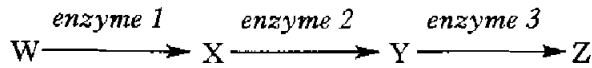


SECTION A

All questions in this section should be attempted.

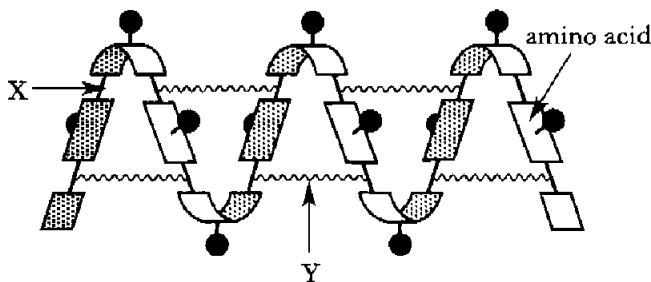
Answers should be given on the separate answer sheet provided.

1. A series of enzyme-controlled reactions is shown below.



If an inhibitor which affects enzyme 2 is introduced to the system, which of the following will happen?

- A X will accumulate
 - B Y will accumulate
 - C X and Y will accumulate
 - D Y and Z will accumulate
2. Which of the following describes metabolism correctly?
- A The breakdown of chemicals to release energy
 - B The synthesis of large molecules
 - C The chemical reactions of organisms
 - D The breakdown of food molecules
3. The following diagram shows part of a protein molecule.



Which line in the table describes correctly bonds X and Y?

	Bond X	Bond Y
A	hydrogen	peptide
B	hydrogen	hydrogen
C	peptide	hydrogen
D	peptide	peptide

Questions 4 and 5 refer to muscle filaments.

4. Which line of the table identifies correctly the types of filaments found in the light and dark bands of striated muscle?

	Banding pattern	
	Light	Dark
A	actin	myosin
B	myosin	actin + myosin
C	myosin	actin
D	actin	actin + myosin

5. When a muscle contracts what happens to these filaments?
- A Both filaments contract
 - B Actin contracts but not myosin
 - C Myosin contracts but not actin
 - D The filaments slide over one another
6. The diagram of the cell is magnified 400 times. What is the true size of the cell?



- A 20 μm
- B 50 μm
- C 80 μm
- D 500 μm

[Turn over

7. Which of the following statements is true of all viruses?
- A They have a protein-lipid coat and contain DNA.
 - B They have a protein-lipid coat and contain RNA.
 - C They have a protein coat and a nucleus.
 - D They have a protein coat and contain nucleic acid.

8. How many adenine molecules are present in a DNA molecule of 2000 bases, if 20% of the base molecules are cytosine?
- A 200
 - B 300
 - C 400
 - D 600

9. In the formation of gametes, when does DNA replication occur?
- A Before the start of meiosis
 - B As homologous chromosomes pair up
 - C At the end of the first meiotic division
 - D At the separation of chromatids

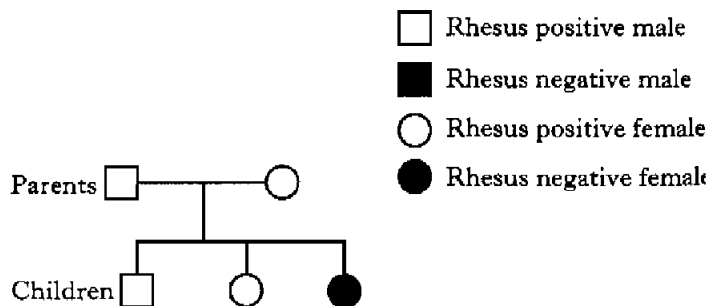
10. Alleles can be described as
- A opposite types of gamete
 - B different versions of a gene
 - C identical chromatids
 - D non-homologous chromosomes.

11. A person has blood group AB.
Which entry on the table identifies correctly the antigens and antibodies present?

	<i>Antigens on cells</i>	<i>Antibodies in plasma</i>
A	A and B	anti-A and anti-B
B	none	anti-A and anti-B
C	A and B	none
D	none	none

12. The gene for albinism is autosomal and recessive. A couple who are both carriers of the gene have a son. What is the chance that he will have the same genotype as his parents?
- A 1 in 1
 - B 1 in 2
 - C 1 in 3
 - D 1 in 4

13. The family tree below shows the transmission of the Rhesus D-antigen. The gene for the Rhesus D-antigen is not sex-linked.



The parents are expecting a fourth child.
What is the chance that this child will be Rhesus negative?

- A 0%
- B 25%
- C 50%
- D 100%

14. Colour blindness is a sex-linked recessive trait.

A woman would have a 50% chance of being colour blind if

- A both of her parents are carriers
- B her father has normal vision but her mother is a carrier
- C her father is a carrier and her mother is colour blind
- D her father is colour blind and her mother is a carrier.

15. Which of the following may result in the presence of an extra chromosome in the cells of a human being?

- A Non-disjunction
- B Crossing over
- C Segregation
- D Inversion

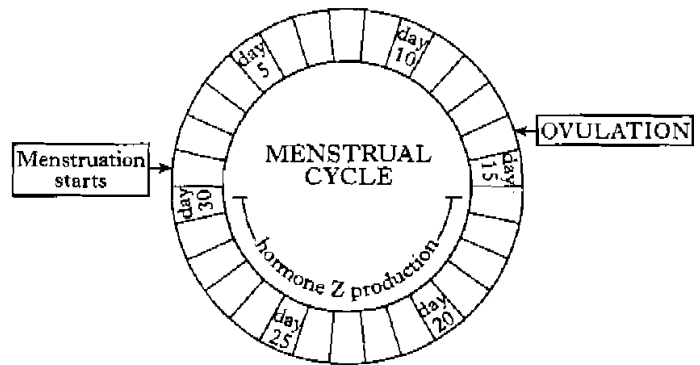
16. As an ovum develops within the ovary, it is surrounded by

- A a Graafian follicle
- B seminal fluid
- C a corpus luteum
- D the endometrium.

