UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International Level 3 Pre-U Certificate
Principal Subject

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9790/02**

Paper 2 Structured **May/June 2012**

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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.

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	
1	
2	
3	
4	
5	
6	
Total	

This document consists of **17** printed pages and **3** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

Answer **all** the questions.

For Examiner's Use

1 In the 1950s, chemists thought that the Earth's atmosphere, before the existence of life, was highly reducing. In 1953, Stanley Miller, working under the supervision of Harold Urey at the University of Chicago, published the results of an experiment that showed that organic molecules could have formed in such an atmosphere.

A diagram of Miller's apparatus is shown in Fig. 1.1.

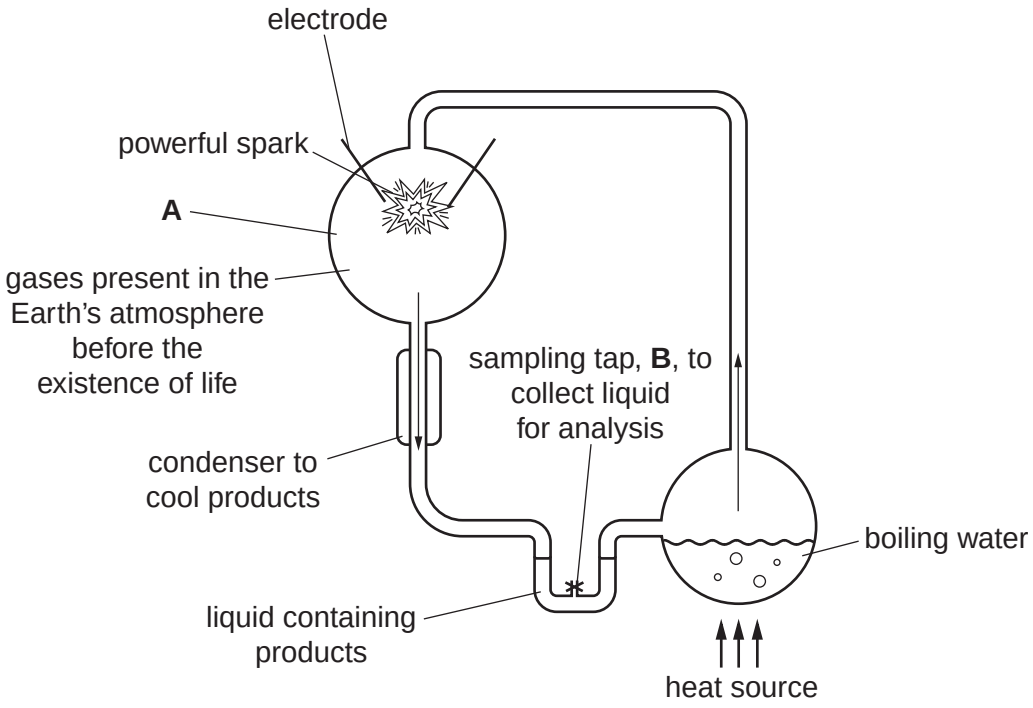

Fig. 1.1

(a) (i) Name three gases, apart from water vapour, that were present in this early atmosphere and that Miller put into chamber **A**.

1. .....

2. .....

3. ..... [3]

(ii) Name two different types of organic molecule that Miller collected at **B**.

For Examiner's Use

1. .....

2. ..... [2]

(iii) State the role of the powerful spark in Miller's apparatus.

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(iv) Explain why liquid water had to be present for life to originate on Earth.

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Fig. 1.2 shows a time line for the early history of the Earth.

