PART I (80 marks)

Mark your answers to Questions 1–40 on the **SEPARATE MULTIPLE CHOICE ANSWER SHEET**, using a 2B, B or HB pencil. If you make an error, follow the instructions given to you on the answer sheet.

SELECT THE SINGLE CORRECT ALTERNATIVE IN EACH OF THE FOLLOWING QUESTIONS

---

1. Which best characterises the dates when recognisable mammals and recognisable primates first appear in the fossil record?

   (a) 1000 million and 100 million years ago.
   (b) 100 million and 60 million years ago.
   (c) 350 million and 60 million years ago.
   (d) 500 million and 100 million years ago.

2. Which of the following characteristics is NOT strong evidence of a brachiating ancestor in the pongids?

   (a) Scapula is rotated toward the back
   (b) Forelimbs longer than hind limbs
   (c) A freely rotating shoulder joint
   (d) Centrally placed foramen magnum

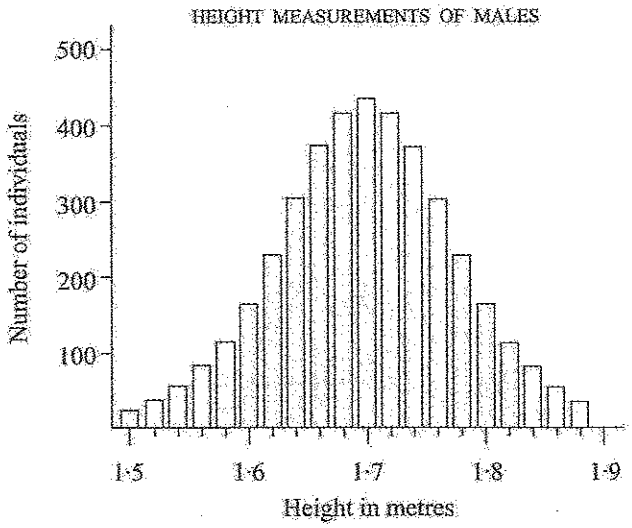
3. What changes in body structure of early hominids are associated in the fossil record with the **earliest** evidence of tool use?

   (a) Brain size increases
   (b) Bipedal stance and locomotion
   (c) Reduction in size and changes in shape of teeth
   (d) Larger hands and longer arms

4. Geographic distribution of hominid fossils most clearly indicates that

   (a) *Homo erectus/ergaster* dispersed out of Africa through Europe and Asia and was later replaced by *Homo sapiens* dispersing out of Africa.
   (b) *Homo erectus/ergaster* dispersed out of Africa through Europe and Asia and evolved into *Homo sapiens* and Neanderthals.
   (c) *Homo erectus/ergaster* dispersed out of Africa into the rest of the world and formed an isolated population that evolved into modern humans and Neanderthals.
   (d) *Homo erectus/ergaster* dispersed out of Africa and European populations evolved into Neanderthals who then evolved into *Homo sapiens*.

Question 5 refers to the following graph.



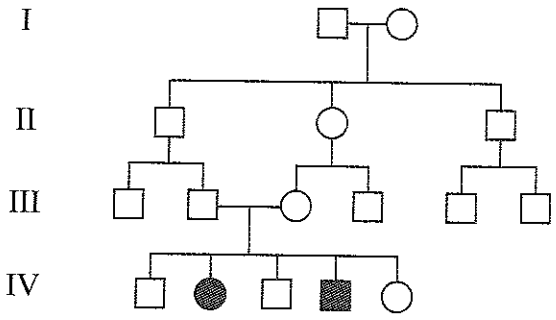
5. From the evidence presented above, this trait is most likely

(a) monogenic recessive/dominant.
(b) monogenic and codominant with environmental influence.
(c) totally environmentally determined.
(d) polygenic and environmentally influenced.

6. The **difference** in heights between boys in well-off families and boys in poorly-off families within one population is most likely

(a) due to nutrition and not strongly influenced by genetics.
(b) due to genetic differences in subpopulations of wealthy and poor.
(c) greater in countries that are generally more wealthy.
(d) a chance finding; growth isn't affected by social class or wealth.

Questions 7 and 8 refer to the following pedigree.



7. This inherited disease is

(a) sex-linked and dominant.
(b) sex-linked and recessive.
(c) autosomal and dominant.
(d) autosomal and recessive.

8. The presence of the inherited disease in two members of generation IV is most likely due to

(a) mating of close relatives.
(b) polygenic inheritance.
(c) random mating.
(d) genetic drift.

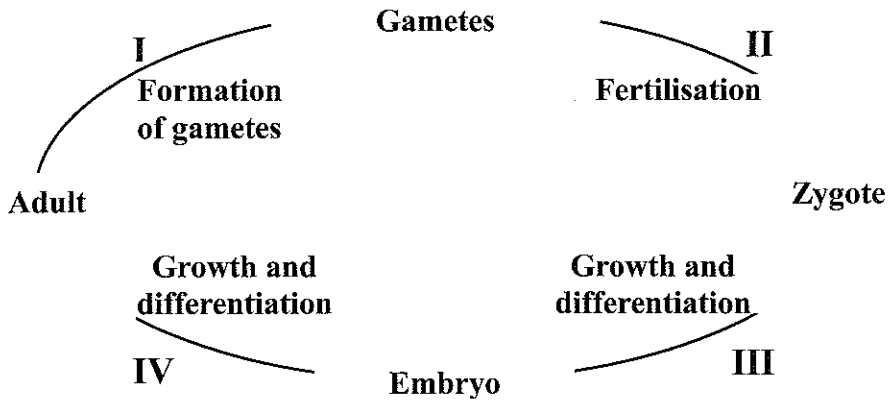
9. In which of the following examples would you expect to find two different sets of genetic information?

