2021.M44

2021L025A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2021

Biology

Sections A and B and Answerbook

Higher Level

Tuesday 15 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 pencil for sketches, graphs and diagrams only.

There are three sections to 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) Identify **one** difference between fats and oils at room temperature.

(b) Triglycerides and phospholipids are two types of lipid.

Identify **one** difference between a triglyceride and a phospholipid.

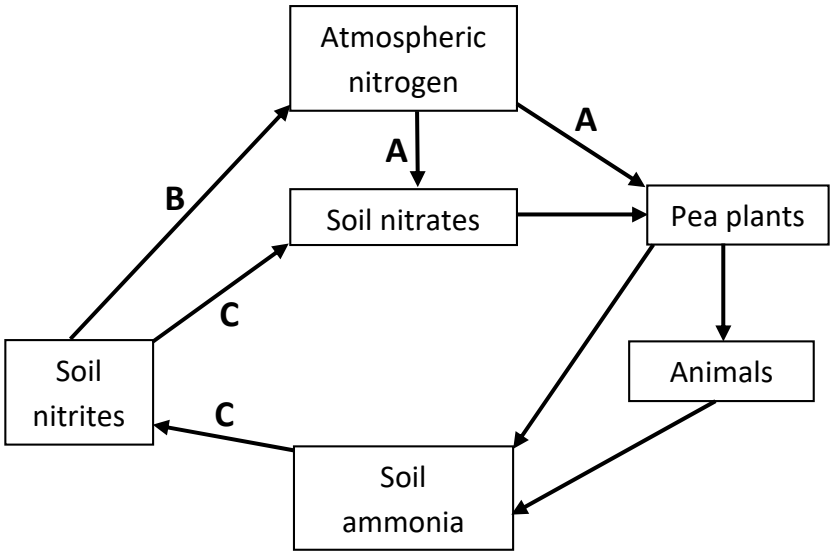
(c) Identify **one** metabolic role for lipids in cells.

(d) Name **one** fat-soluble vitamin present in food.

(e) Name **one** disorder associated with a deficiency of the vitamin named at part (d) above.

(f) Name **one** element present in dissolved salts in food.

2. The diagram below outlines some stages in the nitrogen cycle.



(a) Why do organisms need nitrogen?

(b) Name the processes indicated at **A** and **B** in the diagram above.

A:
B:

(c) Name the type of bacteria involved in the process indicated by **C** in the diagram above.

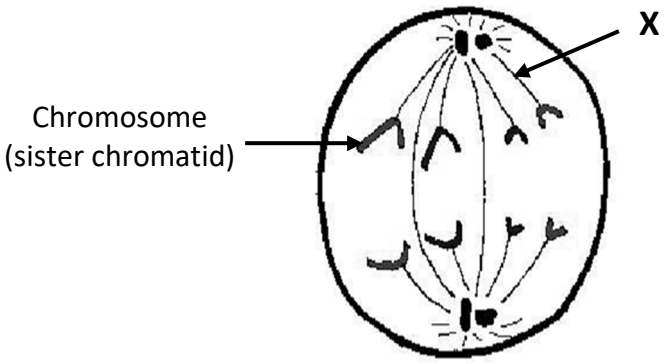
C:

(d) The application of fertilisers in agriculture can increase the amount of soil nitrates. Briefly describe **two** possible outcomes of this practice.

1.
2.

(e) On the diagram, place the letter **D** on **one** location where decomposers act.

3. The diagram shows a nucleus of a diploid cell undergoing one stage of mitosis. Answer the following in relation to mitosis.



(a) Name the stage of mitosis shown in the diagram.

(b) Justify your answer at part (a) above.

(c) Identify the part labelled **X** in the diagram.