For Examiner's Use

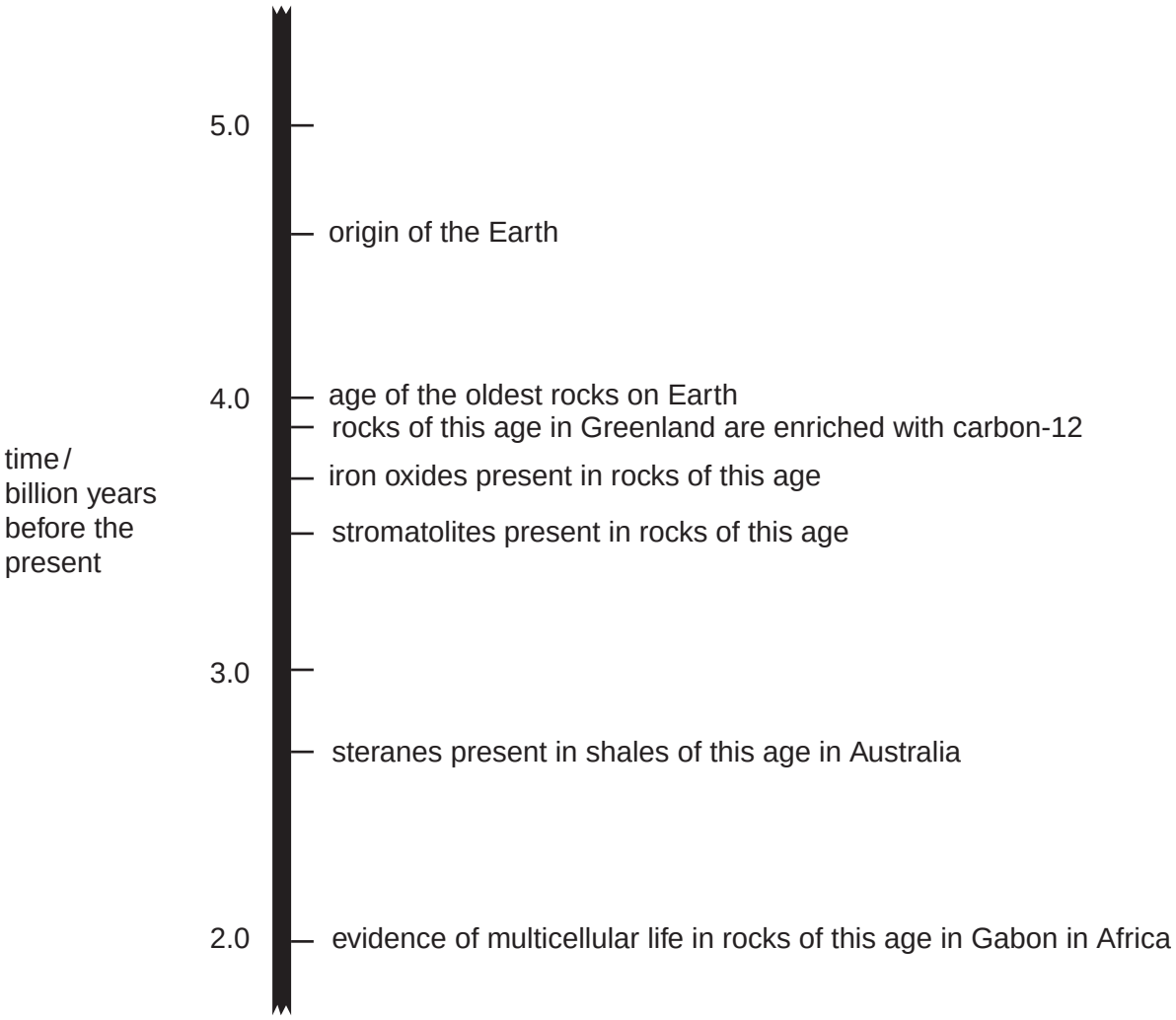

Fig. 1.2

(b) State the significance of,

(i) the enrichment with carbon-12 of rocks that are 3.9 billion years old

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(ii) the presence of stromatolites in rocks that are 3.5 billion years old

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(iii) presence of steranes in shales that are 2.7 billion years old.

For Examiner's Use

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(c) Life may have originated around hydrothermal vents. Today, communities associated with these vents are rich in chemoautotrophic bacteria.

Describe briefly the nutrition of chemoautotrophic bacteria.

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[Total: 16]

For Examiner's Use

2 The Mongolian gerbil, *Merionthes unguiculatus*, lives in semi-arid desert habitats in the steppes of northern Asia where much of the vegetation and drinking water has a high salt content.

A laboratory study was carried out to investigate the effect of supplying gerbils with drinking water with different concentrations of salt. Gerbils were divided into five groups and given equal volumes of either water or four different concentrations of sodium chloride solution for five days. The animals were kept under identical conditions and supplied with the same food.

The urine was collected each day and analysed. The volumes of urine collected on the fifth day and their concentrations of sodium ions are shown in Fig. 2.1.

