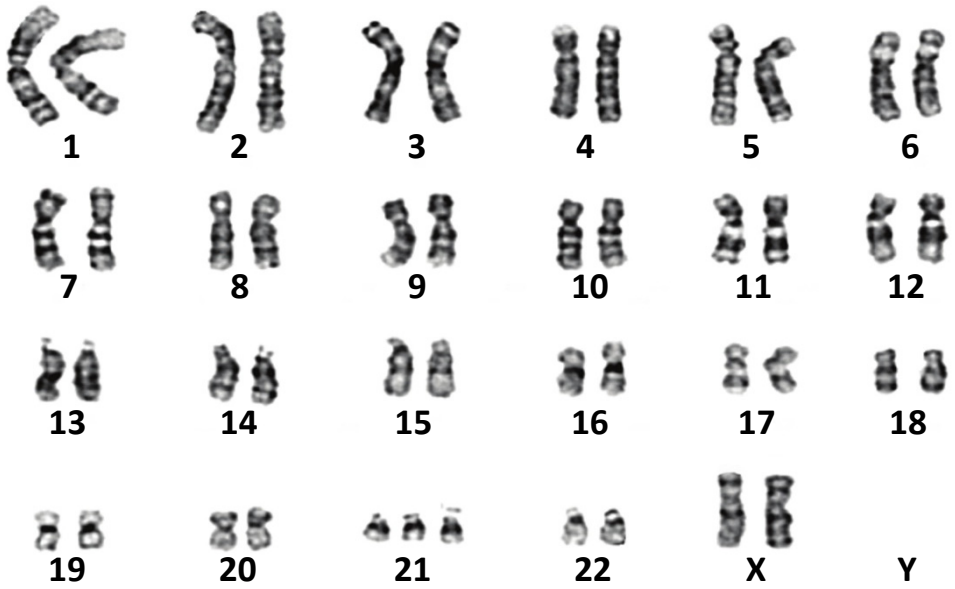
(d) Quantitative study

(e) Omnivore

(f) Contest competition

(g) Nitrogen fixation

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



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

1.
2.

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

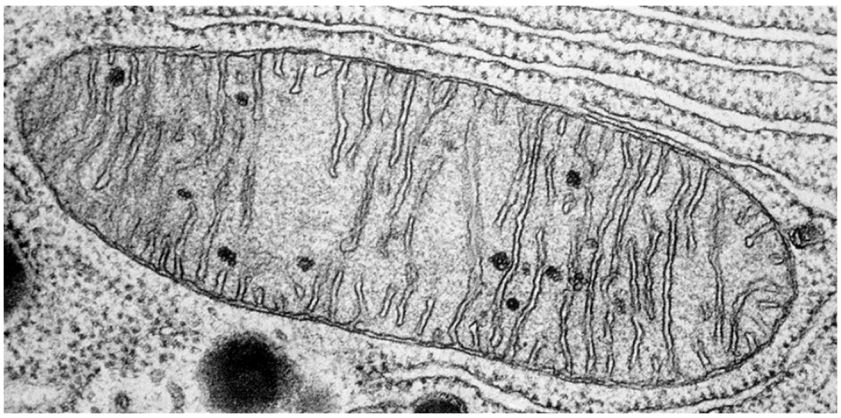
(c) Justify the answer you have given at part (b) above.

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

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

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

4. The image shows a transverse section through a mitochondrion, produced using a transmission electron microscope.



(a) Explain why the image above cannot be produced using a light microscope.

(b) Name **one** type of animal cell that does **not** have mitochondria.

(c) Aerobic respiration involves two stages.

(i) Name **and** give the location of the stage of aerobic respiration that does **not** occur in the mitochondrion.

Name:
Location:

(ii) Name the series of chemical reactions, involving acetyl Co. A, which does occur in the mitochondrion.

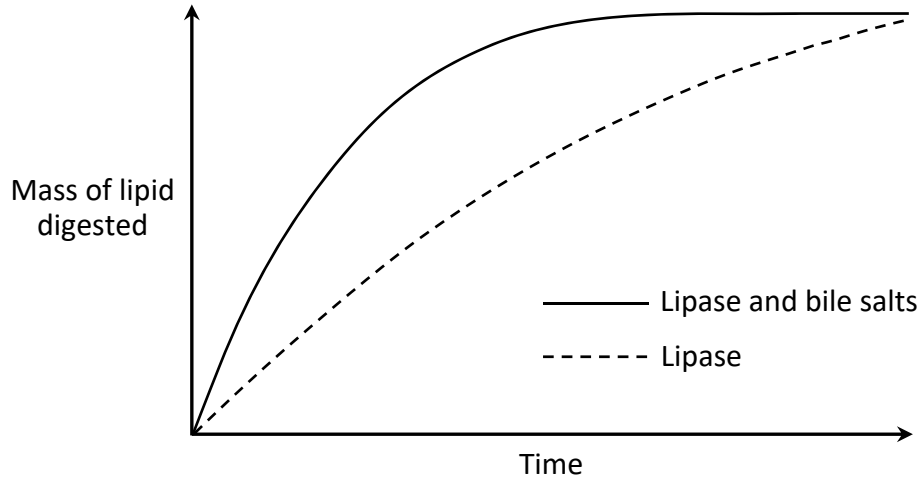
(iii) State the number of carbon atoms in a molecule of acetyl Co. A.

