Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 2

Wednesday 19 May 2021 (morning)

Candidate session number

2 hours 15 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.

2221 – 6014

20 pages

Please **do not** write on this page.

Answers written on this page
will not be marked.

Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1.

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(Question 1 continued)

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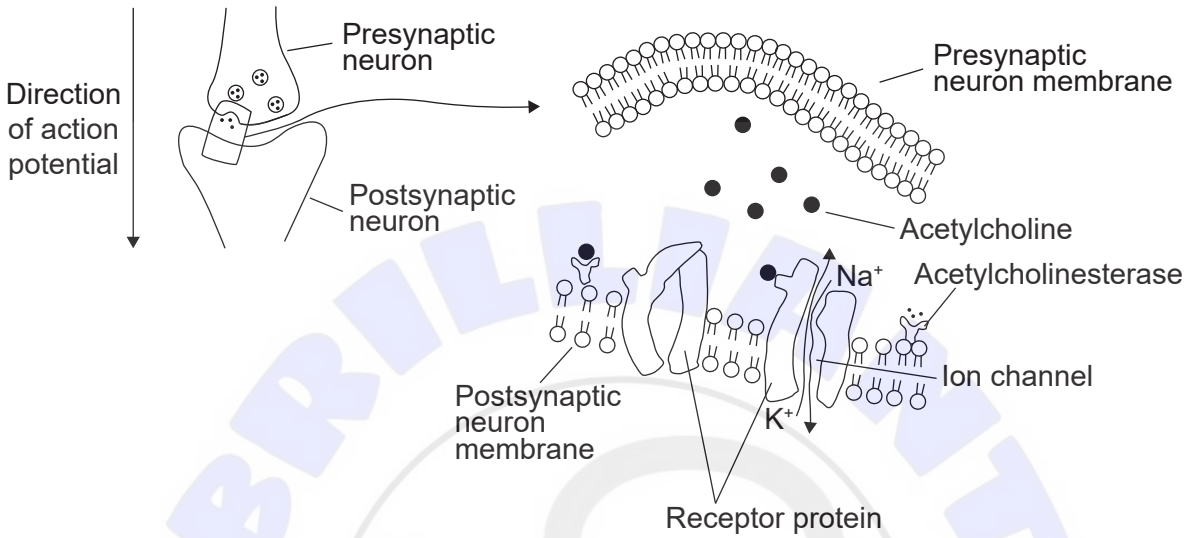
2. Cholinergic synapses use acetylcholine as their neurotransmitter. They are widespread in the body, passing on signals to muscle cells. These synapses are affected by neonicotinoid pesticides.

The diagrams, which are not drawn to scale, show the synapse between two neurons and a detail of the synaptic cleft.



(a) On the diagrams, label:

(i) with a letter H the hydrophilic end of a phospholipid [1]

(ii) with a letter E a vesicle involved in exocytosis [1]

(iii) with a letter P a location where a neonicotinoid pesticide could bind. [1]

(b) Outline how depolarization of the membrane of an axon occurs. [2]

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(Question 2 continued)

(c) Explain how acetylcholine initiates an action potential in a postsynaptic membrane. [2]

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(d) (i) State the action of the enzyme acetylcholinesterase. [1]

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(ii) Explain what happens to an enzyme if there is a change of pH. [3]

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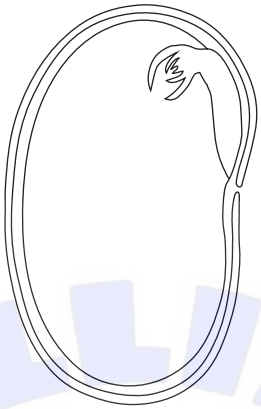
3. A broad bean is the seed of a species, *Vicia faba*, in the Fabaceae, a family of flowering plants. This family contains many species that are used as sources of food.



