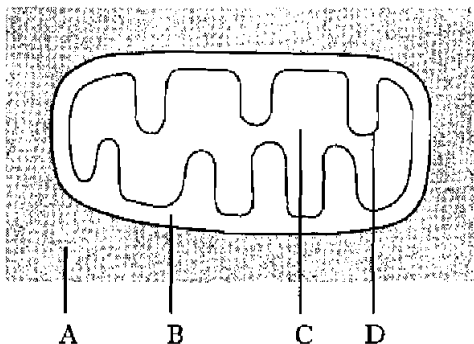


SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below shows a mitochondrion surrounded by cytoplasm.



Where does glycolysis take place?

2. Which of the following statements refer to glycolysis?

- 1 Carbon dioxide is released.
- 2 Occurs during aerobic respiration.
- 3 The end product is pyruvic acid.
- 4 The end product is lactic acid.

- A 1 and 3
- B 1 and 4
- C 2 and 3
- D 2 and 4

3. In respiration, the products of the cytochrome system are

- A hydrogen and carbon dioxide
- B water and ATP
- C oxygen and ADP
- D pyruvic acid and water.

4. During anaerobic respiration in muscle fibres, what is the fate of pyruvic acid?

- A It is converted to lactic acid.
- B It is broken down by the mitochondria.
- C It is broken down to carbon dioxide and water.
- D It is converted to citric acid.

5. The table below shows the antigens and antibodies present in the four different blood groups of the ABO system.

Group	Antigen	Antibody
1	B	a
2	none	a and b
3	A and B	none
4	A	b

Which of these groups could safely receive a transfusion of blood of group A?

- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 3 and 4

6. Which of the following is a cell that engulfs bacteria?

- A B-lymphocyte
- B T-lymphocyte
- C Lysosome
- D Macrophage

7. Which of the following processes occurs during the second division of meiosis?

- A Formation of diploid daughter cells
- B Pairing of homologous chromosomes
- C Separation of paired chromatids
- D Crossing over of genetic material

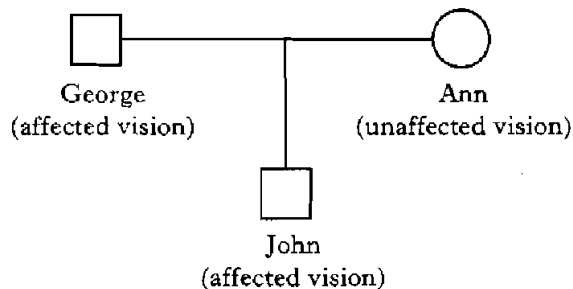
8. Polygenic characteristics are different from monohybrid characteristics because they

- A show random assortment of chromosomes
- B show independent assortment of chromosomes
- C are controlled by many pairs of alleles
- D are caused by non-disjunction during meiosis.

9. The gene (*m*) which causes one type of muscular dystrophy is sex-linked and recessive to the normal gene (*M*). If a carrier female and an unaffected male have children, what would be the predicted effect on their sons and daughters?

	Sons	Daughters
A	100% are affected	100% are carriers
B	50% are affected	50% are carriers
C	50% are affected	100% are carriers
D	100% are affected	50% are carriers

10. Red-green colour deficient vision is a sex-linked condition. John, who is affected, has the family tree shown below.



If *b* is the mutant allele for the condition, which of the following could be the genotypes of George's parents and Ann's parents?

	George's parents	Ann's parents
A	$X^B X^b$ $X^B Y$	$X^B X^B$ $X^B Y$
B	$X^B X^B$ $X^b Y$	$X^B X^B$ $X^B Y$
C	$X^B X^b$ $X^B Y$	$X^B X^b$ $X^B Y$
D	$X^B X^B$ $X^b Y$	$X^B X^B$ $X^b Y$

11. After ovulation, the follicle develops into the
- corpus luteum
  - fallopian tube
  - endometrium
  - zygote.

12. Which of the following best describes monozygotic twins?

- They are genetically similar and have developed from two eggs fertilised by two sperm.
- They are genetically similar and have developed from one egg fertilised by two sperm.
- They are genetically identical and have developed from one egg fertilised by one sperm.
- They are genetically identical and have developed from one egg fertilised by two sperm.

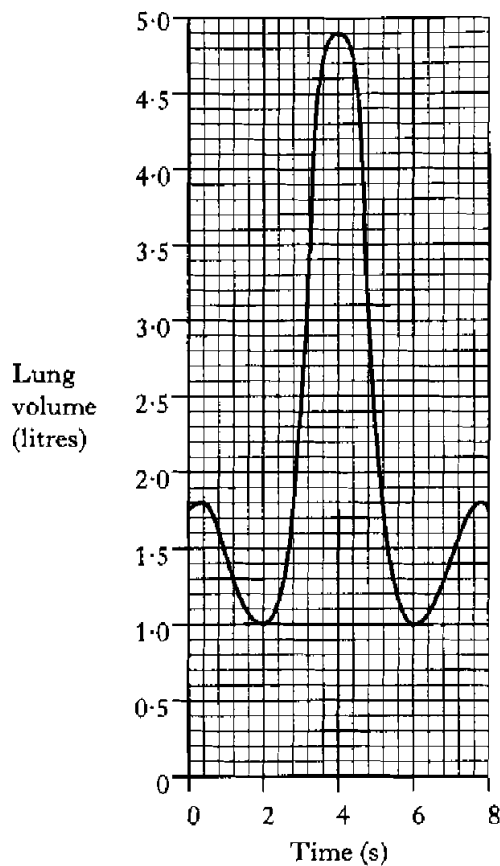
13. Which of the following sequences describes the first stages in the development of an embryo?

