Neap:

HSC Trial Examination 2007

Biology

This paper must be kept under strict security and may only be used on or after the afternoon of Wednesday 15 August, 2007 as specified in the Neap Examination Timetable.

General Instructions

Reading time – 5 minutes

Working time – 3 hours

Write using black or blue pen

Draw diagrams using pencil

Board-approved calculators may be used

Total marks – 100

Section I Pages 2–14
75 marks

This section has two parts, Part A and Part B

Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

Part B – 60 marks
Attempt Questions 16–28
Allow about 1 hour and 45 minutes for this part

Section II Pages 15–21
25 marks

Attempt ONE question from Questions 29–33
Allow about 45 minutes for this section

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2007 HSC Biology Examination.

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Section I

75 marks

Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

Use the multiple-choice answer sheet.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

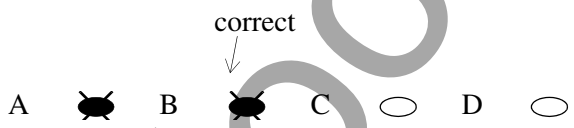
Sample:

2 + 4 =

(A) 2 (B) 6 (C) 8 (D) 9

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows:



1. How does the DNA of one species differ from the DNA of other species?

(A) sugars
(B) phosphate groups
(C) base-pair sequence
(D) all of the above

2. Which of the following DNA sequences would be complementary with the single-stranded DNA base sequence T G A C C G?

(A) T G A C C G
(B) A C T A A G
(C) T A G C C T
(D) A C T G G C

3. Which statement best describes the beginning of the process of DNA replication?

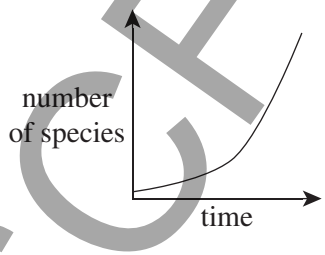
(A) The two strands of the double helix unwind from each other.
(B) The two strands condense tightly for base-pair transfers.
(C) Two DNA molecules bond.
(D) Old strands move to find new strands before bonding.

4. What feature of Mendel's experimental techniques led to his success?

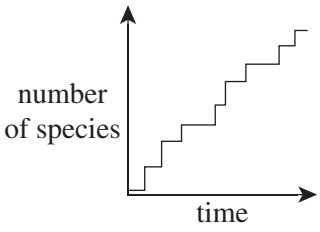
(A) He kept careful records of the parents of every offspring.
(B) He looked at variation in many different traits at once in pea plants.
(C) He picked his parental plants at random.
(D) He performed each cross only once to ensure his numbers were reliable.

5. Which diagram below best illustrates the concept of punctuated equilibrium?

(A)



(B)



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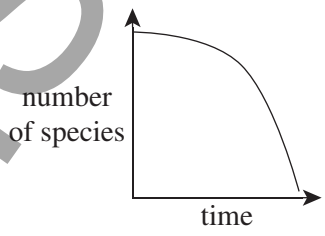
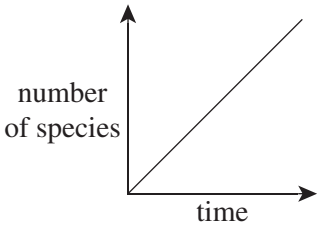
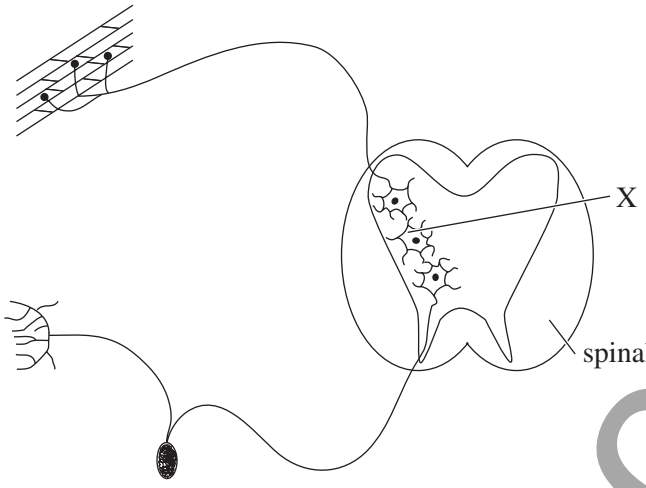


(D)



6. A portion of a nervous system is illustrated in the diagram below.



Which structure is represented by 'X' in the diagram?

