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

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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)**

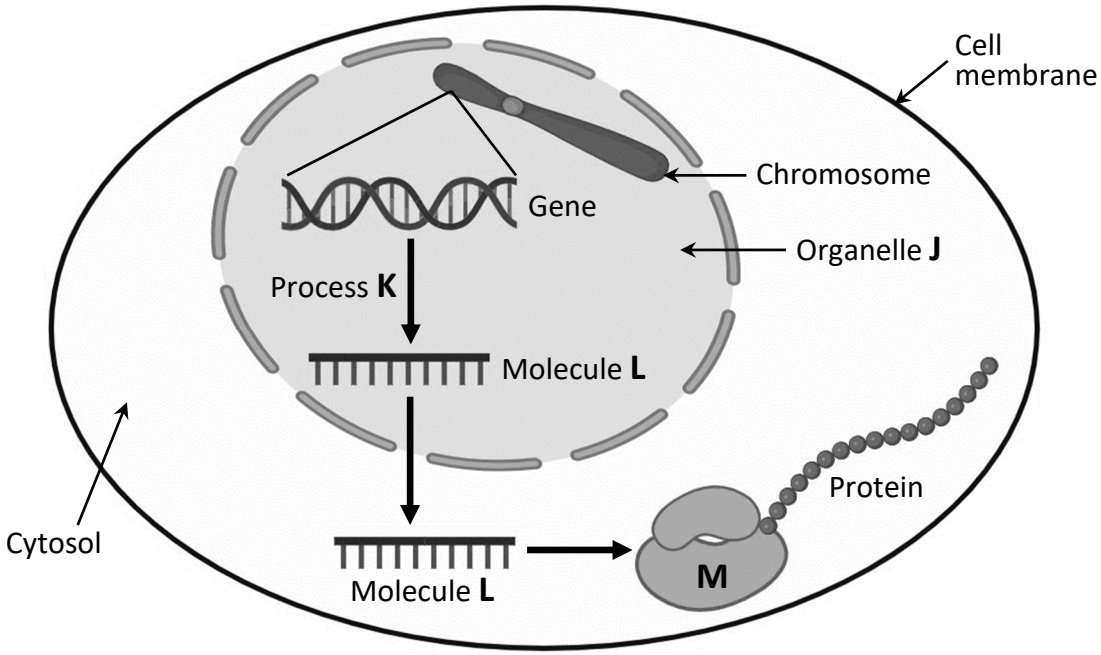
(c) (i) Outline the main events of the carbon cycle.
(ii) Explain why the carbon cycle is critical to life on Earth.

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)**

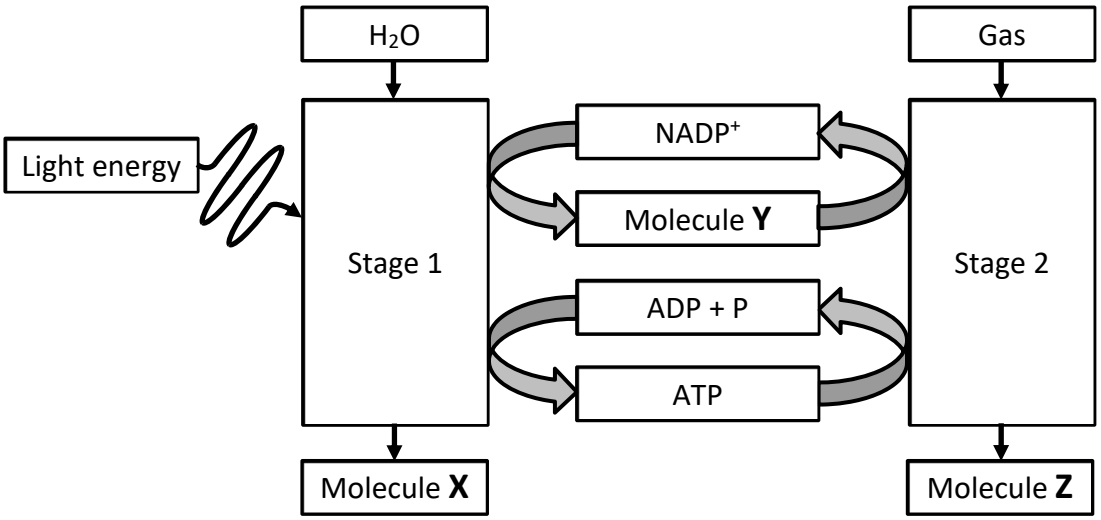
(c) In squash plants, the allele for white fruit (**F**) is dominant to the allele for yellow fruit (**f**). The allele for disc-shaped fruit (**D**) is dominant to the allele for spherical-shaped fruit (**d**). The genes that control fruit colour and fruit shape are located on different chromosomes.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

