Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2021

Biology

Section C
Higher Level

Tuesday 15 June Afternoon 2:00 – 5:00

180 marks

Do not hand this question paper up

The 2021 examination papers were adjusted to compensate for disruptions to learning due to COVID-19. This examination paper does not necessarily reflect the same structure and format as the examination papers of past or subsequent years.

Section C

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

11. (a) (i) Draw a pyramid of numbers from the following food chain:

Cowslips ⟶ Moth ⟶ Bat ⟶ Mites

(ii) Give **one** limitation of the use of pyramids of numbers in ecology. **(9)**

(b) After mating in the autumn, Irish bats hibernate through the winter then stir into life again the following spring. In early summer the gravid (pregnant) females establish maternity roosts in old buildings, attic spaces, under bridges and in other suitably undisturbed locations, where they give birth to and rear their young. Bat populations, in general, are in decline as roosting sites are lost to development and increased use of pesticides is both poisoning bats and robbing them of their insect prey.

A single pipistrelle or soprano pipistrelle – our smallest and most common nocturnal bat species, will eat a staggering 3,500 or so midges, mosquitoes, moths and other small insects every night. Without the bats we'd be plagued by much bigger swarms of biting insects on balmy summer evenings.

(Adapted from "Batty about Irish bats!" www.irelandswildlife.com, 2012)

(i) Suggest **one** advantage of females giving birth in early summer and not in spring.
(ii) Name **and** explain **one** human activity that impacts on Irish bat populations.
(iii) A bat and an insect are involved in a predator-prey relationship.
Sketch and fully label a predator-prey relationship graph to show how the populations of these two species fluctuate.
(iv) Name **one** type of adaptation necessary for organisms to survive.
(v) From the text, or otherwise, give **two** adaptations that bats possess.

(27)

(c) (i) What is meant by the conservation of species?
(ii) Name **and** describe **one** conservation practice from agriculture **or** fisheries **or** forestry.
(iii) Ecologists monitor or survey animal population numbers on a regular basis.
1. Suggest **one** advantage of carrying out these surveys.
2. Describe the steps taken to estimate the population of a named animal species in the ecosystem you have studied.

(24)

12. (a) (i) State **two** agents that can cause mutations.

(ii) Identify **one** characteristic of mutant alleles in a population.

(9)

(b) There is variation in seed shape and seed colour in pea plants.
Round (R) seed is dominant to wrinkled seed and yellow (Y) seed is dominant to green seed. These genes are not linked.

(i) Write the genotype of a plant heterozygous for both traits.

(ii) What are the possible gametes produced by this plant at part (i) above?

(iii) How does the production of these gametes at part (ii) above demonstrate Mendel's second law (independent assortment)?

(iv) The plant at part (i) above was crossed with a plant homozygous recessive for both seed shape and seed colour.
Show using a *Punnet* square how the following results were obtained.

115 plants with round yellow seeds	115 plants with wrinkled yellow seeds
114 plants with round green seeds	116 plants with wrinkled green seeds

(v) Identify the genotypes of the offspring that introduce variation in the cross at part (iv) above.

(27)

(c) The haemophilia gene (n) is sex-linked and recessive. There is currently no cure for haemophilia but recently in trials, genetic engineering has been used to transfer a 'working copy' of the human gene to affected people.

(i) Explain the **three** underlined terms.

(ii) Outline what happens in each of the following steps of genetic engineering:
1. Isolation
2. Cutting
3. Gene expression.

(iii) Give **one** application of genetic engineering in animals other than gene therapy for haemophilia.

