

CANDIDATE
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BIOLOGY (PRINCIPAL)

9790/03

Paper 3 Case Study and Synoptic Essay

May/June 2018

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer **one** question.

Write your answer on the Question Paper.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

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

This document consists of **13** printed pages and **3** blank pages.

Section A – Case Study

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

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

Atrial natriuretic peptide

- 1 Atrial natriuretic peptide (ANP) is a hormone secreted from the muscle cells (myocytes) of the atria of the heart. The active form is a short polypeptide chain of 28 amino acids.

Fig. 1.1 shows the structure of human ANP. Active ANP has a disulfide bridge between amino acid 7 and amino acid 23.

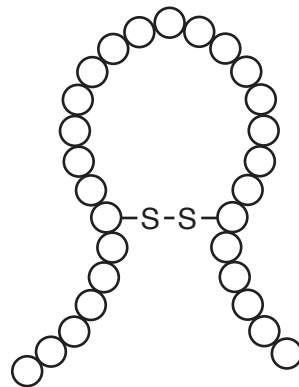


Fig. 1.1

In humans, the gene coding for ANP is found on chromosome 1 and consists of three exons and two introns. Transcription and translation result in the formation of pre-proANP (151 amino acids), which is cleaved (cut) into proANP (126 amino acids). The proANP is a storage form of the molecule and is cleaved into the active ANP as it is secreted from the cell, as shown in Fig. 1.2.

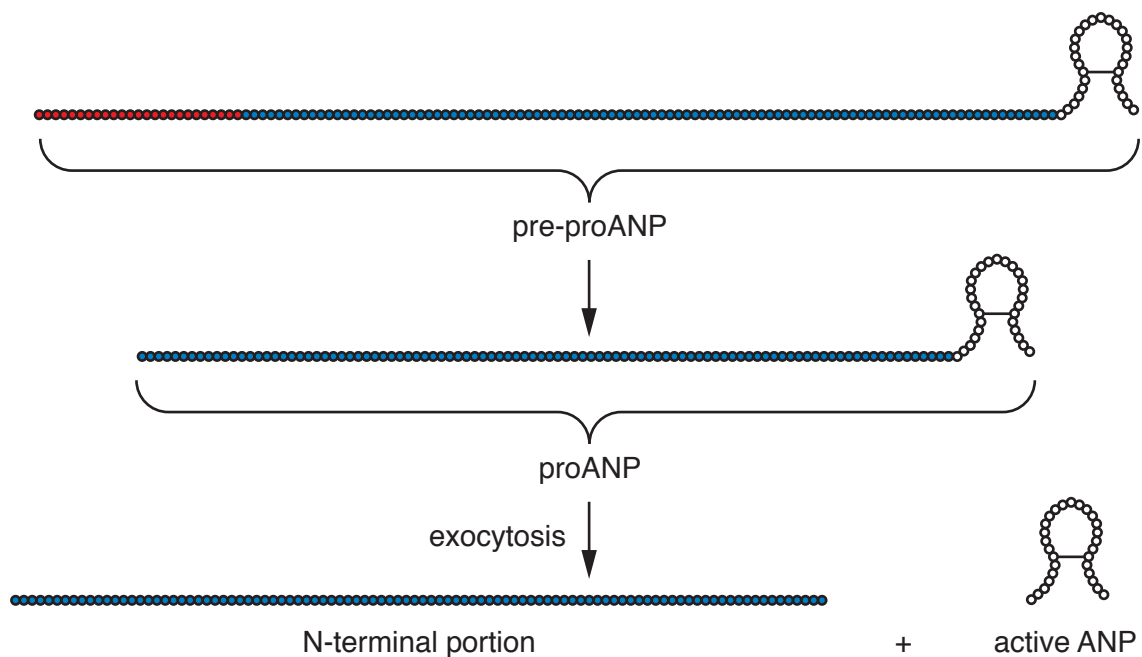


Fig. 1.2

(a) Human ANP and rat ANP differ by only a single amino acid at position 12.

Suggest reasons for the similarity in the structure of human ANP and rat ANP.

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..... [2]

(b) Disruption of the disulfide bridge results in complete loss of activity of the ANP molecule.

Explain why.

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(c) The gene for ANP consists of 2637 base pairs.