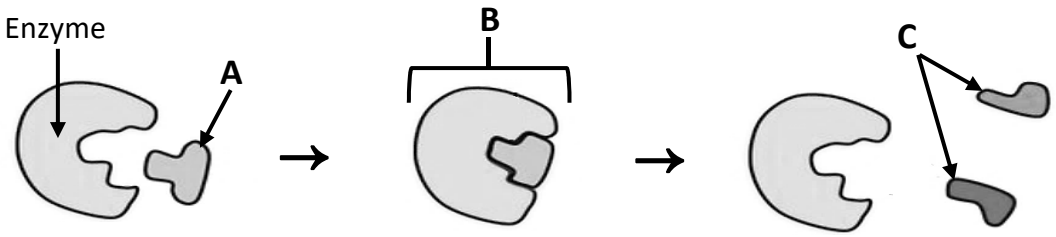
(d) Explain the term *diploid*.

(e) What is the diploid number of this cell?

(f) Outline **one** function of mitosis in humans.

(g) Give **one** example of a human cell not produced by mitosis.

4. A current theory of enzyme action is illustrated in the diagram below.



(a) Identify what is represented by each of the labels **A** and **B.**

A:
B:

(b) Which theory of enzyme action is illustrated by the diagram?

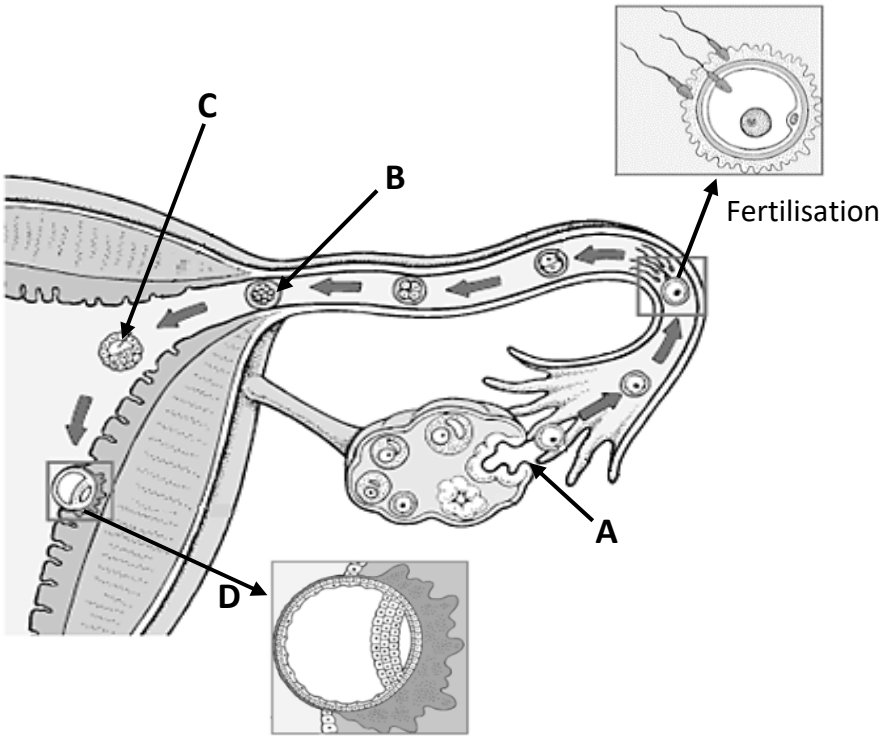
(c) What type of metabolic reaction is illustrated by the diagram?

(d) Justify your answer at part (c) above.

(e) What is meant by specificity in relation to enzymes?

(f) Identify the cell organelle where enzymes are produced.

5. The diagram shows some of the early stages in the development of a human embryo.



(a) Name the event that occurs at **A** in the diagram.

(b) Identify the hormone responsible for the event named at part (a) above.

(c) Identify the stages labelled **B** and **C** in the development of the embryo.

B:
C:

(d) What event is illustrated by **D** in the diagram?

(e) Name the **two** tissues involved in the formation of the placenta.

Tissue 1:
Tissue 2:

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

		True	False
(a)	Adrenaline is secreted into the blood when experiencing a threat.	☐	☐
(b)	Plants are producers; however, they still need mitochondria.	☐	☐
(c)	Neurotransmitters are transported in the blood.	☐	☐
(d)	A potato is a root modified to store food.	☐	☐
(e)	Tissue culture involves growing cells on an artificial medium.	☐	☐
(f)	There are four bones in the middle ear.	☐	☐
(g)	Monocotyledonous plants are almost always herbaceous.	☐	☐

7. In the case of **each** of the following pairs of terms, clearly distinguish between the first term and second term by writing a brief sentence about each.

