FOR OFFICIAL USE

Total for Sections B & C

X009/12/02

NATIONAL QUALIFICATIONS 2012

WEDNESDAY, 23 MAY
1.00 PM – 3.30 PM

HUMAN BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

SECTION A—Questions 1–30

Instructions for completion of Section A are given on page two.

For this section of the examination you must use an **HB pencil**.

SECTIONS B AND C

1 (a) All questions should be attempted.

(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.

2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.

3 Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the Invigilator and should be inserted inside the **front** cover of this book.

4 The numbers of questions must be clearly inserted with any answers written in the additional space.

5 Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required a supplementary sheet for rough work may be obtained from the Invigilator.

6 Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.

Read carefully

1 Check that the answer sheet provided is for **Human Biology Higher (Section A)**.

2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.

3 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

4 If any of this information is wrong, tell the Invigilator immediately.

5 If this information is correct, **print** your name and seat number in the boxes provided.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).

7 There is **only one correct** answer to each question.

8 Any rough working should be done on the question paper or the rough working sheet, not on your answer sheet.

9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

The digestive enzyme pepsin is most active in the

A stomach

B mouth

C duodenum

D pancreas.

The correct answer is **A**—stomach. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).

Changing an answer

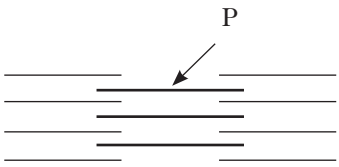
If you decide to change your answer, carefully erase your first answer and, using your pencil, fill in the answer you want. The answer below has been changed to **D**.

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 some protein filaments in muscle. Which protein is labelled with the letter P?



A Actin

B Adenine

C Adenosine

D Myosin

2. The following cell components are involved in the synthesis and secretion of an enzyme.

1 Golgi apparatus

2 Ribosome

3 Cytoplasm

4 Endoplasmic reticulum

Which of the following identifies correctly the route an amino acid molecule would follow as an enzyme is synthesised and secreted?

A 3 2 1 4

B 2 4 3 1

C 3 2 4 1

D 3 4 2 1

3. How many adenine molecules are present in a DNA molecule of 4000 bases, if 20% of the base molecules are cytosine?

A 400

B 600

C 800

D 1200

4. The following statements refer to respiration:

1 Carbon dioxide is released

2 Occurs during aerobic respiration

3 The end product is pyruvic acid

4 The end product is lactic acid

Which statements refer to glycolysis?

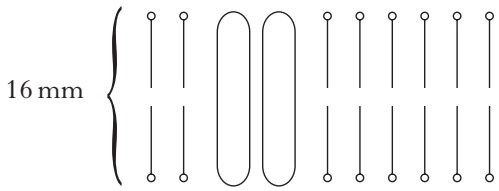
A 1 and 4

B 2 and 3

C 1 and 3

D 2 and 4

5. The diagram below represents a cross-section of a membrane magnified 2 million times.



What is the actual width of the membrane?

$1\text{ nm} = 1 \times 10^{-6}\text{ mm}$

A 1·6 nm

B 3·2 nm

C 8·0 nm

D 16·0 nm

6. During the manufacture of protein in a cell, the synthesis of mRNA occurs in the

A nucleus

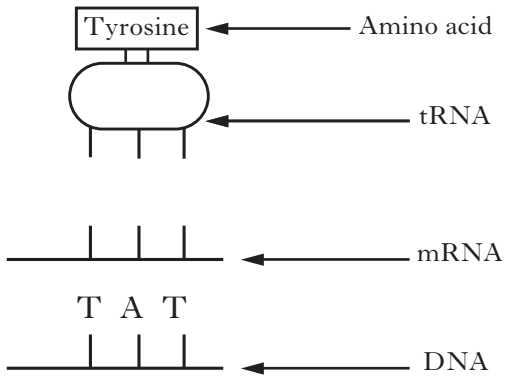
B ribosomes

C Golgi body

D endoplasmic reticulum.

[Turn over

7. The following diagram shows some stages in the synthesis of part of a polypeptide.



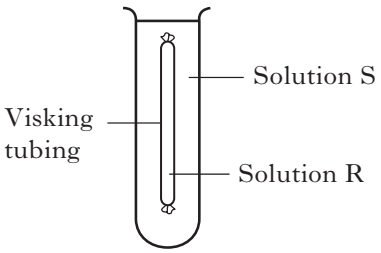
Identify the triplet codes for the amino acid tyrosine.

	On mRNA	*On tRNA*
A	ATA	UAU
B	UAU	AUA
C	AUA	UAU
D	ATA	TAT

8. Visking tubing is selectively permeable. In the experiment shown below, to demonstrate osmosis, the following results were obtained.

Initial mass of visking tubing + contents = 10·0 g

Mass of visking tubing + contents after experiment = 8·2 g



The results shown would be obtained when

A R is a 5% salt solution and S is a 10% salt solution

B R is a 10% salt solution and S is a 5% salt solution

C R is a 10% salt solution and S is water

D R is a 5% salt solution and S is water.

9. In the formation of gametes when does DNA replication occur?

A At the separation of chromatids

B As homologous chromosomes pair

C Before the start of meiosis

D At the end of the first meiotic division

10. Identical twins can result from

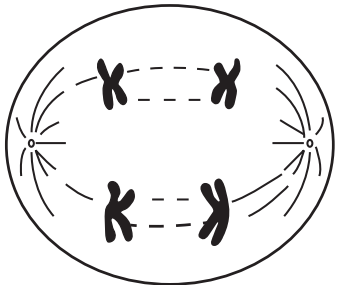
A a haploid egg fertilised by a single sperm

B a haploid egg fertilised by two identical sperm

C a diploid egg fertilised by a single sperm

D two haploid eggs fertilised by two identical sperm.

11. The diagram below represents a stage in the division of a cell.



Which line of the table identifies correctly the type of division and the number of chromosomes?

	Type of division	*Number of chromosomes*
A	mitosis	8
B	mitosis	4
C	meiosis	8
D	meiosis	4

12. Phenylketonuria is caused by a single autosomal gene.

A man and a woman, who are unaffected, have an affected child.

What is the probability that their next child will be affected?

A 25%

B 50%

C 75%

D 100%

13. The offspring from a mother who is homozygous for blood group A and a father who is heterozygous for blood group B, will have a blood group which is

A AB or A

B AB or B

C A or B

D A or O.

