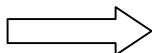


Write your Examination Number here



M44



# Coimisiún na Scrúduithe Stáit State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2004

## BIOLOGY – HIGHER LEVEL

WEDNESDAY, JUNE 16 – AFTERNOON, 2.00 TO 5.00

- Section A.** Answer any **five** questions from this section.  
Each question carries 20 marks.  
Write your answers in the spaces provided on the examination paper.
- Section B** Answer any **two** questions from this section.  
Each question carries 30 marks.  
Write your answers in the spaces provided on the examination paper.
- Section C** Answer any **four** questions from this section.  
Each question carries 60 marks.  
Write your answers in the answer book.

**You should spend not more than 30 minutes on Section A and 30 minutes on Section B, leaving 120 minutes for Section C.**

**You must return your examination paper with your answer book at the end of the examination.**

## Section A

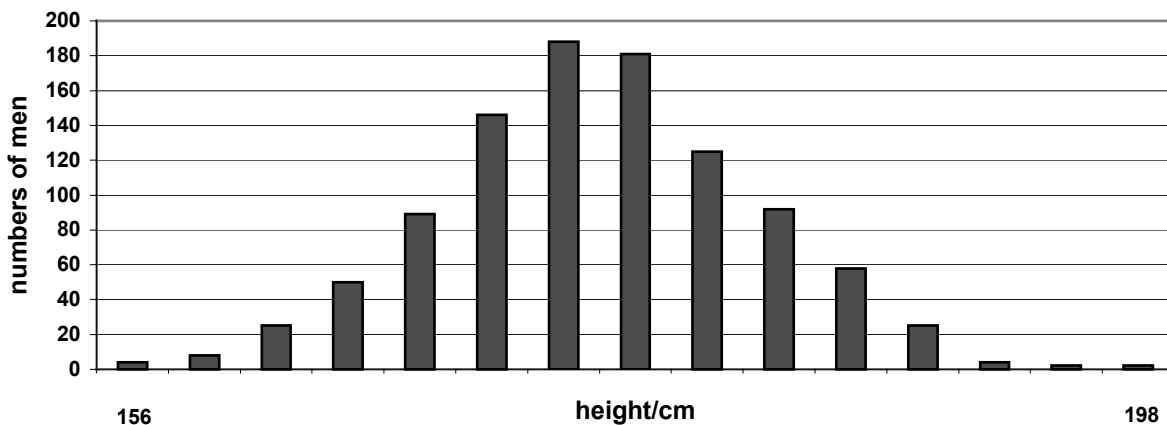
Answer any five questions.

Write your answers in the spaces provided.

1. Answer **any five** of the following.
- (a) Name an autotrophic organism .....
  - (b) Give an example of a catabolic reaction .....
  - (c) The conversion of atmospheric nitrogen to nitrates by bacteria is called .....
  - (d) What is the ratio of hydrogen atoms to oxygen atoms in a carbohydrate?.....
  - (e) A relationship between two organisms in which both benefit is called .....
  - (f) An example of a protein that has a structural role is .....

2. The diagram shows the distribution of heights in a group of men between the ages of 18 and 23.

**Distribution of human heights**



What term is used by biologists to describe differences within a population with respect to features such as height? .....

State **two** factors that could be responsible for the differences shown.

- 1. ....
- 2. ....

Would you expect a similar distribution if the students were weighed instead of being measured for height?

.....

Explain your answer. ....

.....

What is a mutation? .....

State **one** cause of mutation. ....

Give an example of a condition, found in the human population, that results from a mutation.

.....

3. In tomato plants the allele responsible for purple stem (**P**) is dominant to that for green stem (**p**) and the allele for cut leaf (**C**) is dominant to the allele for potato type leaf (**c**). A plant with a purple stem and cut leaves was crossed with a plant with a green stem and potato type leaves. A total of 448 seeds was obtained. When the seeds were germinated four types of progeny resulted and they had the following phenotypes;

- 110 purple stem and cut leaves
- 115 green stem and potato type leaves
- 114 purple stem and potato type leaves
- 109 green stem and cut leaves

What were the genotypes of the tomato plants that gave rise to these progeny?