- fertilisation → cleavage → implantation
- implantation → fertilisation → cleavage
- cleavage → fertilisation → implantation
- fertilisation → implantation → cleavage

14. Which of the following hormones is produced by the placenta?

- Growth hormone
- Prolactin
- Progesterone
- Oxytocin

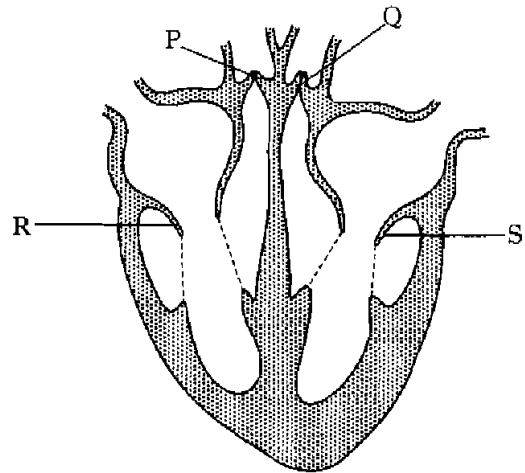
15. The graph shows changes in lung volume during a breathing exercise.



What is the volume of air exhaled between 4 and 6 seconds?

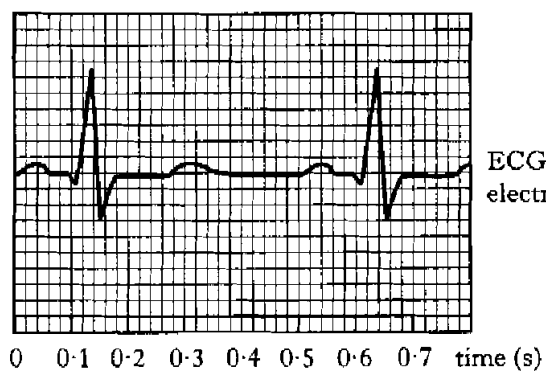
- A 3.8 litres
  - B 3.9 litres
  - C 4.8 litres
  - D 4.9 litres
16. Which of the following structures is **not** involved in the production or breakdown of red blood cells?
- A Spleen
  - B Pancreas
  - C Liver
  - D Bone marrow

17. The diagram shows a cross-section of the heart.



Which of the following describes correctly the movement of the valves during ventricular systole?

- A Valves P and Q open and valves R and S close
  - B Valves P and R open and valves Q and S close
  - C Valves P and Q close and valves R and S open
  - D Valves P and R close and valves Q and S open
18. The trace below was obtained from a patient who was having the electrical activity of his heart monitored.

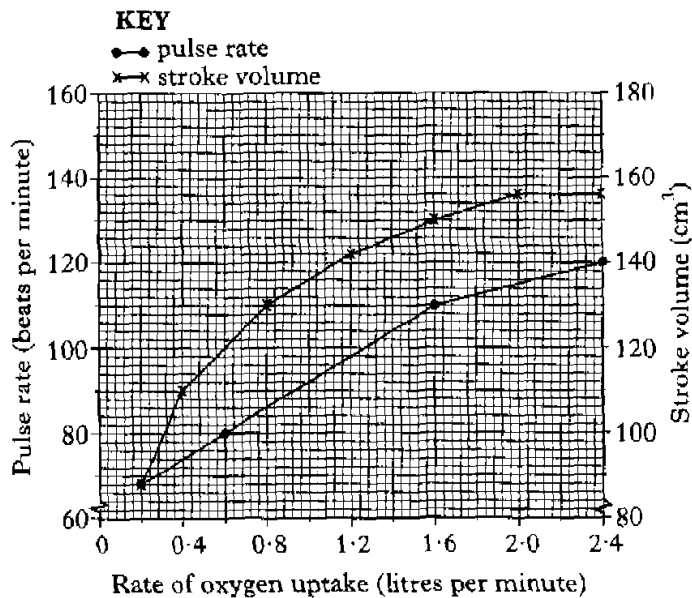


ECG trace from electrocardiogram

What was the heart rate of this patient?

- A 42 beats per minute
- B 72 beats per minute
- C 86 beats per minute
- D 120 beats per minute

19. The graph below shows how pulse rate and stroke volume change with the rate of oxygen uptake.



Cardiac output = pulse rate  $\times$  stroke volume

What is the cardiac output when the oxygen uptake is 1.6 litres per minute?

- A 13.1 litres per minute  
 B 14.3 litres per minute  
 C 16.5 litres per minute  
 D 16.9 litres per minute
20. In a healthy human, blood entering the kidney contains more glucose than blood leaving the kidney because the glucose is
- A changed to waste by the kidney tubules  
 B stored by the kidney cells  
 C excreted by the kidney tubules  
 D used by the kidney cells for respiration.
21. The concentration of urea rises from 0.03 g/100 cm<sup>3</sup> to 0.15 g/100 cm<sup>3</sup> as it passes through a kidney tubule.

What is the difference in concentration, expressed as a whole number ratio?

- A 1 : 5  
 B 1 : 50  
 C 3 : 100  
 D 2 : 1

22. When body temperature rises, which of the following is true of blood flow in the skin capillaries?

- A The flow of blood in the capillaries increases and heat loss decreases.  
 B The flow of blood in the capillaries increases and heat loss increases.  
 C The flow of blood in the capillaries decreases and heat loss decreases.  
 D The flow of blood in the capillaries decreases and heat loss increases.