17. Which line in the table best describes dizygotic twins?

	<i>Number of sperm involved in formation</i>	<i>Number of ova involved in formation</i>	<i>Resulting genotypes</i>
A	1	1	identical
B	1	1	non-identical
C	2	2	identical
D	2	2	non-identical

18. The diagram below illustrates the hormonal control of a 30-day menstrual cycle.



Which line of the table identifies correctly hormone Z and the structure which produces this hormone?

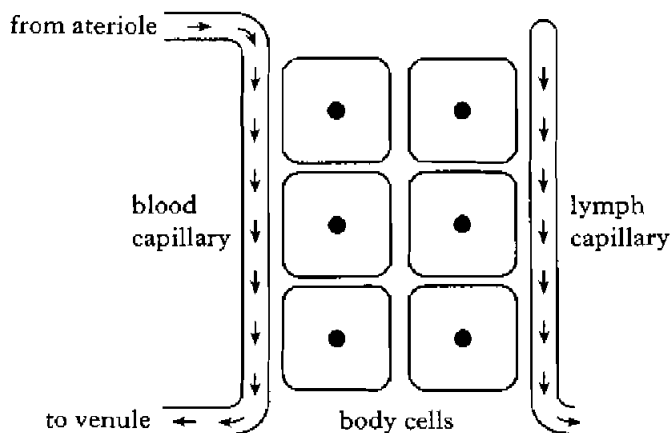
	<i>Hormone Z</i>	<i>produced by</i>
A	LH	ovary
B	oestrogen	corpus luteum
C	progesterone	Graafian follicle
D	progesterone	corpus luteum

19. Which of the following babies would be most likely to require a blood transfusion immediately after birth?

- A The first baby of a Rhesus negative mother and Rhesus positive father
- B The first baby of a Rhesus positive mother and Rhesus negative father
- C The second baby of a Rhesus negative mother and Rhesus positive father
- D The second baby of a Rhesus positive mother and Rhesus negative father

[Turn over

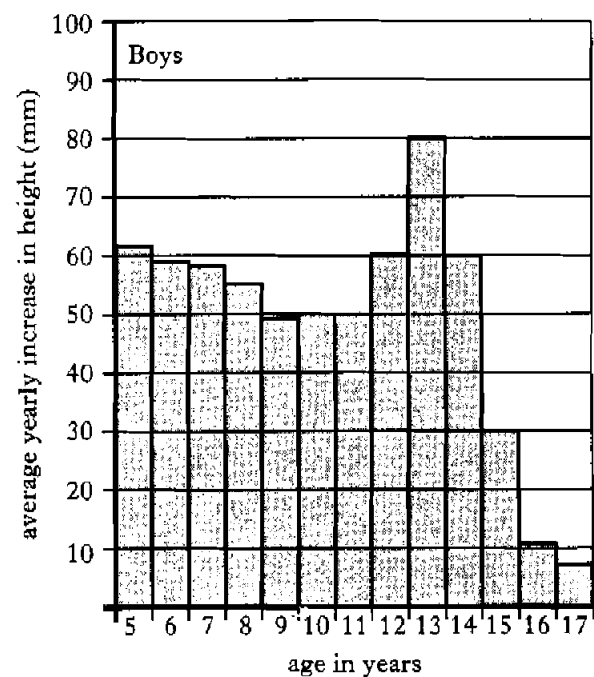
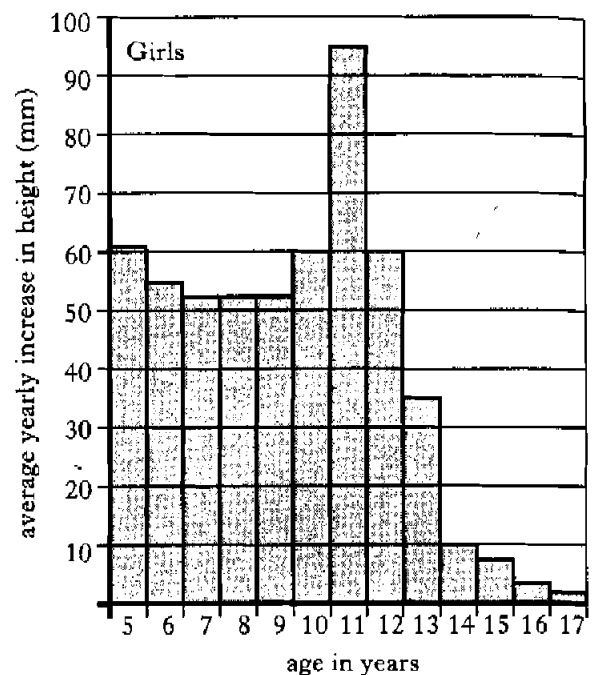
20. The diagram below shows the relationship between blood capillaries, body cells and lymph capillaries.



Which of the following is a correct description of the movement of oxygen to and from the body cells?

- A From body cells to blood and lymph capillaries
 B From blood capillaries to body cells
 C From lymph capillaries to body cells
 D From blood and lymph capillaries to body cells
21. If body temperature drops below normal, which of the following would result?
- A Vasodilation of skin capillaries
 B Vasoconstriction of skin capillaries
 C Decreased metabolic rate
 D Increased sweating

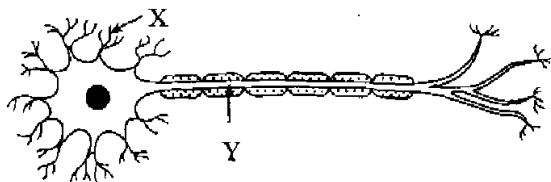
22. The graphs below show the average yearly increase in height of girls and boys.



Which of the following statements is correct?

- A The greatest average yearly increase for boys occurs one year later than the greatest average yearly increase for girls.
 B Boys are still growing at seventeen but girls have stopped growing by this age.
 C Between the ages of five and eight boys grow more than girls.
 D There is no age when boys and girls show the same average yearly increase in height.

