Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2023

Biology

Section C

Higher Level

Tuesday 13 June Afternoon 2:00 - 5:00

240 marks

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The 2023 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 four questions.
Write your answers in the answerbook containing Sections A and B.

11. (a) Explain each of the following terms as used in ecology:
(i) *Ecosystem*
(ii) *Habitat*
(iii) *Niche* **(9)**

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

Ash dieback is a serious disease of ash trees caused by the invasive pathogen *Hymenoscyphus fraxineus*, which originates in Asia and was brought to Europe in the early 1990s.

Ash dieback was first detected in the Republic of Ireland in October 2012 on plants imported from continental Europe. The disease is now prevalent throughout most of the island of Ireland and is likely to cause the death of the majority of the ash trees over the next two decades. This will also have an effect on organisms that feed on ash (such as moths) and other animals along the food chain (such as birds, e.g. the robin).

Teagasc, the Irish agriculture development authority, is aiming to establish a gene bank composed of genotypes of ash trees that are tolerant or resistant to the deadly pathogen with the future aim of producing planting stocks for forests and hedgerows in Ireland.

Adapted from *Ash Dieback Disease*, www.teagasc.ie

(i) Name the type of ecological relationship that exists between ash trees and the pathogen that causes ash dieback.
(ii) From the passage, or otherwise, state a way that ecologists could ensure the survival of ash trees in Ireland.
(iii) Write down a food chain (with at least three trophic levels) based on the information given in the passage above.
(iv) Sketch a pyramid of numbers based on the food chain you gave in part (b) (iii) above.
(v) Suggest **two** possible effects on the ecosystem if all ash trees in Ireland died.
(vi) 1. Name the type of ecological relationship that exists between the robin and the moth.
2. Explain the importance of this type of ecological relationship in nature.
(27)

(c) Describe the main events of **each** of the following:
(i) The nitrogen cycle
(ii) The carbon cycle. **(24)**

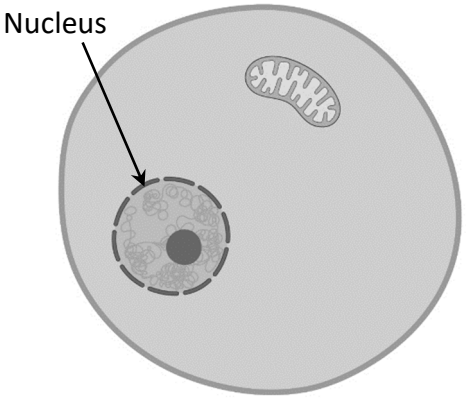
12. (a) (i) Explain the term *metabolism*.

(ii) Is the reaction shown below an anabolic reaction or a catabolic reaction? Explain your answer.

A ⟶ B + C + Energy

(9)

(b) Aerobic respiration is a metabolic reaction that occurs in two stages in living cells.



(i) Copy the diagram of the cell **into your answerbook and** indicate clearly the specific locations of stage **1** and stage **2**.

(ii) What is the name given to stage **1**?

(iii) Stage **1** ends with the formation of a three-carbon compound.
Name this compound.

(iv) This three-carbon compound is converted into acetyl coenzyme A, which passes into a series of reactions called Krebs cycle where electrons are removed.
Describe in detail what happens to these electrons after they are removed.

(v) ATP is produced during respiration.
Copy the following word equation **into your answerbook and** complete the missing parts of the equation.

ADP + _____ + Energy ⟶ ATP + _____

(27)

(c) Enzymes are important in all metabolic reactions.

(i) What is an *enzyme*?

(ii) Describe in detail the active site theory of enzyme action.

(iii) Describe what happens to an enzyme if it is overheated.

(iv) Give **one** example of a catabolic enzyme **and one** example of an anabolic enzyme.

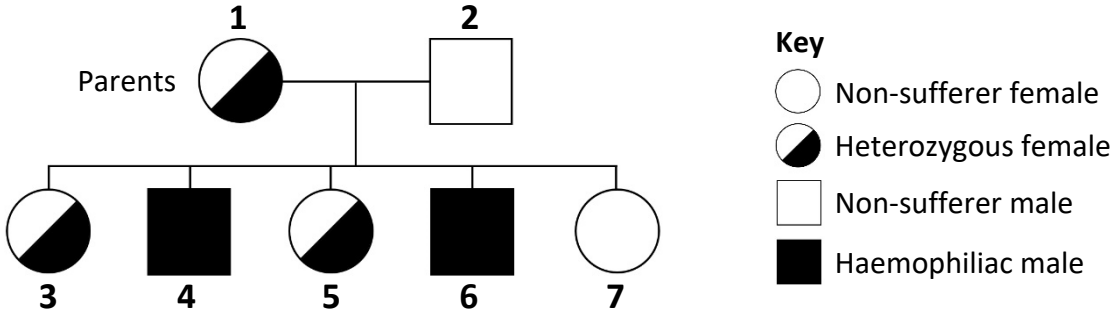
(24)

