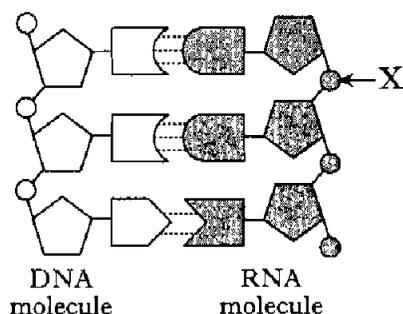


SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

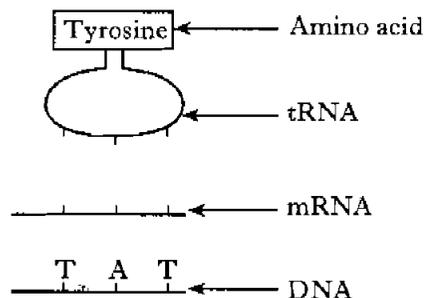
1. The diagram represents part of a molecule of DNA on which a molecule of RNA is being synthesised.



What does component X represent?

- A Ribose sugar
 - B Deoxyribose sugar
 - C Phosphate
 - D Ribose phosphate
2. DNA controls the activities of a cell by coding for the production of
- A proteins
 - B carbohydrates
 - C amino acids
 - D bases.

3. The diagram shows a stage in the synthesis of part of a polypeptide.



Identify the triplet codes for the amino acid tyrosine.

	<i>mRNA</i>	<i>tRNA</i>
A	ATA	UAU
B	UAU	AUA
C	AUA	UAU
D	ATA	TAT

4. The base sequence of a short piece of DNA is shown below.

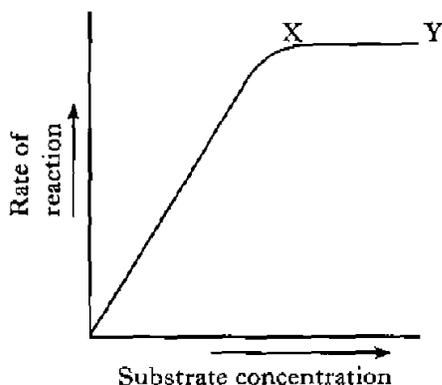
A G C T T A C G

During replication, an inversion mutation occurred on the complementary strand synthesised on this piece of DNA.

Which of the following is the mutated complementary strand?

- A T C G A A T G A
- B A G C T T A G C
- C T C G A A T C G
- D T C G A A T G C

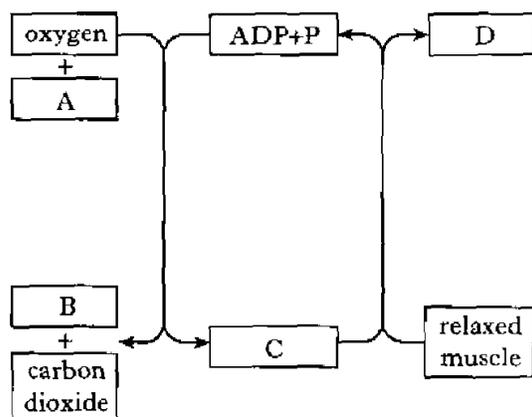
5. The graph shows the effect of substrate concentration on the rate of an enzyme-controlled reaction.



The graph levels out between points X and Y because the

- A enzyme is denatured
 - B active sites are saturated with substrate
 - C enzyme is inhibited
 - D enzyme is activated.
6. When a protease enzyme is added to an amylase solution, which of the following could be produced?
- A Amino acids
 - B Maltose
 - C Glucose
 - D Glycrol

7. The diagram below represents stages in tissue respiration.



Which box represents ATP?

8. A piece of muscle was cut into three strips X, Y and Z and treated as described in the table.

Their final lengths were then measured.

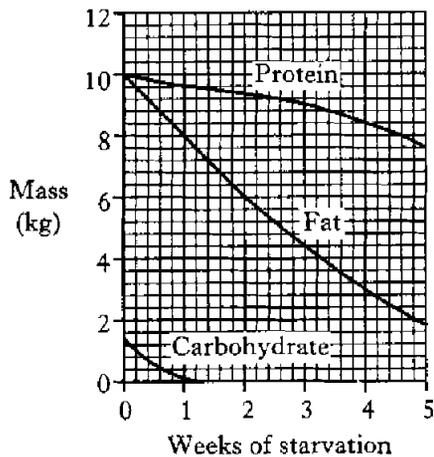
Muscle strip	Solution added to muscle	Muscle length (mm)	
		Start	After 10 minutes
X	1% glucose	50	50
Y	1% ATP	50	45
Z	1% ATP boiled and cooled	50	46

From the data it may be deduced that

- A ATP is not an enzyme
 - B muscles contain many mitochondria
 - C muscles synthesise ATP in the absence of glucose
 - D muscles do not use glucose as a source of energy.
9. Which line in the table has pairs of statements which are true with regard to aerobic respiration and anaerobic respiration in human muscle tissue?

	Aerobic respiration	Anaerobic respiration
A	There is a net gain of ATP	Carbon dioxide is not produced
B	There is a net gain of ATP	Oxygen is used up
C	Carbon dioxide is evolved	There is a net loss of ATP
D	Lactic acid is formed	Ethanol is formed

10. The graph below shows changes which occur in the masses of protein, fat and carbohydrate in a boy's body during five weeks of starvation.



The boy weighs 60 kg. Predict his weight after two weeks without food.

- A 43 kg
 B 50 kg
 C 54 kg
 D 57 kg
11. Which of the following will result in the gain of active immunity by the body?
- A Transfer of antibodies across the placenta
 B Injection of antitoxin
 C Suckling of breast milk
 D Invasion by viruses
12. Which of the following reactions describes autoimmunity?
- A The production of antibodies in response to infection
 B The rapid production of antibodies in response to reinfection
 C The production of antibodies in response to immunisation
 D The production of antibodies in response to the body's own cells

13. Two parents, one of blood group A and the other of blood group B, have four children.

The phenotypes of the children are all different – blood group A, blood group B, blood group AB and blood group O.