23. The diagram below shows a motor neurone.



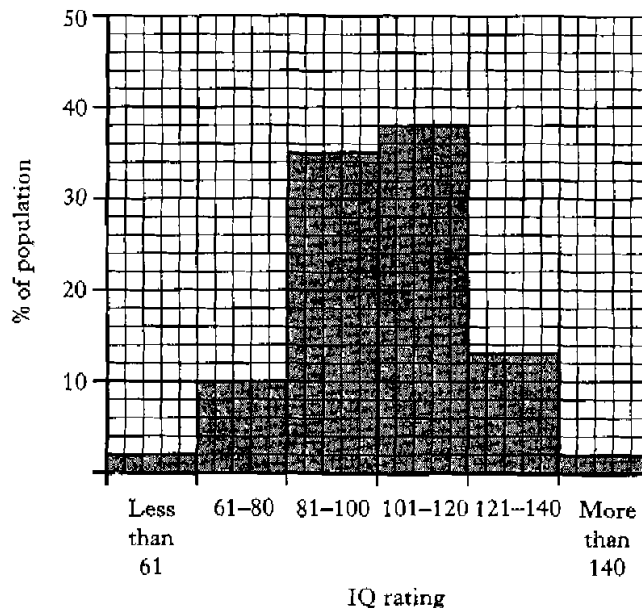
Which line of the table identifies correctly the labelled parts and the direction of impulse?

	X	Y	Direction
A	dendrite	axon	X → Y
B	dendrite	axon	Y → X
C	axon	dendrite	X → Y
D	axon	dendrite	Y → X

24. Vision in dim light is improved by the rods having

- A peripheral neural pathways
- B diverging neural pathways
- C central neural pathways
- D converging neural pathways.

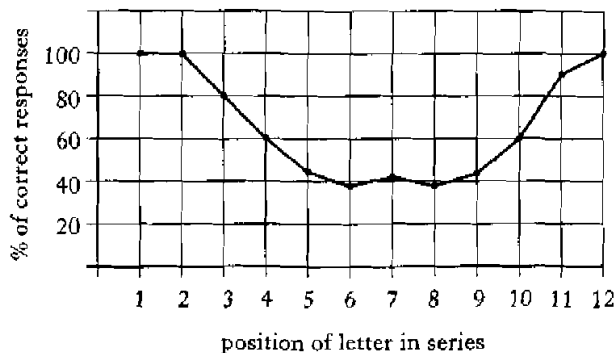
25. The histogram shows the percentage distribution of IQ rating in a sample of 1000 Scottish children.



How many children have an IQ of over 120?

- A 15
- B 53
- C 150
- D 530

26. Students were asked to recall twelve letters of the alphabet in any order, after hearing the list of letters read slowly once over. An analysis of their performance is shown in the graph below.

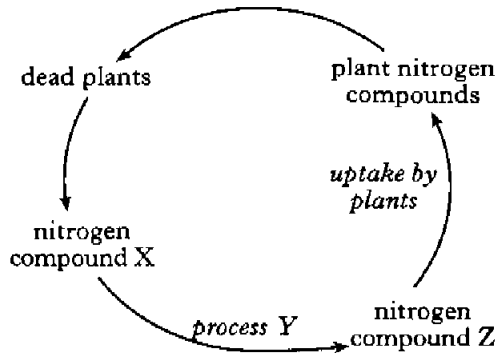


On how many occasions was a letter recalled by more than half of the students?

- A 5
- B 7
- C 9
- D 10

27. Rivers polluted by raw sewage have low oxygen concentrations as a direct result of
- A large numbers of bacteria
 - B algal blooms
 - C high nutrient levels
 - D low nutrient levels.

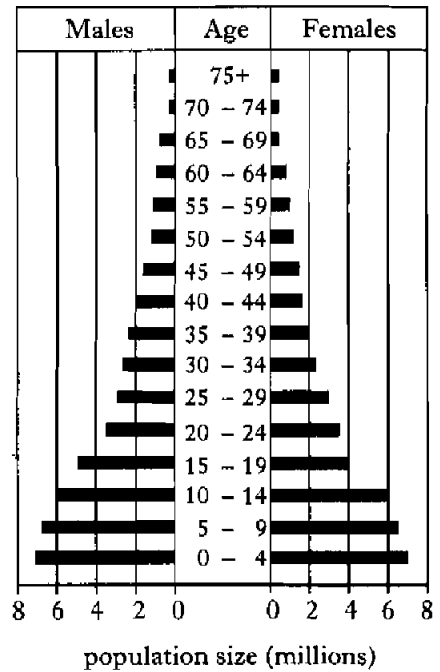
28. The diagram represents part of the nitrogen cycle.



Process Y is the production of

- A ammonia by decomposition
 - B nitrates by nitrification
 - C ammonia by nitrogen fixation
 - D nitrates by denitrification.
29. A country has a population of 10 million. What is the likely increase in population over a two-year period given a growth rate of 2% per annum?
- A 102 000
 - B 104 040
 - C 204 000
 - D 404 000

30. The diagram below shows a population pyramid for a country.



How many girls between the ages of 10 and 19 are there in the population?

- A 6 million
- B 10 million
- C 12 million
- D 21 million

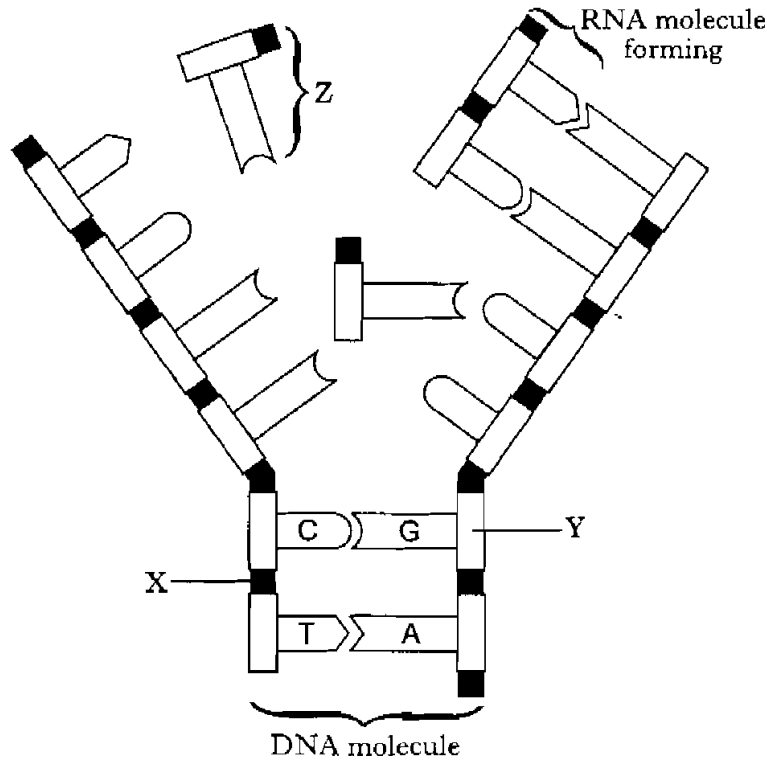
**Candidates are reminded that the answer sheet MUST be returned
INSIDE the front cover of this answer booklet.**

SECTION B

Marks

All questions in this section should be attempted.