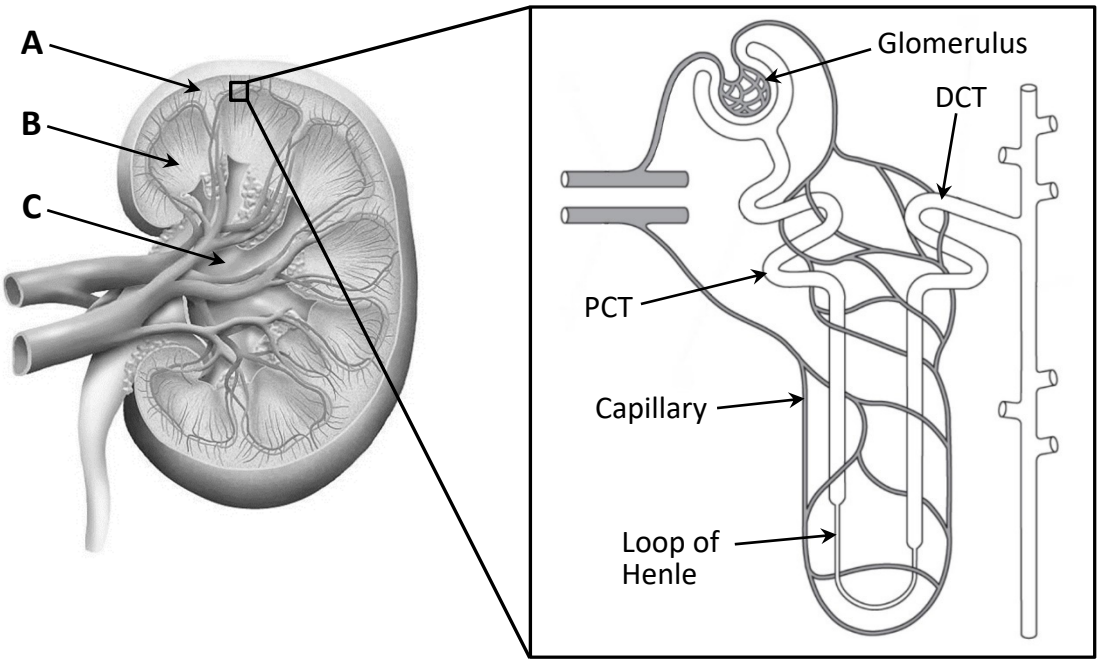
(27)

(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**.