23. In which part of the brain are the control centres for both speech and hearing located?

- A Limbic system  
 B Hypothalamus  
 C Medulla oblongata  
 D Cerebrum

24. The function of the corpus callosum is to

- A transfer information from a sensory nerve to a motor nerve  
 B control balance and coordination  
 C transfer information from one hemisphere to the other  
 D control all sensory activities.

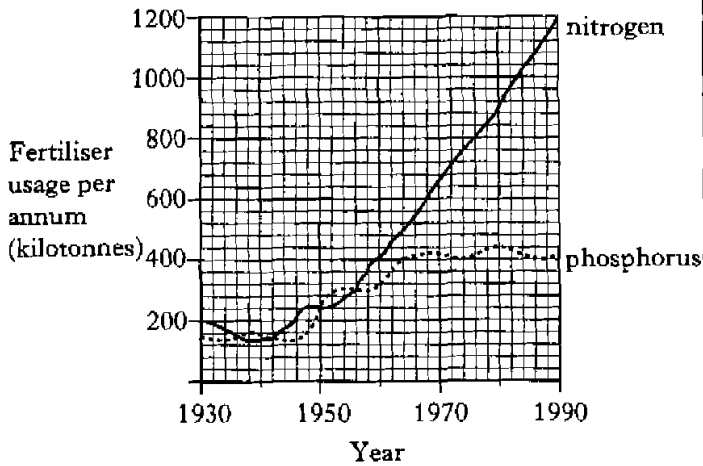
25. In which of the following is part of the autonomic nervous system correctly linked to the response it causes?

	Part of the autonomic nervous system	Response
A	sympathetic	acceleration of heart beat
B	sympathetic	vasodilation of skin arterioles
C	parasympathetic	secretion of sweat
D	parasympathetic	vasodilation of coronary blood vessels

26. When a person's beliefs are changed as a result of persuasion, this is an example of

- A internalisation
- B identification
- C deindividuation
- D social facilitation.

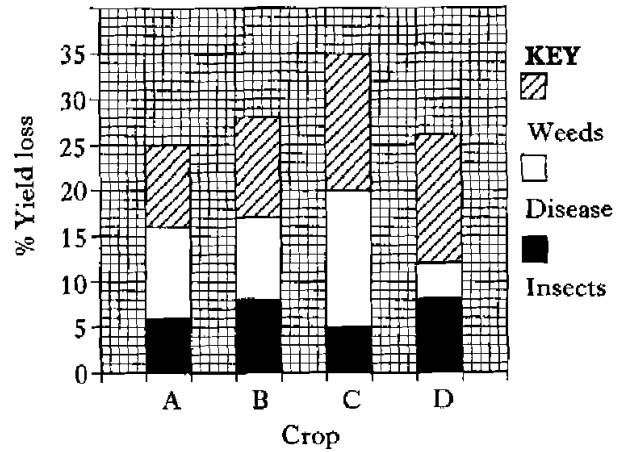
27. The graph below contains information about fertiliser usage.



Which of the following statements about nitrogen usage between 1930 and 1990 is correct?

- A It increased steadily.
- B It increased by 500%.
- C It increased by 600%.
- D It always exceeded phosphorus usage.

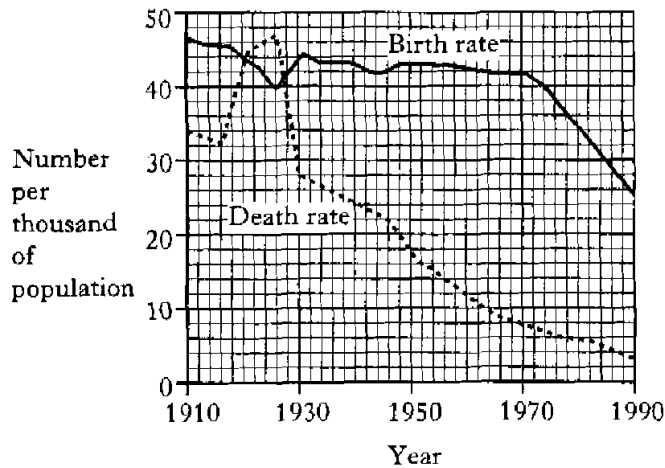
28. The bar chart below shows the percentage loss in yield of four organically grown crops as a result of the effects of weeds, disease and insects.



Predict which crop is most likely to show the greatest increase in yield if herbicides and insecticides were applied.

[Turn over

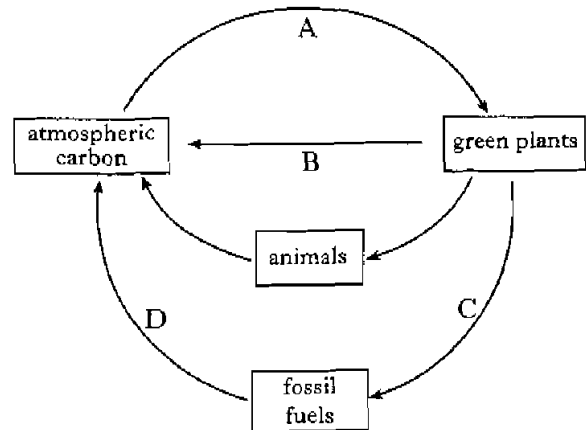
29. The graph below contains information about the birth rate and death rate in Mexico.



Which of the following conclusions can be drawn from the graph?