(a) two muscle cells, one in each of two monozygotic twins
(b) two nerve cells in the same person
(c) two ova in the same person
(d) a liver cell and a skin cell in the same person

10. Both parents are carriers of a recessive gene 'a'. The probability that their child will **NOT** inherit the gene 'a' is

(a) $^{7}/_{8}$
(b) $^{3}/_{4}$
(c) $^{1}/_{2}$
(d) $^{1}/_{4}$

Question 11 refers to the following diagram.



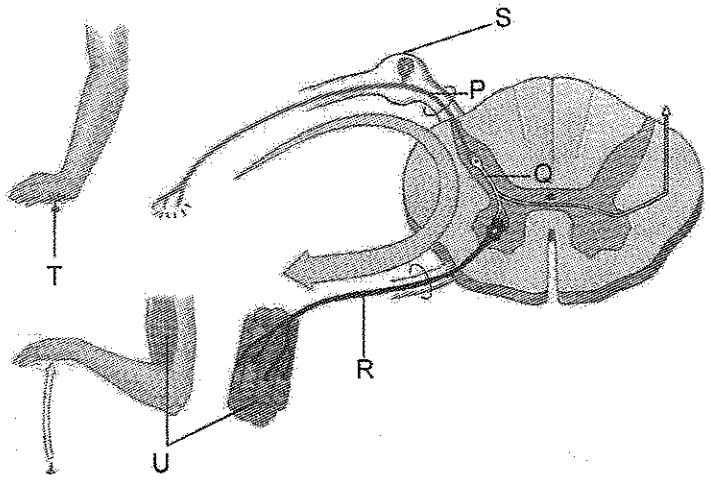
11. The diagram represents the life cycle of a human. Which processes cause the variation in the genotype of the offspring?

(a) I only
(b) I and II
(c) III and IV
(d) IV only

12. Which of the following could best explain an increasing population size?

(a) Birth rates and emigration rates are high and death rates and immigration are high.
(b) Birth rates are low, death rates are low and emigration is greater than immigration.
(c) Birth rates are high, death rates are low and emigration is lower than immigration.
(d) Birth rates are high, death rates are high and emigration is greater than immigration.

Questions 13 and 14 refer to the following diagram.



13. The CORRECT sequence and structures involved in transmitting impulses as part of a simple reflex arc is:

(a) **P** (sensory neuron), **Q** (connector neuron), **R** (motor neuron).
(b) **P** (motor neuron), **Q** (connector neuron), **R** (sensory neuron).
(c) **R** (sensory neuron), **Q** (connector neuron), **P** (motor neuron).
(d) **R** (motor neuron), **Q** (connector neuron), **P** (sensory neuron).

14. The effector in the above diagram is

(a) S
(b) U
(c) R
(d) T

15. A student is using a microscope with a 10x ocular lens. His high power objective lens is 40x and the field of view is 325μm. He then changes to a low power objective lens of 10x.

What is the 'field of view' at low power?

(a) 0.65 mm
(b) 0.82 mm
(c) 1.30 mm
(d) 1.64 mm

16. A woman's doctor takes a blood sample from her and finds that she has high progesterone levels, low LH and low FSH. What stage of the menstrual cycle is she in?

(a) ovulatory
(b) menstrual
(c) proliferative
(d) secretory

17. The link between the endocrine and nervous systems is the

(a) thalamus
(b) hypothalamus
(c) pons
(d) cerebral cortex

18. A dorsal root ganglion is composed mainly of

(a) cell bodies of motor neurons.
(b) axons of motor neurons.
(c) cell bodies of sensory neurons.
(d) axons of sensory neurons.

19. Regulation of autonomic functions begins in the

(a) heart.
(b) cerebellum.
(c) medulla oblongata.
(d) cerebrum.

20. The simplest reflexes are controlled in the

(a) spinal cord.
(b) cerebellum.
(c) medulla oblongata.
(d) hypothalamus.

21. Human populations that have existed at high altitudes tend to be shorter, stockier and have shorter limbs than those at lower altitudes nearby. This is most likely due to

(a) genetic drift.
(b) founder effect.
(c) natural selection for oxygen efficiency.
(d) natural selection for heat retention.

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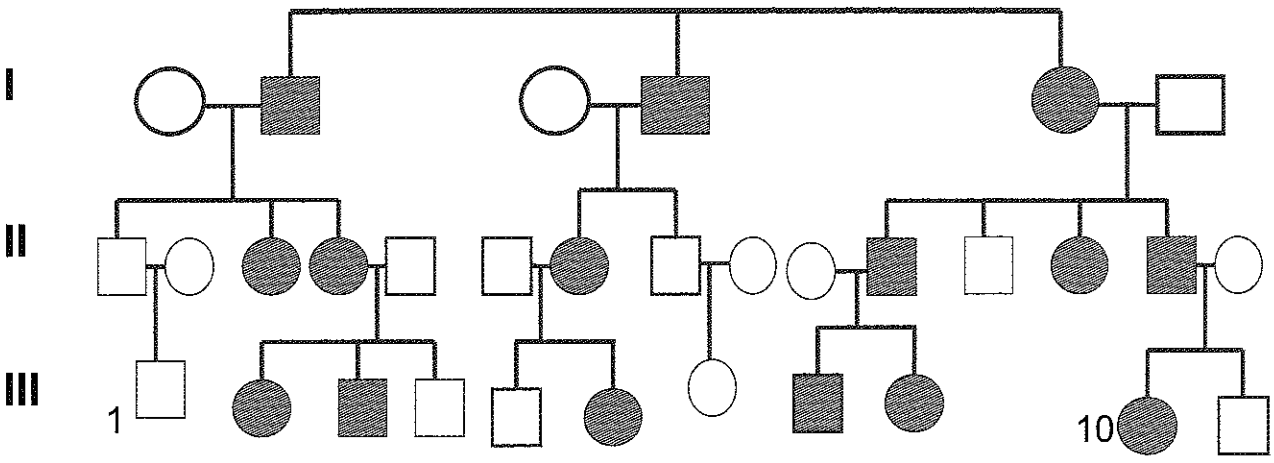
Questions 22 and 23 refer to the pedigree below.