1. The diagram below represents the process of RNA synthesis.



- (a) Where in the cell does this process take place?

1

- (b) Name the components X, Y and Z.

X _____

Y _____

Z _____

2

- (c) State the full names of any **two** different RNA bases shown in the diagram.

1 _____

2 _____

1

- (d) Name another substance, **not** shown in the diagram, which is essential for RNA synthesis.

1

1. (continued)

Marks

- (e) (i) What name is given to the triplets of bases in an mRNA molecule?

1

- (ii) The table below shows some amino acids and the triplets of bases specific to them.

<i>Amino acid</i>	<i>Triplet of mRNA bases</i>
alanine	GCU
arginine	CGA
serine	UCG
histidine	CAC
valine	GUG

Name the **two** amino acids that would be specified by the mRNA molecule forming on the DNA strand in the diagram.

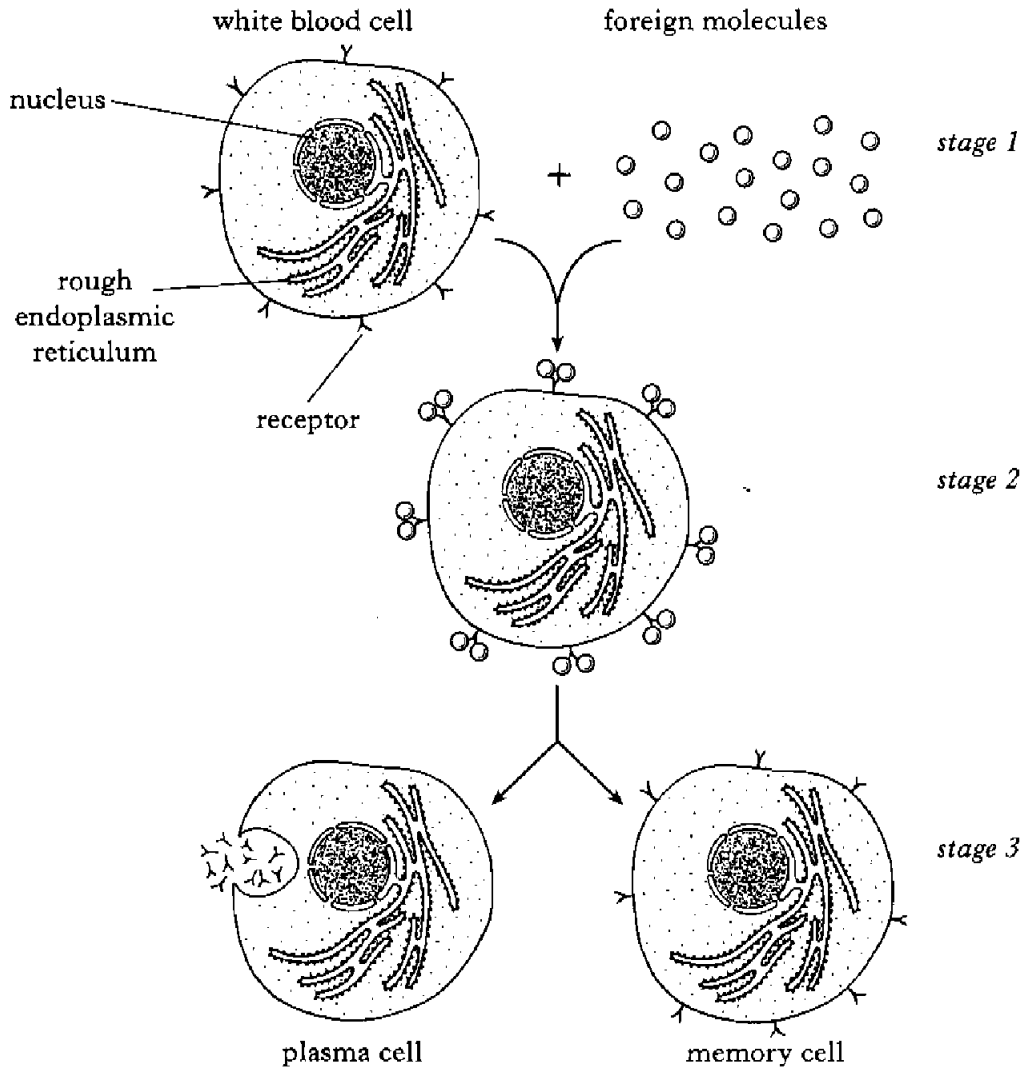
1 _____ 2 _____

1

[Turn over

2. The diagram below shows three stages in the humoral immune response.

Marks



(a) (i) What type of white blood cell carries out the humoral immune response?

1

(ii) What name is given to foreign molecules which stimulate the immune response?

1

(b) Describe **two** responses made by the white blood cell as a result of the attachment of the foreign molecules.

1 _____

2 _____

1

2. (continued)

Marks

- (c) Mature plasma cells contain a large quantity of rough endoplasmic reticulum. Explain this feature of these cells.

2

- (d) Suggest the role of memory cells in the immune response.

1

- (e) What term describes the secretion of substances, such as antibodies, out of a cell?