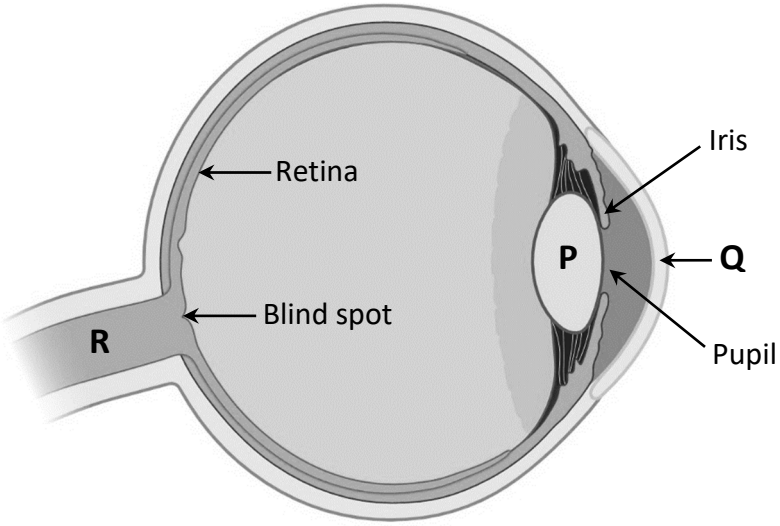
(iii) Distinguish between the function of an interneuron **and** a sensory neuron by writing a brief sentence on **each**.

(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.

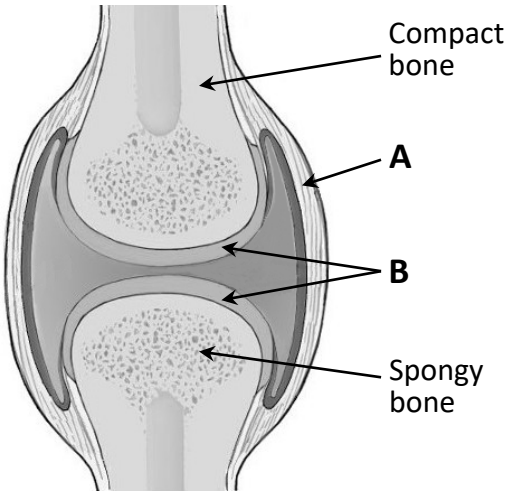
(iii) Explain why damage to the part labelled **R** could result in blindness.

(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.

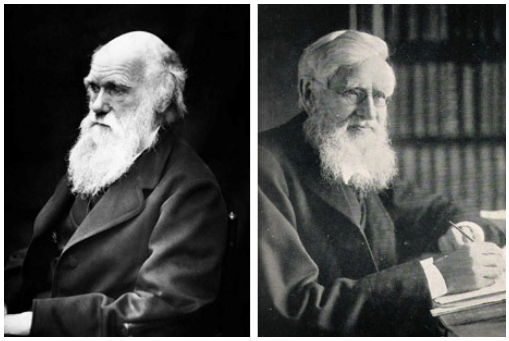


(i) Name **one** type of synovial joint **and** give **one** location in the body where it is found.
(ii) Name the structure **A** that connect two bones in a joint.
(iii) Name **and** give **one** function of the part labelled **B**.
(iv) Name the structure that connects muscles to bones.
(v) Give **one** 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.

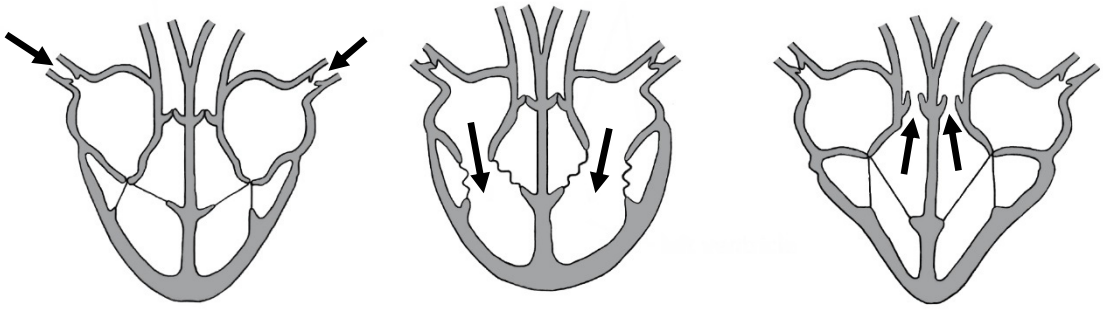
(iv) Outline **one** role of genetics in fruit production.

(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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