Affected individuals are indicated by shading.



22. The gene for this trait is most likely inherited as

(a) an x – linked recessive because affected daughters have an affected father.
(b) an x – linked dominant because affected sons have an affected mother.
(c) an autosomal recessive because more individuals aren't affected than are affected.
(d) an autosomal dominant because affected males and females have an affected parent.

23. If individual III.1 and III.10 had a child, what is the probability that the child would be affected?

(a) 0.25
(b) 0.50
(c) 0.75
(d) 1.0

24. Molecular genetics studies have established that modern humans and chimpanzees have approximately 98.7% of their DNA in common. Chimpanzees share 98.4% with gorillas. Gorillas and humans share 98.3%. A reasonable interpretation of these data is that

(a) chimpanzees and gorillas shared a common ancestor more recently than chimpanzees and humans.
(b) gorillas and humans shared a common ancestor more recently than chimpanzees and gorillas.
(c) chimpanzees and humans shared a common ancestor more recently than chimpanzees and gorillas.
(d) one cannot measure evolutionary divergence using DNA sequence overlaps.

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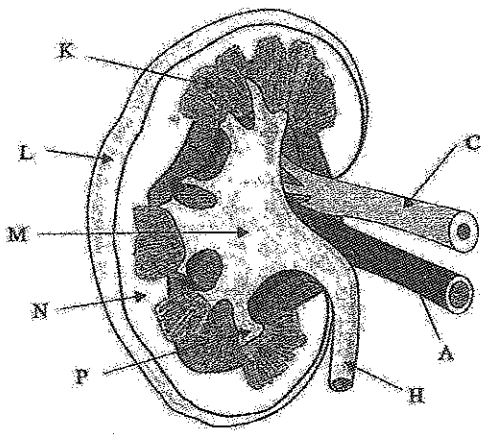
25. Prior to the development of agriculture, the population density of humans was likely to be limited most by which of the following characteristics?

(a) density of plants and animals for food, and fresh water supplies
(b) availability of shelter from extreme weather
(c) diversity of diseases and parasites
(d) deaths due to fighting between groups over scarce resources

Question 26 refers to the following diagram.



26. Which of the following statements is correct?

(a) H is the urethra, K is a renal pyramid, M is the renal pelvis, P is a minor calyx.
(b) C is the renal artery, K is a renal pyramid, L is the renal capsule, N is the cortex.
(c) A is the renal artery, H is the urethra, M is the pelvis, N is the medulla.
(d) L is the renal capsule, M is the renal pelvis, N is the medulla, P is a minor calyx.

Questions 27 and 28 refer to the following table.

Substance	Blood Plasma g/100mL	Filtrate g/100mL	Urine g/mL
1	0.03	0.03	2
2	0.1	0.1	0
3	8	0	0

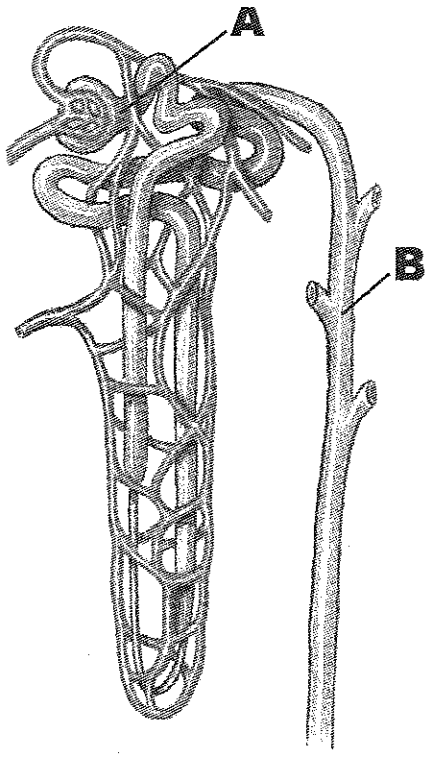
27. The table shows the concentration of three substances found in different body fluids. These substances are likely to be

(a) 1 – urea, 2 – protein, 3 – glucose.
(b) 1 – glucose, 2 – protein, 3 – urea.
(c) 1 – urea, 2 – glucose, 3 – protein.
(d) 1 – protein, 2 – urea, 3 – glucose.

28. If substance 2 was found in the urine at a concentration of 0.05g/ml, which of the following conditions would best explain this observation?

(a) Proteinuria
(b) Ketonuria
(c) Low blood glucose
(d) Diabetes mellitus

Questions 29 refers to the following diagram.



29. Use the diagram to determine which of the following statements is ***INCORRECT***.

(a) Fluid at B would contain more water and be less concentrated than fluid at A.
(b) Fluid at B would have a higher concentration of toxins or drugs than fluid at A.
(c) Fluid at B would have less amino acids than fluid at A.
(d) Fluid at B would have a higher concentration of nitrogenous waste than fluid at A.

30. Which of the following sets includes only the necessary conditions for natural selection to occur?

(a) Changes in gene frequencies in a population from one generation to the next generation
(b) Genetic variation and changing environment
(c) Genetic variation and non-random variation in reproduction among different genotypes
(d) Mutation, non-random variation in reproduction among different phenotypes, and changing environment

31. Using your knowledge of kidney function and the effects of alcohol, on which of the following regions does alcohol exert its greatest influence?

(a) loop of Henle
(b) proximal convoluted tubule
(c) collecting duct
(d) Bowman's capsule

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32. Which of the physiological responses below occurs when core body temperature increases above 37.5° C?