(a) Carpal and tarsal.

(b) Tendon and ligament.

(c) Biceps and triceps.

(d) Osteoblast and osteoclast.

(e) Axial skeleton and appendicular skeleton.

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) Answer parts (i) and (ii) in relation to the principles of experimentation.

(i) Where are the results of an investigation normally reported and published?

(ii) Explain why random selection is important in experimental design.

(b) Answer the following in relation to some laboratory investigations that you carried out.

(i) When conducting qualitative food tests:

1. What reagent or chemicals did you use to test for the presence of protein?

2. What colour indicates the presence of protein in a food sample?

(ii) When isolating DNA from a plant tissue:

1. Why did you chop the tissue?

2. Why did you add salt to the chopped tissue?

3. Why did you add washing up liquid to the chopped tissue and salt?

4. The solution of washing-up liquid, chopped tissue and salt was then heated to 60°C for 15 minutes.
Describe how the DNA was then isolated from this solution.

9. (a) (i) What is meant by enzyme denaturation?

(ii) Other than temperature, give **one** condition that will denature an enzyme.

(b) Answer parts (i) and (ii) in relation to a laboratory activity to investigate heat denaturation of an named enzyme.

Name of enzyme:

(i) Describe how the enzyme was treated in the test investigation **and** in the control.

Test:

Control:

(ii) Compare the results of the test investigation to that of the control.

Test:

Control:

Answer parts (iii) and (iv) in relation to a laboratory investigation on the effect of temperature on the rate of activity of a named enzyme.

Name of enzyme:

(iii) How did you measure the rate of enzyme activity?

(iv) Label the axes below **and** draw a curve to show how the rate of enzyme activity varies with temperature.

10. (a) (i) Is leaf yeast a unicellular or a multicellular organism?

(ii) Name the type of asexual reproduction in yeast.

(b) In an investigation on the growth of leaf yeasts, three malt agar plates were setup as shown in the table and stored in an incubator at 25°C for 7 days.

Plate	Investigation setup	Results after 7 days
A	Unopened	0 colonies
B	5 leaf discs from an ash tree from a quiet rural setting	10 colonies
C	5 leaf discs from an ash tree from a busy urban setting	4 colonies

(i) What is the purpose of malt in these plates?

(ii) Why was the underside of the leaf facing the agar?

(iii) What is the purpose of plate **A** in this investigation?

(iv) Identify the colour of the leaf yeast colonies on plate **B**.

(v) Suggest **one** reason for the difference in results between plates **B** and **C**.

(vi) Describe **two** aseptic techniques that were carried out in this investigation to prevent growth of other microbes.

1.

2.

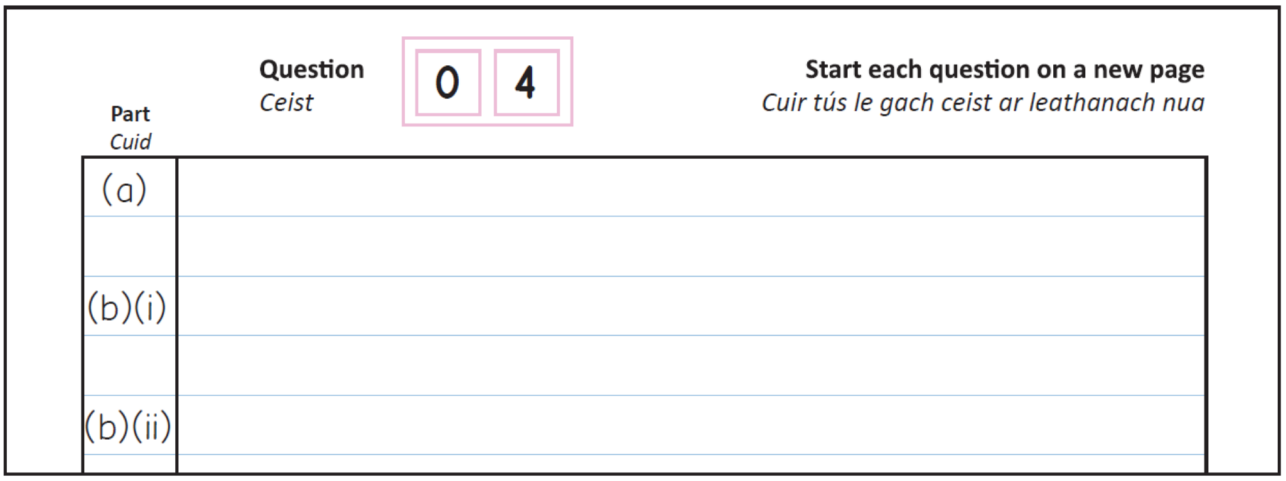
(vii) State **one** correct disposal method for these plates after the investigation.