(A) an effector
(B) a neuron
(C) a red blood cell
(D) a receptor

7. Barley plants are salt tolerant. The table below shows the accumulation of salt in different parts of a barley plant grown in a salt solution over 7 days.

Location/part	*Concentration of sodium ions (Na^+) (µmol)*
salt solution	286
root	127
lower stem	30
upper stem	20
older leaves	82
younger leaves	23
ear	4

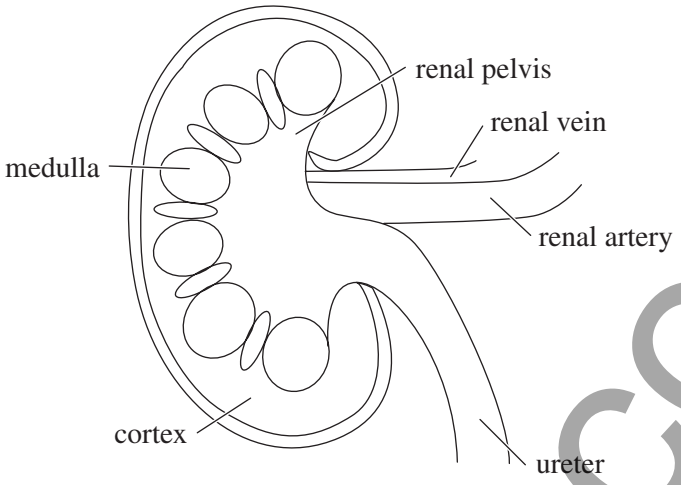
Using the table above, which of the following methods is the barley plant using to control salt levels?

(A) salt exclusion (stop salt entering tissues)
(B) salt excretion (salt glands, often in leaves, actively excrete salt)
(C) control of salt movement (keeping salt in the roots or older parts of the plant)
(D) osmotic adjustment (keeping higher concentrations of solutes in plant cells)

8. Which of the following best describes the chemical composition of enzymes?

(A) amino acid chains
(B) large carbohydrates
(C) complex hormones
(D) three-dimensional proteins

9. The following diagram shows a labelled cross-section of a human kidney.



Which of the following regions is involved in the direct removal of urine to the bladder?

(A) the ureter
(B) the renal artery
(C) the renal vein
(D) the medulla

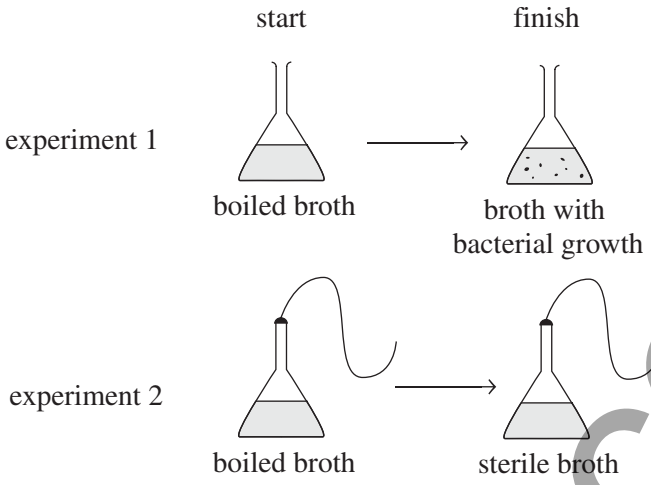
10. In most cases, arteries deliver oxygenated blood and nutrients to the body tissues, while veins transport deoxygenated blood and cellular wastes back to the heart. However, this does not always hold true. Which of the following is correct?

(A) The pulmonary arteries transport deoxygenated blood from the heart to the lungs.
(B) The pulmonary veins transport oxygenated blood from the heart to the lungs.
(C) The pulmonary arteries transport deoxygenated blood to the heart from the lungs.
(D) The pulmonary veins and arteries transport oxygenated blood back to the heart from the lungs.

11. Which of the following does good health **not** depend on?

(A) regulation of mitosis when new cells are formed
(B) functioning of DNA repair genes for accurately copying DNA
(C) regulation of cell specialisation
(D) development of mutated genes called oncogenes

12. The diagram below illustrates Pasteur's classic experiment on the growth of microbes in boiled broth.



Which of the following is the best explanation for the lack of microbial growth in the experiment 2 flask at the finish of the experiment?