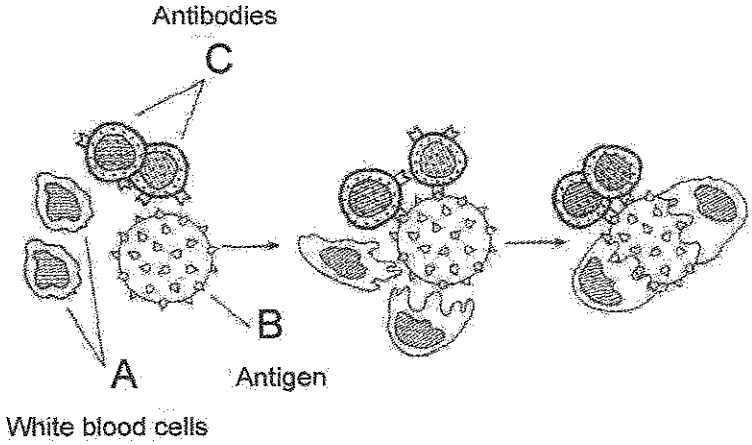
(i) blood circulation to the skin increases
(ii) sebaceous gland activity increases
(iii) radiation of heat increases
(iv) blood circulation to the brain decreases
(v) superficial blood vessels dilate
(vi) sweat gland activity increases

(a) i, ii, iii, v
(b) i, iv, v, vi
(c) i, ii, iv, vi
(d) i, iii, v, vi

33. Which of the following statements best describes what is most likely to happen when an individual receives a vaccination containing a weakened pathogen?

(a) The ability to fight disease will increase due to antibodies received from the pathogen.
(b) The ability to fight disease caused by the pathogen will increase due to antibody production.
(c) The ability to produce antibodies will decrease after the vaccination.
(d) The ability to resist most types of diseases will increase.

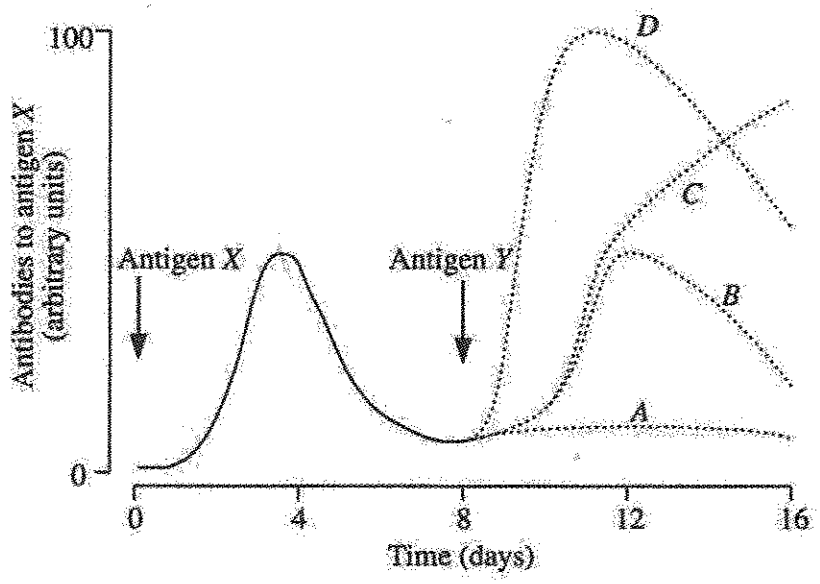
Question 34 refers to the diagram below.



34. The diagram represents one possible immune response that can occur in the human body. The structures that are part of the immune system are

(a) A only.
(b) A and C only.
(c) B and C only.
(d) A, B and C.

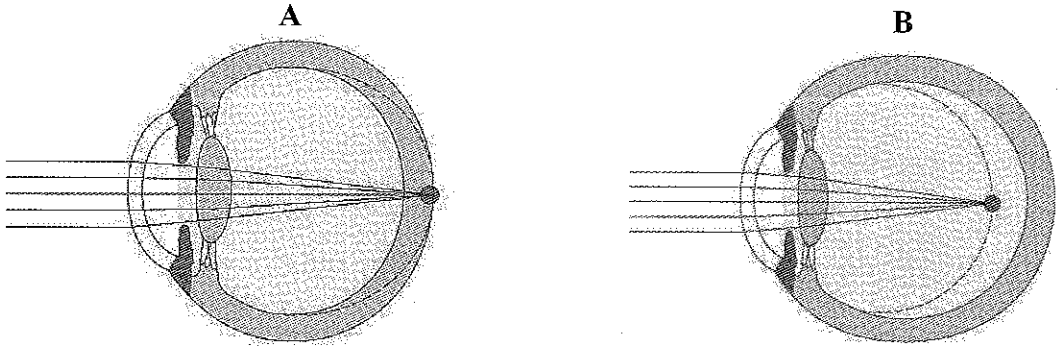
Question 35 refers to the graph below.



35. Which line best depicts the level of antibodies to antigen X from day 8 to day 16?

(a) A
(b) B
(c) C
(d) D

Question 36 refers to the diagrams below:



36. Which of the following statements is correct?

(a) Diagram A represents myopia and is corrected using a concave lens.
(b) Diagram A represents hypermetropia and is corrected using a concave lens.
(c) Diagram B represents myopia and is corrected using a concave lens.
(d) Diagram B represents hypermetropia and is corrected using a concave lens.

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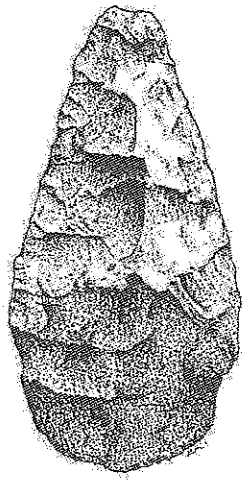
37. When the eye focuses light rays coming from a close object

(a) the lens becomes longer and thinner due to contraction of the ciliary muscle.
(b) the lens becomes shorter and fatter due to the contraction of the ciliary muscle.
(c) the lens becomes longer and thinner due to relaxation of the ciliary muscle.
(d) the lens becomes shorter and fatter due to relaxation of the ciliary muscle.