What are the genotypes of the parents?

- A $AA \times BB$
 B $AO \times BO$
 C $AA \times BO$
 D $AO \times BB$
14. Which one of the following statements about sex-linked traits is true?
- A A female transmits her sex-linked traits to her daughters only.
 B A male transmits his sex-linked traits to his sons only.
 C A male transmits his sex-linked traits to his grandchildren via his daughters only.
 D A female transmits her sex-linked traits to her grandchildren via her sons only.

15. Colour blindness is a sex-linked trait. A man with normal vision marries a woman with normal vision. They have a son who is colour blind.

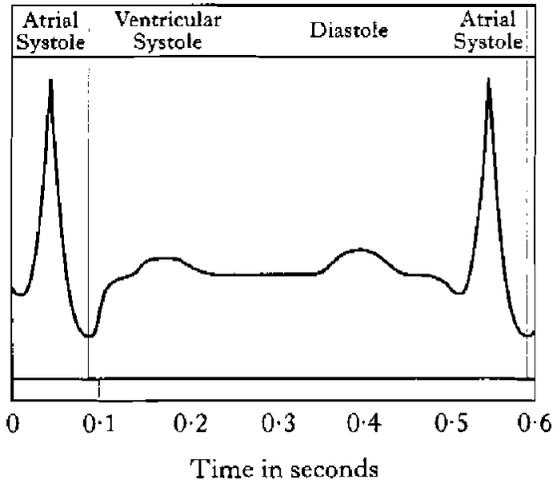
What is the chance of their next son being colour blind?

- A no chance
 B 1 in 2
 C 1 in 3
 D 1 in 4
16. The function of the seminal vesicles is to
- A produce nutrients for sperm
 B allow sperm to mature
 C store sperm temporarily
 D produce testosterone.

[Turn over

17. Which of the following is the sequence of events following fertilisation?
- A Cleavage → Differentiation → Implantation
 - B Implantation → Differentiation → Cleavage
 - C Differentiation → Implantation → Cleavage
 - D Cleavage → Implantation → Differentiation

18. The electrocardiogram shown below records the beat of a human heart.



What is the heart rate?

- A 60 beats/minute
 - B 70 beats/minute
 - C 75 beats/minute
 - D 120 beats/minute
19. Which of the following is **not** a function of the lymphatic system?
- A It returns excess tissue fluid to the blood.
 - B It transports fat from the small intestine.
 - C It destroys bacteria.
 - D It causes the clotting of blood at wounds.

20. The following data refer to the breathing of an athlete resting and just after a race.

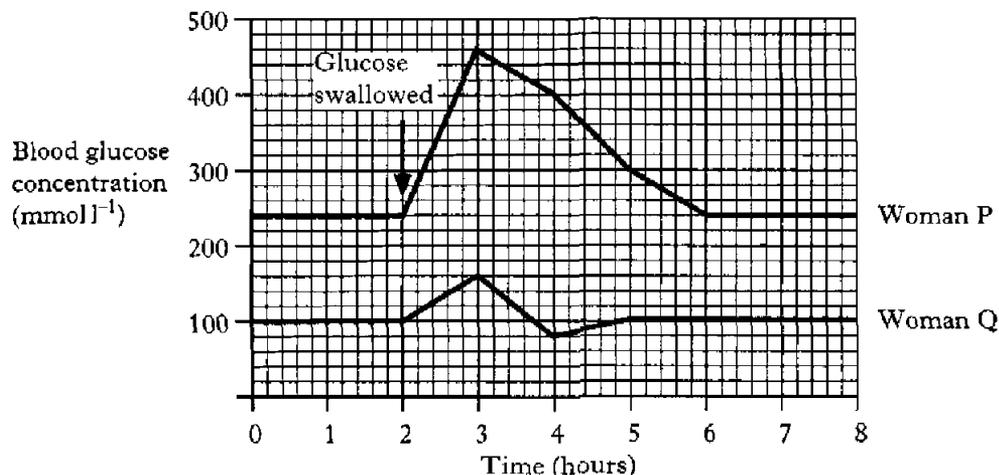
	<i>Breathing Rate</i> (per minute)	<i>Tidal Volume</i> (litres)	<i>% Carbon dioxide in exhaled air</i>
Resting	12	0.3	5
After race	24	1	5

Assuming the rate of breathing remains constant, what would be the volume of carbon dioxide breathed out during the first two minutes after exercise?

- A 0.18 litres
 - B 0.36 litres
 - C 1.2 litres
 - D 2.4 litres
21. Which line in the table below identifies correctly the sites of secretion of the hormones ADH and glucagon?

	<i>ADH</i>	<i>Glucagon</i>
A	pituitary gland	liver
B	kidney	liver
C	kidney	pancreas
D	pituitary gland	pancreas

22. The graph below shows the blood glucose concentrations of two women before and after each swallowed 50 g of glucose.



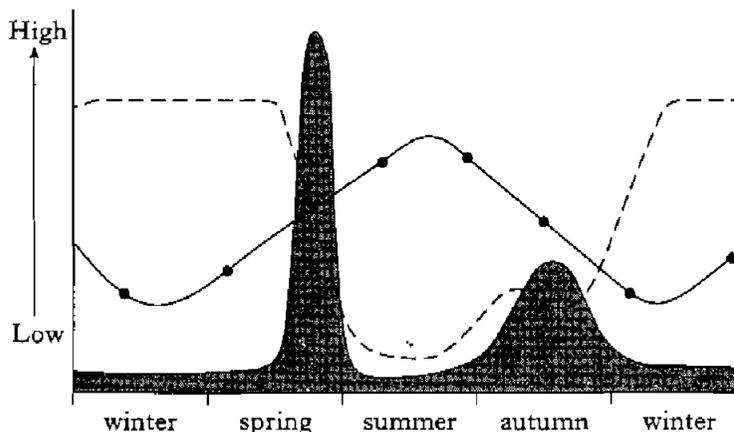
When did the rate of change of blood glucose concentration of the two women differ most?