- A At no time during the century has the population of Mexico decreased.
- B The greatest increase in population occurred in 1970.
- C The population was growing faster in 1910 than in 1990.
- D Birth rate decreased between 1970 and 1990 due to the use of contraception.

30. The diagram below shows the carbon cycle.



Which letter represents combustion?

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

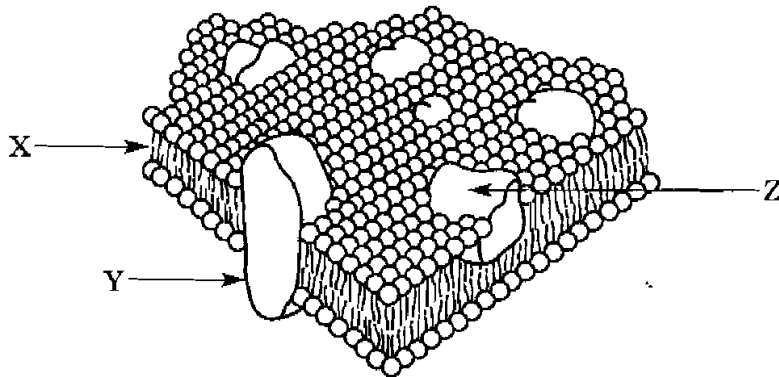
**SECTION B**

Marks

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. (a) The diagram below shows a structural model of the plasma membrane.



(i) What term describes this model of the membrane?

\_\_\_\_\_

1

(ii) Identify components X and Y.

X \_\_\_\_\_

Y \_\_\_\_\_

1

(iii) State a possible function of Z.

\_\_\_\_\_

1

(b) Sodium ions can be moved against a concentration gradient across a membrane.

(i) Explain what is meant by a concentration gradient across a membrane.

\_\_\_\_\_  
\_\_\_\_\_

1

(ii) What term describes the movement of ions against a concentration gradient?

\_\_\_\_\_

1

(iii) Explain why a shortage of oxygen might lead to a decrease in the rate of sodium ion movement.

\_\_\_\_\_  
\_\_\_\_\_

2

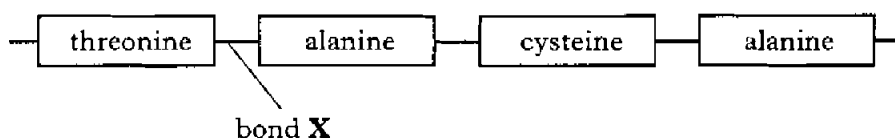
2. (a) Complete the table below to show the mRNA codons and tRNA anticodons for each amino acid.

Marks

<i>Amino acid</i>	<i>mRNA codons</i>	<i>tRNA anticodons</i>
alanine		CGA
threonine	ACC	
cysteine		ACA

1

- (b) The diagram shows the primary structure of part of a protein molecule.



- (i) Use the information from the table above to determine the DNA base sequence which would code for this molecule.

1

\_\_\_\_\_

- (ii) Name bond X.

1

\_\_\_\_\_

- (iii) Describe **one** way in which the secondary structure of a protein differs from the primary structure.

1

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

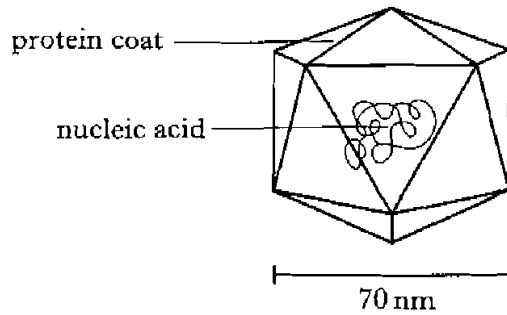
- (c) Where in the cell are proteins packaged and prepared immediately before secretion?

1

\_\_\_\_\_



3. The diagram shows a polio virus.



Marks

(a) Viruses can only reproduce within a host cell.

(i) List **two** substances, supplied by the host cell, which are required for viral replication.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

(ii) What happens after the viruses have been assembled inside the cell?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1

(b) Viruses can be processed to make vaccines to protect against the disease.

Suggest why it is important that the nucleic acid is damaged in the process, but not the protein coat.

Nucleic acid damaged \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

1

Protein coat undamaged \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

1

(c) The average diameter of a red blood cell is  $7\ \mu\text{m}$ .

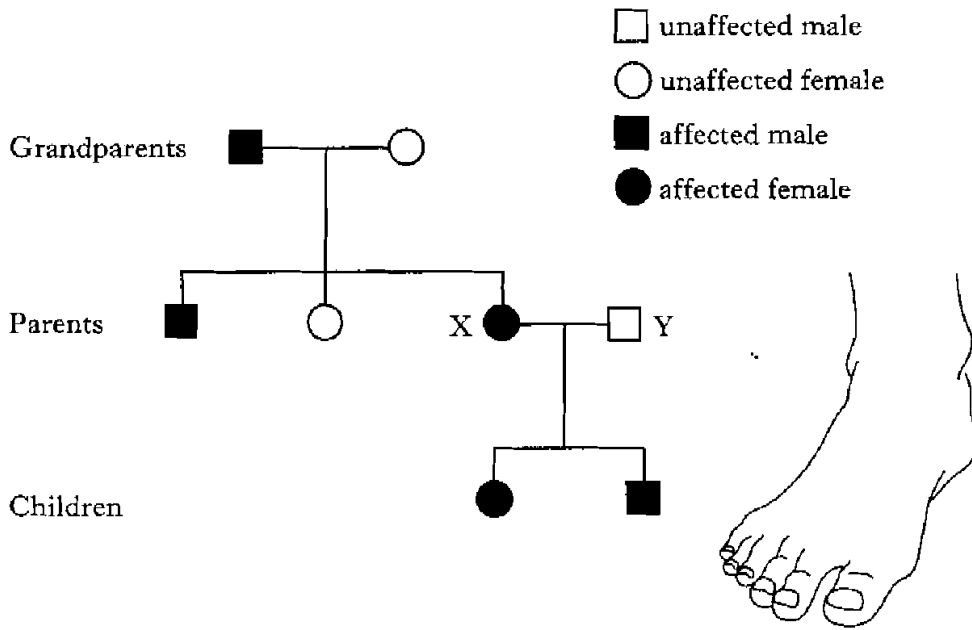
By how many times is a red blood cell bigger than a polio virus? ( $1\ \mu\text{m} = 1000\ \text{nm}$ )