(A) The microbes were killed when the broth was boiled.
(B) Microbes were trapped in the S-bend of the neck.
(C) Air containing oxygen could not reach the broth.
(D) The spores that could pass the S-bend were unable to grow.

13. Koch's postulates are numbered 1 to 4 below.

1 – injecting the pathogen to produce the original disease
2 – isolating the same pathogen in many cases
3 – obtaining the original pathogen from infected laboratory animals
4 – growing the pathogen in pure culture

Which is the correct sequence?

(A) 2 – 4 – 1 – 3
(B) 1 – 4 – 2 – 3
(C) 2 – 1 – 4 – 3
(D) 2 – 4 – 3 – 1

14. Quarantine plays an important role in the prevention of disease. It is best described as

(A) preventing flu outbreaks by studying new virus outbreaks in communities.
(B) using Koch's postulates to determine the causative pathogen.
(C) preventing the spread of disease into Australia or between the states.
(D) collecting cultures from infected organisms to establish causes of diseases.

15. Which of the following lists only non-infectious diseases?

(A) smallpox, tetanus, Down's syndrome
(B) lung cancer, scurvy, haemophilia
(C) polio, diphtheria, smallpox
(D) lung cancer, lead poisoning, tetanus

Section I (continued)

Part B – 60 marks

Attempt Questions 16–28
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (3 marks)

(a) One stage of homeostasis detects change from the stable state. Name the other stage of homeostasis. **1**

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(b) Describe homeostasis. **2**

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Question 17 (3 marks)

Explain why the concentration of water in cells should be maintained within a narrow range for optimal function. **3**

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Question 18 (7 marks)

(a) Using **one** named adaptation in an Australian organism that assists in temperature regulation, explain why it is important for cells to regulate temperature. **3**

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(b) Students breeding ten Australian Lurcher butterflies (*Yoma sabina*), noticed that stationary butterflies maintained different wing orientations depending on the temperature in the butterfly enclosure. That is, wings horizontal (—●—), wings angled (\●/) and wings vertical (|●). The butterflies only become active if the enclosure temperature is 26–27°C.

Design a first-hand investigation the students could use to determine whether the wing orientation of stationary Australian Lurcher Butterflies assists in temperature regulation. **4**

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Question 19 (5 marks)

(a) Name a current piece of technology that allows measurement of oxygen saturation in the blood. **1**

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(b) Describe and explain the conditions under which the technology named in (a) above is used. **4**

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Question 20 (4 marks)

Distinguish between the following pairs of terms.

(a) genotype and phenotype **2**

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(b) homozygous and heterozygous **2**

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Marks

Question 21 (5 marks)

Assume that a gene controlling fur colour has recently been identified in mice. One allele for this gene produces a brown fur colour. A second allele produces a black fur colour.

Suppose you are asked to determine the dominance relationship between these two alleles, including whether it is a case of co-dominance or simple dominance.

(a) Summarise the crosses you would make to determine the dominance relationship between these two alleles. **2**

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(b) Explain the types of observations upon which you could base your conclusions. **3**

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Question 22 (7 marks)

(a) Identify a species you have studied that has changed as a result of environmental change. **1**

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(b) Outline the factors in the environment that changed in the example named in part (a) and how they had an effect on the species. **2**

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(c) Discuss how changes in the species named in part (a) provide evidence for the theory of evolution. **4**

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Question 23 (3 marks)

Describe how current reproductive techniques such as artificial insemination, artificial pollination and cloning may alter the genetic composition of a population. **3**

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Question 24 (2 marks)

Describe how the cleanliness of food, water and personal hygiene practices assist in the control of disease. **2**

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Question 25 (3 marks)

In your Biology course, you have studied the historical development of the cause and prevention of malaria. Describe your findings. **3**

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Marks

Question 26 (8 marks)

Consider the following.

Tuberculosis (TB) is a bacterial disease which affects the lungs of humans. There is a new strain of TB which is known as 'extremely drug-resistant tuberculosis'. The concern about this new strain is the fact that it has the potential to return treatment to the pre-antibiotic era. This would mean treatment would require removal of parts of lungs. Patients who have HIV are very susceptible to TB and this new strain has the potential to cause many more deaths.