(d) Sometimes lactic acid is produced during respiration.
Describe a condition during which this may occur.

5. Indicate whether the following statements are true or false by placing a tick (✓) in the appropriate box in **each** case.

		True	False
(a)	Copper (Cu) is one of the common elements present in food.	☐	☐
(b)	Response is a characteristic of life.	☐	☐
(c)	An animal cell will burst if placed in a concentrated sugar solution.	☐	☐
(d)	Macrophages are white blood cells that secrete perforin.	☐	☐
(e)	Organs are groups of tissues with a shared function.	☐	☐
(f)	Ethene is used to ripen fruit.	☐	☐
(g)	All members of Kingdom Fungi are heterotrophic.	☐	☐

6. A student carried out an experiment comparing the action of lipase on its own with the action of both lipase and bile salts on lipid digestion over time.
The graph below illustrates the student's experimental results.



(a) What conclusion could the student make about lipid digestion based on the graph of results shown above?

(b) Name the **two** products of complete lipid digestion by lipase.

1.

2.

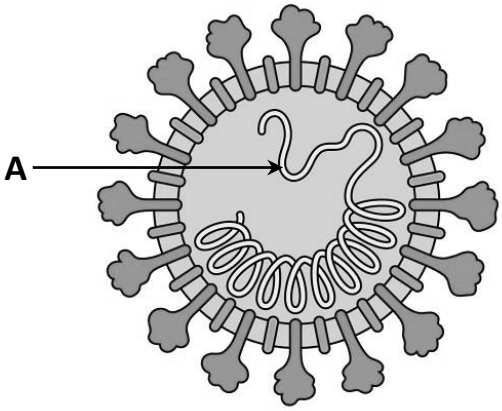
(c) Name a location in the digestive system where lipase digests lipids.

(d) Suggest an optimum pH for digestion of lipids in the location you named at part (c) above.

(e) Describe the action of bile salts on lipids.

(f) Villi are microscopic structures in the digestive system that aid the absorption of nutrients.
Name the structure inside each villus that absorbs the products of lipid digestion.

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



(a) Name molecule **A**.

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

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

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

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

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

Section B

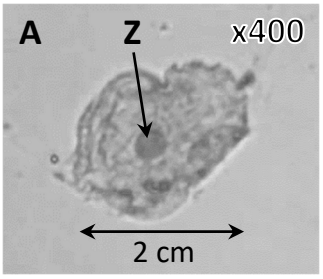
Answer any one question.
Write your answers in the spaces provided.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

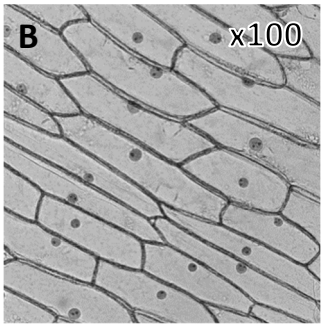
8. (a) Distinguish clearly between a eukaryotic cell **and** a prokaryotic cell, by writing a brief sentence on **each**.

Eukaryotic:
Prokaryotic:

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

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





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

(iii) Identify structure **Z**.

(iv) When examining cells with a microscope:

1. Name a stain that can be used.

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

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

(vi) Image **B** shows cells at x100.
Describe the steps taken to view these cells at x400.

9. (a) (i) What is meant by the term *autotrophic*?

(ii) Explain why photosynthesis is an anabolic reaction.

(b) Answer the following questions based on an activity you carried out to investigate the effect of light intensity **or** carbon dioxide concentration on the rate of photosynthesis.

(i) Name a suitable photosynthetic organism you used for this investigation.

(ii) Why was the organism named at part (b) (i) above suitable for this investigation?