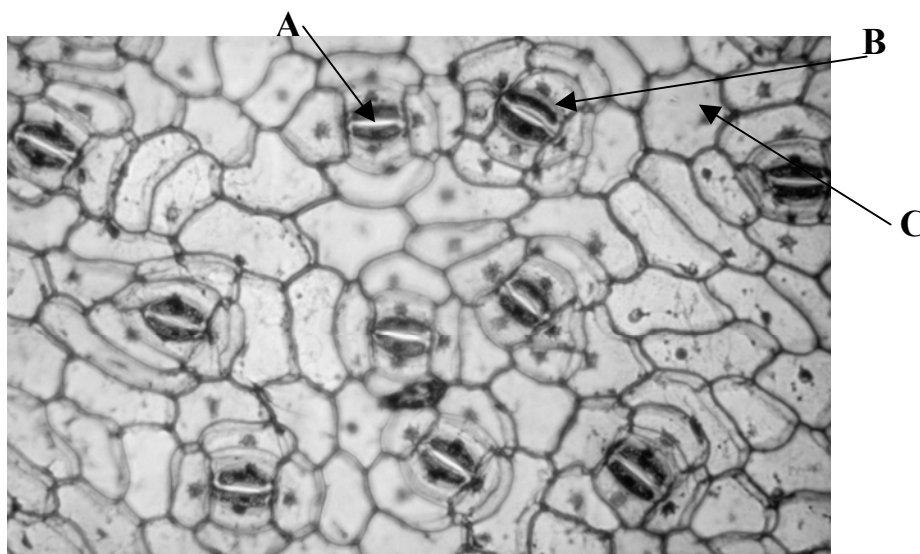
.....

Do the progeny of this cross illustrate the Law of Independent Assortment?.....

Explain your answer.....

.....  
 .....  
 .....

4. (a) The diagram shows part of the under surface of a leaf as seen through the microscope. A is an aperture. B and C are cells.



[Eric Grave/ Science Photo Library]

Name A, B, C.

A ..... B ..... C .....

What is the function of A? .....

Name a factor that influences the diameter of A.....

Name the apertures in stems that are equivalent to A.....

(b) In some species of flowering plants the leaves are modified for the storage of food.

Name a plant in which the leaves are modified for food storage .....

Name a carbohydrate that you would expect to find in the modified leaves of the plant that you named above.....

Name a type of modified stem that functions in food storage.....

5. (a) What is meant by pollution? .....  
.....  
Give an example of a human activity that results in the pollution of air or water .....  
.....  
Suggest a means of counteracting this pollution. ....  
.....

(b) Explain conservation in relation to wild plants and animals.  
.....  
.....  
Suggest **two** reasons for conserving wild species.  
(i) .....  
(ii) .....  
State **one** conservation practice from agriculture **or** fisheries **or** forestry.....  
.....

6. Answer the following questions in relation to the human alimentary canal.  
What is peristalsis? .....  
State **one** reason why a low pH is important in the stomach .....  
.....  
Why is fibre important? .....  
.....  
Name an enzyme that is involved in the digestion of fat .....  
What are the products of fat digestion? .....  
What is the role of bile in fat digestion? .....  
State a role of beneficial bacteria in the alimentary canal .....  
.....

## Section B

Answer any two questions.

Write your answers in the spaces provided.

Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) Yeast cells produce ethanol (alcohol) in a process called fermentation.  
Is this process affected by temperature? .....
- Explain your answer .....
- .....
- .....
- (b) Answer the following in relation to an experiment to prepare and show the presence of ethanol using yeast.
- Draw a labelled diagram of the apparatus that you used.
- .....
- Name a substance that yeast can use to make ethanol. ....
- What substance, other than ethanol, is produced during fermentation? .....
- Describe the control that you used in this experiment. ....
- .....
- Explain the purpose of a control in a scientific experiment. ....
- .....
- .....
- How did you know when the fermentation was finished? .....
- .....
- .....
- Why were solutions of potassium iodide and sodium hypochlorite added to the reaction vessels after a certain period of time? .....
- .....
- .....
- Name a substance produced during aerobic respiration that is not produced during fermentation. ....
- .....

8. (a) Observation of a transverse section of a dicotyledonous stem reveals vascular and other tissues. Name **two** of the tissues that are not vascular tissues.

1 ..... 2 .....

(b) Answer the following questions in relation to the preparation of a microscope slide of a transverse section of a dicotyledonous stem.

State **one** reason why you used an herbaceous stem rather than a woody one.

.....  
.....

Explain how you cut the section.

.....  
.....  
.....  
.....

Why is it desirable to cut the section as thinly as possible? .....

.....

Draw a diagram of the section as seen under the microscope. Label the vascular tissues that can be seen.