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.

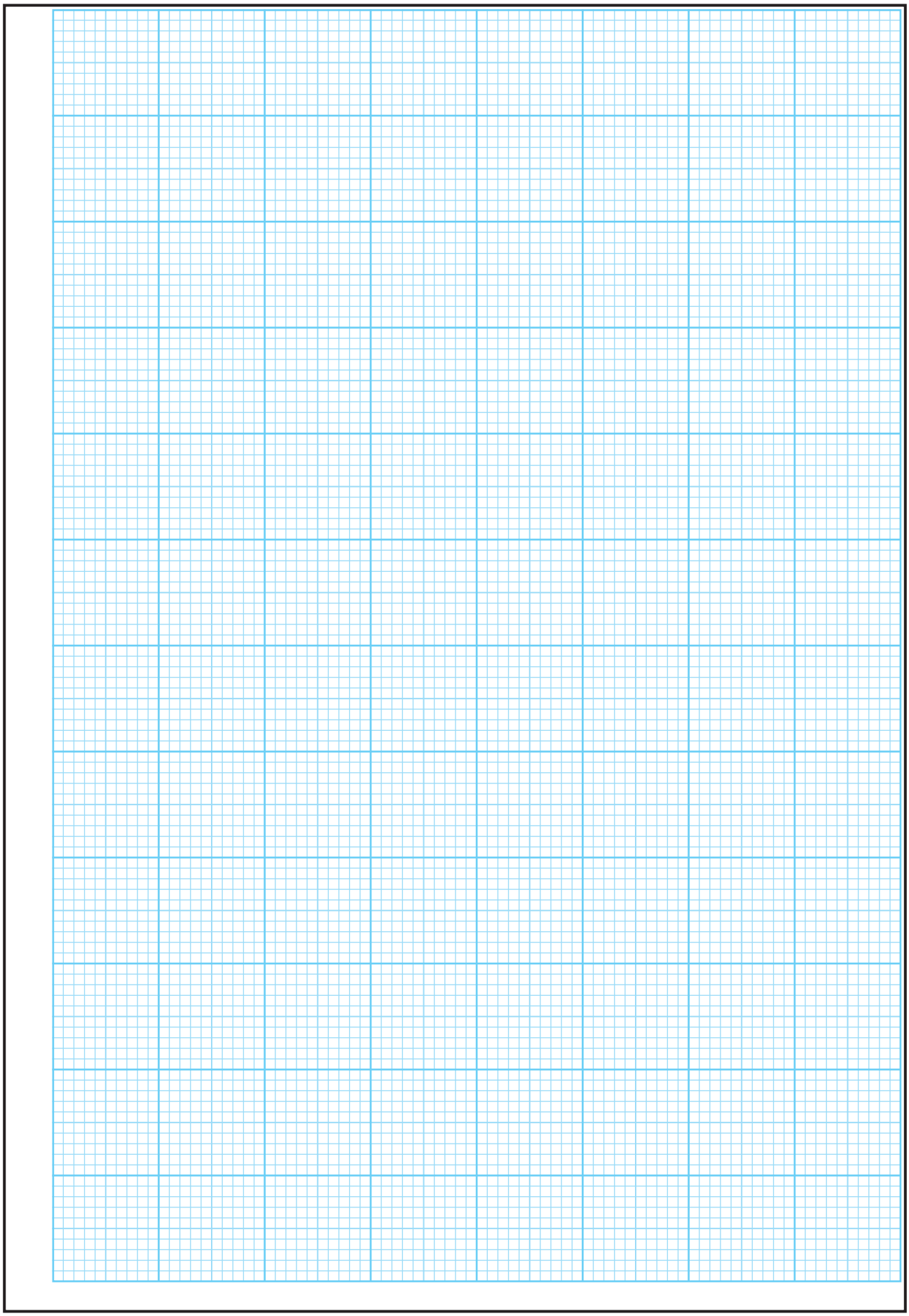


There are four pages of graph paper on the next four pages of this answerbook. On pages with graph paper, the box for the question