13. (a) (i) Which famous scientist is regarded as the father of genetics?
(ii) State the Law of Segregation. **(9)**

(b) Haemochromatosis is an inherited condition where iron levels in the body slowly build up over many years. Classic hereditary haemochromatosis is caused by a gene mutation whereby two recessive alleles are inherited.

(i) Explain **each** of the underlined terms.
(ii) Give **one** possible cause of gene mutations.
(iii) Name another type of mutation **and** give a condition caused by this type of mutation.
(iv) The letter **H** can be used to represent the dominant allele and the letter **h** can be used to represent the recessive haemochromatosis allele.
Using a Punnett square, or a genetic cross, explain how it is possible for two parents, both without haemochromatosis, to have a child who suffers from the condition.
(v) If the parents have a child without haemochromatosis, how might they check to see if their child was a carrier? **(27)**

(c) Haemophilia is caused by a recessive allele (gene mutation) that inhibits the blood's ability to clot. This allele is only found on the X chromosome. The following pedigree chart shows an example of the inheritance of this condition between parents and children.



(i) What term is used to describe an allele present on the X chromosome?
(ii) The letter **N** can be used to represent the dominant allele and the letter **n** can be used to represent the recessive haemophilia allele.
Draw **two** fully labelled chromosome diagrams (one for each parent) showing the positions of **each** allele. Indicate clearly which is female and which is male.
(iii) The pedigree chart above shows that two of their male children (persons **4** and **6**) suffer from haemophilia. Show, using a Punnett square or otherwise, how it is possible for the parents to have a male child who does **not** suffer from haemophilia.
(iv) Explain clearly why it would be almost impossible for person **7** to be the parent of a child with haemophilia. **(24)**

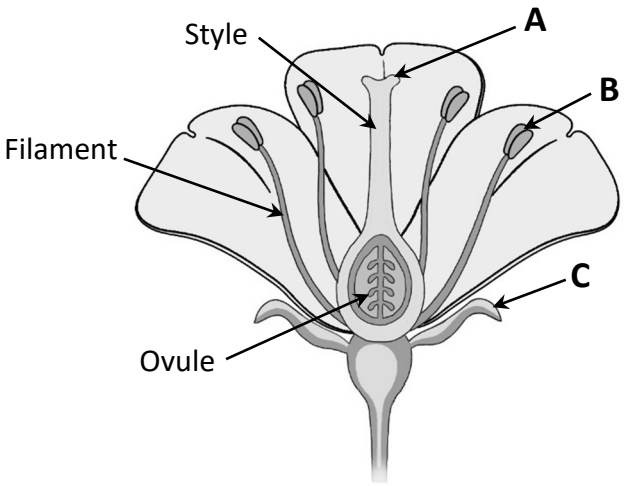
14. (a) Meristematic tissue is an important tissue in plants.

(i) What is the meristem?

(ii) Give **two** locations in plants where meristematic tissue may be found.

(9)

(b) The diagram shows a typical animal-pollinated flower.



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

(ii) Give **one** function for **each** structure **A** and **B**.

(iii) Describe **one** way in which a wind-pollinated flower would differ from the animal-pollinated flower.

(iv) Embryo sac development occurs in the ovule.
Describe embryo sac development in detail.

(v) What does the ovule develop into if fertilisation occurs?

(27)

(c) Many plants can undergo vegetative propagation or horticulturists may carry out artificial propagation.

(i) What is meant by the term *vegetative propagation*?

(ii) Name any **two** methods of vegetative propagation used by plants **and** for **each** named method, give **one** example of a plant that carries out that method of vegetative propagation.

(iii) Name any **three** methods horticulturists may use to artificially propagate plants.