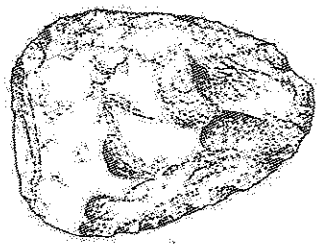
38. Cerebrospinal fluid (CSF) is derived from blood. Which of the following would you NOT normally expect to find in the CSF?

(a) erythrocytes
(b) amino acids
(c) antibodies
(d) urea

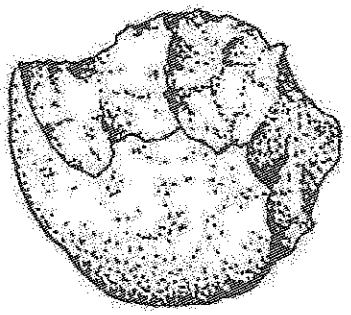
Question 39 refers to the following diagrams. Diagrams are not to scale.



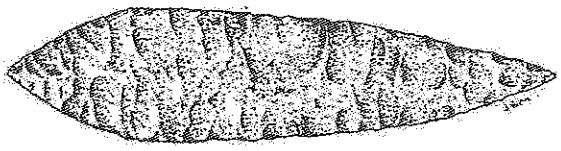
I



II



III



IV

39. Which of the following is the correct match of tool type with hominid species?

	Tool I	**Tool II**	**Tool III**	**Tool IV**
(a)	Neanderthals	*Homo erectus*	*Homo habilis*	*Homo sapiens*
(b)	*Homo habilis*	*Homo erectus*	Australopithecines	Neanderthals
(c)	*Homo erectus*	*Homo sapiens*	*Homo habilis*	Neanderthals
(d)	*Homo erectus*	Neanderthals	Australopithecines	*Homo sapiens*

Question 40 refers to the table below.

DRUG	EFFECTS OF LONG TERM USE
I	Raised blood pressure, heart attack, circulatory problems maybe leading to limb amputation, risk factor in osteoporosis.
II	Possible development of mental illness, personality changes such as loss of motivation and drive, deterioration of short term memory.
III	Liver damage, brain damage, memory loss and confused thinking, cardiovascular damage, nutritional problems.
IV	Risk of illness such as AIDS, neglect of diet and hygiene.

40. Drugs I, II, III and IV are most likely to be (in order):

(a) nicotine, marijuana, alcohol, heroin.
(b) heroin, alcohol, nicotine, marijuana.
(c) nicotine, marijuana, heroin, alcohol.
(d) heroin, marijuana, nicotine, alcohol.

PART II (80 marks)

Write answers to **ALL** questions on the ruled lines after each question or in the spaces provided within each table. Write your answers in blue or black ballpoint or ink pen.

Question 41 (Total 11 marks)

(a) Define *urbanisation.*

(1 mark)

(b) Explain how urbanisation relates to each process below. Include in your answer:

- What has happened.
- Why it has happened.
- What is one action that humans have taken or could take to improve this aspect of the environment.

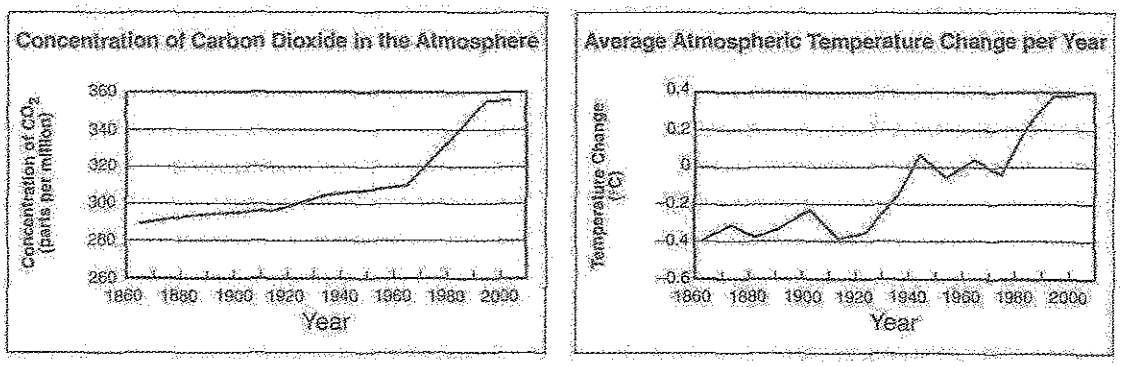
(i) An increase in eutrophication

(3 marks)

(ii) Depletion of the ozone layer

(3 marks)

For over 100 years scientists have monitored the carbon dioxide concentrations in the atmosphere in relation to changes in the atmospheric temperature. The graphs below show the data collected for these two factors.



(c) Identify the general relationship between the concentration of carbon dioxide and changes in atmospheric temperature.

_____

_____

(1 mark)

(d) Explain **two** ways that humans have contributed to the increase in atmospheric carbon dioxide.

_____

_____

_____

_____

(2 marks)

(e) Explain **one** specific negative effect that the continuing rise in temperature is likely to have on the environment.

