INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

BIOLOGY
HIGHER LEVEL
PAPER 3

Tuesday 22 May 2001 (morning)

1 hour 15 minutes

Name

Number

INSTRUCTIONS TO CANDIDATES

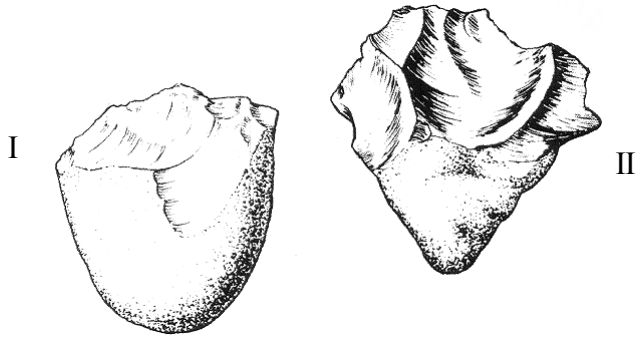
- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the boxes below.

OPTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
		/20	/20	/20
		/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /40	TOTAL /40	TOTAL /40

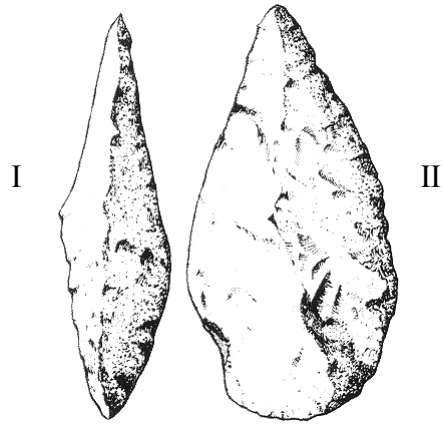
Option D – Evolution

D1. Early stone age tool-cultures can be classified into two groups: Oldowan and Acheulian. Usually, Oldowan tools are made of basalt, whereas Acheulian tools are made of flint. Typical examples of Oldowan and Acheulian tools are shown below. The magnification of the drawings is × 0.5.

Oldowan



Acheulian



[Source: Tompkins S, *The Origins of Humankind* (1998), CUP]

(a) Calculate the length of the Acheulian tool (II). *[1]*

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(This question continues on the following page)

(Question D1 continued)

(b) Compare the two sets of tools by giving **one** similarity and **one** difference. *[2]*

Similarity: . . . . . .

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Difference: . . . . . .

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(c) (i) Deduce, with a reason, which set of tools shows a more advanced state of evolution. *[1]*

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(ii) One set of tools was made by *Homo erectus* and one set by *Homo habilis*. Deduce, with a reason, which hominid made the Acheulian tools. *[1]*

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(d) Identify the type of evolution demonstrated by trends in tool-making. *[1]*

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D2. (a) Discuss the theory that evolution occurs by punctuated equilibrium. *[3]*

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(b) State **one** example of a ring species. *[1]*

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D3. (a) Describe **one** example of adaptation by natural selection shown by moths. *[6]*

(b) Discuss evidence for inheritance of acquired characteristics. *[4]*

Option E – Neurobiology and behaviour

E1. (a) Explain how pre-synaptic neurons can affect post-synaptic transmission of impulses. *[7]*

(b) Outline the pathway of neurons connecting the retina of the eye to the muscles of the iris. *[3]*

E2. Hermit crabs (*Pagurus bernhardus*) live in empty shells of other animals.

Most shells of an appropriate size are occupied by hermit crabs and so fights are common. Typically, the attacker approaches and grabs the shell of the defender. The defender then withdraws into its shell. The attacker repeatedly knocks the defender's shell against its own and tries to pull at the claws of the defender. Either the defender releases its hold and is pulled out or the attacker gives up.

Crabs of various sizes were placed into different-sized shells and their behaviour in a tank was observed.

Group A: Large crabs were placed into small shells and small crabs into large shells. In all cases the large shells suited perfectly the large crabs and the small shells suited the small crabs.

Group B: Large crabs were placed into small shells and small crabs into large shells. The small shells were too big for the small crabs and the large shells were perfect for the large crabs.