Calculate the total number of base pairs that make up the non-translated regions of the ANP gene.

Show your working.

..... base pairs
[2]

(d) The pre-proANP molecule is cleaved in the rough endoplasmic reticulum. The proANP molecule formed is stored in vesicles in the atrial myocytes.

Outline the sequence of events occurring between cleavage in the rough endoplasmic reticulum and exocytosis.

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ANP release and clearance

- 2 Stretching the atrial myocytes as a result of increased blood pressure causes cleavage of proANP and exocytosis of the products into the circulation. The products are active ANP and the inactive N-terminal portion.

Active ANP is rapidly removed from the circulation by binding to specific cell surface receptors on target cells.

In an investigation, a buffer solution, isotonic to rats' blood, was injected into the circulation of rats. Immediately after the injection, the plasma concentration of active ANP was determined and compared with a control group of rats that did not receive the injection. The results, expressed as mean plasma ANP concentration \pm SD (standard deviation), are shown in Fig. 2.1.

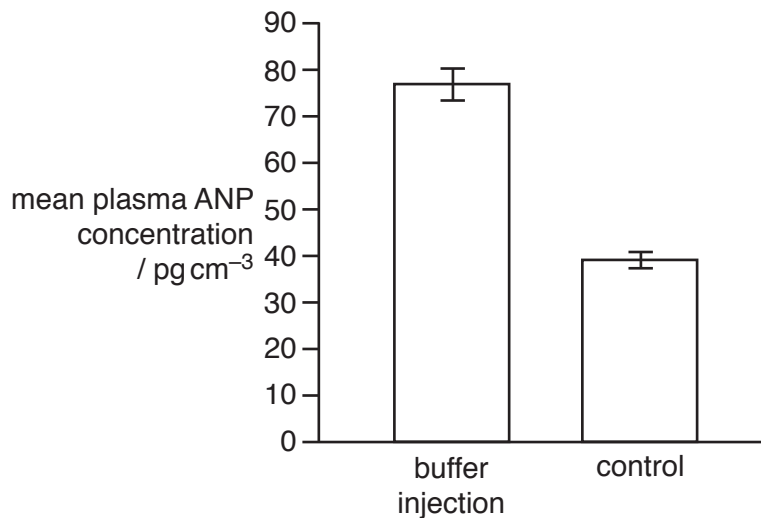


Fig. 2.1

In a separate experiment, different concentrations of endothelin, a hormone that causes arteriole constriction, were injected into rats. The release of active ANP into the blood was determined. The results, expressed as mean ANP released as a percentage of control \pm SE (standard error), are shown in Fig. 2.2.

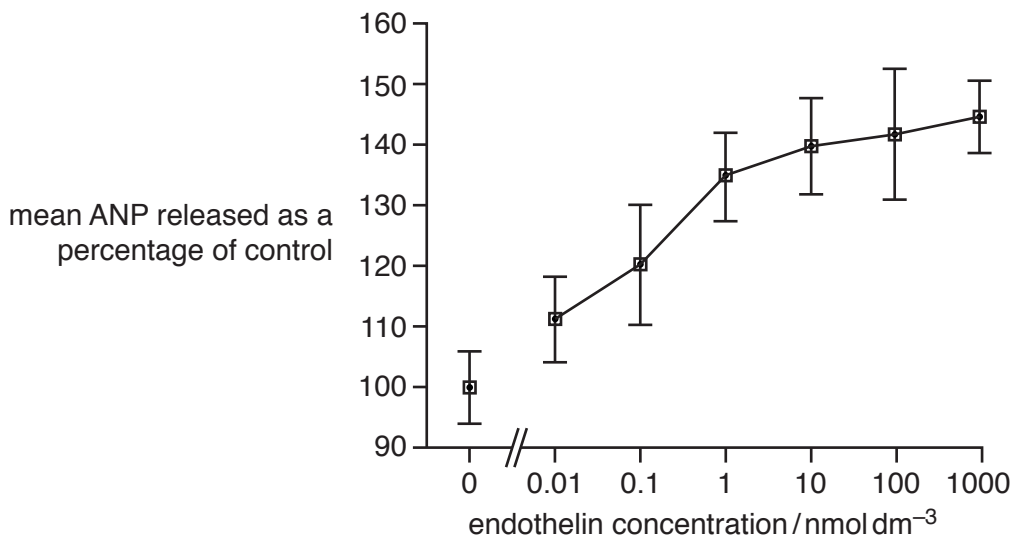


Fig. 2.2

- (a) Explain how injection of an isotonic buffer solution and injection of endothelin could have caused the results shown in Fig. 2.1 and Fig. 2.2.

injection of isotonic buffer solution

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injection of endothelin

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[3]

- (b) It has been shown that a high-salt diet also affects plasma ANP concentration in healthy people.