14. A function of the interstitial cells in the testes is to produce

A sperm

B testosterone

C seminal fluid

D follicle stimulating hormone (FSH).

15. Which of the following is the sequence of events following fertilisation?

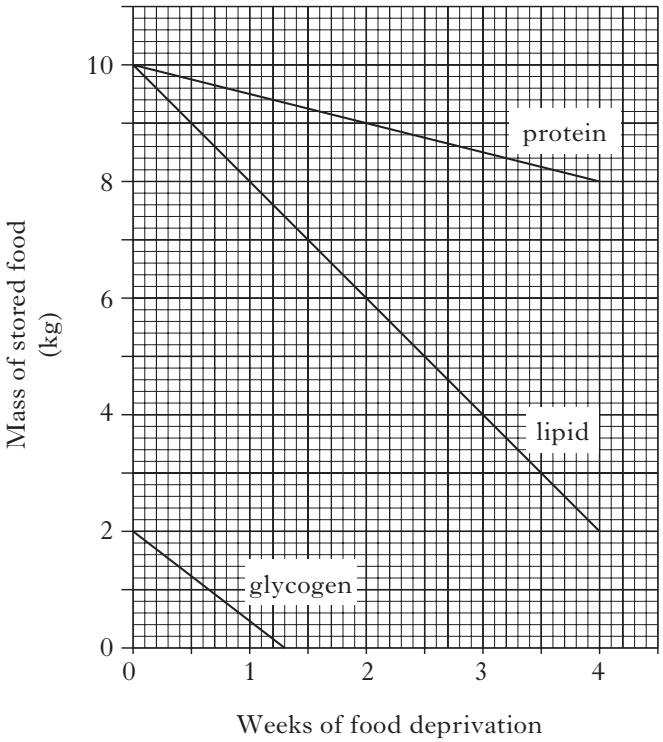
A Cleavage ⟶ Differentiation ⟶ Implantation

B Implantation ⟶ Differentiation ⟶ Cleavage

C Differentiation ⟶ Implantation ⟶ Cleavage

D Cleavage ⟶ Implantation ⟶ Differentiation

16. The graph below shows the changes which occur in a body's food stores during four weeks of food deprivation.



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

A The glycogen food store decreases at the fastest rate during week one.

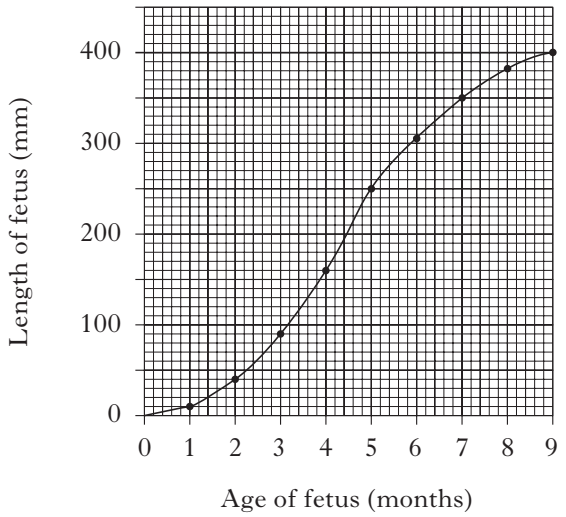
B Between weeks three and four the body gains most energy from protein.

C Each food store decreases at a constant rate during week one.

D Between weeks one and four the body only gains energy from lipid and protein.

[Turn over

17. The graph below shows the growth in length of a human fetus before birth.



What is the percentage increase in length of the fetus during the final 4 months of pregnancy?

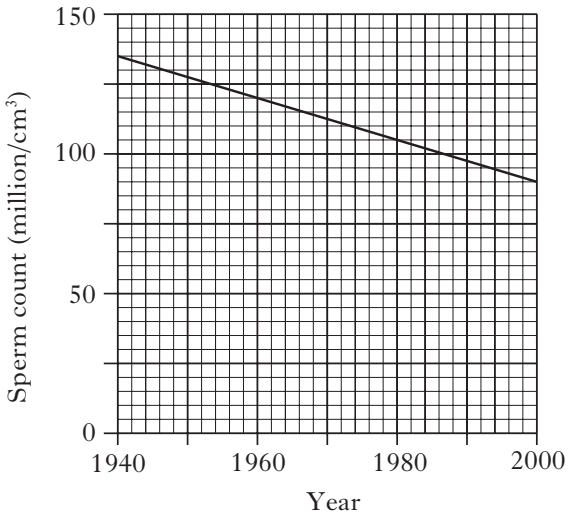
A 33·3

B 60·0

C 62·5

D 150·0

18. The sperm counts of a sample of men taken between 1940 and 2000 are shown in the graph below.



What is the average reduction in sperm count per year?

A 0·67 million/cm^3/year

B 0·75 million/cm^3/year

C 0·92 million/cm^3/year

D 45 million/cm^3/year

19. The effect on the kidney of a high concentration of antidiuretic hormone (ADH) in the blood is to

A increase tubule permeability which increases water reabsorption

B decrease tubule permeability which prevents excessive water loss

C increase glomerular filtration rate which increases urine production

D decrease glomerular filtration rate which reduces urine production.

20. Compared to the blood in the renal artery, the blood in the renal vein has a higher concentration of

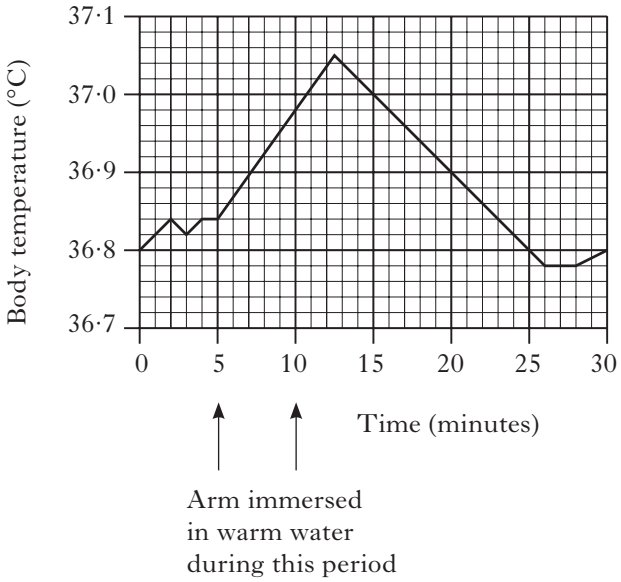
A oxygen

B carbon dioxide

C glucose

D urea.