*Space for calculation*

1

4. Polydactyly is an inherited condition in which individuals are born with extra toes. The allele for polydactyly is dominant and not sex-linked. The family tree below shows the incidence of the condition through three generations.

Marks



- (a) (i) Using the symbol **D** for the allele for polydactyly and **d** for the normal allele, give the genotypes of the two children.

\_\_\_\_\_ and \_\_\_\_\_

1

- (ii) Individuals X and Y are expecting another child. What are the chances of this child inheriting the condition?

\_\_\_\_\_

1

- (b) (i) What evidence from the family tree confirms that the grandfather is heterozygous?

\_\_\_\_\_  
 \_\_\_\_\_

1

- (ii) What evidence from the family tree confirms that the condition is not sex-linked?

\_\_\_\_\_  
 \_\_\_\_\_

1

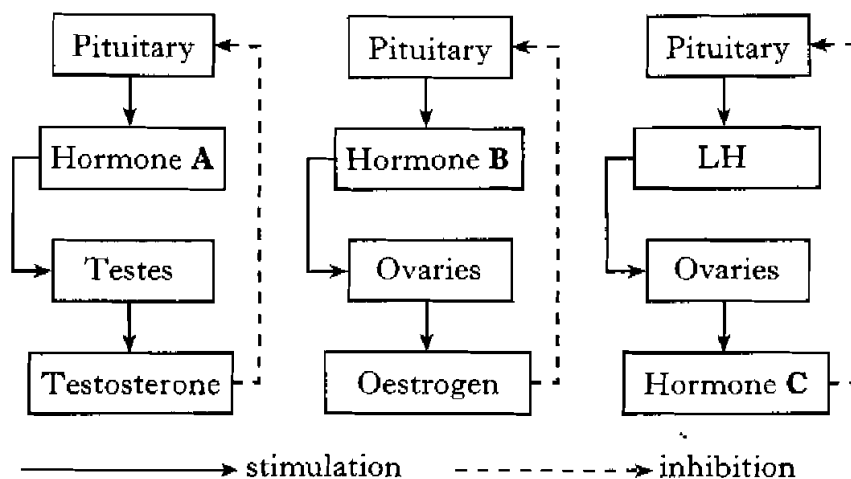
- (c) What term is used to refer to chromosomes which are not sex-chromosomes?

\_\_\_\_\_

1

5. The diagrams show the hormonal control of the testes and ovaries by the pituitary gland.

Marks



(a) (i) What name is given to this type of hormonal control?

\_\_\_\_\_ 1

(ii) Identify hormones A, B and C.

A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

2

(iii) State an effect of oestrogen on the pituitary gland, other than that shown above.

\_\_\_\_\_ 1

(iv) Where in the testes is testosterone produced?

\_\_\_\_\_ 1

(b) Distinguish between cyclical fertility and continuous fertility.

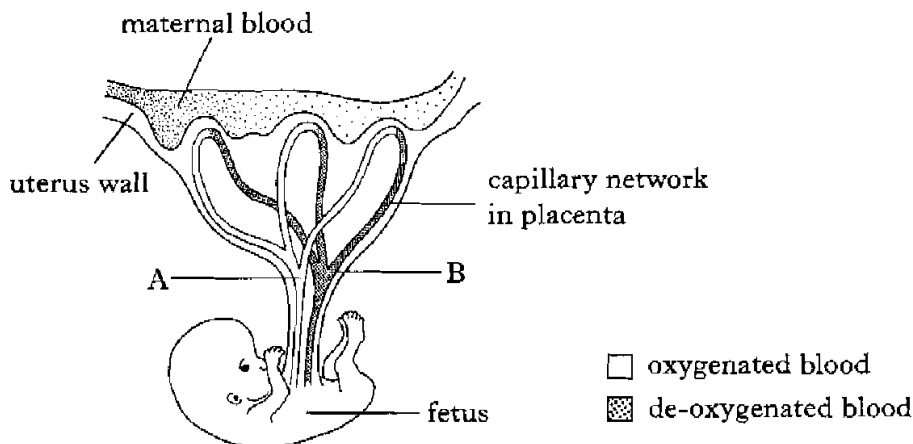
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ 1

(c) The female contraceptive pill raises the levels of ovarian hormones in the blood. Explain why this has a contraceptive effect.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ 2

6. The diagram shows the blood supply between a fetus and its placenta.

Marks



(a) Name **two** waste products that pass from the fetal blood to the maternal blood.

1 \_\_\_\_\_ 2 \_\_\_\_\_ 1

(b) The table shows some substances and their method of exchange between the fetal and maternal blood. Complete the table.

Substance	Method of exchange
	diffusion
glucose	
antibodies	

2

(c) Which of the fetal blood vessels, A or B, is the artery?  
Give a reason for your answer.