Explain the development of the new TB bacterium and assess the development of new antibiotics for use against the new TB bacterium. **8**

Marks

Question 27 (4 marks)

A shopkeeper had been keeping his freshly cooked chickens at a temperature of 30°C for up to one hour before selling them. He wondered whether there would be fewer microorganisms found on the skin of the chickens after an hour if he kept them at 65°C. He asked a microbiologist to carry out an experiment to test his idea.

Outline the design of a valid and reliable experiment that would scientifically test whether the shopkeeper's idea was correct. **4**

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Question 28 (6 marks)

The body has three lines of defence against antigens.

(a) Identify a first line barrier for the body. **1**

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(b) Why would the third line of defence come into action? **1**

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(c) Explain the interaction between B and T lymphocytes. In your answer, include the **mechanism** that allows this interaction to occur. **4**

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Section II

25 marks
Attempt ONE question from Questions 29–33
Allow about 45 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.

Pages

Marks

Question 29 — Communication (25 marks)

(a) (i) State the functions of two structures of the mammalian eye. **2**

(ii) Explain how human sight is able to perceive depth. **3**

(b) (i) In your Biology course, you performed a first-hand investigation to examine an appropriate mammalian brain to gather information to distinguish the cerebrum, cerebellum and medulla oblongata, and to locate the regions involved in speech, sight and sound perception. Describe the procedure you followed. **5**

(ii) State how carrying out this investigation increased your understanding of the function of the cerebrum. **1**

(c) Assess how advances in technology have provided assistance for people with difficulties in hearing. **7**

(d) The following table gives the range of sound frequencies detected by humans and three other animals. Use this table to answer the questions below.

Animal	*Hearing range (Hz)*
human	20–20 000
bat	1000–120 000
dog	15–50 000
grasshopper	100–28 000

(i) Identify the animal that detects the greatest range of sounds. **1**

(ii) Outline the sensory pathway followed by sound waves until they are detected by a human brain. Use a flow chart. **2**

(iii) Referring to the table above, explain the role of the cochlea in the detection of sounds of different frequencies. **4**

Marks

Question 30 – Biotechnology (25 marks)

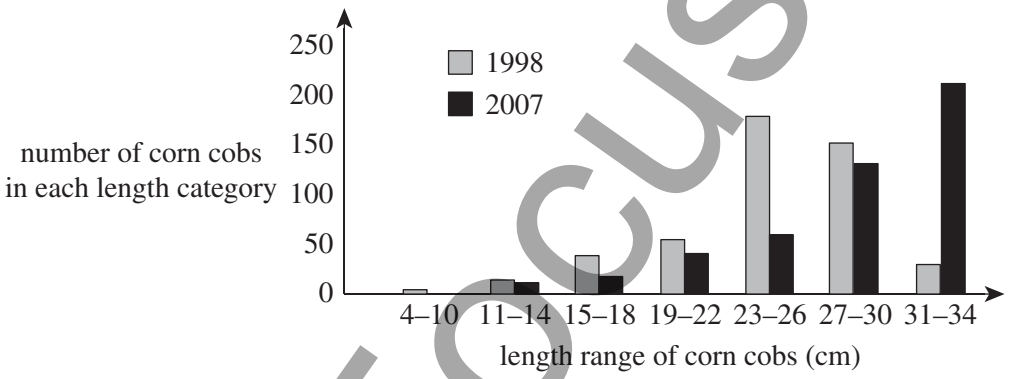
(a) There are many different types of technology, such as biotechnology, chemical technology, nanotechnology and mechanical technology. A technology can be defined as "a process or product developed to meet human needs".

(i) Using this general definition of technology as a model, state a definition for 'biotechnology'. **1**

(ii) To illustrate your definition of biotechnology given in part (a)(i), briefly describe a first-hand investigation you have carried out to demonstrate the fermentation processes in bread or alcohol production. **4**

(b) Mr. Jones grows sweet corn. He sells the sweet corn cobs at a roadside stall. Over the years, he has used one biotechnological practice to change the phenotype of his sweet corn plants. He has not bought new sweet corn seed for twenty years and over this time he has not changed his planting, watering or fertilising routines. Mr. Jones does not have any laboratory equipment.