- A Between hours 2 and 3
 B Between hours 3 and 4
 C Between hours 4 and 5
 D Between hours 5 and 6
-
23. Both nerves and hormones are involved in the control of homeostatic mechanisms.
- In which of the following are the homeostatic mechanisms related correctly to their principal methods of control?
- | | Osmoregulation | Body Temperature |
|---|----------------|------------------|
| A | Nerves | Hormones |
| B | Hormones | Nerves |
| C | Nerves | Nerves |
| D | Hormones | Hormones |
24. The human cerebrum has a highly convoluted surface. This increased surface area allows an
- A increase in the types of neurones present
 B increased blood supply to the brain
 C increased number of interconnections between neurones
 D increase in the amount of white matter on the surface.
25. Which parts of the body are controlled by the largest motor area of the cerebrum?
- A Hands and lips
 B Feet and hands
 C Legs and feet
 D Legs and arms
26. Vision in dim light is improved by the rods having
- A diverging neural pathways
 B converging neural pathways
 C reflex neural pathways
 D peripheral neural pathways.
27. The retrieval of information from long term memory is often aided by remembering the situation in which the information was encoded. This is described as using
- A contextual cues
 B chunking techniques
 C rehearsal methods
 D memory span.
28. The transformation of information into a form that memory can accept is called
- A shaping
 B retrieval
 C encoding
 D storage.

[Turn over

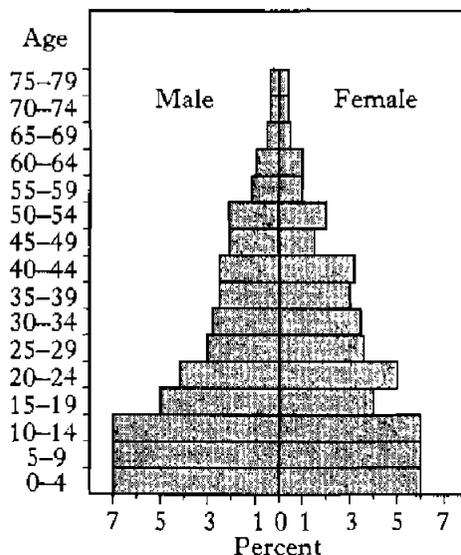
29. The graph shows how the algal population in a freshwater lake is affected by changes in the nitrate concentration in the water and by the changes in light intensity over the year.

Key Size of algal population ■
 Nitrate concentration - - - -
 Light intensity ● — ●



Which of the following statements may be deduced from the graph?

- A The increase in the algal population in the spring is triggered by a high concentration of nitrate.
 - B The changes in size of the algal population are related directly to changes in light intensity.
 - C The increasing concentration of nitrate in the autumn is followed by an increase in the algal population.
 - D The size of the algal population is inversely proportional to light intensity.
30. The diagram below shows the population of a country as a percentage distribution by age.



What percentage of the population is under 15 years of age?

- A 21%
- B 39%
- C 48%
- D 49%

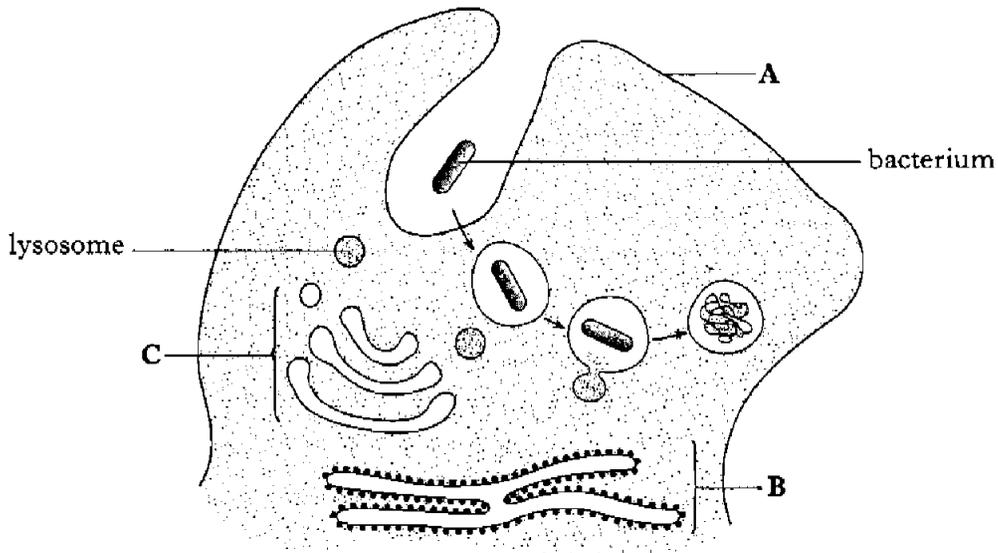
Candidates are reminded that the answer sheet **MUST** be returned **INSIDE** this answer booklet.

SECTION B

Marks

All questions in this section should be attempted.

1. The diagram shows the sequence of events as a white blood cell engulfs and destroys a bacterium.



- (a) Name the structures **A**, **B** and **C**.

A _____

B _____

C _____

2

- (b) (i) What is the name given to this process of engulfing the bacterium?

1

- (ii) Describe the roles of structures **B** and **C** in the cell.

B _____

1

C _____

1

- (c) What does the lysosome contain?

1

1. (continued)

Marks

(d) (i) Analysis of a blood sample yielded the following blood cell counts.

Cell type	Number per mm ³ (× 1000)
White	8
Red	5600

Express as a simple ratio the number of white cells to red cells in this blood sample.