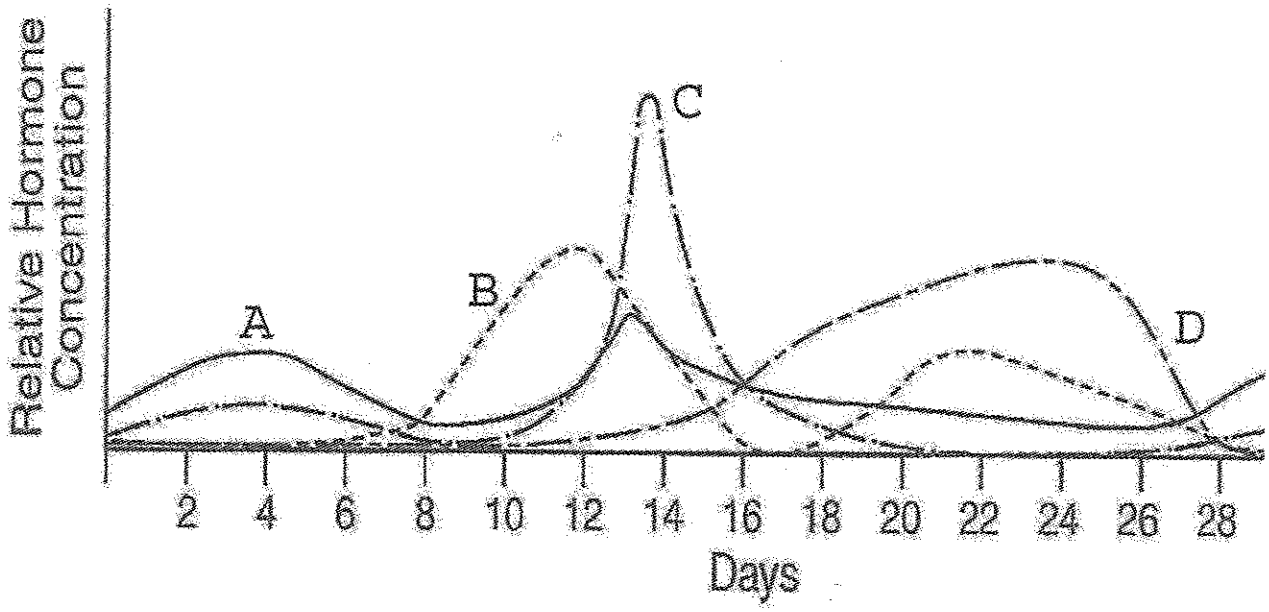
_____

_____

(1 mark)

Question 42 (Total 10 marks)

The graph below shows the different concentrations of female reproductive hormones *A, B, C* and *D* over a 28 day cycle.



(a) Name the hormones

B _____

D _____

(2 marks)

(b) Which gland produces hormone *A* and what is the function of this hormone?

_____

_____

(2 marks)

(c) Name the pair of hormones shown in the above graph (give the name, not the letter) that display a positive feedback relationship.

_____

_____

(2 marks)

(d) Explain what is meant by *positive feedback*.

_____

_____

(2 marks)

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(e) Positive feedback is one type of regulation. Describe the more common type of feedback in the human endocrine system and explain **why** it is more common.

(2 marks)

Question 43 (Total 10 marks)

Blood glucose levels are regulated by the hormones insulin and glucagon.

(a) What part(s) of the pancreas produce these hormones?

(1 mark)

(b) If a person experiences an oversupply of glucagon, explain, at the cellular level, the processes and hormone(s) required to restore homeostasis.

(4 marks)

(c) Thyroxine is another hormone whose function is related to metabolism. If a person has too much circulating thyroxine, what effect will it have on their metabolic rate?

(1 mark)

(d) How does the body reduce the thyroxine to normal levels?

(4 marks)

Question 44 (Total 11 marks)

A woman is shipwrecked, and adrift in a life raft on the ocean without food or water in hot, humid conditions.

(a) What mechanisms would her body employ to maintain homeostasis?

(2 marks)

(b) What effect would the mechanisms mentioned in part (a) have on her blood volume?

(1 mark)

(c) Explain why the volume of her red blood cells changes.

(2 marks)

(d) Explain how the mechanisms listed in part (a) would change after 24 hours in the life raft.

(2 marks)

(e) Explain how and why these changes would affect her cardiac output.

(4 marks)

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Question 45 (Total 10 marks)

A research report states that a group of 50 individuals who took 2 orange flavoured tablets containing 100 μg of vitamin C each at the first sign of a cold recovered more rapidly than did a different group of 50 individuals who took 2 orange flavoured tablets without vitamin C. The individuals were not told what their tablets contained.

(a) What is the hypothesis of this experiment?

(1 mark)

(b) What is the dependent variable and how would it have been measured?

(2 marks)

(c) What are three variables that are controlled in this experiment?

(3 marks)

(d) What are two additional variables that should also be controlled in this experiment and explain why each should be controlled?

(2 marks)

(e) What is a placebo and what is its importance in the study above?