(a) Explain which group has the greater motivation to change shells. *[1]*

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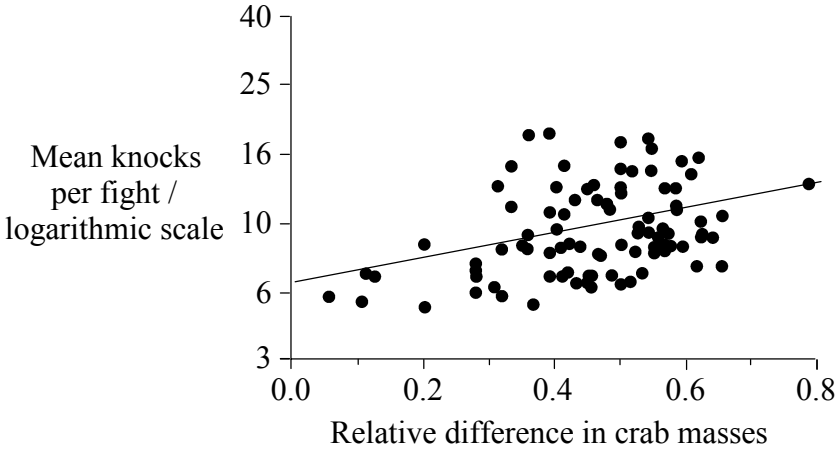
The graph below shows the number of knocks between the two shells (log scale) for each fight and the relative difference between the masses of the two crabs. Both groups appear on the same graph as points.



[Source: Elwood R *et al*, *Nature* (1998), **393**, pages 66–68]

(This question continues on the following page)

(Question E2 continued)

(b) (i) Identify **one** relationship shown by the graph. *[1]*

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(ii) Suggest **one** reason for this relationship. *[1]*

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(c) Suggest **two** factors that could affect the number of knocks per fight. *[2]*

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(d) Suggest a reason why the number of knocks per fight was low when the relative mass difference is small. *[1]*

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E3. (a) Define *imprinting*. *[1]*

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(b) Outline the first experiments done to investigate imprinting in geese. *[3]*

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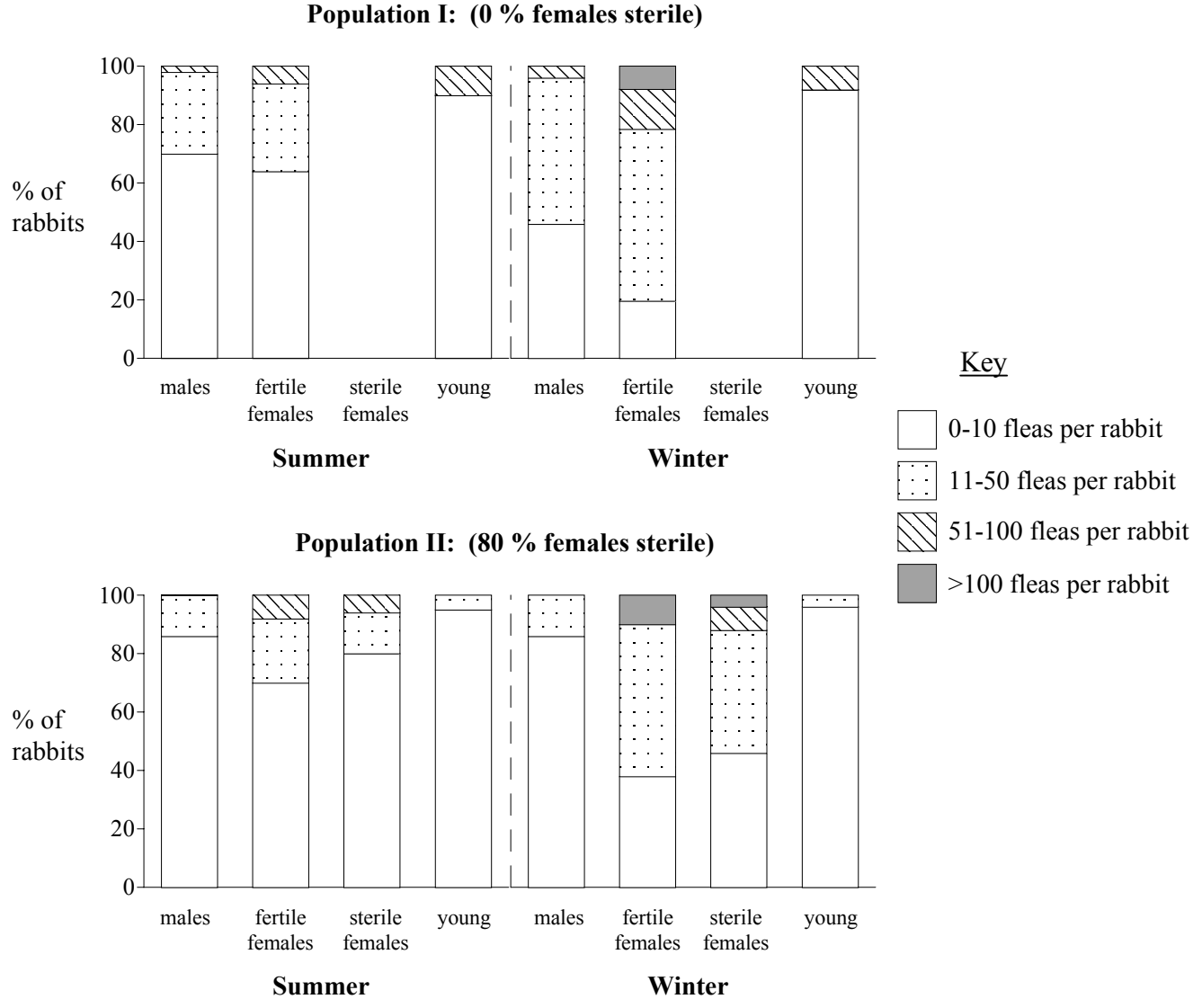
Option F – Applied plant and animal science