Space for calculation

_____ : _____ 1

(ii) Predict how the proportion of white cells to red cells would change if a person was suffering from influenza.

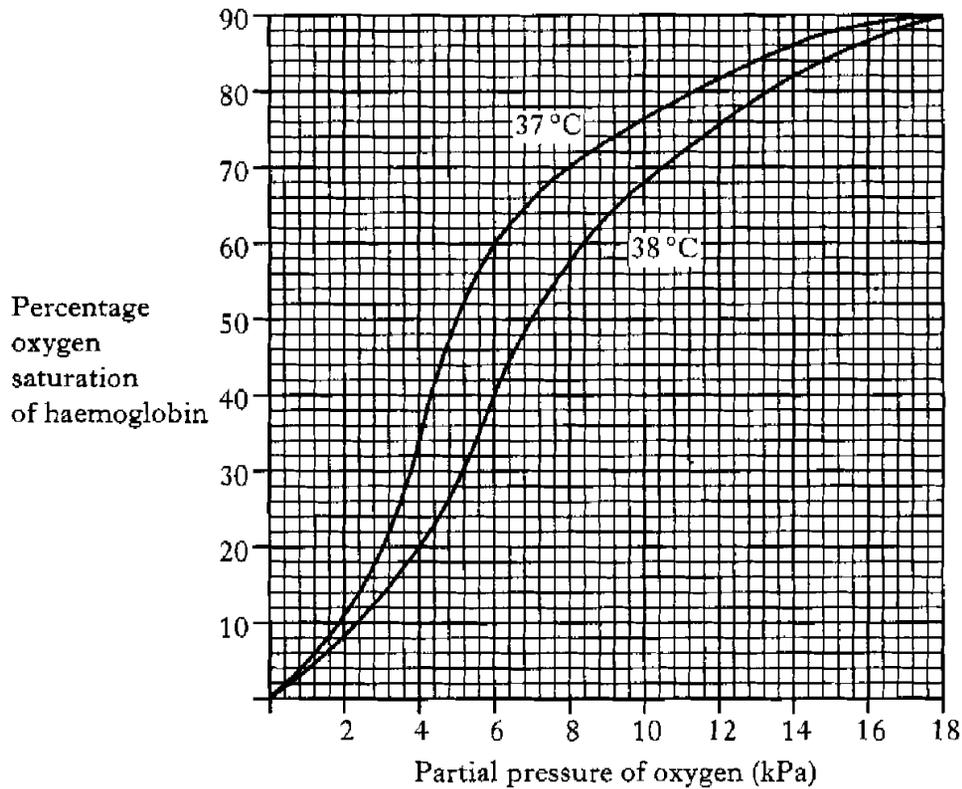
_____ 1

(e) Explain how the shape of the red blood cell is related to its function.

2

[Turn over

2. The graph below shows oxygen-haemoglobin dissociation curves at 37°C and at 38°C. Marks



- (a) (i) Complete the table below to show the change in percentage oxygen saturation of haemoglobin at 37°C and 38°C when the partial pressure drops from 18 to 6 kPa.

Partial pressure kPa	Percentage oxygen saturation of haemoglobin	
	37°C	38°C
18		
6		
change		

2

- (ii) Explain why this change in percentage oxygen saturation of haemoglobin improves the efficiency of working muscles.

2

- (b) The partial pressure of oxygen in fresh air is 20 kPa. The partial pressure of oxygen in the alveoli is 16 kPa. Explain why there is a lower value for oxygen in the alveoli.

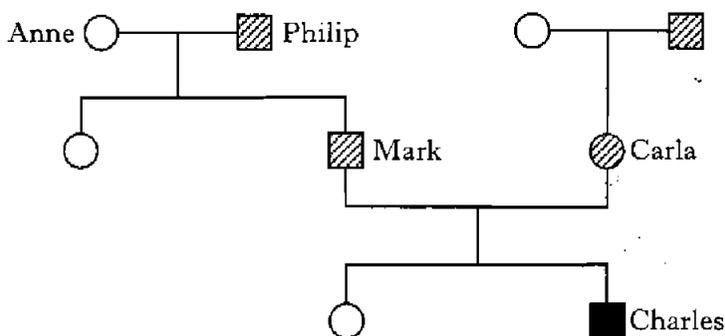
1

Marks

3. Thalassaemia is an inherited blood disorder in which haemoglobin is affected. The condition illustrates incomplete dominance in which the recessive allele has a partial effect. Heterozygous individuals show mild symptoms.

The diagram below shows the incidence of thalassaemia in three generations of a family.

-  male with mild thalassaemia
-  female with mild thalassaemia
-  male with severe thalassaemia
-  unaffected female



- (a) Using the symbol Hb^A to represent the allele for normal haemoglobin, and the symbol Hb^B to represent the recessive allele, complete the table to show the genotypes of Anne, Philip and Charles.

Individual	Genotype
Anne	
Philip	
Charles	

2

- (b) Mark and Carla have a third child. What is the percentage chance that the child will have the same genotype as the parents?

Space for calculation

_____ % 1

- (c) Haemoglobin is found in red blood cells. Where in the body are red cells manufactured and destroyed?

Manufactured _____ Destroyed _____ 2

[Turn over

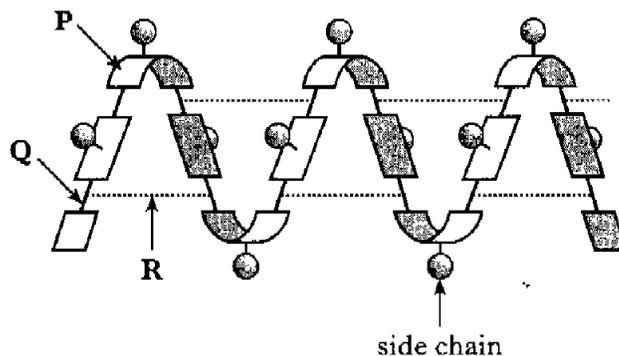
Marks

4. The diagram shows part of an enzyme molecule.

P represents a molecule in the chain which forms the primary structure of the protein.