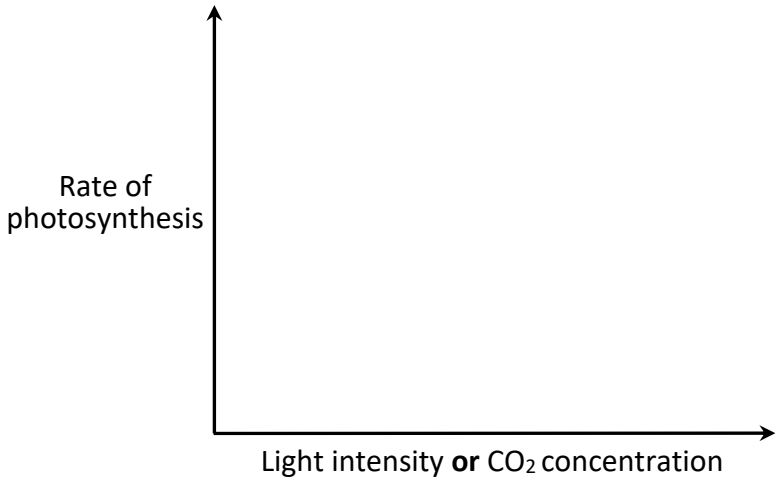
(iii) Why was it important to keep other factors, such as temperature, constant during the investigation?

(iv) How did you keep the temperature of the organism constant for this activity?

(v) Explain how you measured the rate of photosynthesis.

(vi) On the axes below, sketch **two** graphs as described below:

1. Using a solid line (——), sketch the expected result at 25 °C.
2. Using a dashed line (------), sketch the expected result if the activity had been carried out at 60 °C.



10. (a) (i) State a location in plants where growth regulators are produced.

(ii) How are growth regulators transported around a plant?

(b) Answer the following questions based on an investigation you carried out into the effect of IAA growth regulator on a plant tissue.

(i) Name a suitable plant tissue you used in this investigation.

(ii) Describe how you set up the investigation.

(iii) Describe how you measured the effect of IAA on the plant tissue.

(iv) Describe any **one** result of your investigation.

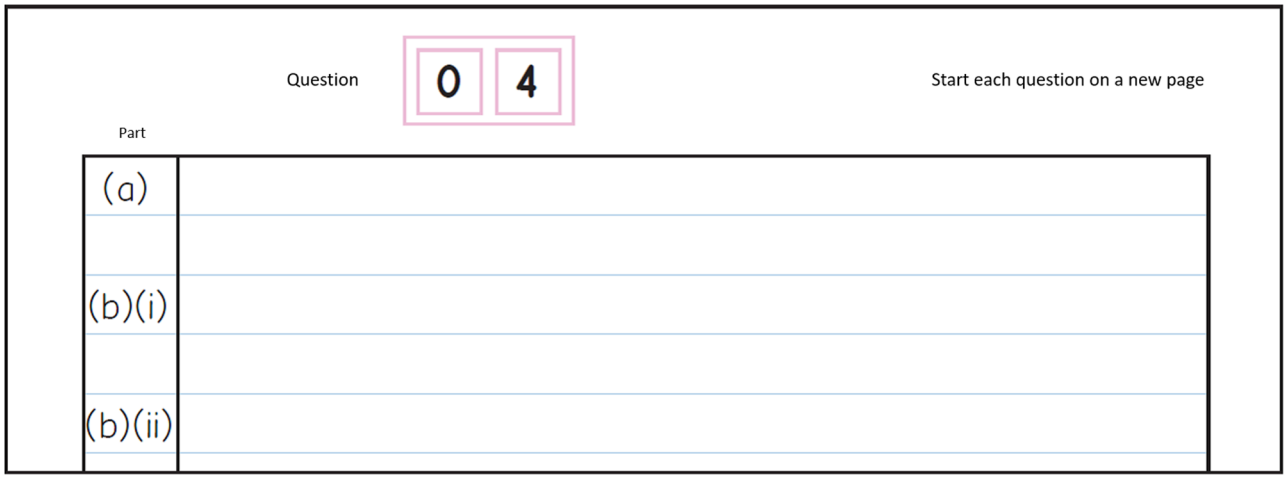
(v) Describe **one** safety precaution you took in carrying out this investigation.

Answerbook for Section C

Instructions

Questions for Section **C** are supplied separately.

Start each question on a new page. Write the question number in the box at the top of each page. Use the left-hand column to label each part, as shown below.



There are two pages of graph paper on the next two pages of this answerbook. On pages with graph paper, the box for the question number is at the bottom of the page.

You do not need to use all of the pages in this answerbook. If you run out of space in this answerbook, you may ask the superintendent for more paper or graph paper.

Write your answers in blue or black pen. You may use a pencil for sketches, graphs and diagrams only.

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Leaving Certificate – Higher Level

Biology Sections A and B and Answerbook

Tuesday 14 June

Afternoon 2:00 - 5:00

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2022

Biology

Section C

Higher Level

Tuesday 14 June Afternoon 2:00 - 5:00

180 marks

Do not hand this question paper up.
This document will not be returned to the State Examinations Commission.