(24)

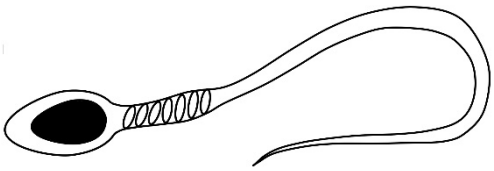
15. (a) (i) What is meant by the term *secondary sexual characteristics*?
(ii) Give **two** examples of secondary sexual characteristics present in males. **(9)**

16. (i) Draw a large diagram of the human male reproductive system, labelling the following parts:

testis **sperm duct** **prostate gland** **epididymis** **penis** **scrotum**

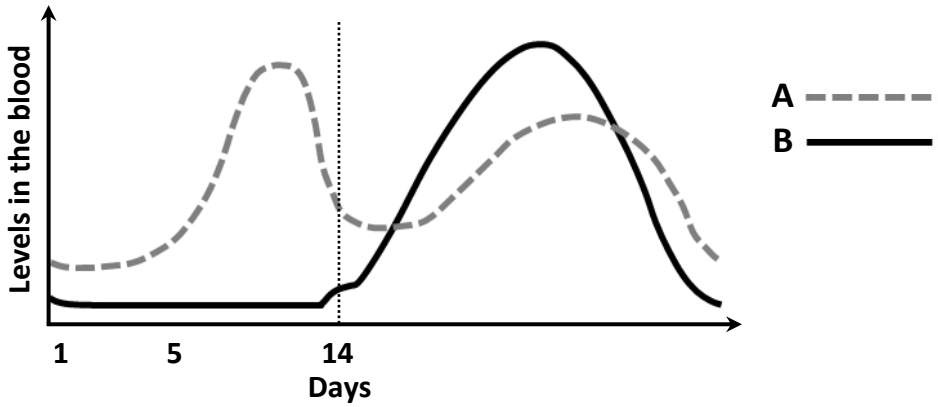
(ii) Give **one** function for **each** of the following parts:
1. Prostate gland
2. Epididymis

(iii) The diagram shows a human sperm cell.



1. How many chromosomes are found in the nucleus of a typical human sperm cell?
2. Copy out the diagram of the human sperm cell **into your answerbook and** indicate on it the location of the mitochondria.
3. In relation to the structure of the sperm cell, or otherwise, suggest **one** possible cause of male infertility. **(27)**

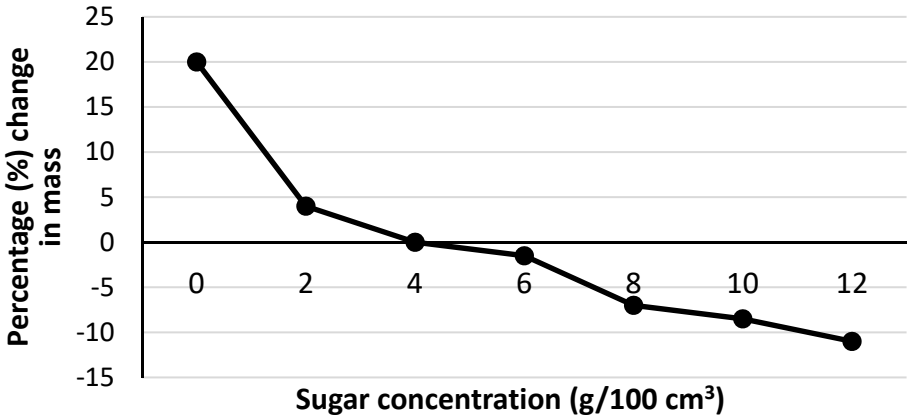
(c) The graphs show the levels of female reproductive hormones (**A** and **B**) in the blood at various stages during one typical menstrual cycle. These hormones are released by the female reproductive system.



(i) How long is the typical menstrual cycle in a human female?
(ii) Name **each** of the hormones **A** and **B**.
(iii) There are low levels of hormone **A** and hormone **B** during the first few days of the menstrual cycle. Describe **one** effect on the female reproductive system of the low levels of hormones **A** and **B**.
(iv) Explain why hormone **A** levels increase after approximately day 5.
(v) What event occurs around day 14 of the menstrual cycle?
(vi) The event you named in part (c) (v) above is caused by a surge in a hormone released from the pituitary. Name this hormone.
(vii) Explain why hormone **B** levels increase in the days after day 14. **(24)**

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

(a) The graph shows the changes in mass of plant tissue when placed in solutions of different sugar concentrations.



(i) Name the substance that causes the change in mass of the plant tissue.

(ii) What term is given to the movement in and out of the plant tissue of the substance you named in part (a) (i) above?

(iii) At what sugar concentration is there no change in the mass of the plant tissue?

(iv) Explain in detail why there is no change in mass at the sugar concentration you have given in part (a) (iii) above.

(v) 1. What term is used to describe the condition of the plant cells that have been soaked in the 0 g/100 cm^3 sugar solution?