State one precise function of each of the vascular tissues labelled in your diagram.

.....  
.....  
.....  
.....

9. (a) (i) Cardiac muscle may be described as a contractile tissue. Explain the meaning of of the underlined term.

.....

(ii) Which chamber of the heart has the greatest amount of muscle in its wall?

.....

(b) Describe how you dissected a mammalian heart in order to investigate the internal structure of atria and ventricles.

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Draw a labelled diagram of your dissection to show the location and structure of the bicuspid and tricuspid valves.

State the procedure that you followed to expose a semilunar valve.

.....  
.....  
.....  
.....

What is the function of a semilunar valve? .....

.....

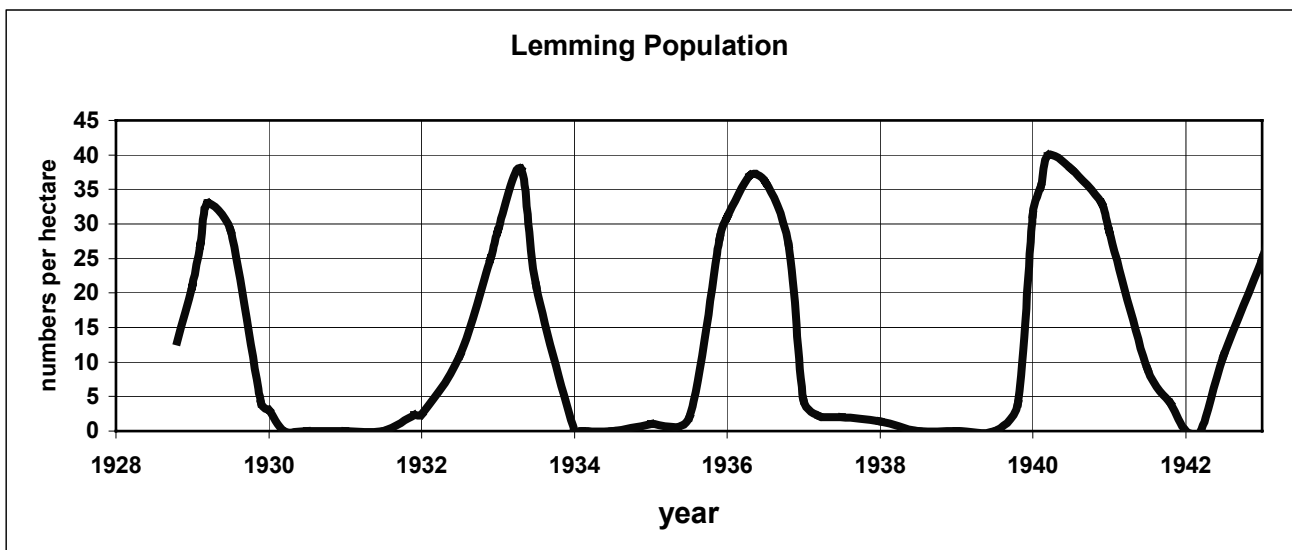
Where in your dissection did you find the origin of the coronary artery? .....

.....

## Section C

Answer any **four** questions  
Write your answers in the answer book.

10. (a) Explain the following terms that are used in ecology: biosphere, habitat, niche. (9)
- (b) In ecological studies it is found that the distribution of organisms is influenced by abiotic and biotic factors.
- (i) Distinguish between the underlined terms.
  - (ii) Name an ecosystem that you have investigated and give an example of an abiotic factor that influences the distribution of a named plant in the ecosystem.
  - (iii) In the case of your named ecosystem give an example of a biotic factor that influences the distribution of a named animal.
  - (iv) What is meant by a pyramid of numbers? Construct a pyramid of numbers from organisms in the ecosystem that you have studied.
  - (v) What term is used by ecologists to describe the organisms that form the base of the pyramid? (24)
- (c) Lemmings are small rodents that are widespread in northern latitudes. The graph shows the fluctuations in lemming numbers in northern Manitoba between 1929 and 1943.