Section C

Answer any three questions.
Write your answers in the answerbook containing Sections A and B.

11. (a) (i) Give **one** precaution scientists use when working with microorganisms in the laboratory.

(ii) Explain the terms *asepsis* **and** *sterility* as applied to living organisms.

(9)

(b) (i) Draw a large labelled diagram of a typical bacterial cell.

(ii) Many species of bacteria can form endospores.
Describe the main events of endospore formation.

(iii) Harmful bacteria can cause disease in humans.

1. Give any **two** examples of harmful bacteria.
2. Bacterial infections can be treated with antibiotics.
   What is an antibiotic?
3. State **one** possible reason why antibiotic resistance has arisen in bacteria.

(27)

(c) Food processing is carried out in a bioreactor using microorganisms, such as bacteria and some fungi.
It can be carried out as batch or continuous flow food processing.

(i) Give **two** factors that affect the growth of microorganisms, such as bacteria.

(ii) Explain how either of the factors you named at part (c) (i) above affects growth.

(iii) Distinguish between batch and continuous flow food processing by writing a brief sentence on **each** type.

(iv) Sketch a plot of a microorganism growth curve.
Label the axes **and** label the curve with the five phases shown below.
Note: the list below is not in the correct order.

stationary **survival** **log** **decline** **lag**

(24)

12. (a) Explain the following **three** ecological terms: *biosphere*; *niche*; *symbiosis*. **(9)**

(b) Read the following passage and answer the questions that follow.

Dragonflies are a deadly group of Irish predators. They chase down gnats with dazzling aerobatics and have a high strike rate due to their huge compound eyes.

Dragonflies hunt close to river banks and other waterways. The water quality has to be very good for most species. They also require vegetation for protection and laying eggs. Dragonflies spend most of their lives as nymphs (young, immature dragonflies) in waterways. These are small opportunistic, ambush predators. They feed mostly on small invertebrates (e.g. water fleas).

It can take between one and three years for nymphs to fully mature into adult dragonflies. Adults only survive for a few weeks as they fall prey to birds (e.g. swallows).

The National Biodiversity Data Centre are running a survey of dragonflies where volunteers are being asked to identify dragonflies and survey their habitats.

(Adapted from "*Irish dragonflies: supreme killing machines*", *The Irish Times*, 5 September 2019)

(i) Suggest **one** reason why dragonflies are such successful predators.
(ii) Give **two** benefits for dragonfly populations living near freshwater vegetation.
(iii) Suggest a benefit of the adult and the nymph having different food sources.
(iv) What type of ecological relationship exists between swallows and dragonflies?
(v) Suggest **one** possible effect on the dragonfly population for **each** of the following:
    1. a disease affecting the swallows
    2. cutting of vegetation (e.g. reeds) along the river banks.
(vi) Suggest **one** reason why volunteers are being asked to identify dragonflies.
(vii) What might a volunteer use to help them identify a dragonfly? **(27)**

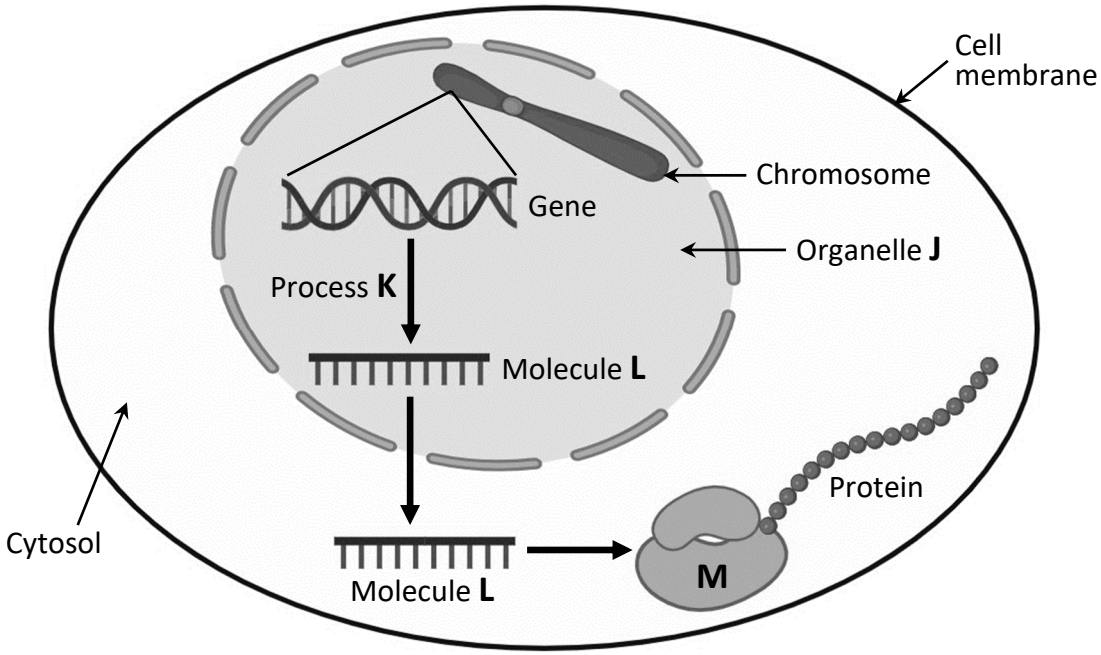
(c) (i) Outline the main events of the carbon cycle.
(ii) Explain why the carbon cycle is critical to life on Earth.