1

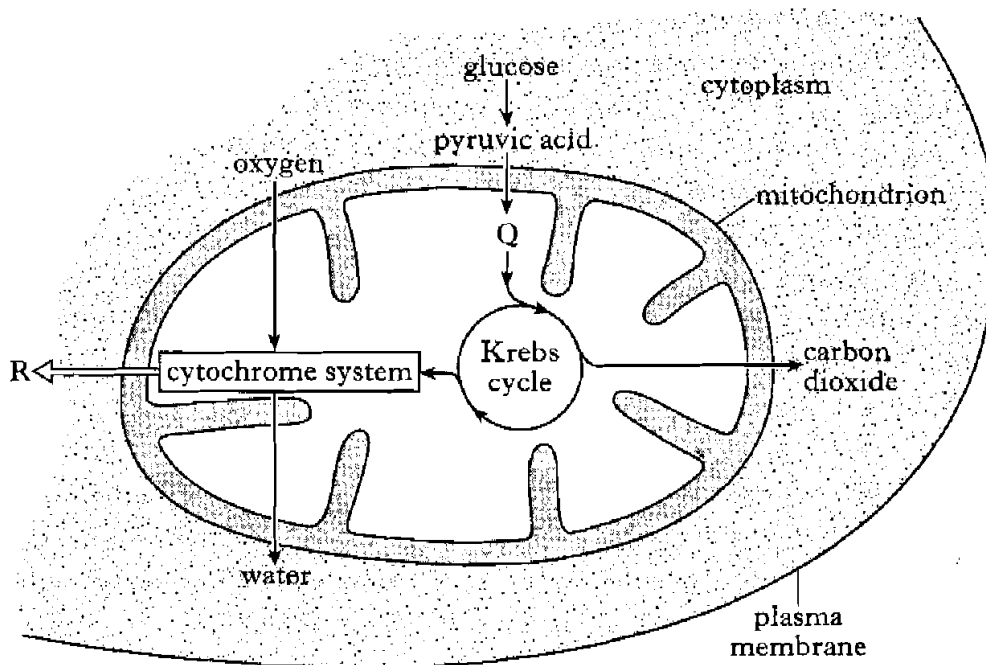
- (f) Describe how the body might obtain antibodies in a natural, passive way.

1

[Turn over

3. The diagram below summarises a metabolic pathway within a cell.

Marks



(a) Name the process which results in the formation of pyruvic acid.

1

(b) Name substance Q.

1

(c) How many carbon atoms are removed in one turn of the Krebs cycle?

1

(d) What is the role of NAD in this process?

1

(e) Why does the cytochrome system stop when oxygen is absent?

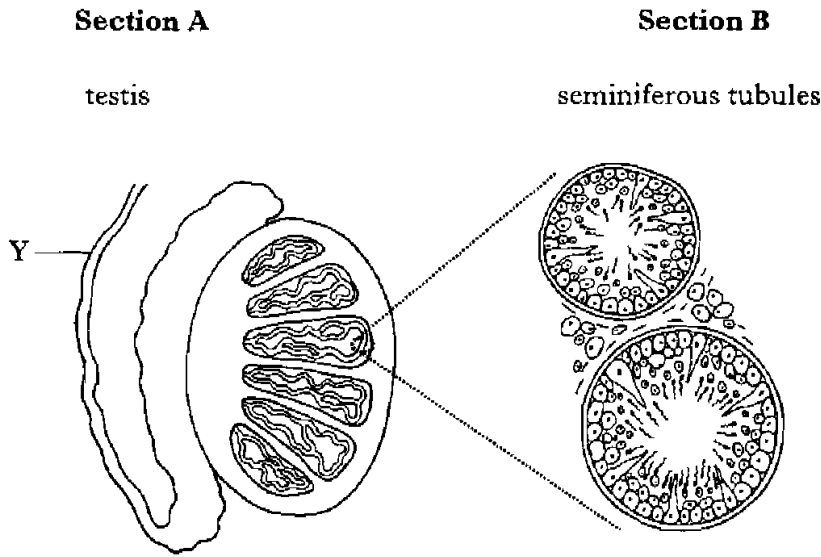
1

(f) Substance R is the main product of the cytochrome system.
Where in this metabolic pathway is substance R required?

1

4. The diagram shows sections of a testis and two seminiferous tubules.

Marks



(a) Name structure Y.

1

(b) Follicle stimulating hormone (FSH) affects the testes.

(i) State where FSH is produced in the body.

1

(ii) What effect does FSH have on the testes?

1

(c) (i) On **Section B** use an **X** to mark the site of testosterone production.

1

(ii) Describe how the concentration of testosterone in the blood is prevented from becoming too high.

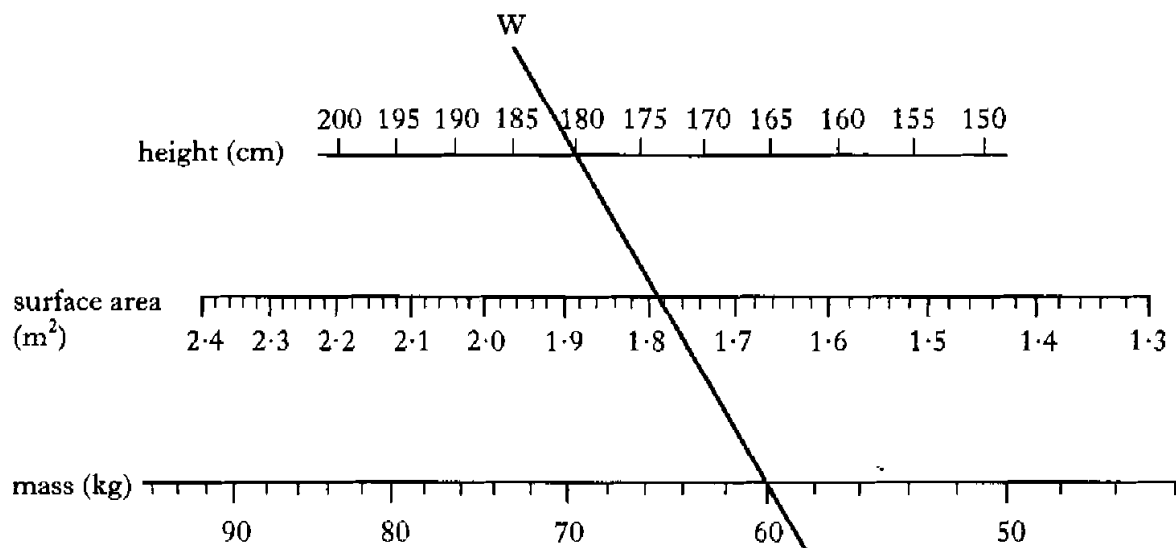
2

(iii) Suggest why testosterone injections are sometimes used to treat infertility in men.

