Cambridge Assessment International Education

Cambridge Pre-U

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

7324203801

BIOLOGY **9790/03**

Paper 3 Case Study and Synoptic Essay **October/November 2020**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
Section A	
Section B	
Total	

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document has **16** pages. Blank pages are indicated.

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Section A – Case study

Read the passages carefully and answer **all** of the questions.

You are advised to spend no more than 50 minutes on this section.

1 Cone snails

Cone snails are a type of carnivorous mollusc that feed on small fish. They produce a mixture of chemicals that they inject into their prey.

Fig. 1.1 shows a cone snail, *Conus geographus*.

Fig. 1.1

Insulin production

Some cone snails produce a cloud of insulin that stuns nearby fish, causing the fish to become unconscious. This allows the cone snail to capture the fish and inject poisons.

(a) (i) Describe the role of insulin in the control of blood glucose in humans.

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(ii) Suggest how the insulin stuns fish.

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(iii) The insulin molecule produced by cone snails has several regions with a similar sequence of amino acids to the insulin of the fish on which they feed. An example is shown in Fig. 1.2.

Each different amino acid is given a separate letter.

	amino acid																			
cone snail insulin	G	V	V	E	H	C	C	H	R	P	C	S	N	A	E	F	K	K	Y	C
fish insulin	G	I	V	E	Q	C	C	H	K	P	C	S	I	F	E	L	Q	N	Y	C

Fig. 1.2

Use Fig. 1.2 to determine the percentage sequence similarity of this region of cone snail insulin to fish insulin.

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[1]

(iv) Researchers were particularly interested in the positions of the cysteine residues (letter **C** in Fig. 1.2).

Explain the significance of cysteine in the structure and function of a protein.

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(v) Explain how cone snails evolved insulin with a similar sequence to that of fish.

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Ziconotide production

Cone snails produce a mixture of poisons that are injected into the prey fish. Some cone snails produce a chemical called ziconotide.

Ziconotide has been used as a powerful painkiller in humans.

It blocks calcium ion channels found in the central nervous system.

(b) (i) Suggest how ziconotide could lead to a reduction in the detection of pain in humans.

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(ii) Name the region of the brain responsible for the perception of pain in humans.

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ρ-TIA production

The cone snail *C. tulipa* produces the polypeptide ρ-TIA that binds to an allosteric site on the α1-adrenergic receptors on muscle cells. This binding prevents the flow of calcium ions into the muscle cells.

(c) (i) Explain how this is similar to allosteric inhibition of an enzyme.

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The intracellular concentration of calcium ions was measured in isolated muscle cells that had been stimulated with 10^{-3} mol dm^{-3} noradrenaline. The investigation was repeated with a range of concentrations of ρ-TIA. The results are shown in Fig. 1.3.

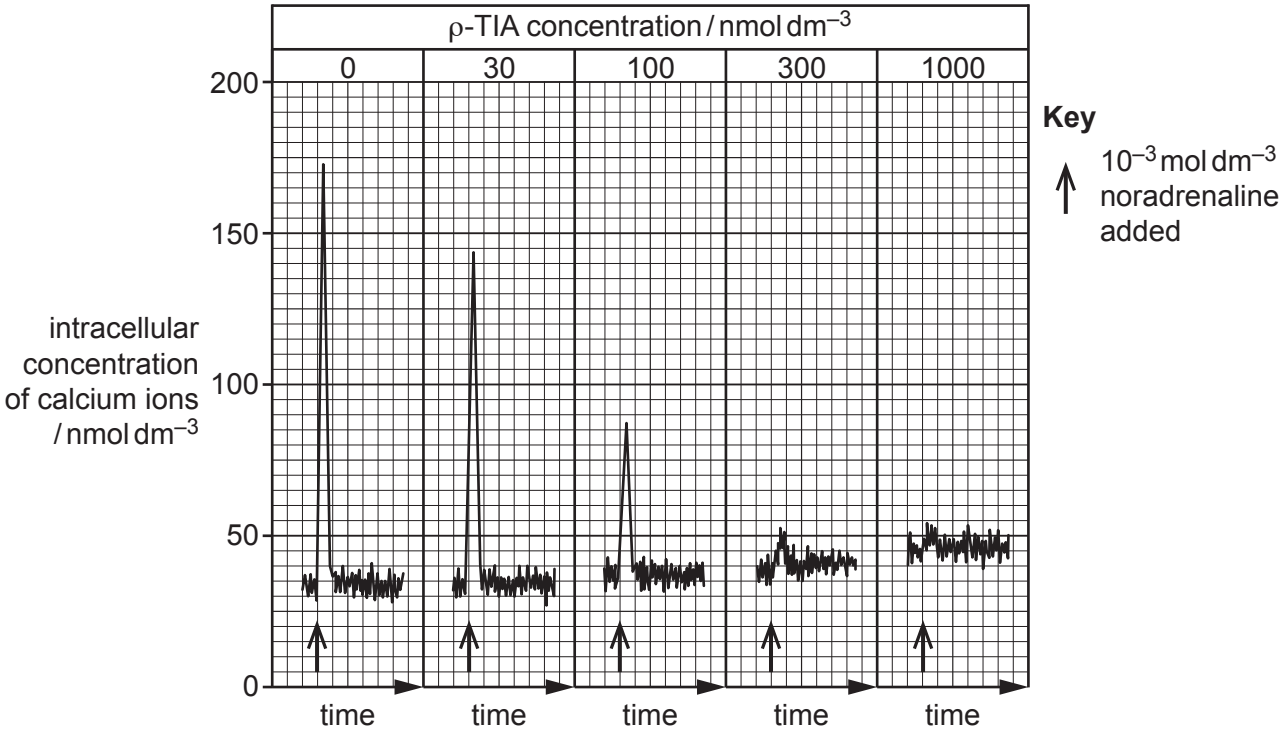

Fig. 1.3

(ii) Name **three** substances that would need to be supplied to isolated muscle cells so that they are capable of contraction. Explain your answers.

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[3]

(iii) Use Fig. 1.3 to describe the effect of ρ-TIA on intracellular calcium ion concentration.

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(iv) Suggest how injection of ρ-TIA into a prey animal could cause muscle paralysis.

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Cone snail ecology

(d) In a study of cone snail distribution in Hawaii, it was found that at least 21 closely related species were living in a relatively small area.

Suggest reasons for such a high species density.

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[Total: 30]

Section B – Synoptic essay

Answer **one** question on the lined paper that follows.

You are advised to spend no more than 50 minutes on this section.

Choose **one** question from Question **2**, Question **3** or Question **4**.

2 Discuss the uses of nitrogen in plants and animals. [30]

3 Experimental biology is essential for a full understanding of living systems.

Discuss this statement with reference to examples. [30]

4 It is possible to produce a vast number of polymers from only a small number of monomers.

Discuss the importance of this for organisms. [30]

Your answer should draw from a wide range of syllabus material and also demonstrate evidence of reading around the subject.

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