Global warming is occurring at an unprecented rate.
This is as a result of <u>pollution</u> of the atmosphere with greenhouse gases.

(iii) Explain the underlined term.
(iv) Waste management is important in controlling pollution.
Give **one** example of waste management from agriculture **or** fisheries **or** forestry.
(v) Other than global warming or pollution, give **two** factors that can have an effect on the human population. **(24)**

13. (a) Nucleic acids are composed of subunits called nucleotides.
Draw **and** label the structure of any **one** nucleotide. **(9)**

(b) The diagram illustrates some of the events of protein synthesis.



(i) What is the name of process **K** that results in the formation of molecule **L**?
(ii) Name molecule **L**.
(iii) Part of the sequence of nitrogenous bases in the gene is as follows:

Base sequence: **A C G T G C T G A**

Using this sequence, write out in order the complementary sequence of bases found in molecule **L**.
(iv) Give the name of the opening through which molecule **L** leaves organelle **J**.
(v) Molecule **L** arrives at structure **M** in the cytosol as shown.
1. Identify structure **M**.
2. Name the main molecule from which structure **M** is made.
(vi) Describe the events that occur at structure **M**, which allow the production of a functioning protein. **(27)**

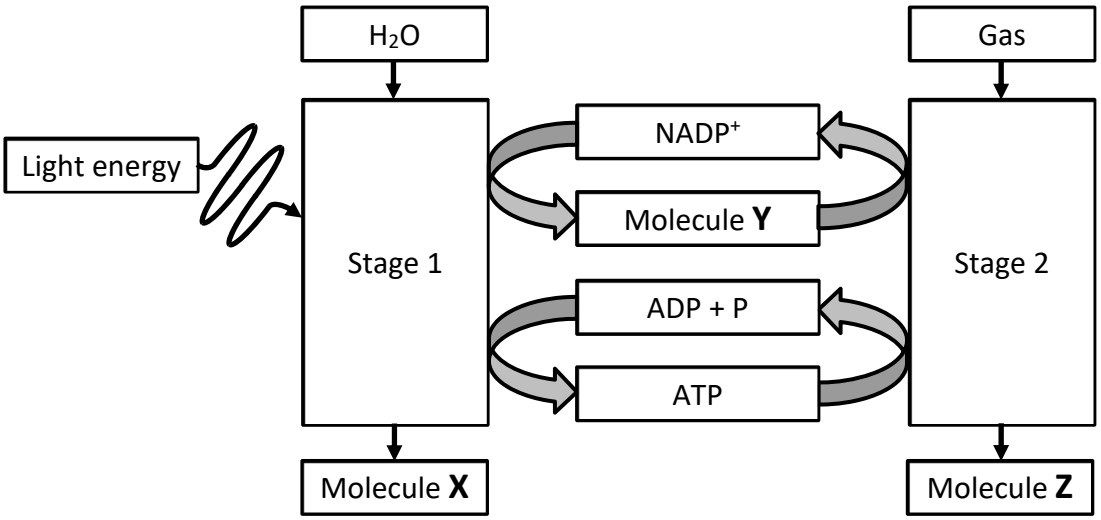
(c) In squash plants, the allele for white fruit (**F**) is dominant to the allele for yellow fruit (**f**). The allele for disc-shaped fruit (**D**) is dominant to the allele for spherical-shaped fruit (**d**). The genes that control fruit colour and fruit shape are located on different chromosomes.
A squash plant, homozygous dominant for both fruit colour and shape, was crossed with a squash plant homozygous recessive for both.

(i) Explain the underlined terms.
(ii) Draw **two** chromosome diagrams (one for each parent) showing the position of **each** allele on homologous chromosomes. Clearly indicate which is homozygous dominant and which is homozygous recessive.
(iii) Using a Punnet square, or otherwise, describe the result of this cross. **(24)**

14. (a) (i) In which cell organelle does photosynthesis occur?
(ii) Name the pigment essential for photosynthesis.
(iii) Describe **one** way in which horticulturists can increase plant yields in greenhouses.