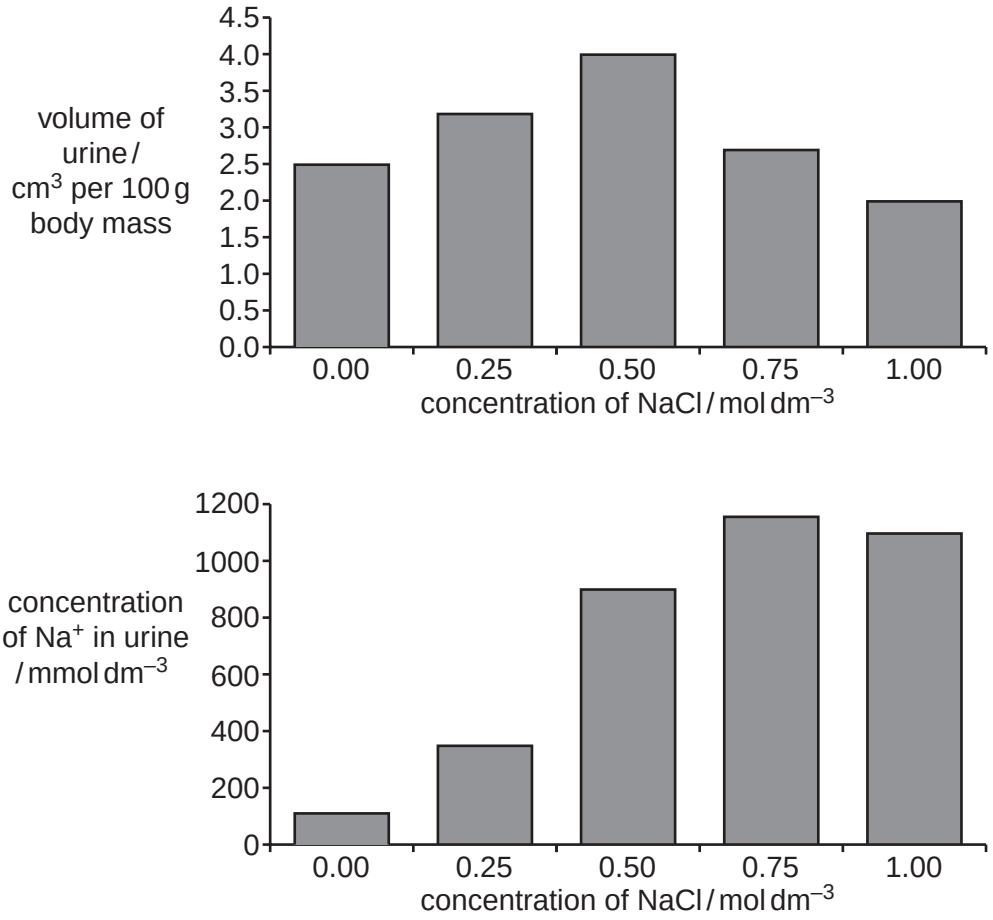

Fig. 2.1

(a) Describe **and** explain the results shown in Fig. 2.1.

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For Examiner's Use

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(b) Humans cannot survive if given a solution of $0.25\,mol\,dm^{-3}$ sodium chloride to drink over several days.

Explain how the kidneys of gerbils allow them to survive while drinking water with a high concentration of salt.

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(c) Another investigation found that gerbils given:

- $0.25\,mol\,dm^{-3}$ sodium chloride solution for five days had stores of ADH (antidiuretic hormone) in the posterior pituitary gland;
- 0.50, 0.75 and $1.0\,mol\,dm^{-3}$ sodium chloride solutions for five days had significantly less ADH in their posterior pituitary glands.

Suggest an explanation for these observations.

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(d) *M. unguiculatus* has both physiological and behavioural adaptations to its desert habitat.

For Examiner's Use

Suggest examples of the physiological and behavioural adaptations that small mammals, such as *M. unguiculatus*, have for desert habitats.

Do **not** include the adaptations of the kidney.

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[Total: 16]

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Question 3 begins on page 10

3 T cells (T lymphocytes) differentiate inside the thymus gland. During T cell differentiation, specific cell surface proteins known as CD proteins are produced and inserted into the cell surface membrane.

For Examiner's Use

Fig. 3.1 shows the stages involved in the synthesis of a CD protein in a T cell.