number is at the bottom of the page.

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.

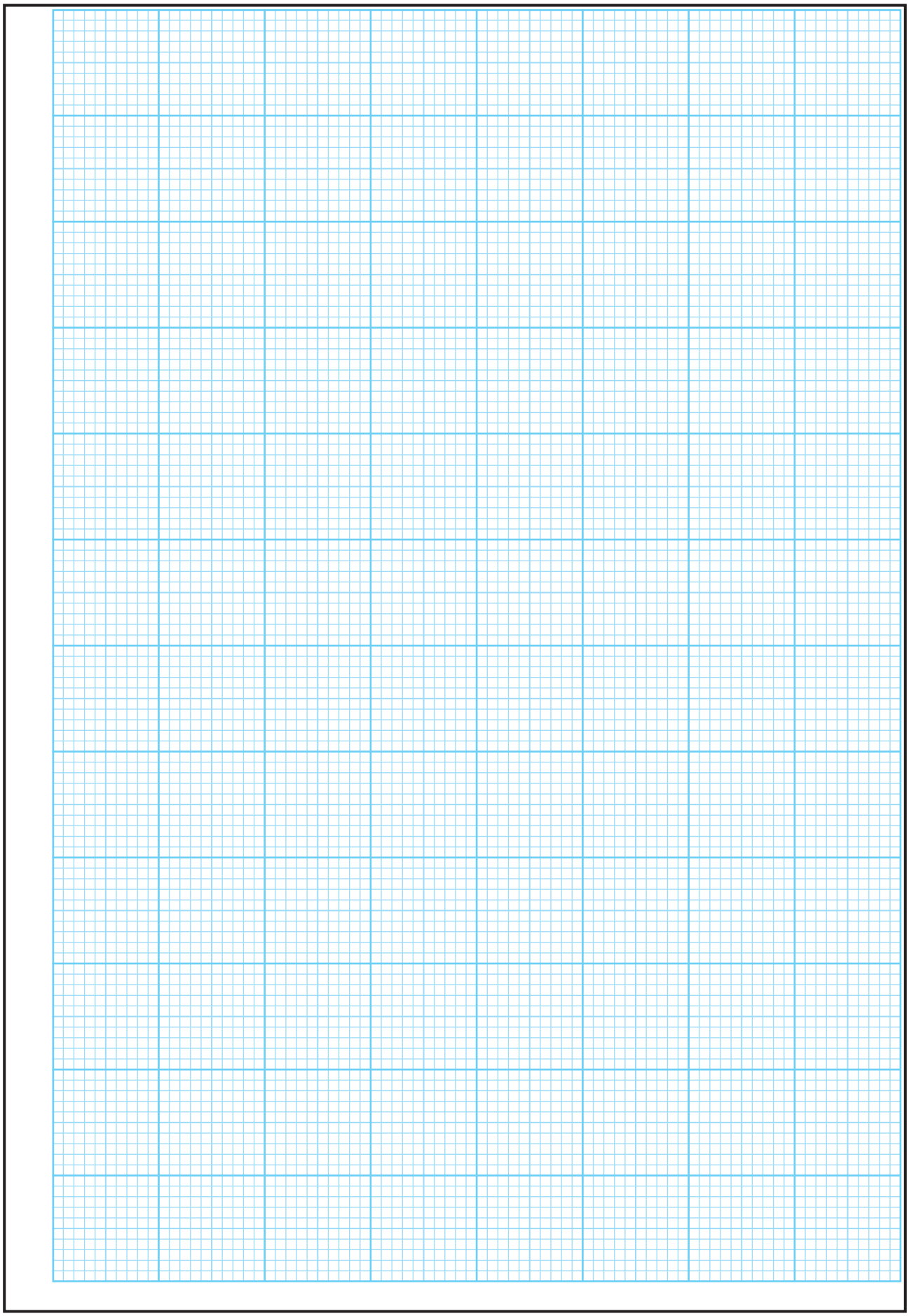
Write your answers in blue or black pen. You may use pencil for sketches, graphs and diagrams.