Q is a bond which links these molecules.

R is a bond which maintains the secondary structure of the protein.



(a) (i) Identify molecule **P**.

1

(ii) Name bonds **Q** and **R**.

Q _____ **R** _____

2

(b) (i) Why are some digestive enzymes produced in an inactive form?

1

(ii) Give an example of a substance which can act as an enzyme activator.

1

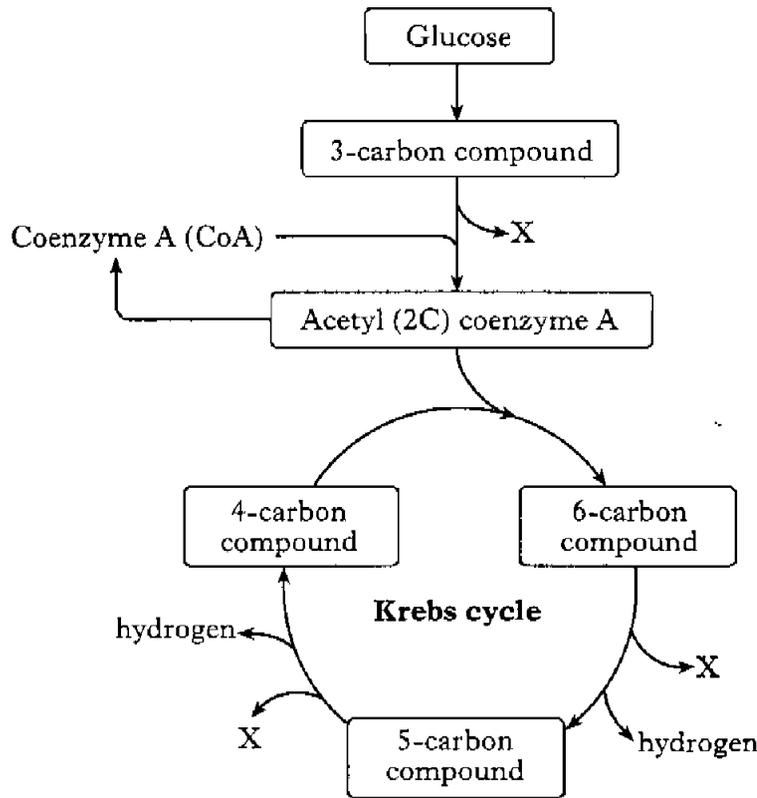
(c) The table below contains information about the effects of environmental factors on enzymes. Complete the table.

<i>Factor</i>	<i>Type of change</i>	<i>Effect on enzyme structure</i>
high temperature		alters active site
	mutation	

3

5. The diagram below represents two stages in the chemistry of respiration in a cell which is respiring aerobically.

Marks



- (a) Name the 3-carbon compound and the 6-carbon compound.
- 3C _____
- 6C _____
- (b) Draw a line across the diagram to indicate where this series of reactions would stop if oxygen were not available.
- (c) State the precise location of the Krebs cycle within the cell.
- _____
- (d) Complete the table below to name product X and to describe what happens to each of the products.

Product	Fate of product
X _____	
Hydrogen	

2

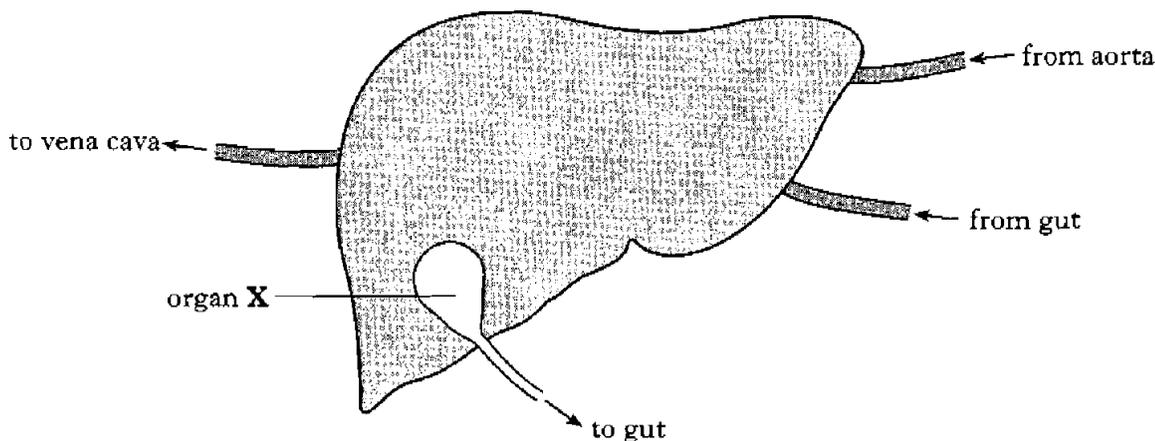
1

1

2

6. The diagram below shows the liver with its blood supply and an associated organ.

Marks



(a) Name the liquid stored in organ X.

1

(b) Complete the table to identify the blood vessels carrying blood to and from the liver and the type of blood carried by each vessel.

Blood supply	Name of blood vessel	Deoxygenated or oxygenated blood
from aorta		
from gut		
to vena cava		

3

(c) Complete the following sentences by underlining one option in each set of brackets.

Deamination occurs in the { gall bladder / kidney / liver }. During this process excess

{ nucleic acids / amino acids / fatty acids } are broken down. A waste product of this process is

{ urea / glycogen / glucose } which is carried in the blood to the { urinary bladder / kidney / liver } where it is

removed from the blood.

2

(d) Name a hormone involved in the processing of carbohydrate in the liver.