(9)

(b) The process of photosynthesis occurs over two stages as shown below.
Study the diagram carefully and answer the questions that follow.



(i) Water is split during stage 1 using the energy in light.
What is the name given to this process?
(ii) Identify molecule **X**, produced as a by-product of the splitting of water.
(iii) Identify molecule **Y**.
(iv) Describe how molecule **Y** is produced.
(v) Name stage 2 shown in the diagram above.
(vi) What does ATP stand for?
(vii) What is the role of ATP in stage 2 of photosynthesis as shown in the diagram above?
(viii) Identify molecule **Z**, the end product of stage 2.

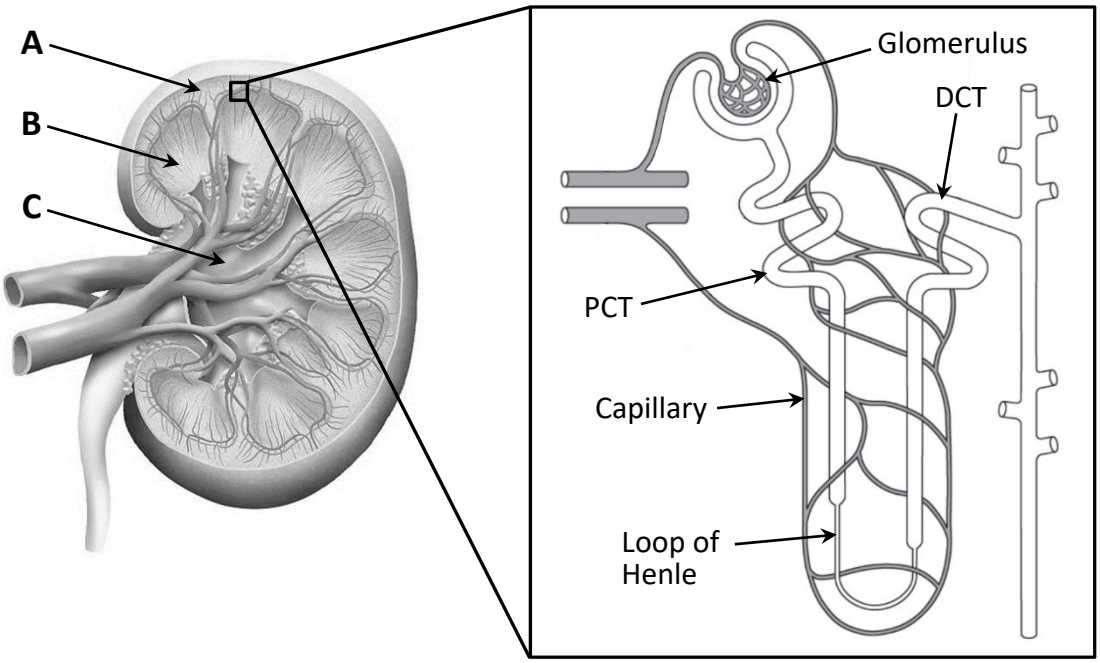
(27)

(c) Interphase and mitosis occur during the cell cycle.
The process of mitosis occurs over four phases (prophase, metaphase, anaphase and telophase).
(i) Describe **two** events that occur during prophase.
(ii) Describe **one** event that occurs during metaphase.
(iii) Draw a large labelled diagram of a cell with a diploid number of four at anaphase of mitosis.
(iv) At the end of mitosis, the cell divides.
Describe how cell division occurs in an animal cell **and** in a plant cell.

(24)

15. (a) Excretion is an important process in homeostasis in living organisms.
(i) Explain the underlined terms.
(ii) Name **one** excretory organ in plants. **(9)**

(b) The diagrams below are of a human kidney and one of its nephrons.
(PCT = proximal convoluted tubule; DCT = distal convoluted tubule)



(i) The kidneys are located in the abdomen surrounded by a thick layer of fat. What is the function of this layer of fat?
(ii) Identify the regions of the kidney labelled **A**, **B** and **C**.
(iii) Identify the region in the kidney, by name or label, where the process of filtration occurs.
(iv) Explain the importance of blood entering the glomerulus under pressure.
(v) State **two** reasons why there are many capillaries surrounding the proximal convoluted tubule (PCT), loop of Henle and distal convoluted tubule (DCT) of the nephron.
(vi) Describe how ADH (anti-diuretic hormone) affects the volume of urine.
(vii) Urine collects at the region labelled **C** on the diagram of the kidney and travels on towards the bladder.
Name the structure through which urine travels to the bladder. **(27)**

(c) Plants require water for survival.
(i) By what process does water enter the root hairs?
(ii) Draw a large diagram of a transverse section of a root **and** label the following tissues: **dermal**; **ground**; **vascular**.
(iii) Name the **two** Irish scientists who first described the upward movement of water in plants.
(iv) Describe in detail the upward movement of water in plants. **(24)**

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

(a) (i) The human nervous system is divided into two parts.
Name **each** of these parts.