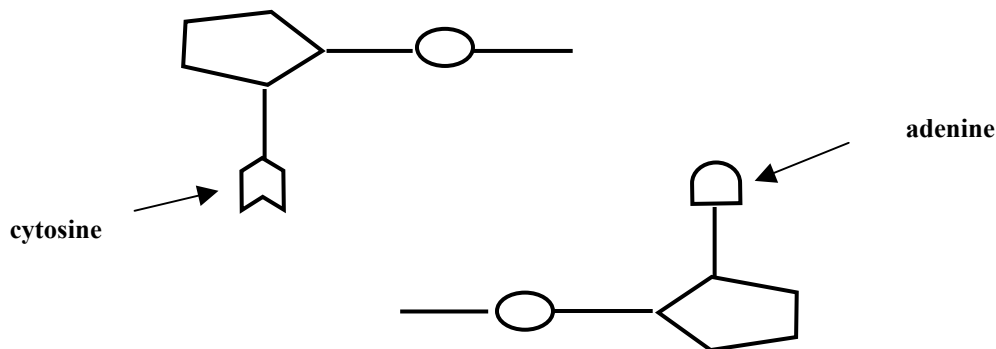
[Adapted from J. P. Finerty (1980). *The Population Ecology of Cycles in Small Mammals*. Yale University Press, New Haven.]

- (i) The graph indicates that population peaks occur at fairly regular intervals. What is the approximate average time between these peaks?
- (ii) What is the mean maximum population density (numbers per hectare) for the period covered by the graph?
- (iii) What is a predator? The Arctic fox is a predator of the lemming. Copy the graph into your answer book and draw on it a graph to show how you would expect the population of the Arctic fox to have varied in northern Manitoba during the period 1929 – 1943.
- (iv) Suggest **two** factors other than predation that might account for the declines in lemmings shown in the graph.
- (v) Suggest **two** factors that may have been responsible for the fairly regular increase in lemming numbers shown in the graph. (27)



11. (a) ATP is an abbreviation. What does it stand for? Explain briefly the role of ATP in the energy exchanges of a cell. (9)
- (b) (i) The first stage of photosynthesis is commonly known as the light-dependent stage. It involves the energising of electrons and their subsequent passage along two possible pathways. Give an account of what happens on each of these pathways.  
(ii) What is the fate of each of the products of the light-dependent stage? (27)
- (c) The effect of changing light intensity or carbon dioxide concentration on the rate of photosynthesis may be investigated by using the pondweed *Elodea*. Answer the following in relation to this investigation.  
(i) Why is a water plant rather than a land plant used in this experiment?  
(ii) How is the temperature kept constant in this experiment?  
(iii) If pond water is used in the experiment, it is likely to contain dissolved carbon dioxide. Suggest **two** possible sources of carbon dioxide in pond water.  
(iv) Explain how light intensity or carbon dioxide concentration may be varied.  
(v) Each time light intensity or carbon dioxide concentration is varied a precaution is necessary. What is this precaution and why is it necessary? (24)
12. (a) What is homeostasis? State the role of the kidneys in homeostasis. (9)
- (b) (i) Draw a labelled diagram of a nephron. Include blood vessels in your diagram.  
(ii) Filtration and reabsorption are vital processes that take place in the nephron. Describe how each of these processes occurs. (27)
- (c) Answer the following questions in relation to human body temperature.  
(i) What is the source of the heat that allows the body to maintain a constant internal temperature?  
(ii) State **two** ways in which the body is insulated against loss of heat.  
(iii) Describe the ways in which the body responds when its internal temperature rises above the normal level.  
(iv) Describe briefly the hormonal and nervous responses that occur when internal body temperature drops. (24)

13. (a) Copy the diagram into your answer book and then complete it to show the complementary base pairs of the DNA molecule. Label all parts not already labelled. (9)