1

5. A nomogram is shown below. Nomograms are used to estimate the surface area of individuals.

Marks



- (a) The table below contains information about three individuals. Use the nomogram to complete the table. Line W has been completed as an example.

Individual	Mass (kg)	Height (cm)	Surface Area (m ²)
W	60	180	1.79
X	70	160	
Y	56		1.58

1

- (b) The table below shows the surface area and volume of two boys.

Name	Surface Area (m ²)	Volume (dm ³)
Iain	2	50
Andy	2	60

Which of these boys is likely to be more susceptible to hypothermia?

Give a reason for your answer.

Boy _____

Reason _____

1

- (c) Name the microscopic structures (1) in the lungs and (2) in the small intestine, which provide an increased surface area.

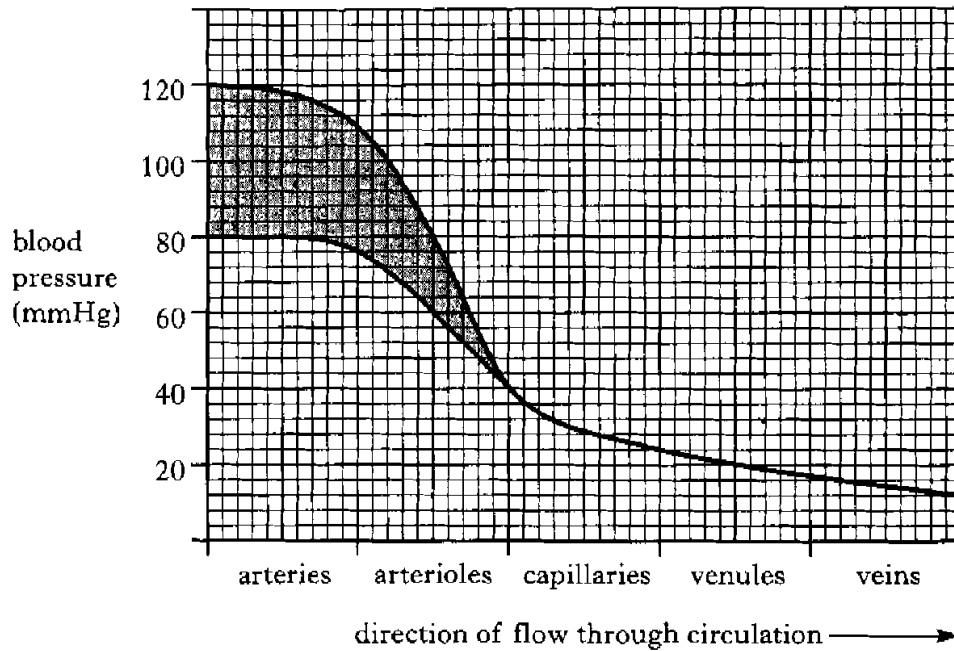
1 Lungs _____

2 Small intestine _____

1

6. The graph below shows the drop in pressure as blood flows through the circulatory system.

Marks



- (a) Calculate the decrease in pressure that occurs in the capillaries.

Space for calculation

_____ mmHg 1

- (b) The pressure of the blood is highest as it leaves the heart. Where in the circulation would blood be found at a pressure 25% of this value?

_____ 1

- (c) Why is there a maximum and minimum value given for the arteries and arterioles?

_____ 1

- (d) Name the blood vessels which link the following organs.

1 From brain to heart _____

2 From small intestine to liver _____

3 From heart to lungs _____ 2

[Turn over

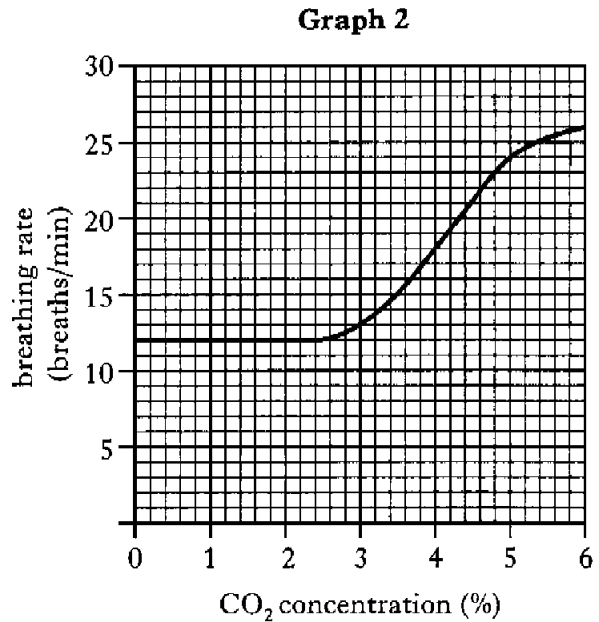
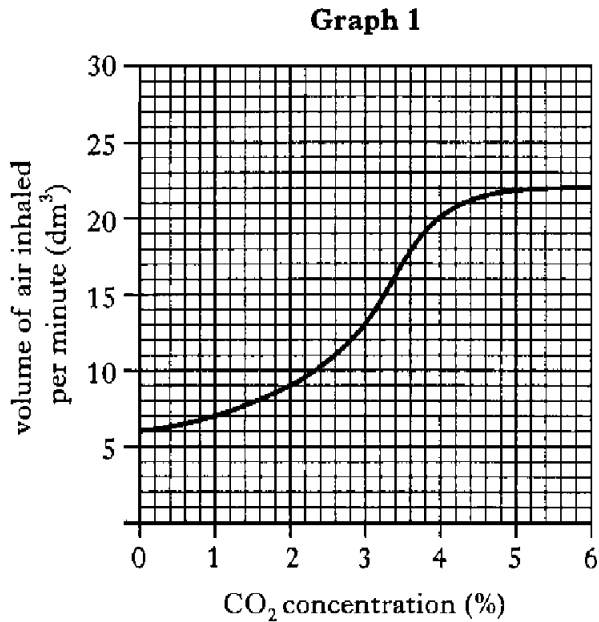
Marks

7. An investigation was carried out to find out how the percentage concentration of carbon dioxide (CO_2) in inhaled air affects the volume of air breathed and the breathing rate. Ten subjects were chosen and tested at seven different concentrations of CO_2 .