(ii) Draw a large diagram of a neuron **and** label the following parts:
dendrites; **axon**; **myelin sheath**.

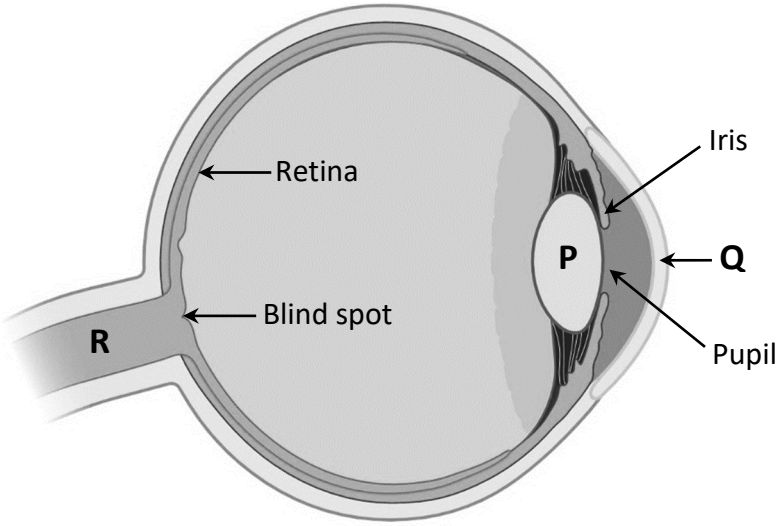
(iii) Distinguish between the function of an interneuron **and** a sensory neuron by writing a brief sentence on **each**.

(iv) How is a nerve impulse conducted along a neuron?

(v) Name the gap that exists between two neurons in close contact.

(vi) Give **one** possible cause for either paralysis **or** Parkinson's disease.
In your answer, state clearly to which nervous system disorder you are referring.

(b) The diagram shows the internal structure of the human eye.



(i) Name the parts of the eye labelled **P**, **Q** and **R**.

(ii) Name the **two** types of light receptor cells in the retina **and** give **one** function of **each** type.

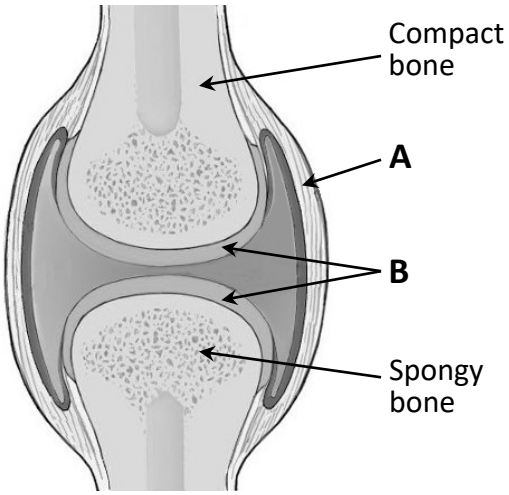
(iii) Explain why damage to the part labelled **R** could result in blindness.

(iv) The iris and pupil are affected by light intensity.
Sketch **two** diagrams of the front of the eye to show:
1. the iris and pupil in bright light
2. the iris and pupil in dim light.

(v) Describe **one** corrective measure for one of the following:
long sightedness **or** short sightedness **or** a named hearing defect.
In your answer, state clearly to which disorder you are referring.

(vi) Vision and hearing are two of the five senses in humans.
Name **one** of the other senses **and** name an organ associated with this sense.

(c) A joint in the human skeleton is where two bones meet.
Most joints are synovial (free moving). There are a number of types depending on the movement they allow. A synovial joint is shown in the diagram.

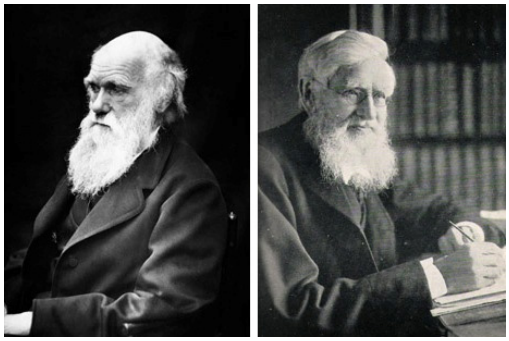


(i) Name **one** type of synovial joint **and** give **one** location in the body where it is found.
(ii) Name the structure **A** that connect two bones in a joint.
(iii) Name **and** give **one** function of the part labelled **B**.
(iv) Name the structure that connects muscles to bones.
(v) Give **one** function of compact bone.
(vi) Spongy bone contains bony bars and plates separated by irregular spaces.
Name the tissue that fills these spaces **and** give **one** function of this tissue.
(vii) Give **one** possible cause for either arthritis **or** osteoporosis.
In your answer, state clearly to which musculoskeletal disorder you are referring.