Predict and explain how a high-salt diet would affect plasma ANP concentration in healthy people.

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[Total: 8]

Effects of ANP

3 Some effects of ANP include:

- renal effects
 - increased renal blood flow
 - inhibition of ADH

- cardiovascular effects
 - dilation of arterioles.

The renal effects of ANP lead to an increase in the volume of urine produced.

(a) Explain how the two renal effects of ANP could bring about an increase in urine production.

increased renal blood flow

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inhibition of ADH

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[5]

- (b) Coronary heart disease is associated with high blood pressure and is a major cause of heart attacks.

It is not always obvious when a person has had a heart attack. In some hospitals, the concentration of the N-terminal portion of the proANP molecule in the blood is used as an indicator of a heart attack.

- (i) Describe how coronary heart disease could result in an increase in blood pressure.

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- (ii) Suggest why the N-terminal portion is used as an indicator of a heart attack instead of the active ANP.

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- (c) It has also been suggested that giving ANP as a drug could help to reduce the incidence of heart attacks.

Suggest how ANP injections could help to reduce heart attacks in some people.

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- (d) A mutation in the ANP gene causes the deletion of two base pairs. This results in a modified form of ANP (m-ANP) that has an additional 12 amino acids but is still very active.

Fig. 3.1 shows ANP and m-ANP.

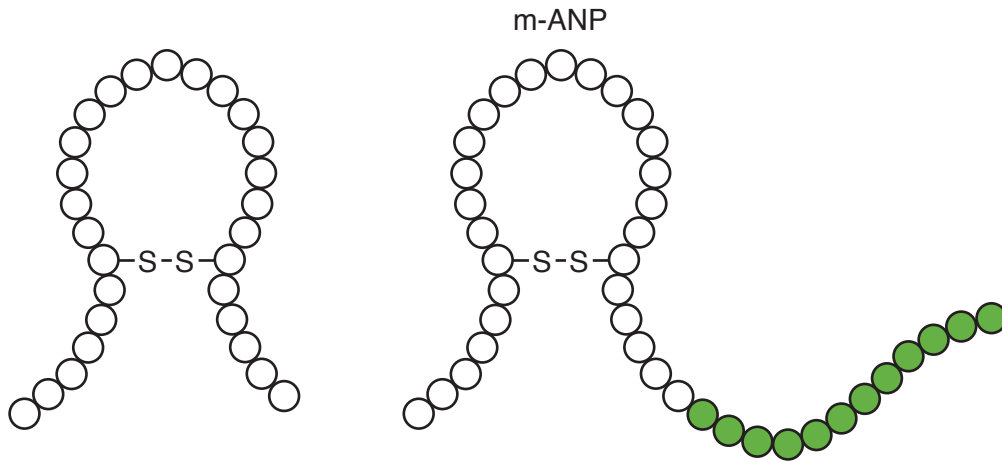


Fig. 3.1

- (i) Suggest **and** explain how the two base pair mutation leads to the m-ANP molecule having 12 additional amino acids.

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- (ii) Suggest **and** explain why this modification does not reduce the activity of the hormone.

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[Total: 14]

Section B – Synoptic Essay

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

You are advised to spend no more than 55 minutes on this section.

Choose **one** question from Question 4, Question 5 or Question 6.

- 4 Discuss why intracellular enzymes are essential to life.
- 5 ‘A highly developed nervous system has been crucial for the evolutionary success of mammals.’
Discuss this statement.
- 6 Discuss the difference between mass extinction and background extinction and comment on the influence of human activity on both of these.

Your answer should draw from a wide range of syllabus material and also demonstrate evidence of reading around the subject. [30]

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[Total: 30]

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