21. The graph below records the body temperature of a woman during an investigation in which her arm was immersed in warm water for 5 minutes.



By how much did the temperature of her body vary during the 30 minutes of the investigation?

A 2·7 °C

B 0·27 °C

C 2·5 °C

D 0·25 °C

22. The flow chart below shows how the concentration of glucose in the blood is regulated.

Blood glucose concentration rises → Pancreas secretes less of compound X and more of compound Y → Liver converts glucose to insoluble carbohydrate → Blood glucose concentration falls

Which line identifies correctly the compounds X and Y?

	Compound X	*Compound Y*
A	glycogen	insulin
B	insulin	glycogen
C	glucagon	insulin
D	insulin	glucagon

23. The somatic nervous system controls the

A skeletal muscles

B heart and blood vessels

C endocrine glands

D muscular wall of the gut.

24. The following is a list of body parts:

1 tongue

2 eyebrows

3 hands

4 eyes.

Which of these body parts can be used in non-verbal communication?

A 3 only

B 2 and 4 only

C 2, 3 and 4 only

D 1, 2, 3 and 4

25. An athlete has a much better chance of achieving a "personal best" time in a race rather than in training because of

A internalisation

B deindividuation

C identification

D social facilitation.

26. The rewarding of patterns of behaviour which approximate to desired behaviour is called

A generalisation

B discrimination

C extinction

D shaping.

27. In the nitrogen cycle, which of the following processes is carried out by nitrifying bacteria?

The conversion of

A nitrate to ammonia

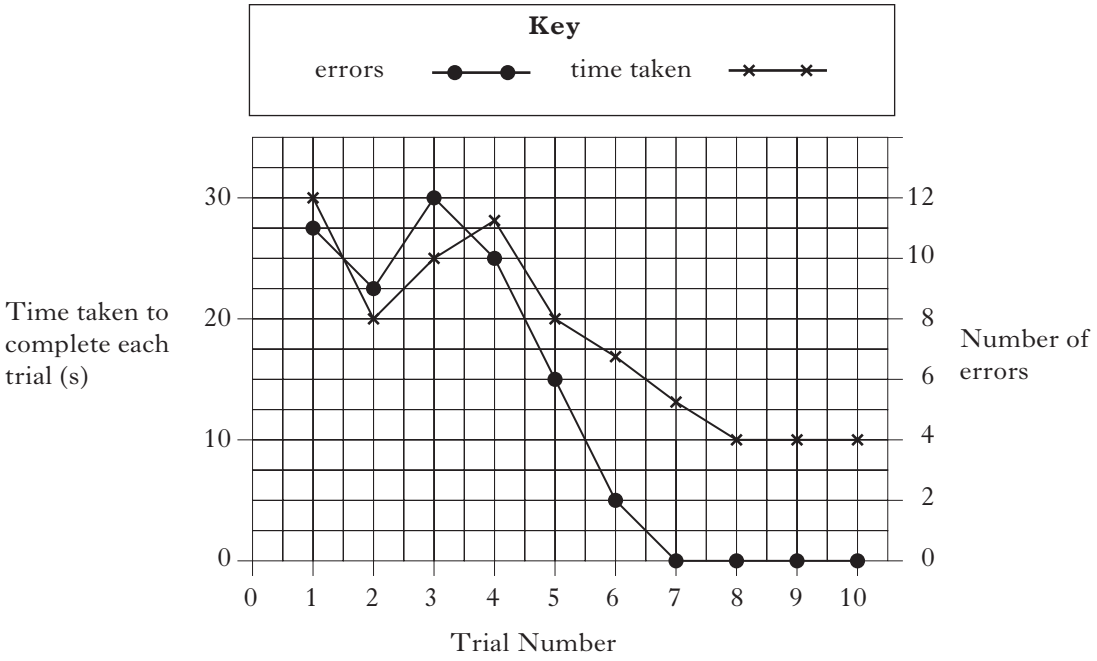
B nitrogen gas to ammonia

C ammonia to nitrate

D nitrogen gas to nitrate.

[Turn over

28. The graph below shows the time taken by a student to complete a finger maze, over a number of trials, and the number of errors at each trial.



Which of the following statements is correct?

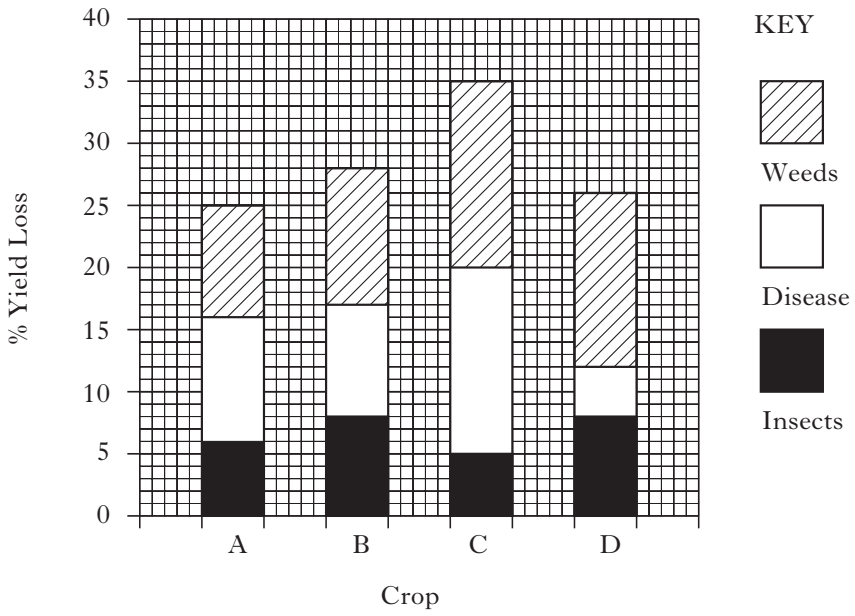
A The fastest time to complete the maze correctly is 4 seconds.

B The time taken at trial 5 is 20 seconds.

C When the number of errors is 10, the time taken is 25 seconds.