F1. The myxoma virus causes a disease in rabbits. The virus is transmitted from rabbit to rabbit by a bloodsucking flea. Scientists in Australia wanted to reduce the numbers of rabbits by using a modified myxoma virus that could act as a immunocontraceptive. An immunocontraceptive is a chemical that interferes with proteins essential for successful reproduction. However, the flea needs hormones in the blood of pregnant rabbits for its own reproduction. If the immunocontraceptive was successful in preventing pregnancy in rabbits, the flea might not be able to reproduce and so the virus could not be spread.

To investigate this hypothesis, groups of female rabbits in several populations were sterilised and then released back into the original areas. The charts below show the results of two studies; one carried out in summer and the other in winter. In population I **all** the females were fertile and in population II 80 % of females had been sterilised.



[Source: Twigg L, *et al*, *J Applied Ecology* (2000), **37**, pages 16–39]

(This question continues on the following page)

(Question F1 continued)

(a) Suggest **one** reason why young rabbits have few fleas. *[1]*

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(b) Compare the results for the adults by giving **two** similarities between population I and population II. *[2]*

1. . . . . .

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2. . . . . .

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(c) Evaluate the hypothesis that the flea populations are reduced if some of the females in the rabbit population are sterile. *[3]*

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F2. (a) (i) Define *leaf area index*. *[1]*

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(ii) Define *harvestable dry mass*. *[1]*

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(b) Outline the use of antibiotics in livestock production. *[2]*

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F3. (a) Outline how the use of greenhouses can increase plant productivity. *[4]*

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(b) Discuss ethical issues surrounding the eating of meat, fish, eggs and dairy products. *[6]*