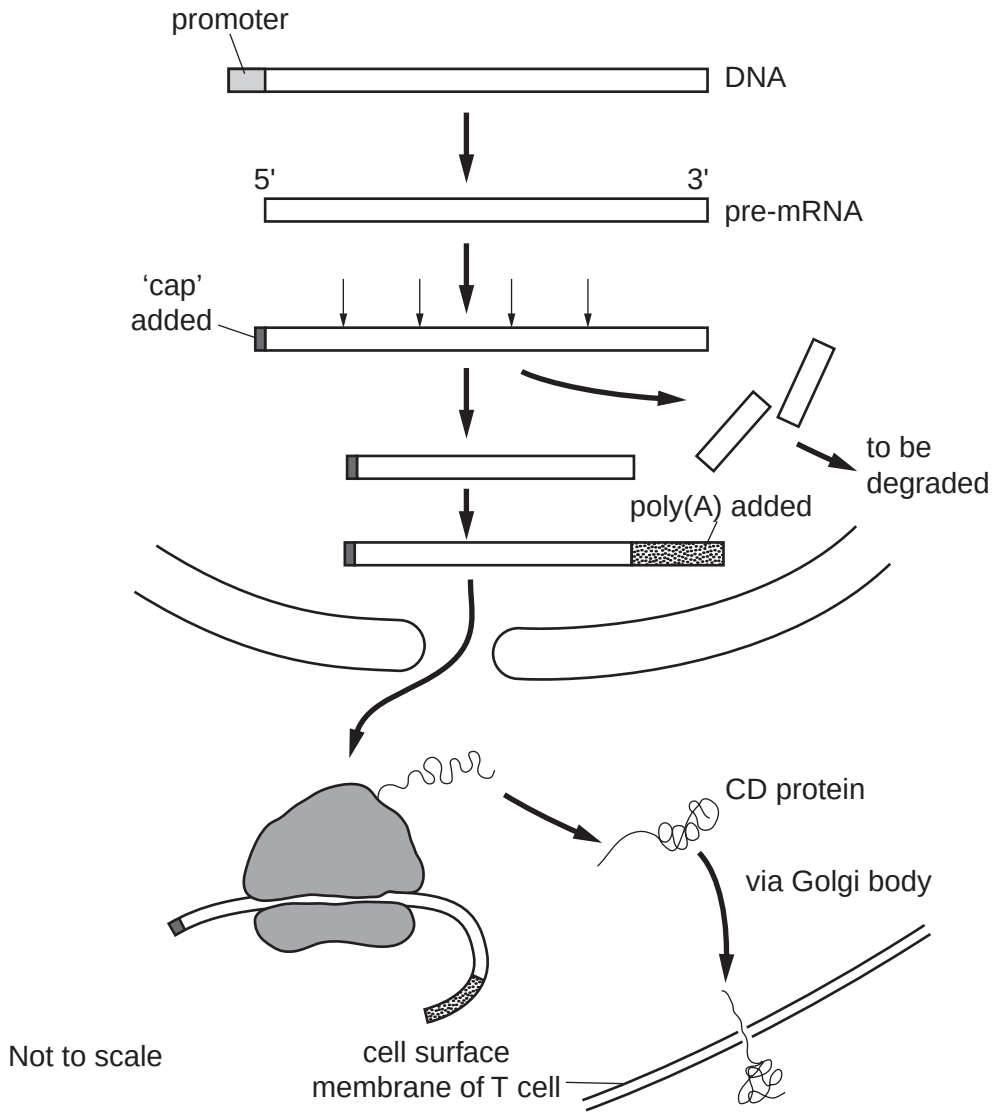

Fig. 3.1

(a) Explain the function of the promoter region of the DNA.

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(b) Using Fig. 3.1 as a guide, describe the events that occur in the nucleus of the T cell to produce a functional molecule of mRNA encoding a CD protein.

For Examiner's Use

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(c) Explain why the cuts made in pre-mRNA are necessary for the T cell to produce a functional CD protein.

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(d) Suggest possible functions for the 'cap' and the poly-A region attached to the mRNA.

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(e) Each clone of fully differentiated T cells expresses a particular set of CD proteins on the cell surface membranes.

For Examiner's Use

Explain how monoclonal antibodies are able to identify different CD proteins.

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(f) Explain why it is necessary to use hybridoma cells, rather than B cells, to produce monoclonal antibodies.

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[Total: 19]

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Question 4 begins on page 14

For Examiner's Use

4 **(a)** ATP is often known as the universal 'energy currency'.

Outline how ATP is suitable for acting as an energy currency.

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Most ATP is made in cells by membrane systems that create proton gradients by pumping protons from one compartment to another.

Fig. 4.1 shows three such membrane systems.