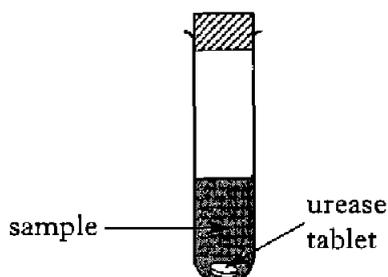
1

Marks

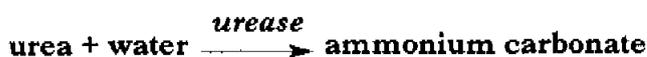
7. An investigation was carried out to determine the urea content of three samples taken from a healthy individual. The three fluids sampled were:

- A plasma from the renal artery
- B plasma from the renal vein
- C urine from the urethra.

One urease tablet was added to each sample as shown in the diagram below.



The urease catalyses the breakdown of urea to ammonium carbonate.



Once the reaction had finished, the samples were analysed to determine the concentration of ammonium carbonate.

(a) List **two** variables which would have to be kept constant for a valid comparison of the three samples.

- 1 _____
- 2 _____

2

(b) The table below shows the results of this investigation.

Complete the table to identify the three samples.

Fluid sample (A, B or C)	Ammonium carbonate concentration (g/litre)
	0.16
	16.7
	0.52

1

(c) Suggest how the investigation could be improved to ensure the reliability of the results.

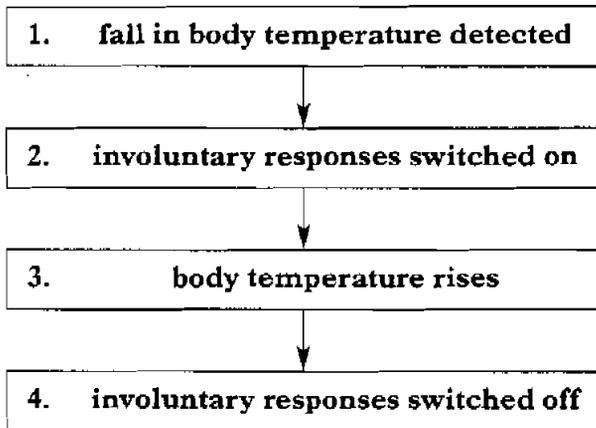
- _____
- _____

1

[Turn over

8. The diagram below shows stages in the control of a person's body temperature.

Marks



(a) Where in the body is the temperature monitoring centre located?

1

(b) State **two** involuntary responses which may be switched on in this individual.

1 _____

2 _____

2

(c) Explain the role of negative feedback control in this process.

2

(d) The table below shows the surface area and mass of a baby and an adult.

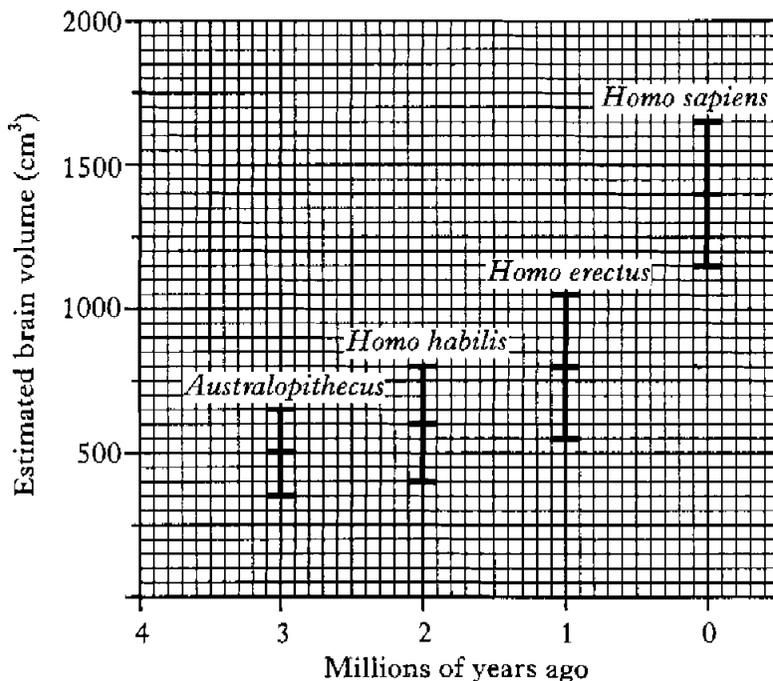
	Surface area (m ²)	Mass (kg)
Baby	0.2	4
Adult	2.0	80

With reference to the table, explain why babies are more susceptible to hypothermia than adults.

2

9. The graph shows increases in brain volume at four stages of human evolution over the last four million years. Marks

The bars indicate the range of volumes and the mid (median) volume.



- (a) State the range of brain volume for *Homo habilis*.

_____ to _____ cm³

1

- (b) Complete the table below for *Homo sapiens*.

Species	Median volume (cm ³)	Percentage increase
<i>Australopithecus</i>	500	-
<i>Homo habilis</i>	600	20%
<i>Homo erectus</i>	800	33%
<i>Homo sapiens</i>		

2

- (c) Name the part of the brain which

- (i) contributes most to brain volume;

1

- (ii) links the two hemispheres;

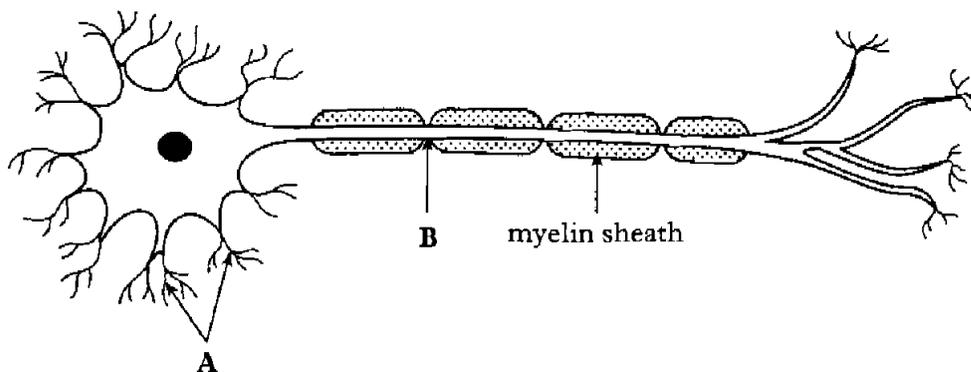
1

- (iii) is rich in the receptor NMDA.