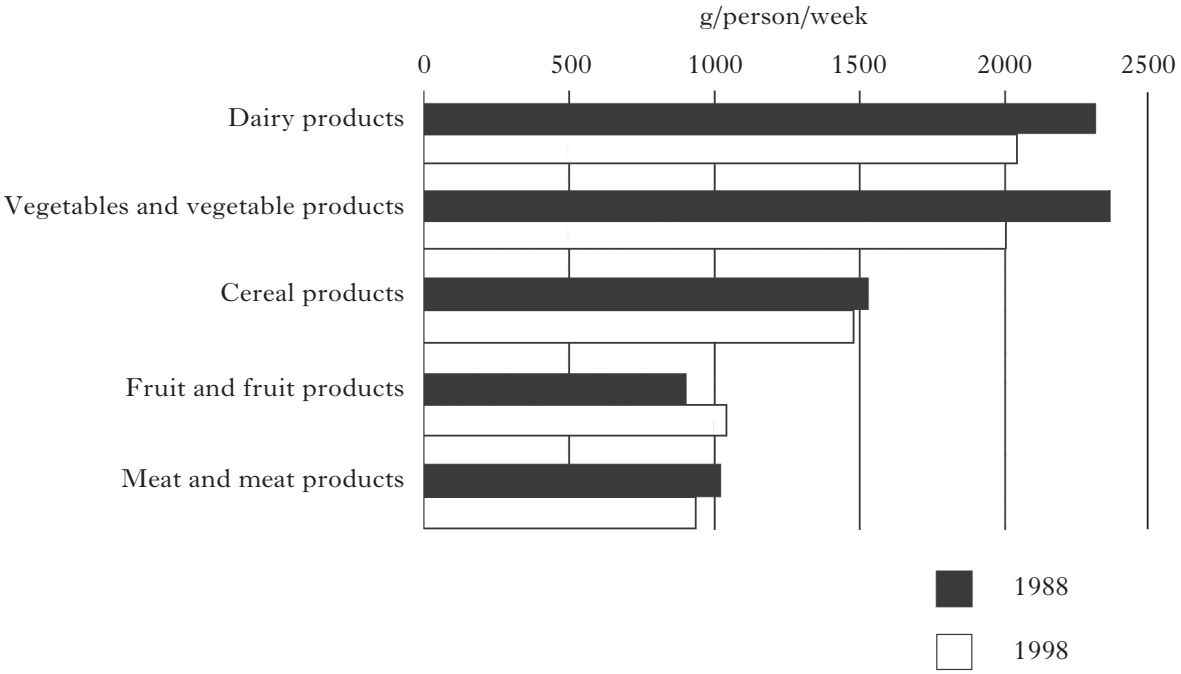
D The number of errors decreased with each subsequent trial.

29. 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.



Which crop is likely to show the greatest increase in yield if herbicides and insecticides were applied?

30. The graph below shows how the UK diet changed between 1988 and 1998.



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

A People ate more food in 1998 than in 1988.

B People ate less food in 1998 than in 1988.

C People ate a greater variety of food in 1998 than in 1988.

D People ate a lesser variety of food in 1998 than in 1988.

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

[Turn over for Section B on *page ten*

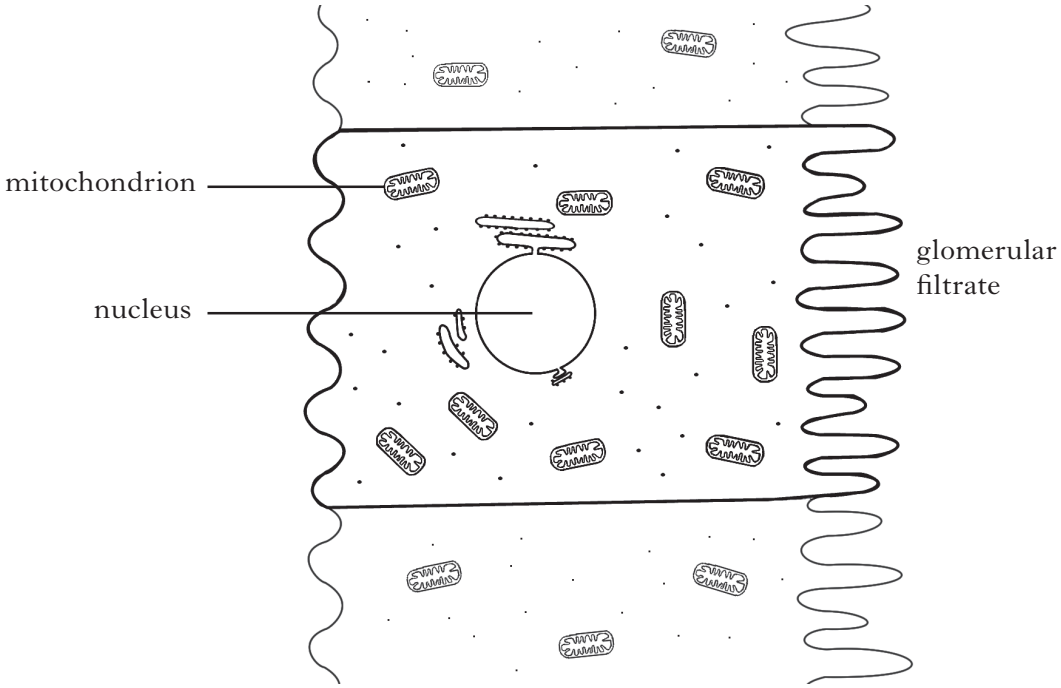
SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

Marks

1. The diagram below shows a cell from the lining of a kidney tubule.



(*a*) This cell is adapted to reabsorb substances from the glomerular filtrate by active transport.

(i) What is meant by active transport?

_____

_____ **1**

(ii) Describe how this cell is adapted for active transport.

_____

_____ **1**

(iii) Explain how this cell is adapted for reabsorption.

_____

_____ **1**

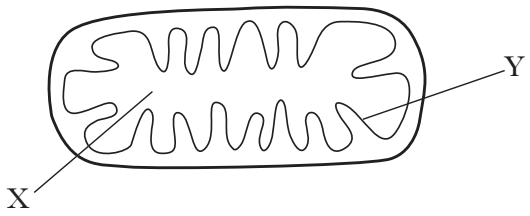
Marks

1. (continued)

(*b*) Name the component of the membrane which is involved in active transport.