Vessel \_\_\_\_\_

Reason for answer \_\_\_\_\_

1

(d) Why might the second Rhesus positive child of a Rhesus negative mother be in danger from the mother's immune system?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2

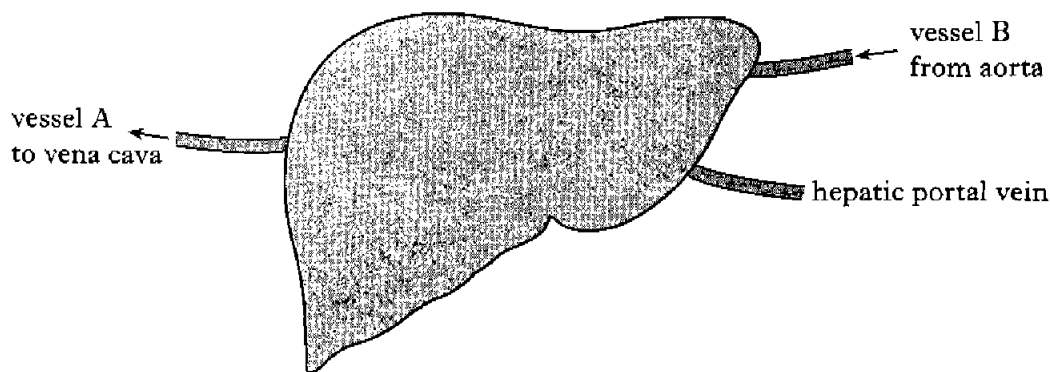
(e) Why do some inborn errors of metabolism, such as phenylketonuria (PKU), only have an effect on the baby *after* birth?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1

7. The diagram shows the liver and its associated blood supply.

Marks



(a) (i) Identify the vessels labelled A and B.

A \_\_\_\_\_ B \_\_\_\_\_ 1

(ii) Name an organ which is linked to the liver by the hepatic portal vein.

\_\_\_\_\_ 1

(b) The table below relates to products of digestion, their vessel of transportation in the villus and their possible fate in the body.

Complete the table.

<i>Product of digestion</i>	<i>Vessel of transportation</i>	<i>Possible fate</i>
glucose		
		deamination in the liver
	lacteal	

3

(c) Identify **two** hormones which cause the liver to release glucose, and state the conditions under which each of the hormones is released.

1 Hormone \_\_\_\_\_

Condition \_\_\_\_\_ 1

2 Hormone \_\_\_\_\_

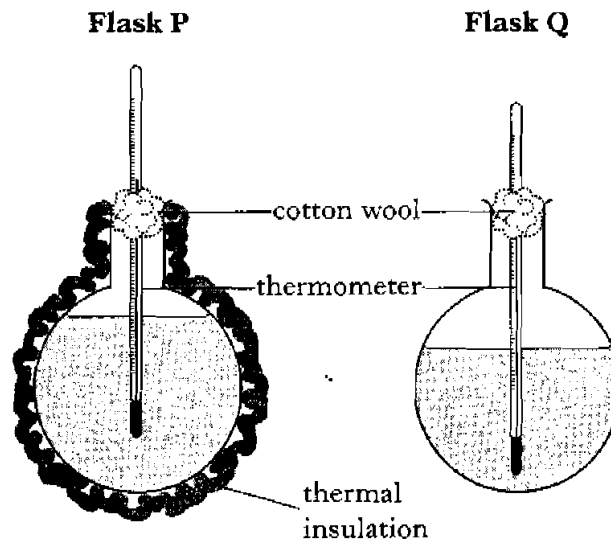
Condition \_\_\_\_\_ 1

[Turn over

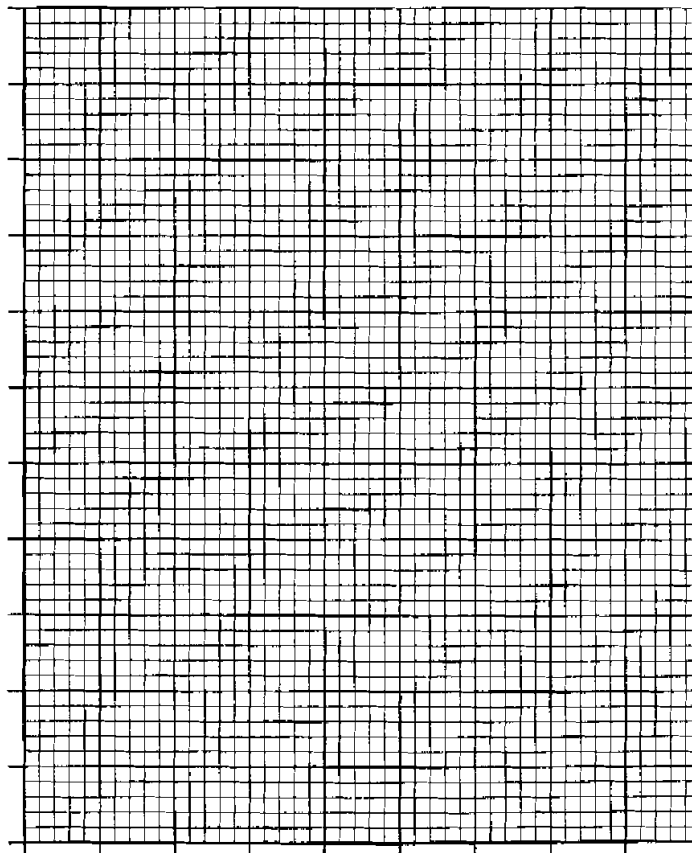
Marks

8. A student carried out an investigation into the effectiveness of thermal insulation. Two flasks containing water at 50 °C were left for forty minutes. During this time the temperature of the water was recorded every ten minutes. The results are given in the table below.