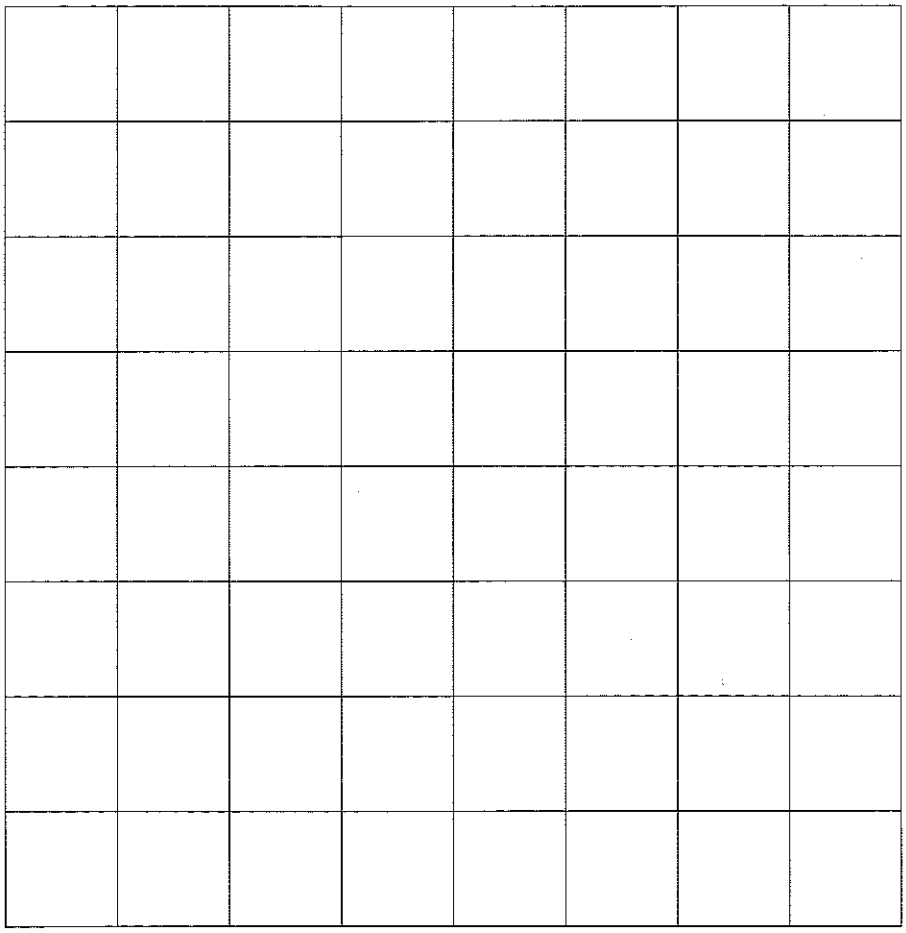
(2 marks)

Question 46 (Total 14 marks)

Carbon 14 dating techniques are commonly used methods for fossil dating. Given that the half life of C^{14} is 5730 years,

(a) Graph the C^{14} decay curve. Carefully label the axes and indicate the values on each axis. (6 marks)

GRAPH



(b) Making specific references to your graph, explain what a half life is and the importance of isotope decay rates to the most accurate dating of fossil materials.

(4 marks)

(c) Potassium^{40} (K^{40}) is another radio-isotope used in dating fossil objects. Given that the half life of K^{40} is 1.25×10^9 (1,250,000,000) years and what you know about this dating method, explain the circumstances under which you would use K^{40} rather than C^{14} to estimate the age of a fossil.

(4 marks)

Question 47 (Total 14 marks)

Question 47 refers to diagrams A and B below. Diagram A shows the structure of a population at the beginning of a 25 year interval. Diagram B shows the structure of the same population 25 years later.

Diagram A

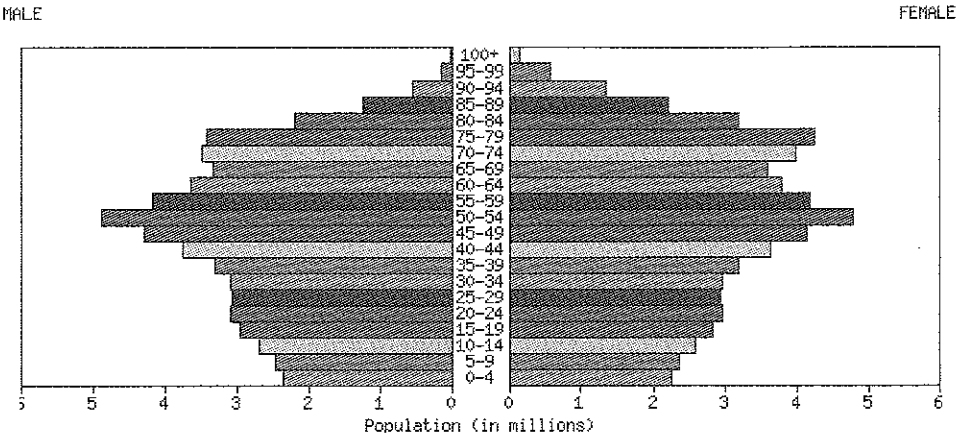
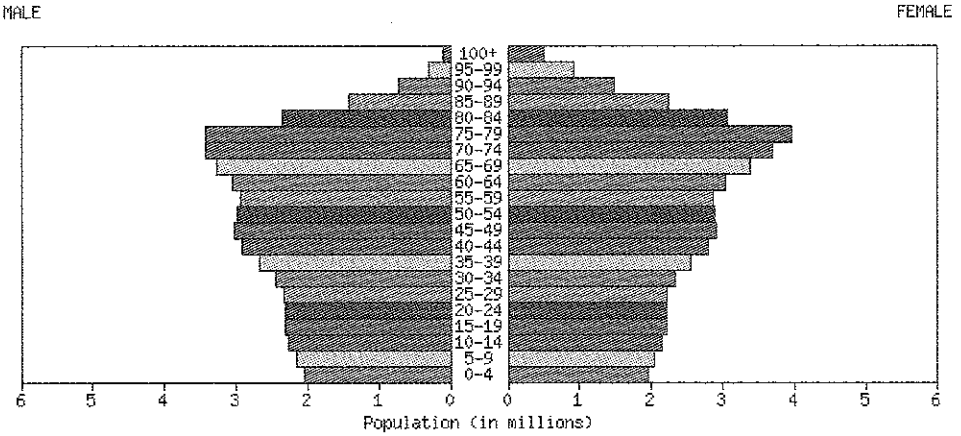


Diagram B



a) Indicate the stage of demographic transition illustrated in:

(i) Diagram A _____

(ii) Diagram B _____

(2 marks)

b) What two population **processes** determine the shape of population structure?

_____

_____

(2 marks)

c) Identify two major **structural** changes in the population between time A and time B.

_____

_____

(2 marks)

d) Explain two population processes responsible for the specific changes identified in (c).