_____ **1**

(*c*) The diagram below shows one of the mitochondria from this kidney tubule cell in greater detail.



(i) Complete the table below by naming the labelled regions of the mitochondrion and the stage of respiration that occurs there

Region	*Name*	*Respiration stage*
X		
Y		

2

(ii) Suggest how the structure of a mitochondrion from a less active cell would differ from the structure of the mitochondrion shown.

Give a reason for your answer.

Structural difference _____

_____

Reason _____

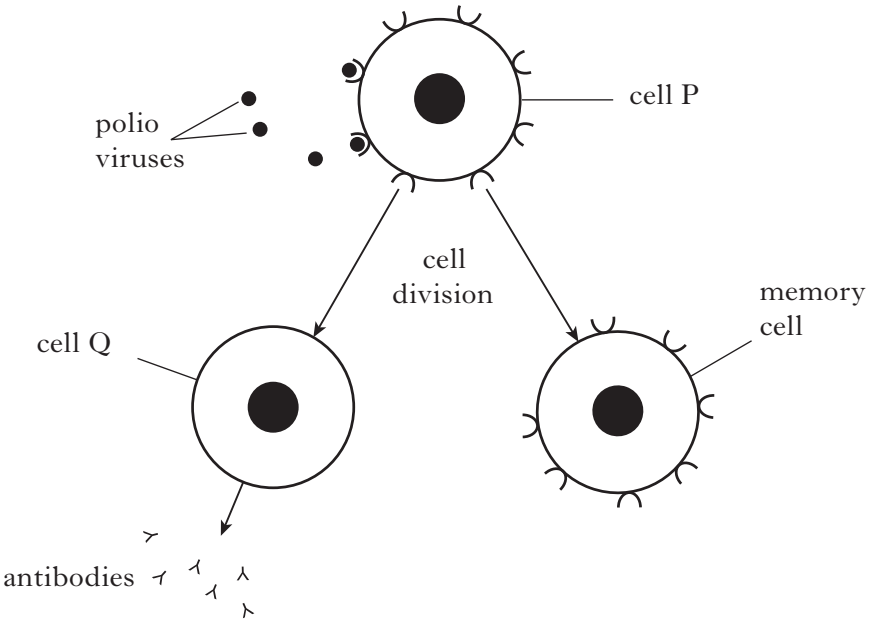
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. The diagram below shows how the immune system responds to a polio virus in a vaccine.



(*a*) What type of immunological response involves the production of antibodies?

_____ **1**

(*b*) (i) Name cell Q.

_____ **1**

(ii) Describe **two** functions of cell P that are shown in the diagram.

1 _____

2 _____ **1**

(*c*) Describe the role of memory cells in the immune system.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

2. (continued)

(*d*) Explain why vaccination against polio would not provide immunity against the measles virus.

_____

_____ **1**

(*e*) In an emergency, ready-made antibodies can be injected into an individual.

(i) Name the type of immunity that this gives.

_____ **1**

(ii) State **one** advantage and **one** disadvantage of this type of immunity.

Advantage _____

_____

Disadvantage _____

_____ **2**

[Turn over

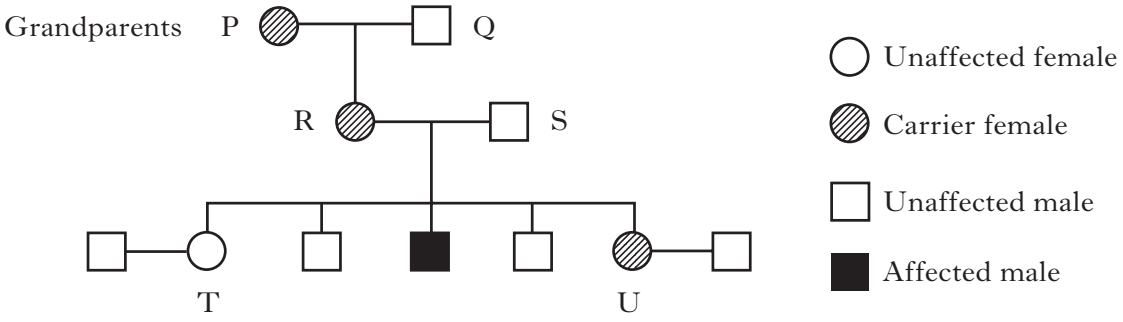
DO NOT WRITE IN THIS MARGIN

Marks

3. Duchenne's muscular dystrophy is an inherited condition in which muscle fibres gradually degenerate.

The condition is sex-linked and caused by a recessive allele.

The family tree below shows the inheritance of the condition through three generations of a family.



(*a*) (i) Using the symbols **D** and **d** to represent the alleles, state the genotypes of individuals R and S.

R _____ S _____ **1**

(ii) What percentage of the grandsons have muscular dystrophy?

_____ **1**

(iii) Sisters T and U each go on to have a son.

For each sister, state the percentage chance of her son having muscular dystrophy.

Son of T _____ Son of U _____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

3. (continued)

(*b*) In humans there is a gene which codes for the essential muscle protein dystrophin.

When this gene is altered, dystrophin is not produced.

An individual with Duchenne's muscular dystrophy cannot make dystrophin.

(i) What general term is used to describe a gene alteration?

_____ **1**

(ii) How might the structure of the gene which codes for dystrophin be altered?

_____

_____ **1**

(iii) Why does this altered gene fail to produce dystrophin?

_____

_____ **1**

(*c*) Where conditions such as Duchenne's muscular dystrophy exist in a family, the family history can be used to determine the genotypes of its individual members.

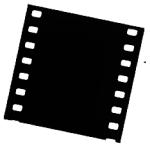
What term is used for this process?

_____ **1**

[Turn over

Marks

4. (*a*) Photographic film consists of a clear sheet of plastic coated with chemicals that give it a dark appearance. The chemicals are stuck to the plastic by the protein gelatine.



An investigation was carried out using photographic film and the enzyme trypsin which digests protein.

A piece of photographic film was placed in a test tube containing a solution of trypsin, as shown in **Figure 1** below.

The time taken for the film to turn clear was measured.

The procedure was then repeated using different concentrations of trypsin solution.

The results of the investigation are shown in **Table 1** below.