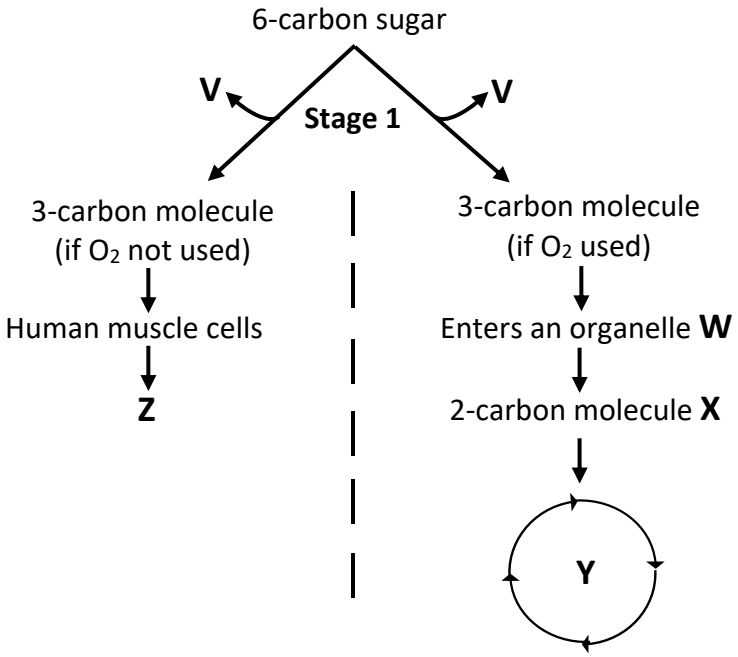
(iv) Give **one** application of genetic engineering in plants.

(24)

13. (a) (i) Define metabolism.

(ii) Write a balanced chemical equation for aerobic respiration. **(9)**

(b) The diagram outlines some of the main steps that may occur during respiration of a 6-carbon sugar.



(i) What name is given to **stage 1** as shown on the diagram?

(ii) Identify molecule **V** which is released during stage 1.

(iii) Describe how molecule **V** is made.

(iv) Name the 3-carbon molecule formed in stage 1.

(v) Identify organelle **W**.

(vi) Name the 2-carbon molecule **X**.

(vii) Name the series of events represented by **Y**.

(viii) What substance is represented by the letter **Z** in the diagram?

(ix) Using your knowledge of respiration, compare the amount of energy released when oxygen is used **and** not used. **(27)**

(c) Chlorophyll is a green pigment found in plants. It is a mixture of a number of different chemicals.

(i) Name the cell organelle which contains chlorophyll.

(ii) What is the function of chlorophyll in plants?

(iii) Suggest why it is an advantage that chlorophyll contains a number of chemicals rather than just one.

(iv) Outline the events of the dark stage of photosynthesis.

(v) Explain how the dark stage is necessary for the continuation of the light stage.

(vi) Using your knowledge of chlorophyll and photosynthesis, describe **one** way to increase plant production in a greenhouse. **(24)**

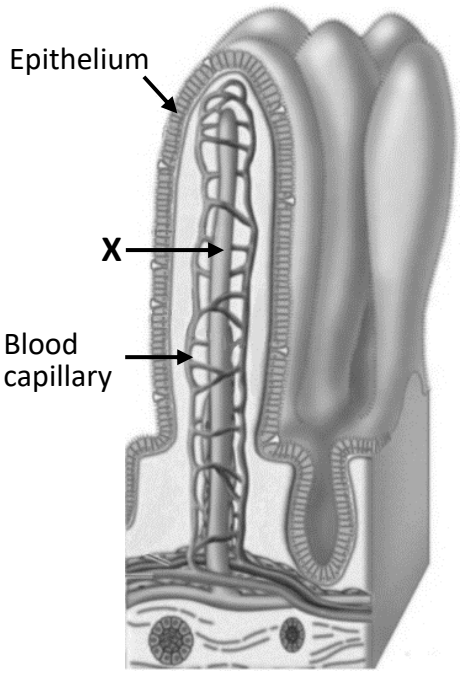
14. (a) (i) What is meant by the term digestion?

(ii) Why is digestion necessary in humans?

(iii) What name is given to the removal of undigested wastes from the human body?

(9)

(b) The diagram shows a longitudinal section (L.S.) of a villus from the human digestive system.



(i) Give the precise location where villi are most abundant.

(ii) What is the main function of villi?

(iii) Name the part labelled **X and** state its role.

(iv) Name the blood vessel that carries digested nutrients away from the digestive system.

(v) To what organ in the body are digested nutrients first transported?