Question



Question

Question



Question

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Do not write on this page

Leaving Certificate – Higher Level

Biology Sections A and B and Answerbook

Tuesday 15 June

Afternoon 2:00 – 5:00

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

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.

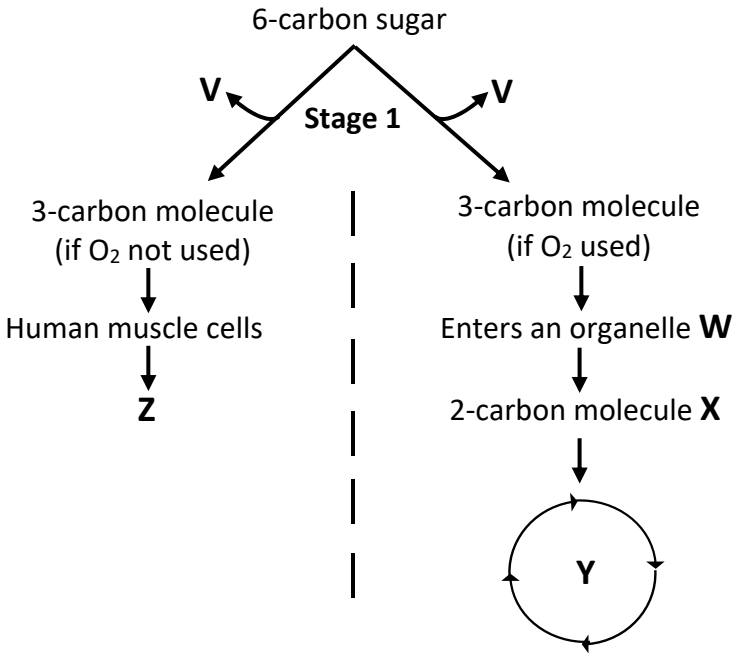
(iv) Give **one** application of genetic engineering in plants.

(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)**

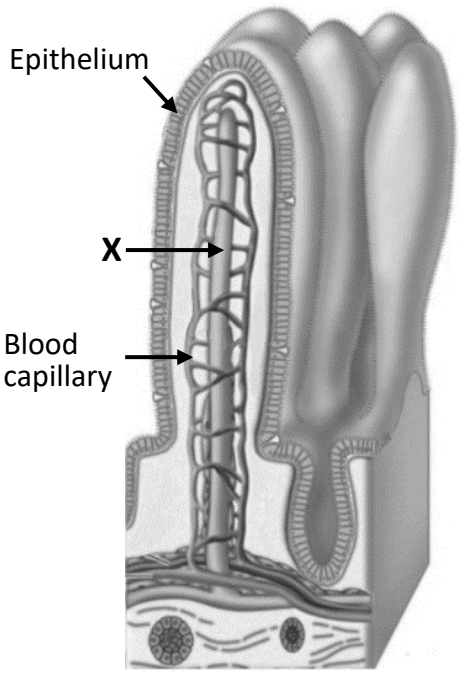
14. (a) (i) What is meant by the term digestion?