Figure 1

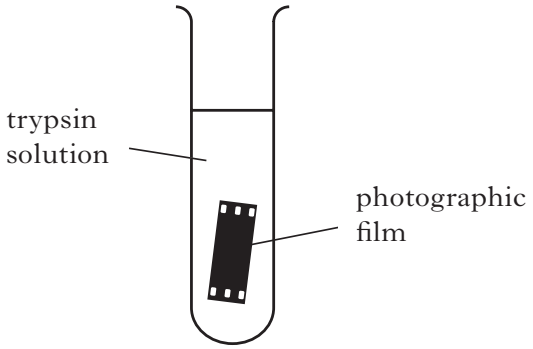


Table 1

Trypsin concentration (%)	*Time taken for film to clear* (s)
1	112
2	102
3	93
4	84
5	84
6	84

(i) Explain why the photographic film turns clear in this investigation.

_____

_____ **1**

(ii) List **two** variables which would have to be kept constant throughout the investigation.

1 _____

2 _____ **2**

(iii) How could the reliability of the results of this investigation be improved?

_____

_____ **1**

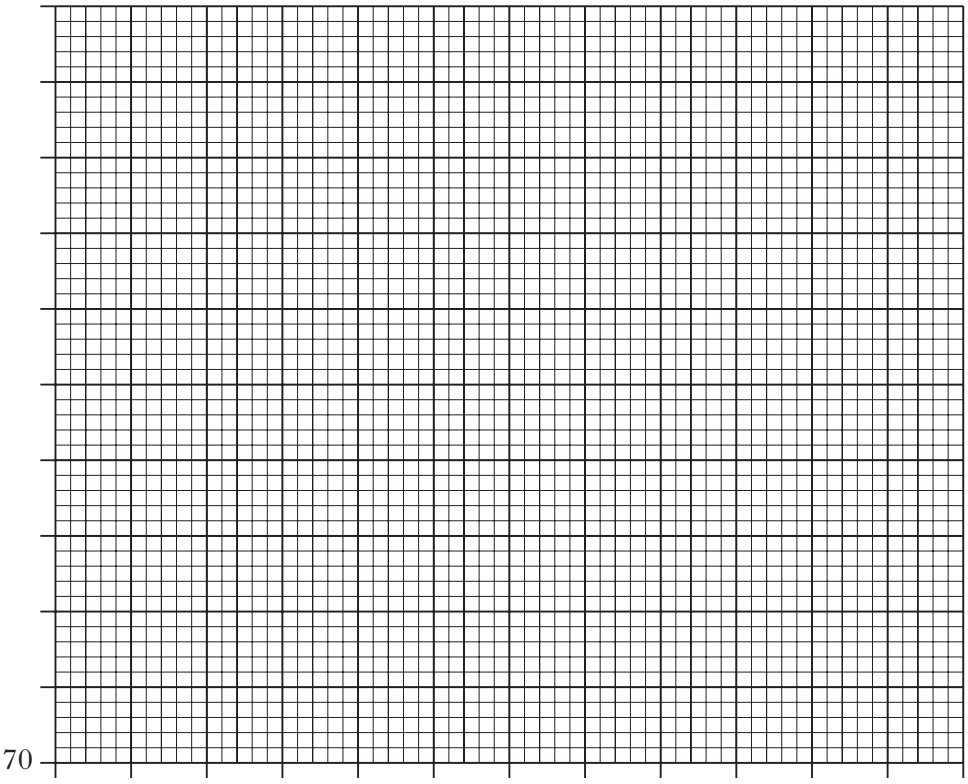
DO NOT WRITE IN THIS MARGIN

Marks

4. (*a*) (continued)

(iv) Plot a line graph to illustrate the results of the investigation.

(Additional graph paper, if required, can be found on *Page thirty-six*)



2

(v) Explain why the time taken for the film to clear changed as trypsin concentration increased from 1% to 4%.

_____

_____ **1**

(vi) Suggest why there was no change in the time taken to clear the film at trypsin concentrations above 4%.

_____

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

4. (continued)

(*b*) An inactive form of trypsin called trypsinogen is produced and released from the pancreas. Trypsinogen is then converted to trypsin by another enzyme.

(i) In which part of the digestive system does activation of trypsin occur?

_____ **1**

(ii) Why are some enzymes such as trypsin produced in an inactive form?

_____

_____ **1**

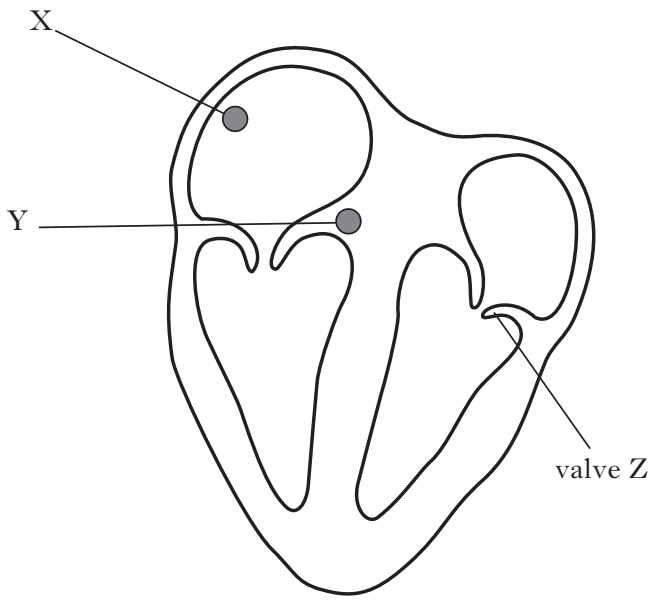
(iii) Apart from other enzymes, name another type of molecule that can act as an enzyme activator.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

5. The diagram shows a section through the heart and two areas, X and Y, which help to coordinate the heart beat.



(*a*) (i) Name structures X and Y.

X _____

Y _____ **1**

(ii) Electrical impulses travel from X to Y.

What is happening to the heart during this time?

_____ **1**

(iii) **Draw** arrows on the diagram to show the pathway taken by electrical impulses produced by structure Y. **1**

(*b*) (i) Name valve Z.

_____ **1**

(ii) During which stage of the cardiac cycle is valve Z closed?