2. Explain how plant cells maintain the condition you named in part (a) (v) 1. above.

(vi) Explain in detail why the mass of the plant cells reduces in the 12 g/100 cm^3 sugar solution.

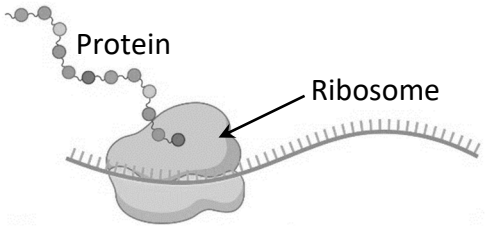
(vii) What do you think would happen to an animal cell in the 0 g/100 cm^3 sugar solution?

(b) Genetic engineering is an important biological technique.

(i) What is meant by the term *genetic engineering*?

(ii) Describe the process of genetic engineering up to the point of expression of the gene of interest.

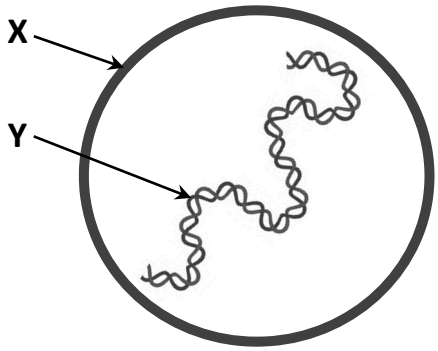
(iii) The final part of genetic engineering, gene expression, involves the formation of a protein. Protein synthesis occurs on ribosomes, as shown in the diagram. Ribosomes are composed of rRNA subunits.
Name the other **two** types of RNA involved in protein synthesis.



(iv) State **one** application of genetic engineering for **each** of the following:

1. Animals
2. Microorganisms
3. Plants.

(c) Viruses are found in all habitats in nature.



(i) The diagram shows a typical spherical-shaped virus.
Name the structures **X** and **Y**.

(ii) Explain the difficulty in describing viruses as living.

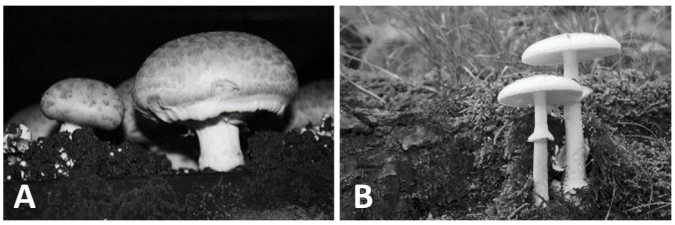
(iii) Name **two** harmful viruses.

(iv) Give **one** way in which viruses can be beneficial to humans.

The human body can defend itself against viruses using two defence systems: the general defence system and the specific defence system.

(v) Give **two** ways in which the general defence system works to defend against viruses **and two** ways in which the specific defence system defends against viruses.

(d) The photographs show some edible mushrooms (image **A**) and some poisonous mushrooms (image **B**). Mushrooms belong to kingdom Fungi.



(i) Suggest **one** way in which you could distinguish between edible and poisonous mushrooms.

(ii) Name any **one** example of an edible mushroom.

(iii) Name any **one** example of a poisonous mushroom.

Another member of kingdom Fungi is *Rhizopus* (or common bread mould).

(iv) Draw a diagram showing the basic structure of *Rhizopus*, labelling the following parts: **stolon**, **rhizoid**, **sporangium**.

(v) Give **one** function for **each** of the following parts:

1. Stolon
2. Rhizoid
3. Sporangium

(vi) Name the mode of nutrition used by *Rhizopus*.

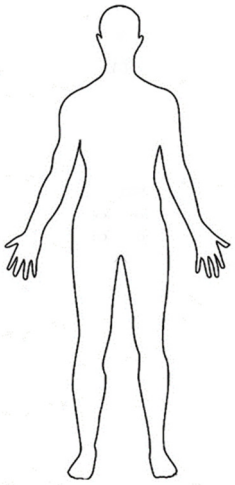
17. Answer any **two** of (a), (b), (c), (d). **(30, 30)**

(a) (i) Give **one** difference between endocrine and exocrine glands.

(ii) Name a gland that has **both** an endocrine function **and** an exocrine function. Name its endocrine product **and** its exocrine product.