(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)

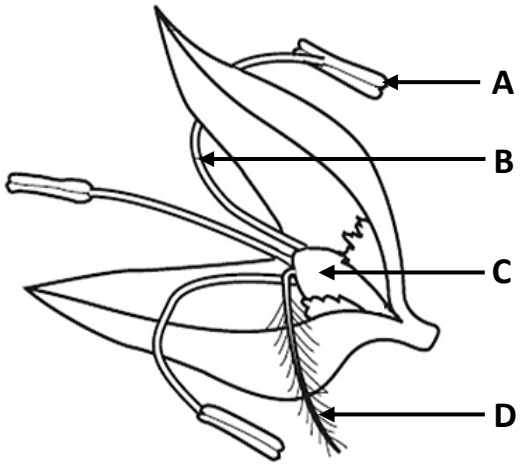
15. (a) Organisms can respond to changes in their external and internal environment in different ways including through homeostasis.

(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.

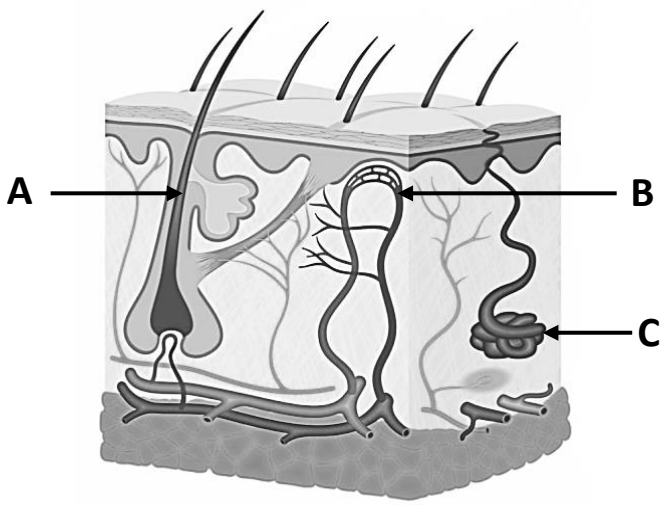
(iii) Give **two** roles of water in the process of germination.

(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.

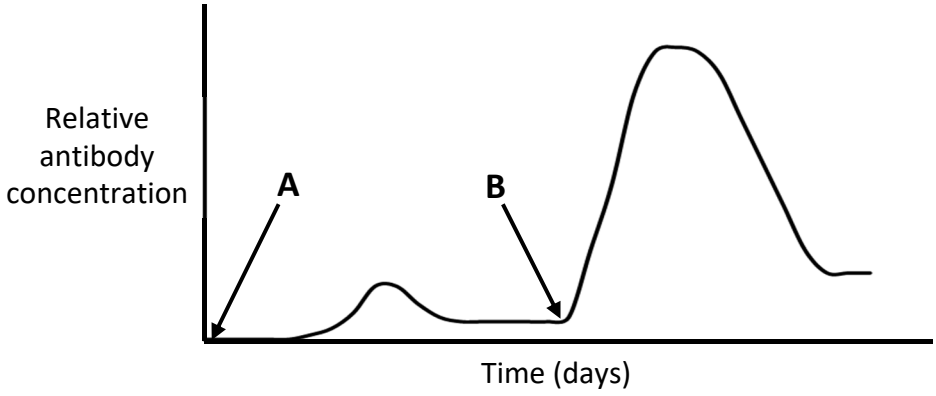
(i) Mucous membrane linings produce mucus which can help as a physical barrier against the entry of viruses.
Name **two** places in the body where mucus membrane linings are found.

(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.

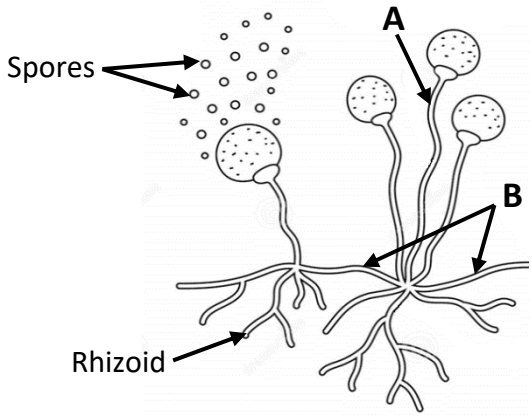
(iv) Identify the region of the human brain which detects the gas you have named at part (iii) above.