1

10. The diagram represents a motor neurone.

Marks



(a) Name the nerve fibres **A** and **B**.

A _____ **B** _____

1

(b) The table below describes features of somatic and autonomic motor neurone function.

Complete the table.

<i>Feature</i>	<i>Somatic</i>	<i>Autonomic</i>
type of control (conscious/unconscious)		
example of target muscle		uterine muscle
example of neurotransmitter		noradrenaline

2

(c) State the effect of sympathetic stimulation on the:

1 heart rate _____

2 digestive system _____

3 skin arterioles _____

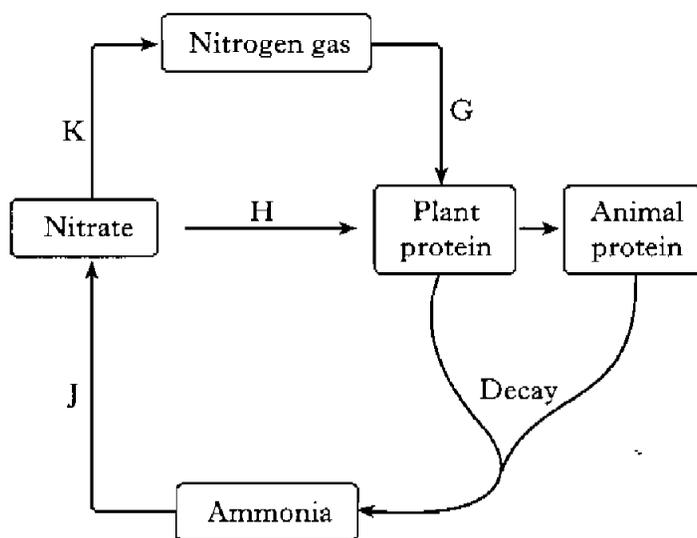
3

(d) The sympathetic and parasympathetic nervous systems often influence organs in opposite ways. What term describes this opposing effect?

1

11. The diagram shows a simplified outline of the nitrogen cycle.

Marks



(a) The table below shows some of the processes involved in the nitrogen cycle. Complete the table using information from the diagram.

Label	Type of bacteria	Process in nitrogen cycle
G		trap atmospheric nitrogen
	nitrifying	
K		convert nitrate to nitrogen gas

2

(b) Nitrate is lost from the soil by leaching. Describe the effect of nitrate pollution on fresh water environments.

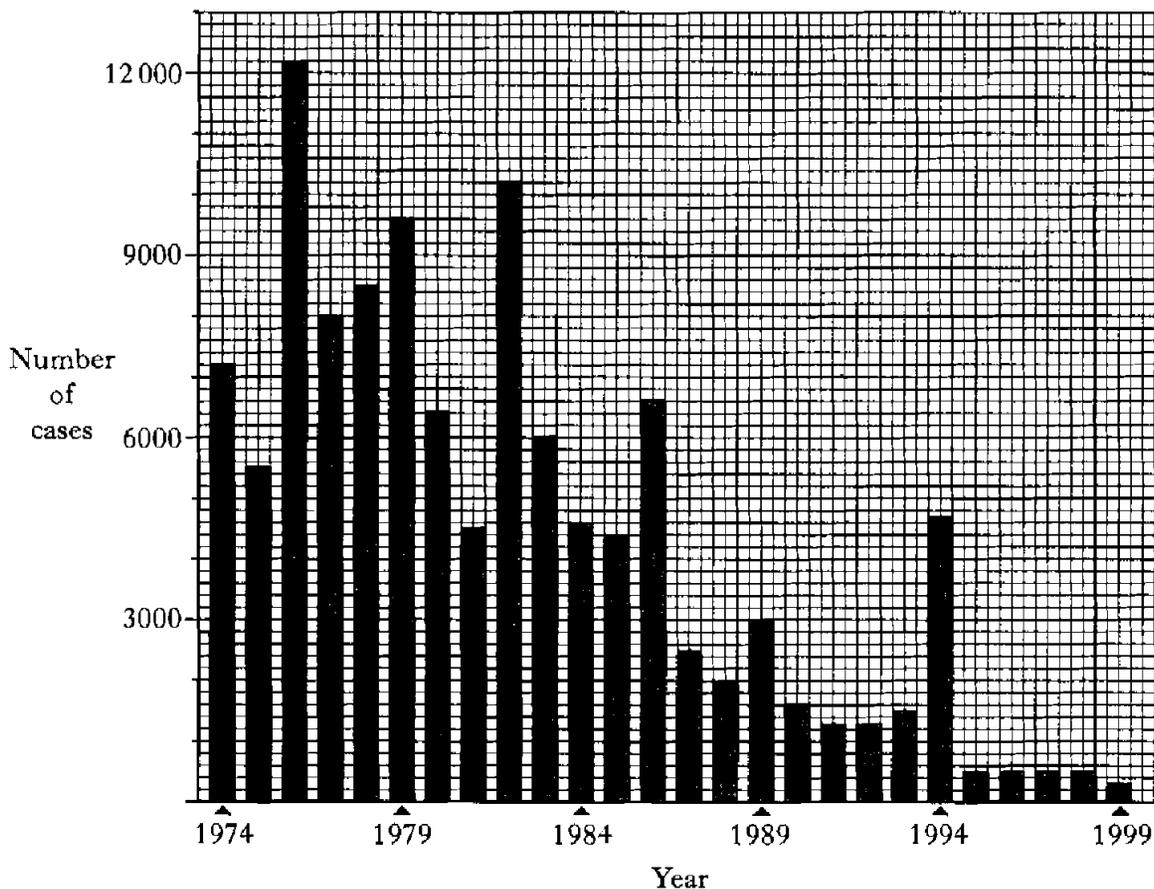
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[Turn over