(iii) Copy the outline of the human body **into your answerbook**.
Draw in **each** of the following endocrine glands labelling them in their correct locations:

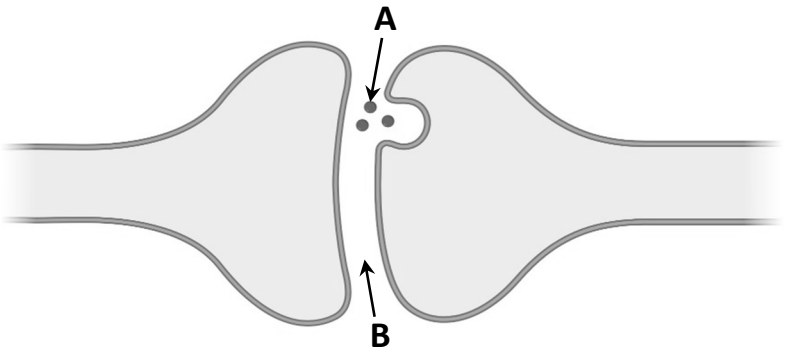
1. Pituitary gland
2. Thyroid gland
3. Adrenal glands



(iv) For **each** of the following endocrine glands, name a hormone it secretes **and** give its corresponding function:

thyroid; **adrenals**

(b) The diagram shows two separate neurons in close contact. Chemical **A** is produced by one of the neurons to allow the transfer of nerve impulses.



(i) What term describes the region where two neurons come into close contact?

(ii) What is the name given to the gap between two neurons, indicated by the letter **B** in the diagram?

(iii) What is the general name given to the chemical **A** in the diagram?

(iv) Where in a neuron is chemical **A** made?

(v) Describe in detail how nerve impulses travel between two neurons in close contact.

(vi) Interneurons are one type of neuron found within the central nervous system. Give the names of the other **two** types of neuron found in the human nervous system.

(vii) Describe **one** possible treatment for **either** of the following nervous system disorders: paralysis **or** Parkinson's disease.

(c) Answer the following questions in relation to your knowledge of the human circulatory and breathing systems.

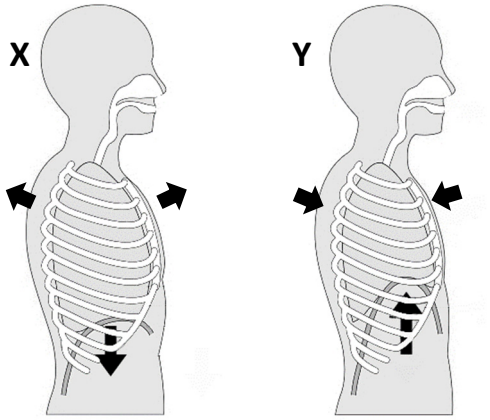
(i) In each of the following, name the vein that best matches the description:

1. Carries blood richest in oxygen.
2. Carries blood between the intestine and the liver.
3. Carries blood lowest in metabolic wastes.
4. Carries blood into the right atrium of the heart.

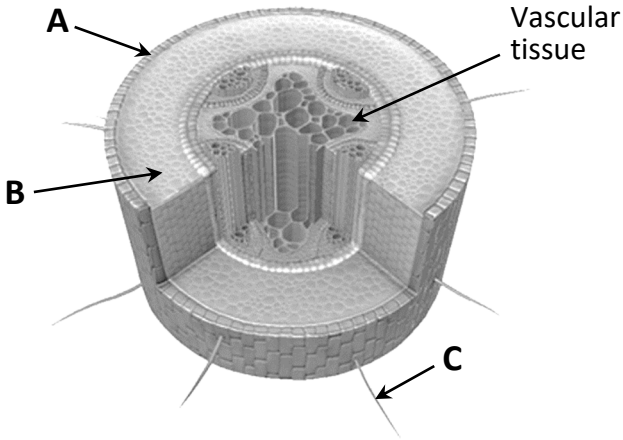
(ii) **In your answerbook**, sketch the structure of an alveolus and its associated blood supply.
On your diagram, clearly indicate the overall directions in which oxygen **and** carbon dioxide are moving.

(iii) The diagrams (**X** and **Y**) show the two stages of breathing with the arrows representing the body movements involved in breathing.

1. State which diagram (**X** or **Y**) represents inhalation.
2. Explain in detail how you know inhalation is occurring in this diagram.



(d) The diagram shows part of a plant organ composed of various tissues.



(i) Identify the plant organ.
(ii) Name tissues **A** and **B and** the structure labelled **C**.
(iii) Give **one** function for **each** part **A**, **B** and **C**.
(iv) Give **one** function of vascular tissue in plants.
(v) Name the **two** types of vascular tissue present in plants.
(vi) Draw **and** label a longitudinal section (L.S.) of **either** type of vascular tissue you named in part (d) (v) above.

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