(vi) Give **one** function of the organ you named at part (v) above other than the storage of nutrients.

(vii) Name **and** explain the process of how food is moved along the digestive system.

(27)

(c) The 'transpiration stream' has an important role in the transport of water and minerals up, into and out of plant leaves. The water and minerals move through specialised vascular tissues.

The stomatal density (number of stomata per mm^2) from the leaves of three different plants was measured and the results shown in the table.

Plant	Stomatal density
A	43
B	28
C	68

(i) Which of the three plants would you expect to show the lowest rate of transpiration? Explain your answer.

(ii) Indicate **two** other ways plants use to control transpiration.

(iii) Xylem and phloem are two vascular tissues in plants.
Give **two** structural differences between xylem and phloem.

(iv) Draw **and** label a longitudinal section (L.S.) of a xylem vessel.

(24)

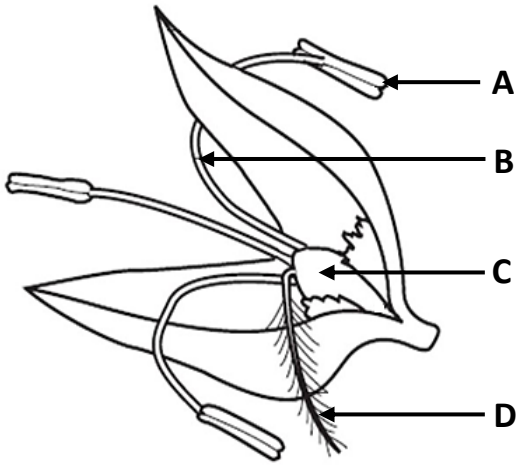
15. (a) Organisms can respond to changes in their external and internal environment in different ways including through homeostasis.

(i) Explain the underlined term.

(ii) Name **one** anatomical **and one** chemical way plants can protect themselves.

(9)

(b) The diagram is of a flower.



(i) Name the structures labelled **A**, **B** and **C**.

(ii) Is this flower insect or wind-pollinated?

(iii) Using the diagram, give **two** reasons to support your answer at part (ii) above.

(iv) What is the role of each of the parts labelled **A** and **D**?

(v) This flower can exhibit self-pollination.
Give **one** disadvantage of self-pollination.

(vi) Seed and fruit development follow successful fertilisation.

1. Which labelled part develops into the fruit?
2. Give one way seedless fruits may develop.

(27)

(c) Germination in seeds follows dispersal and a period of dormancy.

(i) Explain **each** of the underlined terms.

(ii) Outline how dormancy in seeds benefits plant species.

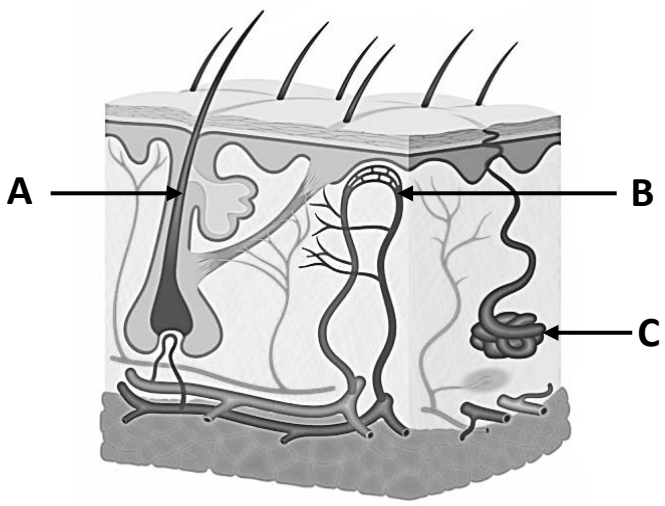
(iii) Give **two** roles of water in the process of germination.

(iv) Identify **two** possible food stores in seeds.