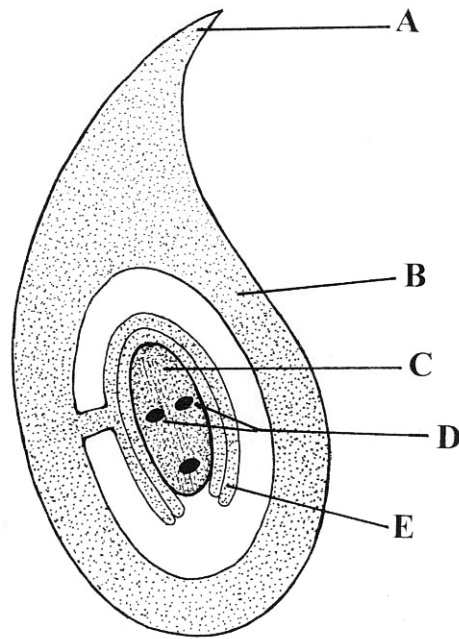


- (b) The genetic code incorporated into the DNA molecule finds its expression in part in the formation of protein. This formation requires the involvement of a number of RNA molecules. List these RNA molecules and briefly describe the role of each of them. (24)
- (c) Read the following passage and answer the questions that follow.
- Dolly, the most famous sheep in the world, was cloned in the Roslin Institute in Scotland in 1996. When this was announced in February 1997 it caused a sensation, because until then many scientists thought that such cloning was impossible.
- Such cloning is the production of one or more animals that are genetically identical to an existing animal. This cloning technique is based on the fact that, with the exception of the sperm and the egg, every cell in the body contains in its DNA all of the genetic material needed to make an exact replica of the original body. During the normal development process from embryo to fully-fledged animal, all of the cells in the body are differentiated to perform specific physiological functions. Before Dolly, the majority view was that such differentiated cells could not be reprogrammed to be able to behave as fertilised eggs.
- Dolly was produced by a process known as "adult DNA cloning", which produces a duplicate of an existing animal. The technique is also known as "cell nuclear replacement". During adult DNA cloning, the DNA is sucked out from a normal unfertilised egg cell, using a device that acts somewhat like a miniature vacuum cleaner. DNA that has already been removed from a cell of the adult to be copied is then inserted in place of the original DNA. Following this stage, the cell containing the inserted DNA is implanted in the womb of an animal of the same species, and gestation may begin.
- To make Dolly, a cell was taken from the mammary tissue of a six-year-old sheep. Its DNA was added to a sheep ovum (egg) from which the nucleus had been removed. This artificially fertilised cell was then stimulated with an electric pulse and implanted in an ewe.
- {Adapted from [www.biotechinfo.ie](http://www.biotechinfo.ie)}
- (i) What is the difference between a nucleus of an egg cell and that of a somatic (body) cell of an animal?
- (ii) Suggest an advantage of producing genetically identical animals.
- (iii) Suggest a disadvantage of producing genetically identical animals.
- (iv) "Every cell in the body contains in its DNA all of the genetic material needed to make an exact replica of the original body". Comment on this statement.
- (v) What is the precise meaning of the term "implanted" in the extract above?
- (vi) Suggest a purpose for stimulating the fused egg with an electric pulse.
- (vii) What do you think is meant by the phrase "artificially fertilised cell"? (27)

14. Answer **any two** of (a), (b), (c).

(30, 30)

(a) The diagram shows a vertical section through a carpel.



- (i) Name A, B, C, D, E.
- (ii) What happens to the two nuclei labelled D?
- (iii) In the case of B and E state what may happen to each of them after fertilisation.
- (iv) Copy the diagram into your answer book and add a pollen tube that has completed its growth. Label the nuclei in the pollen tube.
- (b) (i) Draw a labelled diagram of the reproductive system of the human female.
- (ii) What is fertilisation? Indicate where fertilisation normally occurs on your diagram.
- (iii) State **one** cause of infertility in the female and **one** cause of infertility in the male.
- (iv) What is meant by *in vitro* fertilisation? What is done with the products of *in vitro* fertilisation?
- (c) Answer the following questions from your knowledge of human embryology.
- (i) What is a germ layer? List the **three** germ layers.
- (ii) Relate each of the germ layers that you have listed in (i) to an organ or system in the adult body.
- (iii) From what structures does the placenta develop? State **three** functions of the placenta.
- (iv) Name a hormone associated with the maintenance of the placenta.
- (v) Describe the amnion and state its role.

15. Answer **any two** of (a), (b), (c).

(30, 30)

- (a)
- (i) Draw and label sufficient of two neurons to show a synaptic cleft.
  - (ii) Describe the sequence of events that allows an impulse to be transmitted across a synapse from one neuron to the next.
  - (iii) Suggest a possible role for a drug in relation to the events that you have outlined in (ii).
- (b)
- (i) What is an auxin? State a site of auxin secretion. How may the action of an auxin be considered similar to the action of a hormone in the human body?
  - (ii) Define tropism. List **three** types of tropism.
  - (iii) Relate the role of an auxin to one of the tropisms that you have listed in (ii)
- (c)
- (i) Draw a labelled diagram to show the structure of *Rhizopus*. State **one** feature in your diagram that indicates that *Rhizopus* belongs to the kingdom Fungi.
  - (ii) Sexual reproduction in *Rhizopus* leads to the formation of a zygospore. Show, by means of labelled diagrams, the stages involved in the production of the zygospore.
  - (iii) Explain what happens when the zygospore reaches a location at which conditions for its germination are suitable.