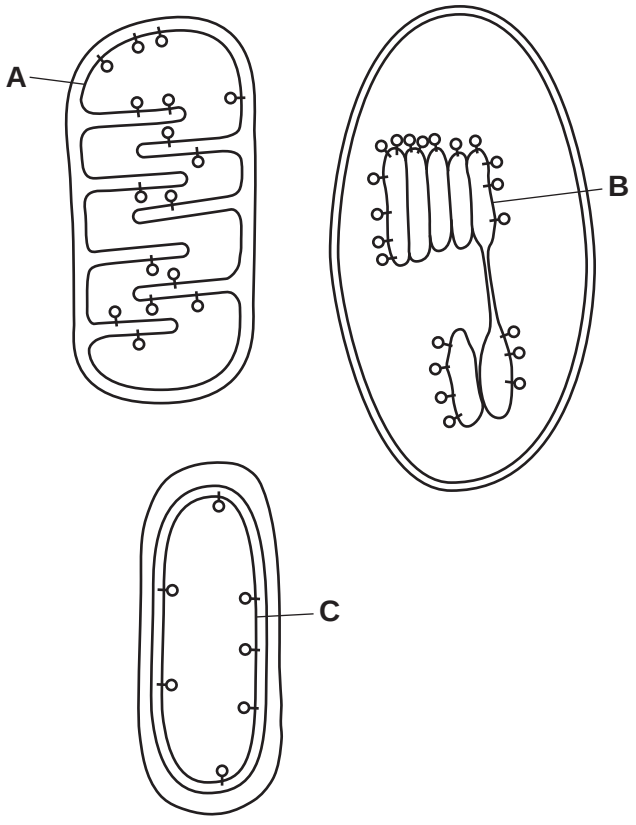

Fig. 4.1

(b) **(i)** Identify the precise location of membranes **A**, **B** and **C**.

For Examiner's Use

A .....

B .....

C ..... [3]

(ii) Draw arrows onto each of the membrane systems in Fig. 4.1 to show the direction in which protons are pumped. [1]

(iii) Outline how energy is made available for pumping protons across such membranes.

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(iv) Explain how ATP synthase is involved in the production of ATP.

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[Total: 13]

For Examiner's Use

5 Certain flowering plant species, such as the violet, *Viola odorata*, produce some flowers that open and are cross-pollinated by insect pollinators and others that never open and are self-pollinated.

(a) Suggest the advantages of having flowers that self-pollinate.

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Many species of orchid have flowers that look as if they offer food to their insect pollinators, but offer no edible reward in the form of nectar. This form of attraction is known as food deception. An example is *Calypso bulbosa* as shown in Fig. 5.1.

Other species of orchid practise sexual deception as their flowers look like female bees or wasps. These flowers release a scent that attracts males which then attempt to mate with the flowers. While doing this the insects pick up or deposit pollen. Fig. 5.2 shows *Ophrys scolopax* which is such a species.

Orchids that practise food deception attract a wide variety of different insect species as pollinators. Those that mimic a female bee or wasp attract males of a single species.

Fig. 5.1

Fig. 5.2

(b) **(i)** State an advantage of attracting insects without offering an edible reward.

For Examiner's Use

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(ii) Explain the advantage of mimicking the appearance of a female of only one species of insect.

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(iii) State a disadvantage of the sexual deception strategy of pollination.

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(c) Suggest different ways in which the success of pollination mechanisms might be assessed experimentally.

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[Total: 10]

For Examiner's Use

6 The rate of contraction of the mammalian heart is influenced by impulses from neurones that terminate in the heart. The impulses originate from the cardiac (cardiovascular) centre in the brain as shown in Fig. 6.1.

Stimulation by neurone **X** decreases the heart rate; stimulation by neurone **Y** increases the heart rate.