The graph below shows one phenotypic change to Mr. Jones' sweet corn over the past nine years.



(i) State the changes in cob length that have occurred in Mr. Jones' sweet corn plant community over the past nine years. **2**

(ii) Identify a biotechnological practice that Mr. Jones may have used to change the phenotype of the sweet corn plants. **1**

(iii) Explain how Mr. Jones used the biotechnological practice to change the phenotype of his sweet corn plant community. **3**

(c) Scientists are constantly improving existing biotechnologies and developing new biotechnologies.

(i) Use a specific example to demonstrate how one change in industrial fermentation procedures has resulted in an increase in the production of different compounds. **2**

(ii) Describe one benefit to humans of a medical biotechnology. **2**

(iii) The discovery of restriction enzymes and ligases made recombinant DNA technology possible. Draw a simple diagram to show how each of these enzymes functions in recombinant DNA technology. **3**

(d) Consider the following statement.

"Governments should not support the development of genetically modified organisms, animal cloning or gene cloning."

Assess this statement for **one** of the biotechnologies mentioned. **7**

Marks

Question 31 – Genetics: The code broken? (25 marks)

(a) (i) Identify the differences between germ line and somatic mutations in terms of their effect on species. **2**

(ii) Describe the effects of two different types of mutations in chromosomes. **3**

(b) (i) Describe the procedure used, and outline the findings obtained, when you constructed a model of DNA. **5**

(ii) State how this model demonstrates understanding of the structure of genes. **1**

(c) Assess the value of the Human Genome Project for modern medicine. **7**

(d) The table below shows the results of test crosses performed to develop a chromosome map for four genes.

Cross number	*Genes involved*	*Resultant recombinant offspring*
1	W and X	5%
2	W and Y	20%
3	W and Z	11%
4	X and Y	25%
5	X and Z	16%
6	Y and Z	9%

(i) Identify the significance of the percentages in the third column of the above table when developing a chromosome map. **1**

(ii) State the correct arrangement of the genes W, X, Y and Z on a chromosome map based on the results of the test crosses. **2**

(iii) Explain the role of chromosome mapping in identifying relationships between species. Include in your answer some arguments for and against the use of chromosome maps for this purpose. **4**

Marks

Question 32 – The human story (25 marks)

(a) In the course of your study of the classification of humans you gathered information from secondary sources to illustrate the identifying features of humans that are used to classify them.

(i) Identify the data sources used in your investigation, and explain why they are valid sources. State the **major** identifying features of humans that classify them into the following groups: chordates, mammals, primates. **3**

(ii) The terms 'hominid' and 'hominin' have been used to classify humans. Explain why hominin is now the preferred term for many anthropologists, placing apes and humans in the family hominines. Explain the difference in the meaning of the terms 'hominin' and 'hominid'. **2**

(b) The cultural development of humans is unique but similar to that of many other primates. You have investigated these differences and similarities from secondary sources or by visiting a museum or zoo. The following two animals in particular were investigated.

Animal A

Animal B

(i) Using the data from your investigation, describe your results in a table which compares the two animals above in terms of **5**

- care of the young;
- length of the juvenile stage;
- development and use of tools;
- communication systems; and
- development and size of the social group.

(ii) For any **one** of the cultural features given in (b)(i), state the evolutionary significance of the similarities and differences that you have described. **1**

(c) Human evolution has been affected by several factors including increased population mobility, modern medicine and genetic engineering. Some of these effects have been positive and some have been negative. **7**