(d) Answer the following questions from your knowledge of sexual reproduction in flowering plants.
(i) State the collective term used to describe the anther and filament of the flower.
(ii) Pollen grains are produced in the anther.
Outline the main events in the development of pollen grains in the anther.
(iii) What is meant by the term *pollination*?
(iv) Name **two** methods by which pollination can occur.
(v) Describe the main events that occur immediately after pollination.

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

(a) The photographs are of the two scientists credited with the co-development of the theory of evolution by natural selection.
One of the points put forward by the theory of natural selecton is:



There is variation among members of a species and these variations are inherited.

Variations are differences among members of the same species. Mutations and meiosis contribute to these variations.

(i) Name the **two** scientists credited with developing the theory of evolution by natural selection.
(ii) Explain the **three** underlined terms.
(iii) Explain how meiosis contributes to variation.
(iv) Describe **three** points put forward in the theory of natural selection, other than the one described in the passage above.
(v) Give **one** piece of evidence that supports the theory of natural selection.

(b) Answer the following questions based on human reproduction.
(i) The placenta forms from tissues of the mother and the embryo.
Give **two** roles of the placenta.
(ii) Give an outline description of the birth process, including the role of hormones.
(iii) State **one** method of birth control.
(iv) Name the hormone responsible for milk production.
(v) State **two** biological benefits of breastfeeding.

(c) Answer the following questions from your knowledge of reproduction in flowering plants.

(i) State the location where food is usually stored in a:
1. monocoytledonous seed
2. dicotyledonous seed

(ii) Describe how seeds contribute to the formation of fruit.

(iii) Name **one** part of a flower from which a fruit may develop.

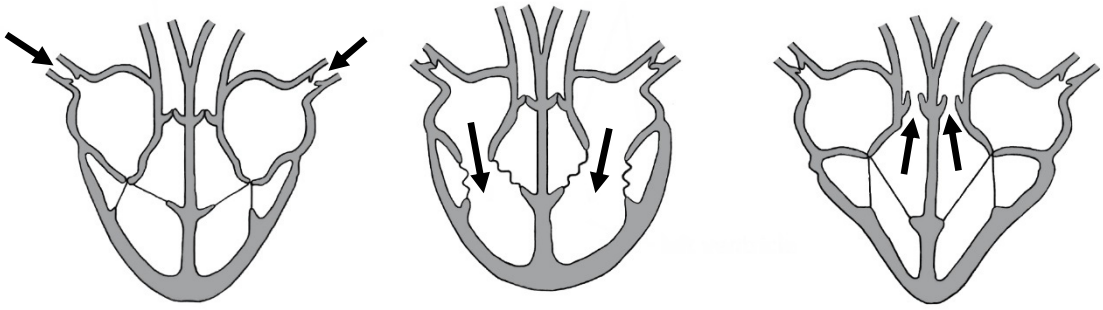
(iv) Outline **one** role of genetics in fruit production.

(v) Dispersal is where seeds are transferred away from the parent plant.
Give **two** advantages of seed dispersal.

(vi) Germination is the regrowth of a plant embryo.
Describe the role of **each** of the following in germination:
1. Digestion
2. Respiration

(vii) Many flowering plants can reproduce asexually.
Give **one** example of asexual reproduction in flowering plants.

(d) Diagrams **X**, **Y** and **Z** below show the heart during periods of the heart cycle.
Study these diagrams carefully and answer the questions that follow.



X **Y** **Z**

(i) Name the period of the heart cycle when the cardiac muscle of the heart is:
1. Contracting
2. Not contracting

(ii) In which diagram, **X** or **Y** or **Z**, are the ventricles contracting?
Explain how you know the ventricles are contracting.

(iii) State the location of the sinoatrial (SA) node in the heart.

(iv) There is a two-circuit circulatory system in humans.
Name the circuit to which:
1. the right ventricle pumps blood.
2. the left ventricle pumps blood.

(v) Each heartbeat creates two audible sounds. What causes these sounds?

(vi) What is the function of the coronary (cardiac) artery?

(vii) Describe the effect on the circulatory system of either **one** of the following: smoking **or** exercise.

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Leaving Certificate – Higher Level

Biology Section C

Tuesday 14 June
Afternoon 2:00 - 5:00