The graphs below show the results of this investigation.

Graph 1 Effect of CO_2 concentration on the volume of air inhaled

Graph 2 Effect of CO_2 concentration on the breathing rate



- (a) From **Graph 1**, what is the volume of air inhaled in one minute when the CO_2 concentration is 3%?

1

- (b) From **Graph 2**, describe the effect of increasing CO_2 concentration on breathing rate.

2

- (c) (i) Complete the table below to show the mean volume of air inhaled in a single breath at each of the concentrations of CO_2 given.

<i>CO₂ concentration of inhaled air (%)</i>	<i>Volume of air inhaled per minute (dm³)</i>	<i>Breathing rate (breaths per minute)</i>	<i>Mean volume of one breath (dm³)</i>
0	6	12	0.50
2	9	12	
4	20		
6			

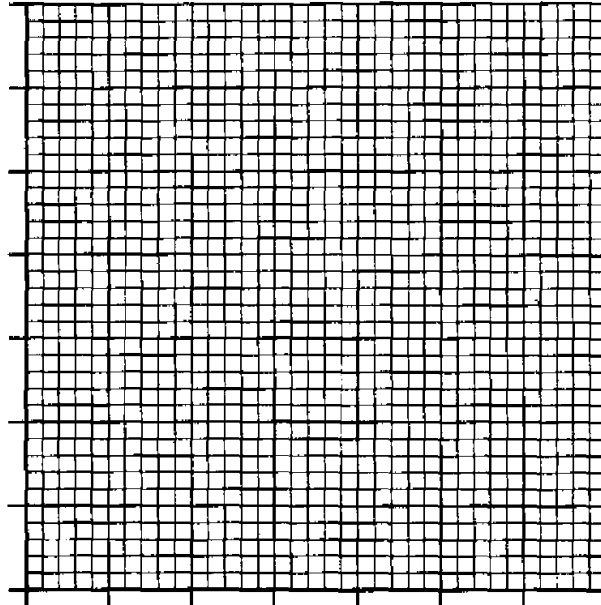
2

7. (c) (continued)

Marks

- (ii) Draw a graph to show the relationship between the concentration of CO₂ in inhaled air and the mean volume of one breath.

(Additional graph paper, if required, can be found on page 32.)



2

- (iii) What conclusion can be drawn from the graph? Quote data from your graph to illustrate your answer.

1

- (d) (i) Before each reading was taken, each subject breathed the air samples for two minutes. Suggest a reason for this.

1

- (ii) Suggest another variable, apart from time, which would have to be controlled between each reading.

1

- (e) Suggest why ten subjects were chosen rather than just one.

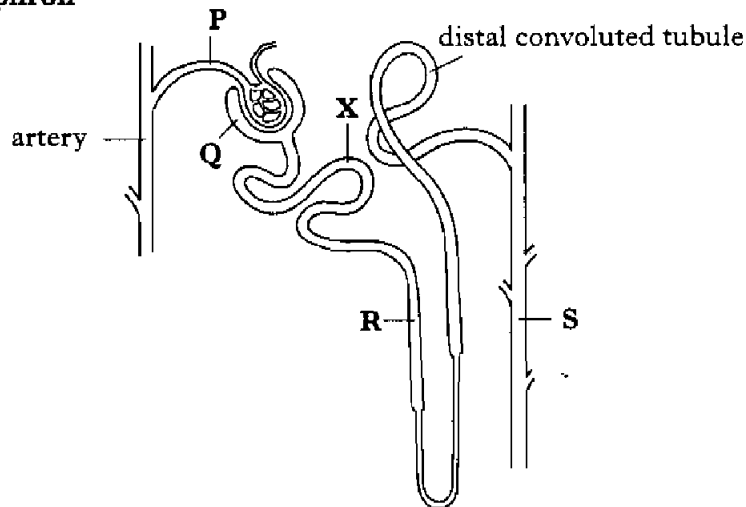
1

[Turn over

8. An investigation was carried out to determine the rates of flow and the composition of fluids in a human kidney. These were measured at positions P, Q, R and S, shown in the diagram below.

Marks

Kidney nephron



The results are given in the table below.

Position	Total flow rate through kidney (cm ³ /minute)	Solute concentration (g/100 cm ³)		
		Protein	Glucose	Urea
P	1000	7.4	0.1	0.03
Q	100	0.0	0.1	0.03
R	20	0.0	0.0	0.15
S	1	0.0	0.0	1.85

- (a) (i) Name structure X.

_____ 1

- (ii) What process takes place in this part of the nephron?

_____ 1

- (b) Explain why there is no protein at point Q in the nephron.

_____ 1

- (c) (i) By how many times does the concentration of urea increase between points Q and R?

_____ 1

8. (c) (continued)

Marks

- (ii) Explain why the concentration of urea increases between points R and S.

1

- (iii) Using data from the table, calculate the weight of urea which would pass from the collecting duct (S) to the bladder in one hour.

Space for calculation

_____ g

1

- (d) Express the concentration of glucose at point Q in grams per litre.

Space for calculation

_____ g/l

1

- (e) What effect would an increasing concentration of ADH in the blood have on each of the following?

- (i) The concentration of urea at point S.

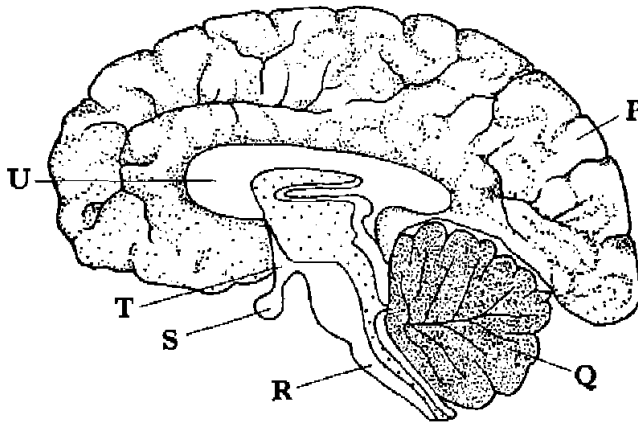
1

- (ii) The concentration of glucose at point P.