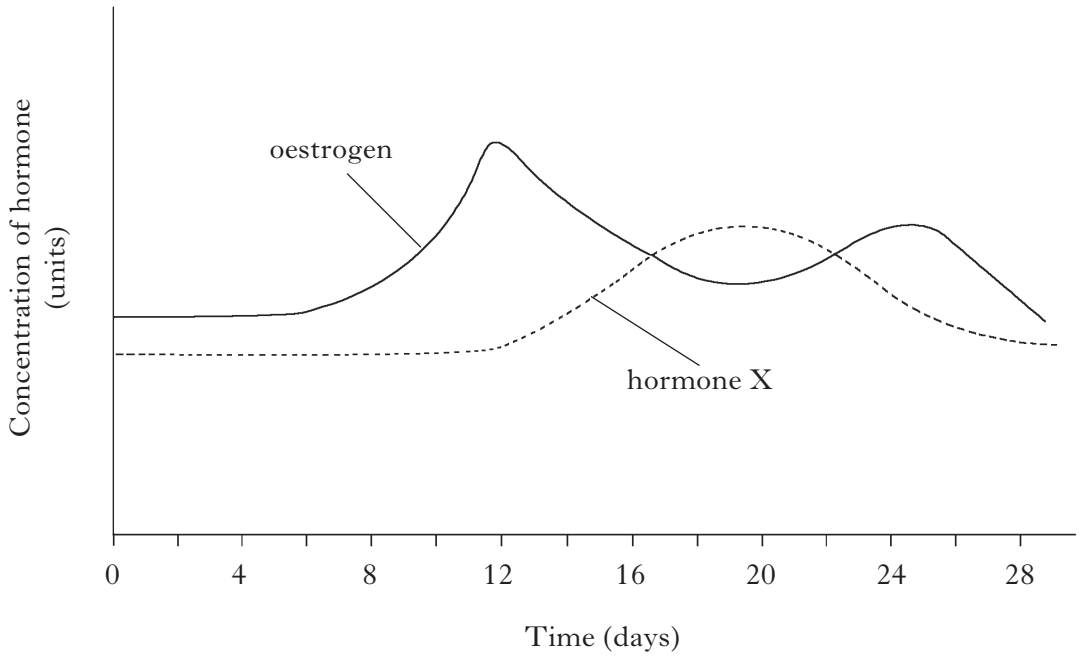
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. The graph below shows the concentrations of two ovarian hormones in a woman's blood during her menstrual cycle.



(*a*) Name hormone X.

_____ **1**

(*b*) What effect does oestrogen have on the following structures?

(i) The uterus between days 4 and 12 in the cycle.

_____

_____ **1**

(ii) The pituitary gland on day 12 of the cycle.

_____

_____ **1**

(*c*) Describe **one** way in which the graph would be different if the woman became pregnant during this cycle.

_____

_____ **1**

Marks

6. (continued)

(*d*) The diagrams below show sections through two structures found in the ovary at different times in the menstrual cycle.

(i) Name structures P and Q.

P _____ Q _____ **1**

(ii) What key event in the menstrual cycle occurs before P develops into Q?

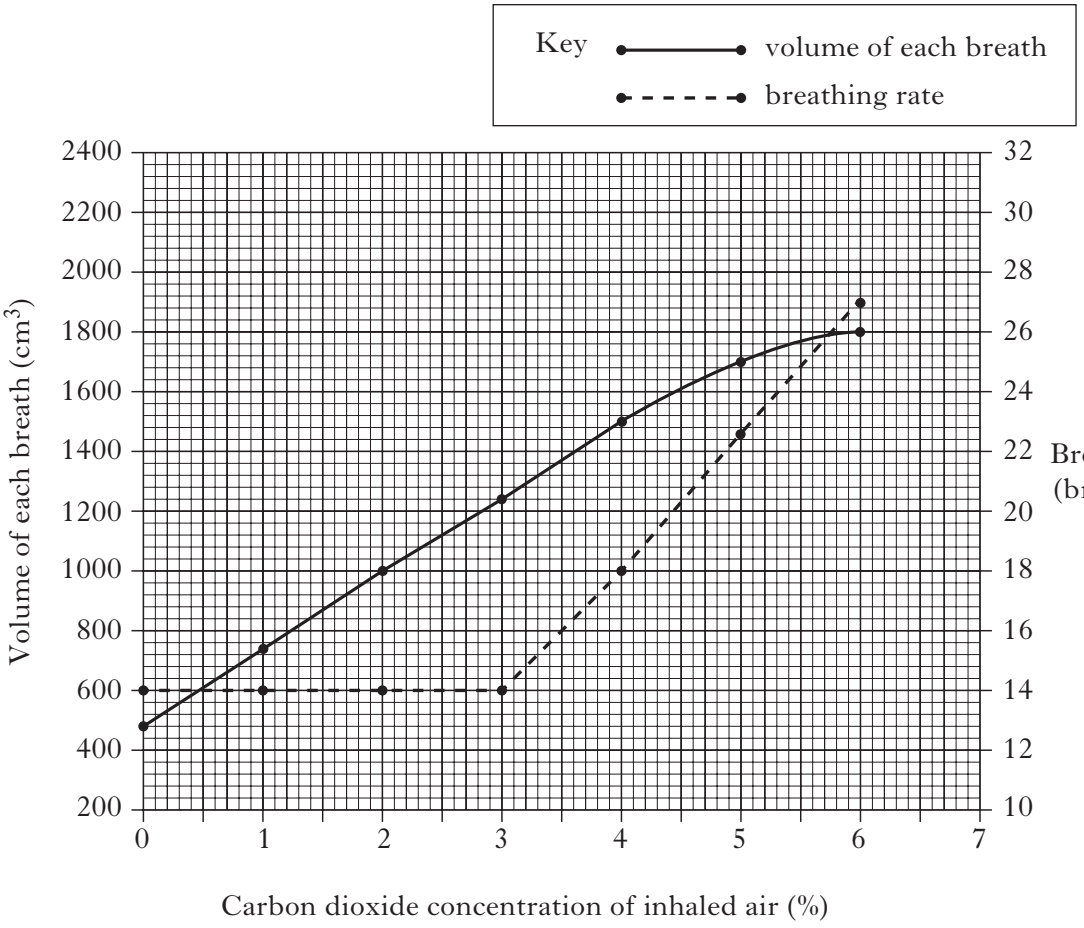
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. The graph below shows changes that occurred in a man's breathing when he inhaled air containing different concentrations of carbon dioxide.