(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.

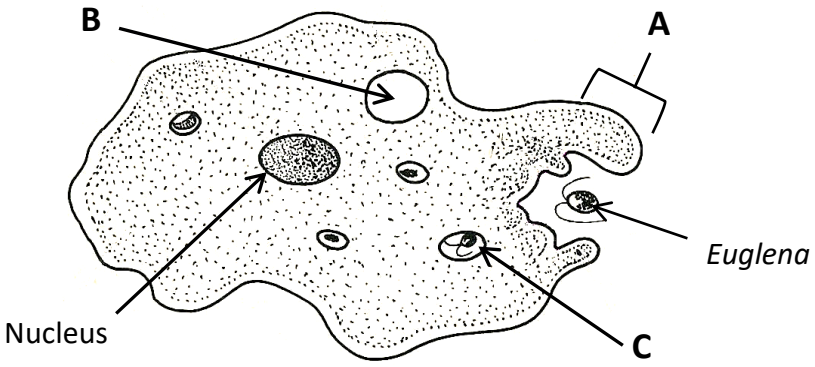
17. Answer any **two** of (a), (b), (c), (d). **(30, 30)**

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



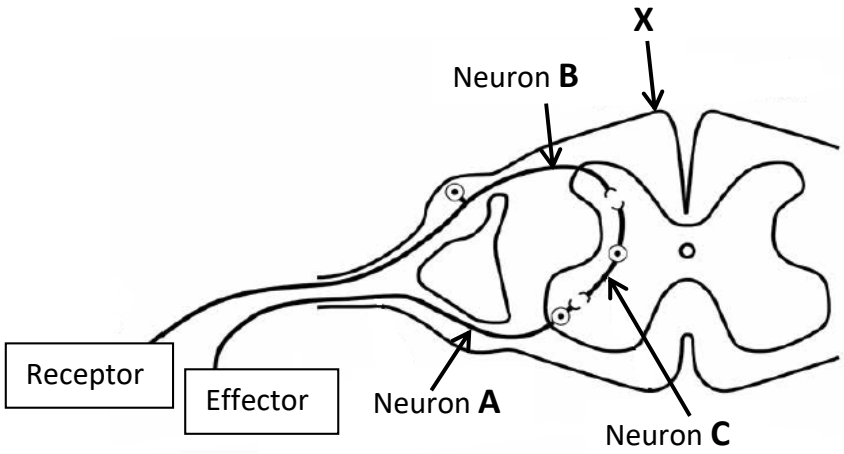
(i) Name the organism shown in the diagram **and** the kingdom to which it belongs.
(ii) Name the part labelled **A**.
(iii) State the mode of nutrition used by this organism.
(iv) Discuss the importance in nature of the type of nutrition named at part (iii) above.
(v) Name the horizontal hyphae labelled **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.

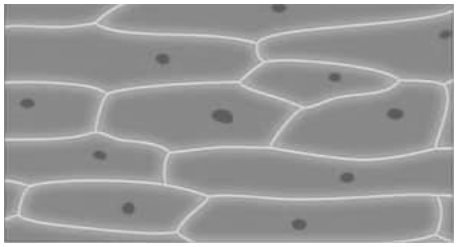
(c) The diagram shows a cross section of the spinal cord along with some neurons from the peripheral nervous system.



(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.

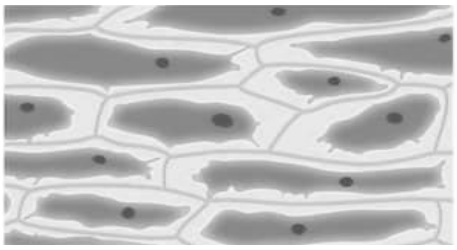
(d) A scientist used a light microscope to view images **A** and **B** of the same red onion epidermal cells in two solutions of different concentrations.
The dark grey shaded areas show the vacuoles filled with solution.

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.

Do not hand this question paper up

Leaving Certificate – Higher Level

BIOLOGY

Tuesday 15 June
Afternoon 2:00 – 5:00

Do not hand this question paper up