1

[Turn over

9. The diagram shows the main parts of the human brain as seen in a vertical section. Marks



- (a) Complete the table by adding the correct letters, names and functions of the parts.

<i>Label</i>	<i>Name</i>	<i>Function</i>
P		
	pituitary gland	
		temperature regulation

3

- (b) Describe a feature of part **P** which improves its function.

1

- (c) What is meant by the term "localisation of function"?

1

- (d) Why is the part of the brain which controls the right hand much larger than the part which controls the right foot?

1

Marks

10. The following diagrams represent a form of communication.



(a) What is this form of communication called?

1

(b) (i) Describe the significance of such communication in infancy.

1

(ii) Give **two** examples of this type of communication which are used by babies.

1 _____

2 _____

1

(c) The following are standard symbols.



Why are such symbols used worldwide?

1

[Turn over

11. The account below relates to the effect of experience on behaviour.

Marks

Nicky decided she wanted to learn how to play golf. Sam, the professional, was very helpful, offering her five introductory lessons at a reasonable rate, with the offer of five more if Nicky showed consistent improvement. He emphasised that she would have to pay careful attention to his demonstrations and copy his technique.

Nicky enjoyed driving the ball but hated putting, so Sam always started lessons with putting and only moved on to using other clubs when sufficient improvement was shown. As the lessons went on, Sam expected a higher and higher standard before any driving was allowed.

Four years later Nicky was good enough to represent her country at junior level but she refused to use any of the latest graphite-shafted clubs as she had lost her first championship when using a graphite putter.

(a) With reference to the above account, give an example of each of the following types of behaviour.

Imitation _____
 _____ 1

Generalisation _____
 _____ 1

(b) The professional used the technique of shaping in his teaching.
 What is meant by "shaping"? Give an example from the text above.

Shaping _____
 _____ 1

Example _____
 _____ 1

(c) As well as rewarding Nicky for doing well, Sam could also have punished any poor performance. What term is used to describe this type of training?

_____ 1

11. (continued)

Marks

(d) The paragraph below provides further information on human behaviour.

Nicky loved playing in big championships as she found she always played better in front of a crowd. To begin with she did not like her school friends attending her big events as they, uncharacteristically, tried to distract her opponents. However, her sporting success resulted in an improvement in her friends' behaviour, and she found herself relying on their presence to raise her game.

Complete the table to identify **two** types of group or social behaviour with illustrations from the paragraph.

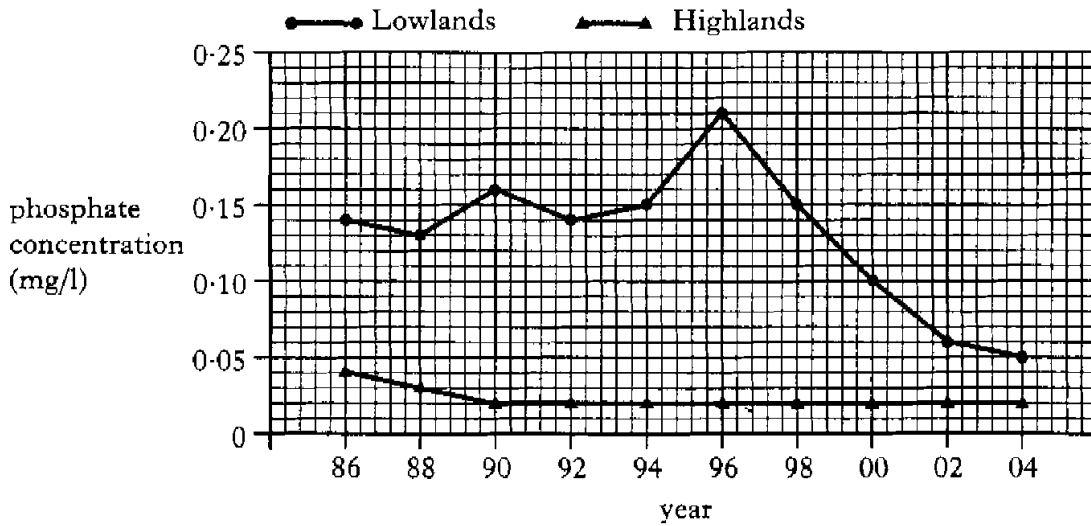
<i>Type of behaviour</i>	<i>Illustration from paragraph</i>
1	
2	

2

[Turn over

12. The following data refer to concentrations of phosphate detected in water of Scottish rivers between 1986 and 2004.

Marks



- (a) What are the maximum and minimum concentrations of phosphate recorded in each of the areas?

Area	Phosphate Concentration (mg/l)	
	Maximum	Minimum
Highlands		
Lowlands		

1

- (b) (i) Compare and contrast the data from 1996 to 2004.

2

- (ii) Explain how the higher rainfall in the Highlands might contribute to the difference between the phosphate concentrations of rivers in the Highlands and Lowlands.

1

Marks

12. (b) (continued)

- (iii) Suggest a reason for the change in phosphate concentration of the rivers in the Lowlands since 1996.

1

- (c) (i) Aquatic plants absorb phosphate from river water against the concentration gradient. What term is used to describe this process?

1

- (ii) What type of molecule in the plant cell membrane is involved in this process?

1

[Turn over

SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Questions 1 and 2 should be attempted on the blank pages which follow.

Supplementary sheets, if required, may be obtained from the invigilator.

Labelled diagrams may be used where appropriate.

1. Answer either A or B.

A. Describe the functions of the liver under the following headings:

- (i) production of urea; 2
- (ii) metabolism of carbohydrates; 5
- (iii) breakdown of red blood cells. 3

(10)

OR

B. Describe the cardiac cycle under the following headings:

- (i) nervous and hormonal control of heart beat; 4
- (ii) the conducting system of the heart. 6

(10)

In question 2 ONE mark is available for coherence and ONE mark is available for relevance.

2. Answer either A or B.

A. Give an account of the transmission of a nerve impulse at a synapse. (10)

OR

B. Give an account of the carbon cycle and its disruption by human activities. (10)

[END OF QUESTION PAPER]