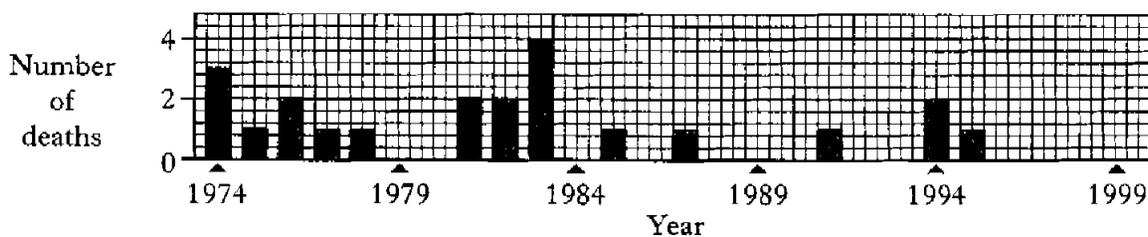
12. **Graphs 1 and 2** below contain information about measles in Scotland from 1974 to 1999.

Marks

Graph 1 – Cases of measles



Graph 2 – Deaths from measles



(a) From **Graph 1** construct a table to show the years in which measles cases were at their lowest and highest levels. The table should include the number of cases in each year.

12. (continued)

Marks

(b) Suggest a reason for the trend in measles cases shown in **Graph 1**.

1

(c) From **Graphs 1** and **2**, what percentage of individuals who contracted measles in 1995 died from the disease?

Space for calculation

_____ %

1

[Turn over

13. The following information relates to the impact of human activities on the carbon cycle in the year 2000.

Table 1 World carbon reserves

<i>Reservoir</i>	<i>Mass of carbon stored</i> (billions of tons of carbon per year)
Oceans	35 000
Fossil fuels	10 000
Soil	1500
Atmosphere	500
Plants	500

Table 2 Mass of carbon released by human activity

<i>Activity</i>	<i>Mass of carbon released</i> (billions of tons of carbon per year)
Burning of fossil fuels	5.5
Deforestation	1.5

Table 3 Annual carbon gain by the atmosphere and the oceans

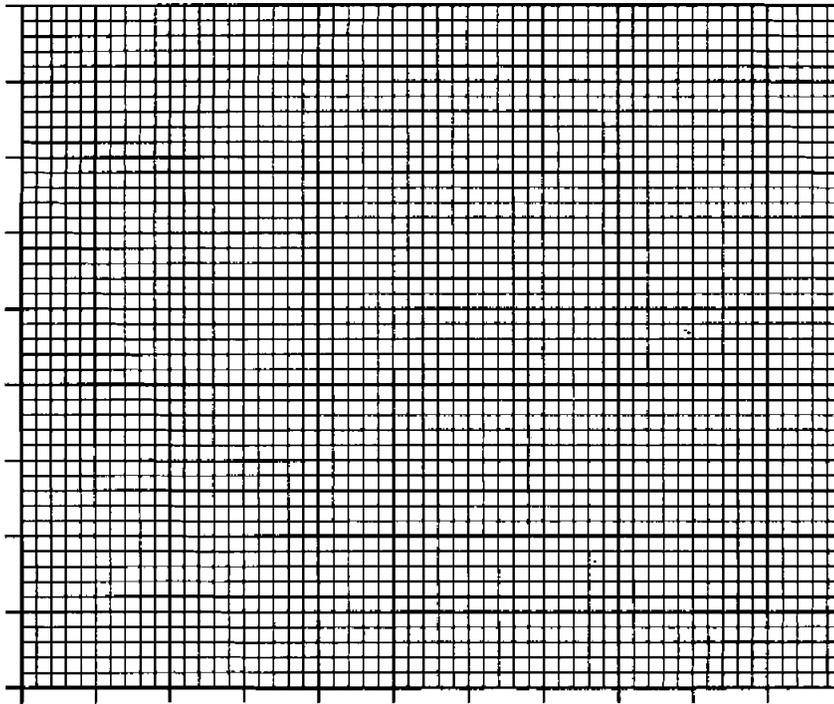
<i>Reservoir</i>	<i>Mass of carbon gained</i> (billions of tons of carbon per year)
Atmospheric carbon	3.3
Oceanic carbon	2.0

Marks

13. (continued)

(a) Construct a bar chart to illustrate the data in **Table 1**.

(Additional graph paper, if required, can be found on page 28.)



2

(b) It is estimated that only 10% of fossil fuel reserves are available for human use. Using information from **Tables 1** and **2** calculate how long these reserves will last.

Space for calculation

1

(c) Use the information from **Tables 1** and **3** to estimate the number of years it will take for atmospheric carbon to exceed 550 billion tons.

Space for calculation

1

(d) State **two** likely consequences of increased atmospheric carbon levels on global climate patterns.

1 _____

2 _____

2

Marks

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. Discuss the influence of others on an individual's behaviour under the following headings:

- (i) Social facilitation; 3
- (ii) Deindividuation; 3
- (iii) Influences that change beliefs. 4

(10)

OR

B. Discuss the exponential growth of the human population under the following headings:

- (i) Demographic trends; 2
- (ii) Agriculture; 4
- (iii) Disease. 4

(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 influence of hormones on the testes. (10)

OR

B. Describe the events which take place in the first half of the menstrual cycle. (10)

[END OF QUESTION PAPER]