Time (min)	Temperature (°C)	
	Flask P	Flask Q
0	50	50
10	44	37
20	39	30
30	36	24
40	34	20



- (a) Present the data in a suitable form on the graph paper.  
(Additional graph paper, if required, can be found on page 28.)



8. (continued)

Marks

- (b) Calculate the percentage decrease in temperature in flasks P and Q over the 40-minute period.

P \_\_\_\_\_ %                      Q \_\_\_\_\_ %

1

- (c) The student concluded that the insulation had slowed the cooling rate of the flask.

Describe **two** aspects of the experimental design which make his conclusion invalid.

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

1

- (d) Another student went on to compare flasks of different sizes without any insulation. She compared a 50 cm<sup>3</sup> flask with a 100 cm<sup>3</sup> flask, each completely filled with hot water.

- (i) State **two** variables that would have to be kept the same during this second investigation.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

- (ii) Which flask would cool more quickly? Give a reason for your answer.

Flask \_\_\_\_\_

Reason \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1

- (e) What part of the brain monitors body temperature?

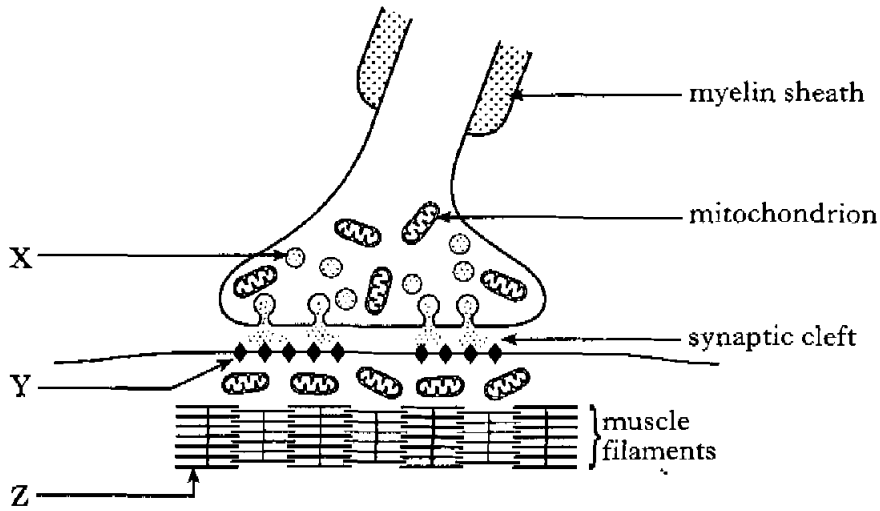
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1

[Turn over

9. The diagram shows a neuromuscular synapse.

Marks



(a) (i) Name cell structure X.

\_\_\_\_\_

1

(ii) Describe the role of structure X in exocytosis.

\_\_\_\_\_

\_\_\_\_\_

1

(b) What is the function of molecule Y?

\_\_\_\_\_

\_\_\_\_\_

1

(c) The areas on both sides of the synaptic cleft are rich in mitochondria. Explain why mitochondria are needed in each area.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2

(d) (i) Name protein filament Z.

\_\_\_\_\_

1

(ii) Describe what happens to the length of this filament when the muscle contracts.

\_\_\_\_\_

1



10. An investigation was carried out to study the serial position effect. Twelve pictures were shown, one by one, to five children. The children were then asked to recall the pictures they saw. The results of the investigation are shown below. The table shows the recall success for each picture.

Marks

Child	Position of picture in list shown to children											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1	✓	✓	✓	✓	×	×	✓	×	✓	✓	✓	✓
2	✓	✓	✓	×	×	✓	×	×	✓	×	✓	✓
3	✓	×	✓	✓	×	×	×	×	×	✓	✓	×
4	✓	✓	×	×	×	×	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	×	✓	×	×	✓	×	✓	✓	✓
Recall (%)	100	80	80	40	20	20	40	40	60	80	100	80

✓ = picture recalled

× = picture forgotten

- (a) (i) Describe the trend shown by these results.

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1

- (ii) Explain these results in terms of the serial position effect.

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3

- (b) To make sure that the children tried their best, the investigation was designed as a competition and the child with the best recall was rewarded.

What behavioural term describes improved performance in competitive situations?

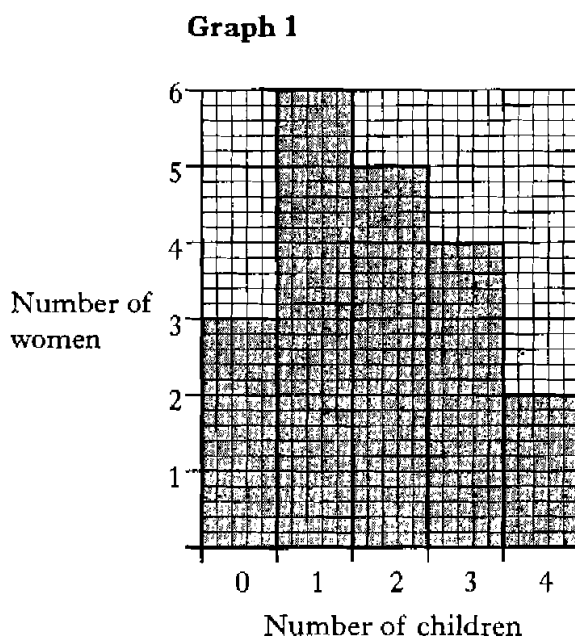
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1

11. Analysis of fertility rates can be used to predict population change over the next hundred years.

Marks

**Graph 1** shows the number of children born to a sample of twenty UK women of reproductive age. The sample was taken in the year 2000.