(24)

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

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



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

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

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

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

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

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

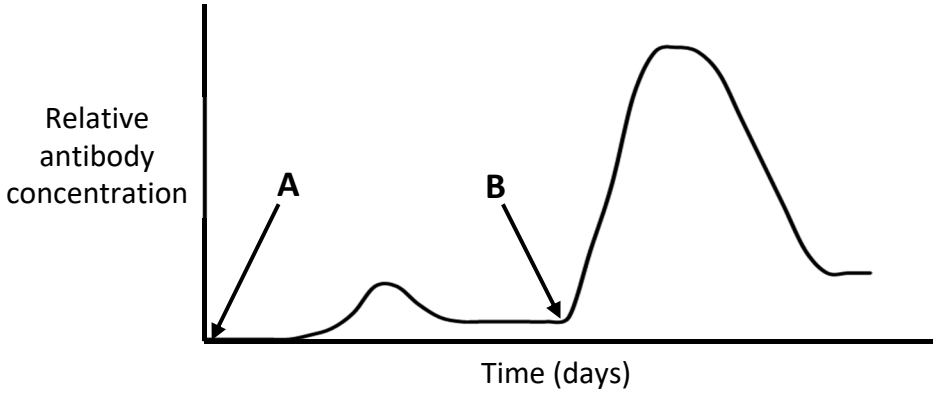
(i) Mucous membrane linings produce mucus which can help as a physical barrier against the entry of viruses.
Name **two** places in the body where mucus membrane linings are found.

(ii) Give the precise location in the body where lymphocytes are produced.

(iii) Identify the specific type of lymphocyte that produces antibodies.

(iv) Identify **one** type of white blood cell, other than lymphocytes, that is involved in an immune response.

(v) The graph below shows the antibody production after a person receives a vaccine **(A)** and after the same person becomes infected with the virus (**B**).



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

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

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

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

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

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

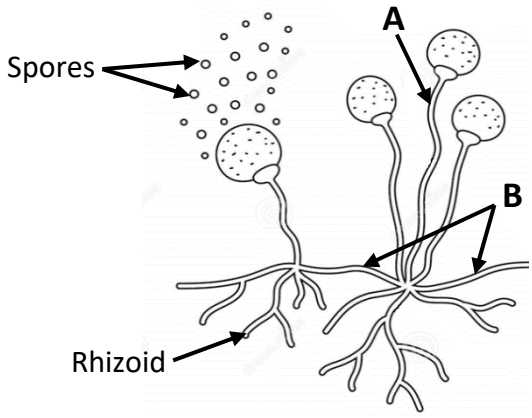
(iv) Identify the region of the human brain which detects the gas you have named at part (iii) above.

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

(vi) Describe in detail the process of inhalation.

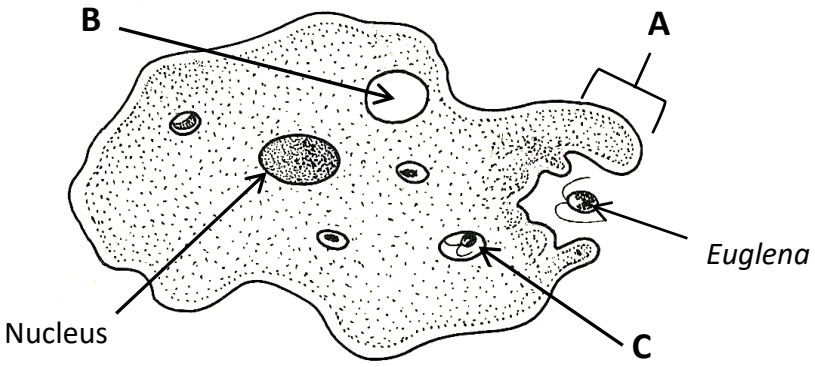
17. Answer any **two** of (a), (b), (c), (d). **(30, 30)**

(a) The diagram shows an organism you have studied.