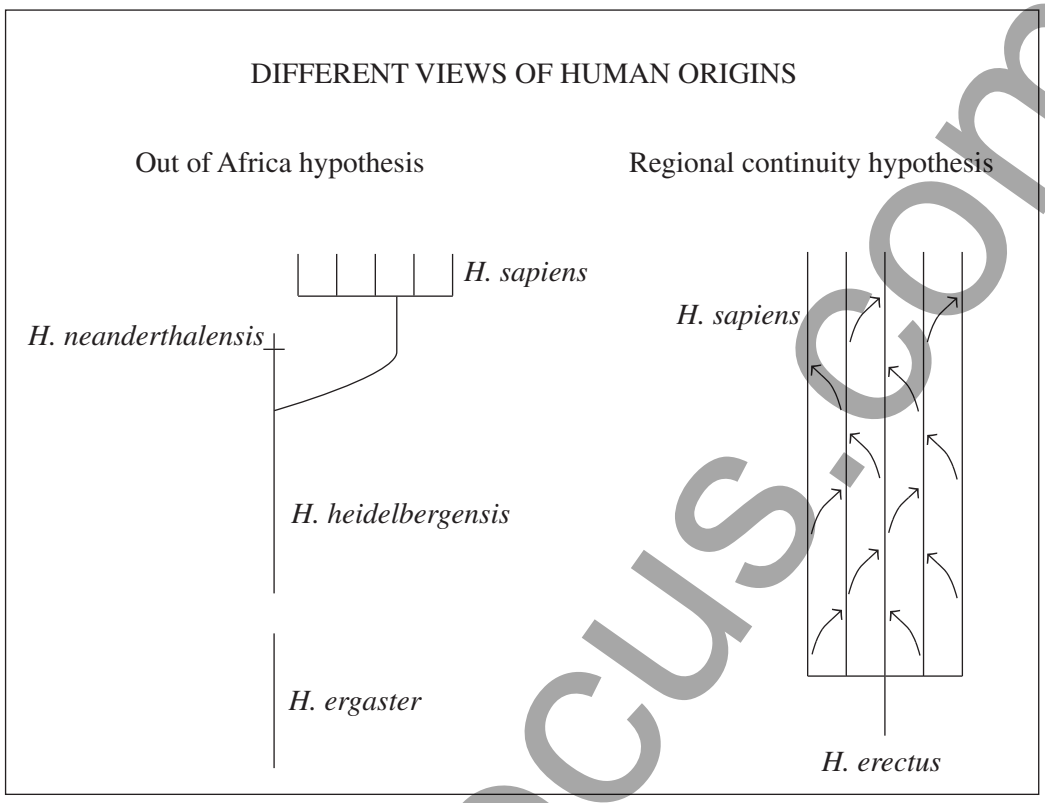
Assess the effects that each of these factors has had on human evolution, using examples for each factor.

Question 32 continues on page 20

Marks

Question 32 (continued)

(d) Humans are thought to have evolved in one of the ways shown below.



(i) One hypothesis for human evolution is the 'out of Africa' hypothesis. The other hypothesis is known as the 'multiregional hypothesis' or the 'hypothesis of regional continuity'. Identify the main difference between the two hypotheses. **1**

(ii) Using your knowledge of patterns of human migration, outline reasons why one of the two hypotheses is more likely. **2**

(iii) Explain how your understanding of evolutionary processes **and** analysis of mitochondrial DNA have supported one of the two hypotheses. **4**

End of Question 32

Marks

Question 33 – Biochemistry (25 marks)

(a) (i) State the two-step process that Blackman and Mathgel hypothesised for photosynthesis. **2**

(ii) Explain Mayer's conclusions in relation to energy in the process of photosynthesis. **3**

(b) (i) Describe the procedure and results obtained for the first-hand investigation you performed in class to extract a mixture of pigments from leaves, examine the absorption spectrum of these pigments and separate the pigments using chromatography. **5**

(ii) State the significance of pigments found in the chromatogram, other than chlorophyll, to explain why Englemann's action spectrum for chlorophyll does not exactly match the action spectrum for photosynthesis. **1**

(c) Assess the importance of the development of the electron microscope in increasing our understanding of the process of photosynthesis. **7**

(d) The following are results that were obtained by

- Hill and Scarisbruck in 1939.

$$2H_2O + 4[Fe(CN)_6]^{3-} \rightarrow 4[Fe(CN)_6]^{4-} + 4H^+ + O_2$$

This equation was determined as a result of shining light on chloroplast preparations in the absence of carbon dioxide. The chloroplasts were supplied with salts of ferric iron such as ferricyanide or ferrioxalate to accept the hydrogen instead of carbon dioxide.

- Sam Ruben in 1940.
Ruben used an isotope of oxygen, ^{18}O, to find out where the oxygen atoms went in photosynthesis. Ruben supplied the plants water containing ^{18}O and traced the path of the oxygen using a mass spectrometer.

(i) Identify the hypothesis proposed by van Niel about the source of oxygen given out in photosynthesis. **1**

(ii) Outline the conclusions of Hill and Scarisbruck and Sam Ruben. **2**

(iii) Explain the significance of these conclusions. **4**

End of paper