- (a) The fertility rate for a country is calculated by dividing the total number of children by the number of women in the sample.

(i) From **Graph 1**, calculate the fertility rate of this UK sample.

\_\_\_\_\_

1

(ii) How could the calculation of the UK fertility rate be made more reliable?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1

(iii) The age of each woman is not given. Why might this information be important?

\_\_\_\_\_

\_\_\_\_\_

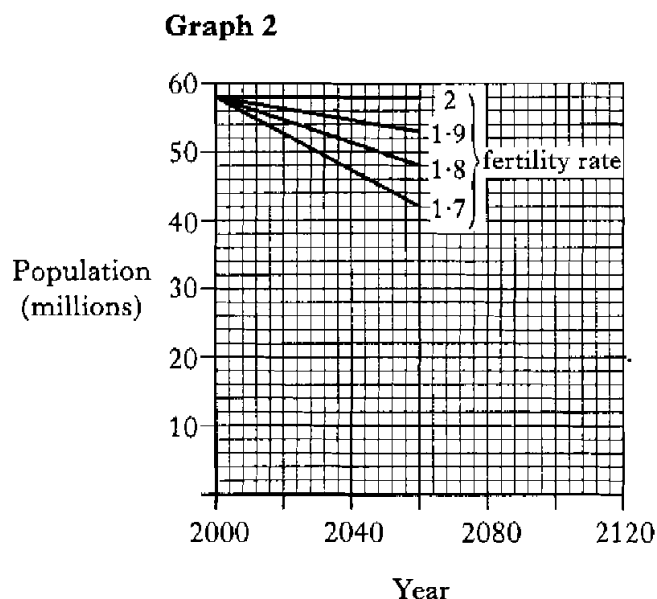
\_\_\_\_\_

1

11. (continued)

Marks

Graph 2 shows the predicted population changes in the UK for four different fertility rates.



(b) Using the fertility rate you calculated from **Graph 1**, predict the population of the UK in the year 2100.

\_\_\_\_\_

1

(c) In a sample of twenty families in Thailand, a developing country, three women have two children, ten women have three children and seven women have four children.

(i) What is the fertility rate for this sample?

*Space for calculation*

\_\_\_\_\_

1

(ii) Suggest a reason for the difference in fertility rate between Thailand and the UK.

\_\_\_\_\_

\_\_\_\_\_

1

(d) Birth rates and death rates can also be used to predict population changes. Give **one** other factor which would affect the size of a population.

\_\_\_\_\_

1

(e) What term is used to describe studies of population statistics such as this?

\_\_\_\_\_

1

12. The tables below contain information about the population of the United Kingdom in the year 2000. Marks

**Table 1** – Populations of individual countries

Country	Population (millions)
England	48.9
Scotland	4.9
Wales	2.7
Nothern Ireland	1.5
<b>Total</b>	<b>58.0</b>

**Table 2** – Population profile of UK

Group	Numbers (millions)
Under 16 years	11.6
16–59 years	34.4
60 years and over	12.0
Males	28.0
Females	30.0

- (a) From **Table 1**, calculate the percentage of the UK population that is Scottish.

*Space for calculation*

\_\_\_\_\_ % 1

- (b) From **Table 2**, calculate the male to female sex ratio.

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_ 1  
male female

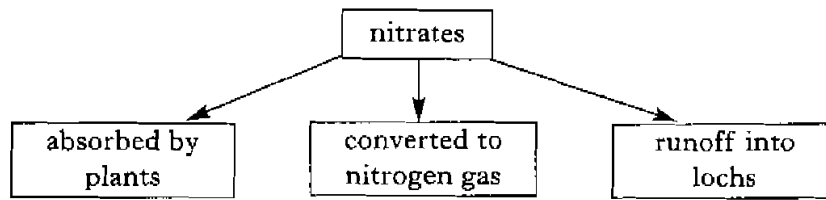
- (c) Use the information in **Tables 1** and **2** to estimate the number of children under sixteen years of age, living in Scotland.

*Space for calculation*

\_\_\_\_\_ 1

Marks

13. The diagram below shows three possible fates of nitrates which have been added to the soil as fertiliser.



- (a) Why are nitrates essential for plant growth?

\_\_\_\_\_

1

- (b) What type of bacteria convert nitrate to nitrogen gas?

\_\_\_\_\_

1

- (c) Explain how the runoff of nitrates into a loch ecosystem might result in a drop in the oxygen concentration of the water.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

2

- (d) Describe **two** ways by which the nitrate content of the soil can increase naturally.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

1

[Turn over for SECTION C on Page twenty-four

**SECTION C**

*Marks*

**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. Give an account of respiration under the following headings:

- (i) the role of ATP within the cell; 4
- (ii) the use of different respiratory substrates. 6

(10)

**OR**

B. Give an account of enzymes under the following headings:

- (i) factors affecting enzyme activity; 7
- (ii) activation of enzymes. 3

(10)

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

2. Answer **either** A or B.

A. Describe the effect of experience on learning. (10)

**OR**

B. Discuss the impact of an increasing population on the world's water supplies. (10)

[END OF QUESTION PAPER]