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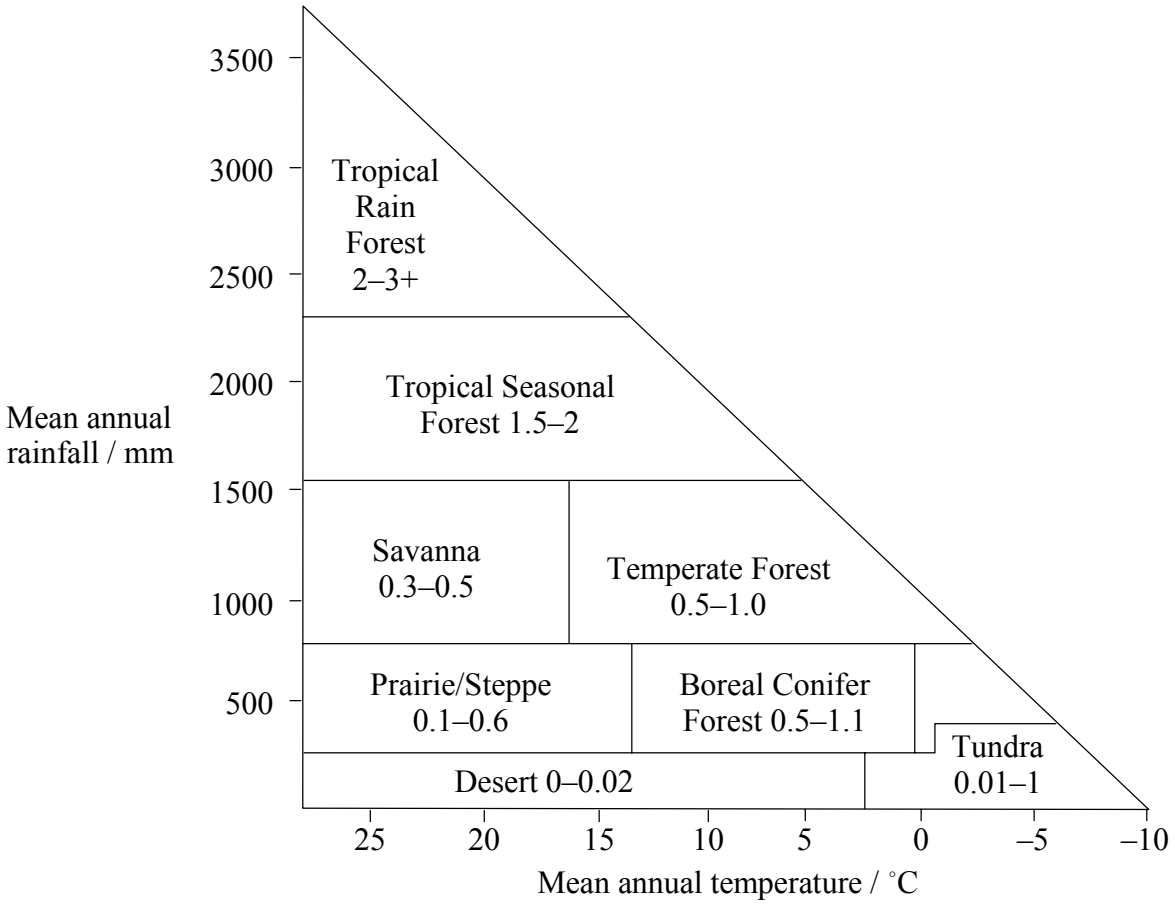
Option G – Ecology and conservation

G1. (a) Explain the use of biotic indices and indicator species in monitoring environmental change. *[7]*

(b) Outline **three** factors affecting the distribution of animal species. *[3]*

G2. Rainfall (precipitation) and temperature have a considerable influence on the distribution of biomes in the world. This can be represented by a diagram which shows the biomes and their net annual productivity ($kg\,m^{-2}\,yr^{-1}$).



[Source: Etherington J, *Plant Physiological Ecology* (1978), Ed Arnold]

(a) Identify the biome that is found in areas with a precipitation of 1200 mm and 22 °C. *[1]*

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(b) Identify the biome that is found over the greatest range of temperature. *[1]*

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(c) Explain which of the two factors seems to have the greatest influence on plant productivity. *[2]*

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(This question continues on the following page)

(Question G2 continued)

(d) Discuss the conditions which favour the formation of forest. *[2]*

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G3. (a) Outline the conditions necessary for the generation of methane from biomass. *[3]*

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(b) State **one** chemical reaction involved in methane production. *[1]*