_____

_____

_____

_____

(4 marks)

e) Explain **how** you could use the information in these diagrams to determine the death **rate** over the 25 year interval of people who were between 50 and 54 years of age at the beginning of the interval.

_____

_____

_____

_____

(4 marks)

PART III (40 marks)

Answer **ONE** question from **SECTION A** and **ONE** question from **SECTION B**. Illustrate your answers with diagrams where appropriate. Up to **TWO MARKS** may be deducted for poorly structured answers: that is, answers in point form or diagrams not explained in the text of your answers. **DO NOT WRITE ANSWERS IN PENCIL.** Write your answers on the lined pages in your Question/Answer Booklet following the end of the questions.

SECTION A

ANSWER EITHER Question 48 OR Question 49 – NOT BOTH

Question 48 (Total 20 marks)

(a) A sound wave arrives at the tympanic membrane. Describe the events that occur and the anatomical structures and their functions that are involved in the process of hearing from the tympanic membrane onward.

(13 marks)

(b) A student attended the "Big Day Out" music concert and spent most of the day next to a bank of loudspeakers. After leaving the concert he had trouble hearing what his friends were saying to him because he had a ringing sound in his ears. Discuss the reason(s) for his immediate hearing problem and for any long term damage that may have occurred.

(7 marks)

OR

Question 49 (Total 20 marks)

There is a hypothesis that children today are developing health problems such as allergies and are more susceptible to diseases because they now live in a more sterile environment. It is hypothesised that in previous generations children were more "dirty" and therefore did not suffer these illnesses to the same extent (the hygiene hypothesis).

(a) Explain what is required for the development of the immune response.

(14 marks)

(b) Apply this to explain the logic of the hygiene hypothesis.

(6 marks)

SECTION B

ANSWER EITHER Question 50 OR Question 51 – NOT BOTH

Question 50 (Total 20 marks)

Two statements relating to human skin colour are given below:

Statement 1: Skin colour in humans tends to be darker toward the equator and in hot areas, and lighter as one moves toward the poles.

Statement 2: The skin colour of indigenous people of Central America is lighter than the skin colour of indigenous people of Africa.

(a) Discuss the pattern of variation described in Statement 1 and the evolutionary force that causes such a pattern.

(6 marks)

(b) Given that humans colonized the western hemisphere (Americas) from northern Asia, explain the observations in Statements 1 and 2 above. Be sure to include two processes of evolution that result in the observations in Statement 2.

(14 marks)

OR

Question 51 (Total 20 marks)

(a) Explain the difference between genetic drift and natural selection as processes that result in evolution. Explain carefully how you might determine whether observations of evolution were due to selection or to genetic drift.

(7 marks)

(b) Discuss two circumstances in which genetic drift is likely to occur. Explain why.

(3 marks)

(c) Using your knowledge of the fossil skulls of early hominids, provide evidence that there were consistent selection pressures on hominids between 4 and 1 million years ago (use specific examples and appropriate dates).

(10 marks)

END OF PAPER

HUMAN BIOLOGY TERTIARY ENTRANCE EXAMINATION 2006

QUESTION SHEET FOR PART III

Extended Answers (40 marks)

Answer **ONE** question from **SECTION A** and **ONE** question from **SECTION B**. Illustrate your answers with diagrams where appropriate. Up to **TWO MARKS** may be deducted for poorly structured answers: that is, answers in point form or diagrams not explained in the text of your answers. **DO NOT WRITE ANSWERS IN PENCIL.** Write your answers on the lined pages in your Question/Answer Booklet following the end of the questions.

SECTION A

ANSWER EITHER Question 48 OR Question 49 – NOT BOTH

Question 48 (Total 20 marks)

(a) A sound wave arrives at the tympanic membrane. Describe the events that occur and the anatomical structures and their functions that are involved in the process of hearing from the tympanic membrane onward.

(13 marks)

(b) A student attended the "Big Day Out" music concert and spent most of the day next to a bank of loudspeakers. After leaving the concert he had trouble hearing what his friends were saying to him because he had a ringing sound in his ears. Discuss the reason(s) for his immediate hearing problem and for any long term damage that may have occurred.

(7 marks)

OR

Question 49 (Total 20 marks)

There is a hypothesis that children today are developing health problems such as allergies and are more susceptible to diseases because they now live in a more sterile environment. It is hypothesised that in previous generations children were more "dirty" and therefore did not suffer these illnesses to the same extent (the hygiene hypothesis).

(a) Explain what is required for the development of the immune response.

(14 marks)

(b) Apply this to explain the logic of the hygiene hypothesis.

(6 marks)

SECTION B

ANSWER EITHER Question 50 OR Question 51 – NOT BOTH

Question 50 (Total 20 marks)

Two statements relating to human skin colour are given below:

Statement 1: Skin colour in humans tends to be darker toward the equator and in hot areas, and lighter as one moves toward the poles.

Statement 2: The skin colour of indigenous people of Central America is lighter than the skin colour of indigenous people of Africa.

(a) Discuss the pattern of variation described in Statement 1 and the evolutionary force that causes such a pattern.

(6 marks)

(b) Given that humans colonized the western hemisphere (Americas) from northern Asia, explain the observations in Statements 1 and 2 above. Be sure to include two processes of evolution that result in the observations in Statement 2.

(14 marks)

OR

Question 51 (Total 20 marks)

(a) Explain the difference between genetic drift and natural selection as processes that result in evolution. Explain carefully how you might determine whether observations of evolution were due to selection or to genetic drift.

(7 marks)

(b) Discuss two circumstances in which genetic drift is likely to occur. Explain why.

(3 marks)

(c) Using your knowledge of the fossil skulls of early hominids, provide evidence that there were consistent selection pressures on hominids between 4 and 1 million years ago (use specific examples and appropriate dates).

(10 marks)