(a) On the diagram, label the testa and the radicle. [2]

(b) An experiment was done to test the hypothesis that temperature affects the rate of germination of the broad bean. Outline **two** factors apart from temperature that should be controlled in this experiment. [2]

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(c) State the genus of the broad bean. [1]

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(Question 3 continued)

(d) Broad beans are rich in starch and cellulose. Compare and contrast the structure of starch and cellulose. [2]

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(e) Once the germinated bean grows above the ground, state the process used by the bean in the production of starch. [1]

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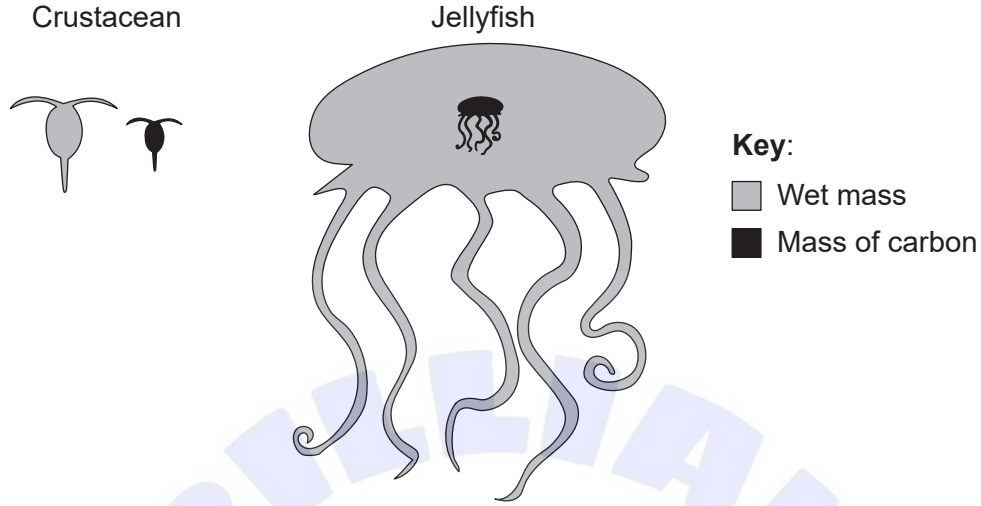
4. The mass of an individual organism can affect its physiology and feeding ecology. The diagram shows the relative mass of carbon (black) and total wet mass (grey) of a marine crustacean, *Calanus hyperboreus* and a jellyfish, *Bathocyroe fosteri*.



[Source: Kristian McConville, Angus Atkinson, Elaine S. Fileman, John I. Spicer, Andrew G. Hirst. Disentangling the counteracting effects of water content and carbon mass on zooplankton growth. *Journal of Plankton Research*. 2017, Volume 39, Issue 2, Pages 246–256. https://doi.org/10.1093/plankt/fbw094. Adapted (and translated) by permission of Oxford University Press.]

(a) State **one** process that results in the loss of carbon dioxide from a marine organism such as a crustacean or a jellyfish. [1]

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(b) The crustacean and the jellyfish obtain carbon compounds by feeding. State **one** source of carbon for marine organisms, other than feeding. [1]

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(c) Explain how energy enters, flows through and is lost from marine food chains. [3]

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(Question 4 continued)

(d) (i) Deduce whether jellyfish or crustacea are a richer source of carbon in a food chain. [1]

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(ii) Suggest with a reason whether having a large body mass is an advantage or disadvantage for jellyfish. [1]

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Section B

Answer **two** questions. Up to one additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

5. (a) Autosomal genes are located in chromosomes that are not sex chromosomes. The inheritance of autosomal genes is affected by whether the genes are linked or unlinked. Explain the **two** types of inheritance, using the example of parents that are heterozygous for two genes A and B. [7]

(b) Outline how sperm are produced from diploid cells in the testis and how this production can be sustained over many decades of adult life. [4]

(c) Testis cells are eukaryotic cells. Identify the structures seen under the electron microscope in testis cells that are not present in prokaryotic cells. [4]

6. (a) Explain the role of hydrogen ions used in photosynthesis. [7]

(b) Describe how the structure of the chloroplast is adapted to its function in photosynthesis. [4]

(c) The enzyme Rubisco is used in carbon fixation during photosynthesis. Identify **four** other examples of proteins that illustrate the wide range of functions of this group of biochemicals in living organisms. [4]

7. (a) Describe the structure of the DNA molecule. [5]

(b) Outline the role of **three** enzymes used in the replication of DNA. [3]

(c) Insulin is produced in β cells of the pancreas and not in other cells of the human body. Explain how differentiation of cells and regulation of gene expression allow proteins such as insulin to be produced in only certain types of body cell. [7]

References:

4. Kristian McConville, Angus Atkinson, Elaine S. Fileman, John I. Spicer, Andrew G. Hirst. Disentangling the counteracting effects of water content and carbon mass on zooplankton growth. *Journal of Plankton Research*. 2017, Volume 39, Issue 2, Pages 246–256. https://doi.org/10.1093/plankt/fbw094. Adapted (and translated) by permission of Oxford University Press.