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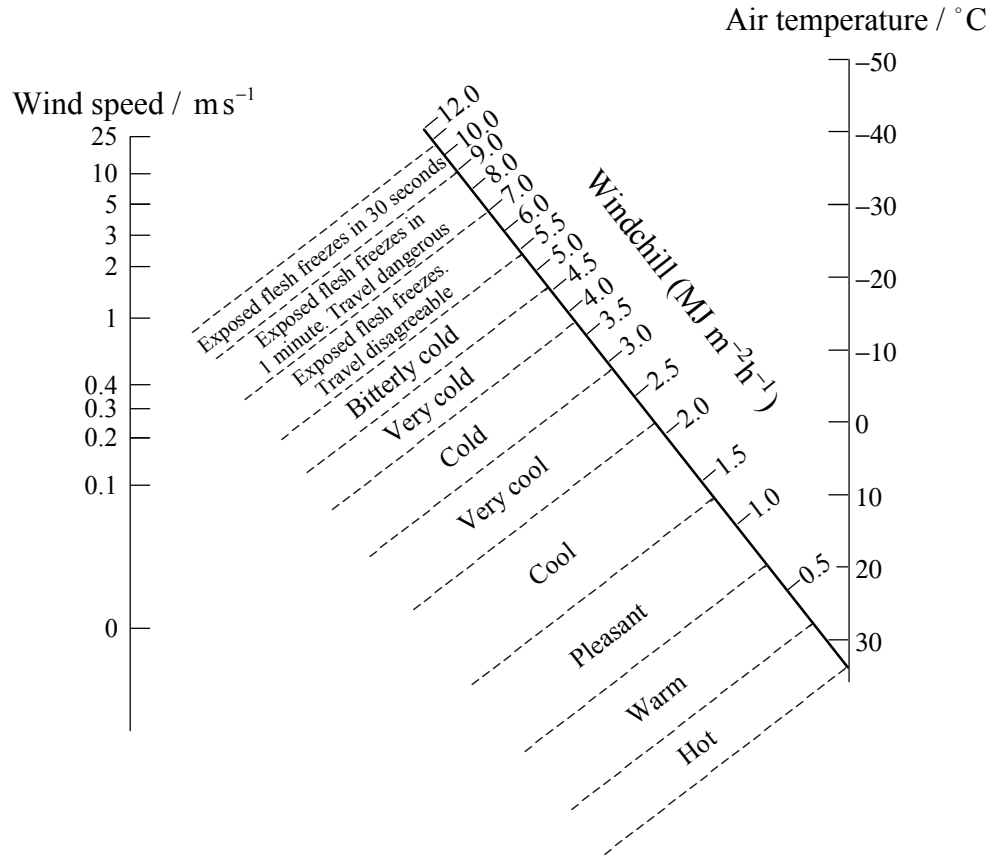
Option H – Further human physiology

H1. Humans must maintain a body temperature close to 37 °C. This is achieved despite wide variations of climatic conditions and amounts of heat produced by the body. Air temperature and air movement both affect heat loss from the body. Although the effect of wind has been recognised for a long time, no satisfactory means of combining air temperature and air movement was devised until Siple and Passel introduced the Windchill Scale.



[Source: modified from Edholm O, *Handbook of Physiology* (1964)]

(a) (i) Estimate, using the nomogram, the windchill for a wind speed of 5 $m s^{-1}$ at a temperature of –30 °C. *[1]*

Answer: . . . . . $MJ m^{-2} h^{-1}$

(ii) Identify how a person would feel if the wind speed is 0.2 $m s^{-1}$ at a temperature of 10 °C. *[1]*

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(This question continues on the following page)

(Question H1 continued)

(b) Calculate the energy lost in one hour for a person with a surface area of 2 m^2, when the air temperature is 20 °C and the wind speed is 1 $m\,s^{-1}$. *[2]*

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(c) Compare the effects of air temperature with wind speed on the value of the windchill. *[2]*

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H2. (a) Outline the role of the liver in the storage of nutrients. *[3]*

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(b) State the name of the mechanism that monitors and corrects the levels of variables in order to maintain homeostasis. *[1]*

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H3. (a) Explain how soluble starch is completely digested as it passes along the alimentary canal. *[6]*

(b) Outline the condition *atherosclerosis* and how it may cause coronary thrombosis. *[4]*