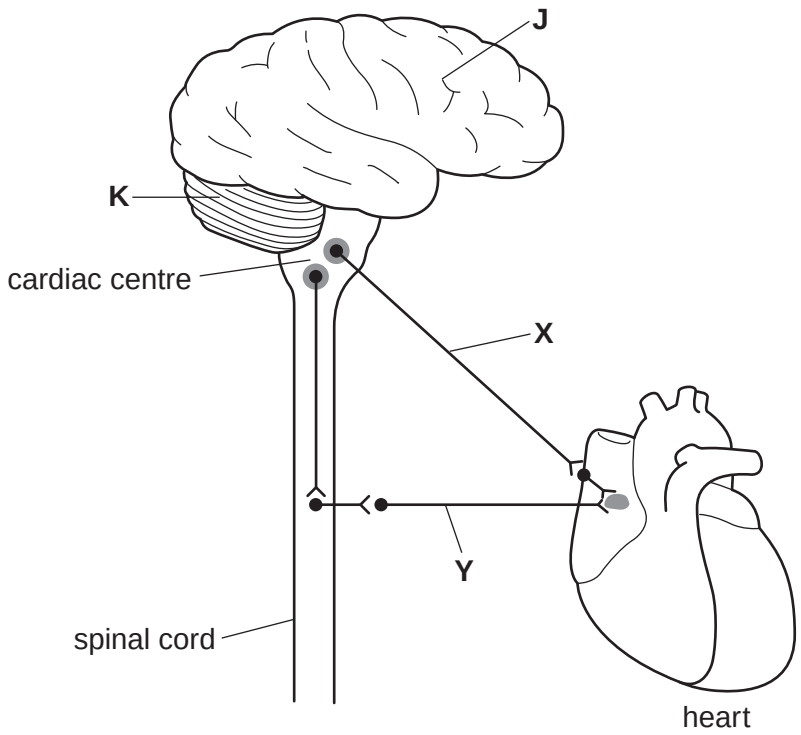

Fig. 6.1

(a) (i) Name the part of the brain in which the cardiac centre is located.

..... [1]

(ii) Name the parts of the brain labelled **J** and **K** on Fig. 6.1.

J .....

K ..... [2]

(b) With reference to Fig. 6.1, explain how the cardiac centre controls the heart rate.

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(c) Fig. 6.2 shows endings of neurones **X** and **Y** in the heart.

For Examiner's Use

Stimulation of **Y** leads to an increase in the concentration of the second messenger, cyclic AMP (cAMP), in the cytoplasm of the heart cell and the stimulation of **X** leads to a decrease.

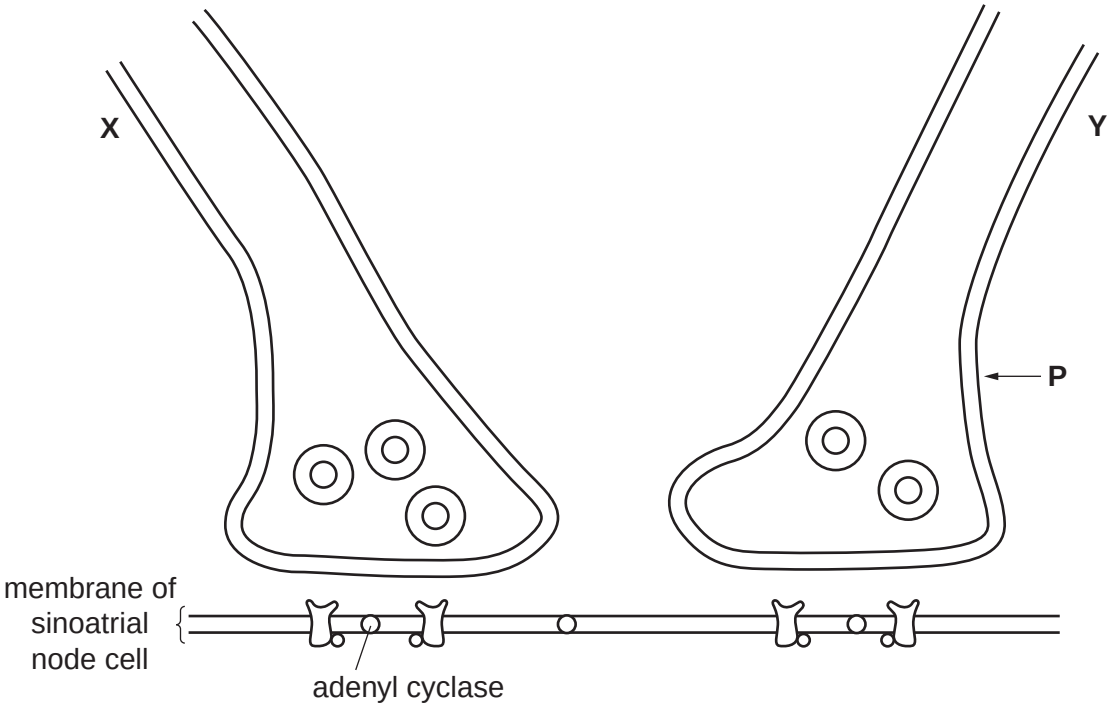

Fig. 6.2

Describe the events that follow the arrival of an impulse at **P** on neurone **Y** that leads to an increase in cAMP.

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[Total: 11]

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