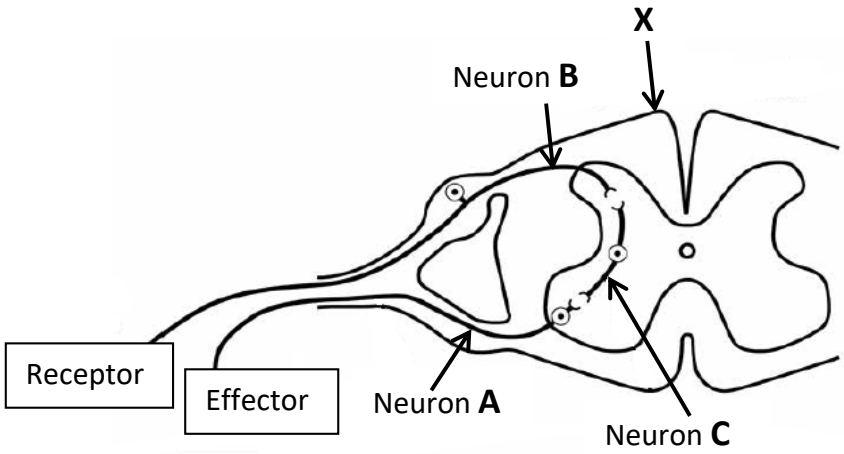
(i) Name the organism shown in the diagram **and** the kingdom to which it belongs.
(ii) Name the part labelled **A**.
(iii) State the mode of nutrition used by this organism.
(iv) Discuss the importance in nature of the type of nutrition named at part (iii) above.
(v) Name the horizontal hyphae labelled **B and** state their role.
(vi) Spores and rhizoids are labelled in the diagram. Give **one** function of each.
(vii) Describe **one** environmental condition which may stimulate sexual reproduction in this organism.

(b) The diagram below shows a unicellular organism.



(i) Name the unicellular organism shown in the diagram **and** the kingdom to which it belongs.
(ii) Suggest a typical habitat for this organism.
(iii) The organism labelled *Euglena*, is a prey species of the larger organism. Name structure **A** forming around this prey.
(iv) Give **one** function for structure **A** named at part (iii) above, other than engulfing prey.
(v) Name the structure labelled **B and** state its function.
(vi) Name the structure labelled **C**.
(vii) Describe **two** ways in which the cell of this organism differs to a typical bacterial cell.

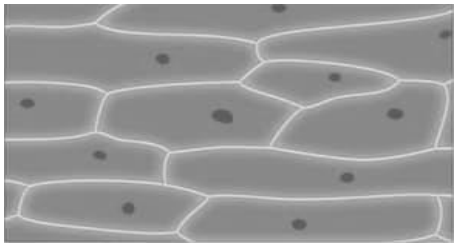
(c) The diagram shows a cross section of the spinal cord along with some neurons from the peripheral nervous system.



(i) Name the tissue labelled **X** which covers and protects the spinal cord.
(ii) What is a reflex action?
(iii) Give **one** example of a reflex action in the human body.
(iv) Give **one** advantage of a reflex action.
(v) Using the labels from the diagram, describe in detail how a reflex action works.
(vi) Give **two** ways in which a nervous response differs from a hormonal response.

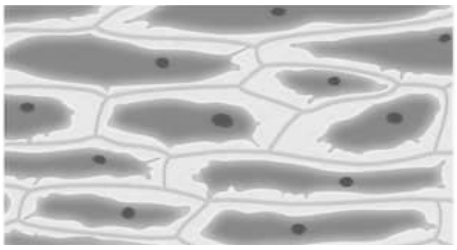
(d) A scientist used a light microscope to view images **A** and **B** of the same red onion epidermal cells in two solutions of different concentrations.
The dark grey shaded areas show the vacuoles filled with solution.

A



Epidermal cells in solution **A**

B



Epidermal cells in solution **B**

(i) Name the condition which describes the cells shown in **A**.
(ii) Describe how the cells in **A** maintain this shape.
(iii) Suggest how solution **B** differs from solution **A**.
(iv) Name **and** describe in detail the process which has occurred to the cells in **B**.
(v) How could these cells in **B** be restored to the condition shown in **A**?
(vi) Describe how a knowledge of the process shown in the cells in solution **B** can be applied to food production.
(vii) When preparing plant cells for viewing using the microscope
1. Outline how a scientist uses a coverslip.
2. Explain why a coverslip is used.

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