(*a*) Use data from the graph to describe the changes that occurred in the man's breathing when the carbon dioxide concentration of inhaled air increased from 0 to 3%.

_____

_____

_____

_____

_____ **2**

(*b*) What was the man's breathing rate when the volume of each breath was 1500 cm^3?

_____ breaths/min **1**

DO NOT WRITE IN THIS MARGIN

Marks

7. (continued)

(*c*) Calculate the volume of air inhaled in one minute when the carbon dioxide concentration was 2%.

Space for calculation

_____ cm^3 **1**

(*d*) (i) Predict what the volume of each breath would have been if a carbon dioxide concentration of 7% had been used.

Volume of each breath _____ **1**

(ii) Suggest why the increase in the volume of each breath becomes less at carbon dioxide concentrations above 4%.

_____

_____ **1**

(*e*) On average there is 0·04% carbon dioxide in inhaled air and 4% carbon dioxide in exhaled air.

Explain why this change in carbon dioxide concentration occurs.

_____

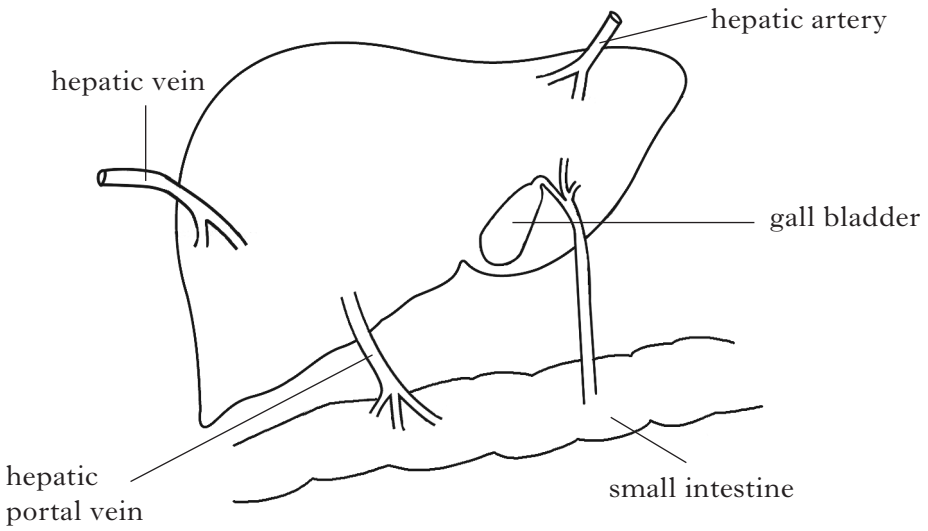
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

8. The diagram below represents the liver and some associated structures.



(*a*) **Draw** arrows beside each of the **three** blood vessels to show the direction of blood flow. **1**

(*b*) (i) Name the liquid stored in the gall bladder.

_____ **1**

(ii) State **one** function of this liquid and explain how it aids digestion.

Function _____

_____ **1**

Explanation _____

_____ **1**

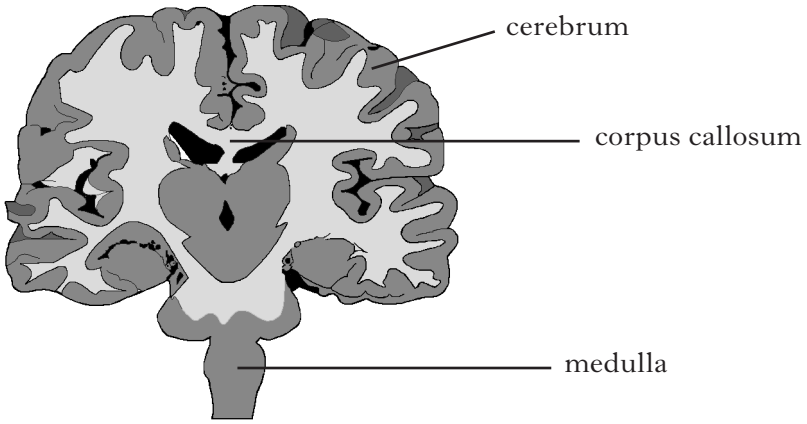
(*c*) Name **one** substance that is stored in the liver.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

9. The image below shows a vertical section through a human brain.



(*a*) Explain how the maximum number of interconnections between neurones is achieved within the cerebrum.

_____

_____

_____ **2**

(*b*) What is the function of the corpus callosum?

_____

_____ **1**

(*c*) (i) Which division of the nervous system is linked to the medulla?

_____ **1**

(ii) Describe how this division of the nervous system controls heart rate.

_____

_____ **1**

[Turn over

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Marks

10. The information in the table below refers to the development of walking by infant boys.

Stage of development	*Description of behaviour*	*Age (weeks) at which behaviour develops*	
		Earliest	*Latest*
1	Rolls over	9	23
2	Sits up without support	16·5	32·5
3	Crawls	21	38
4	Pulls up and stands holding on to furniture	23	43
5	Walks holding on to furniture	28·5	49
6	Stands unsupported	35·5	54
7	Walks alone	44·5	57·5

(*a*) Assuming a normal pattern of distribution, predict by what age 50% of boys would be expected to walk alone.

Space for calculation

_____ **1**

(*b*) Identify all the stages in the development of walking that boys could be at when they are 36 weeks old.

Tick the correct boxes

1		2		3		4		5		6		7	

1

(*c*) Suggest **two** reasons why a boy might still only be crawling when, at the same age, his elder brother could stand unsupported.

1 _____

2 _____ **1**

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Marks

10. (continued)

(*d*) (i) What term describes the development of a behaviour which follows a set sequence of stages?

_____ **1**

(ii) Describe the change which occurs in the nervous system that allows children to go through the stages of development leading to walking.

_____ **1**

[Turn over

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Marks

11. An investigation was carried out into the effect that the meaning of words has on the ability to recall them from short and long-term memory.

Two groups of people were each shown lists of five words for 30 seconds.

Group 1 was shown words with related meanings while group 2 was shown words with unrelated meanings.

List of words with related meanings – *large, big, great, huge, wide*.
List of words with unrelated meanings – *late, cheap, rare, bright, rough*.

Immediately after the 30 seconds, the people in both groups were asked to write down, in the correct order, the words that they had been shown.

Everyone was then asked to read a book for one hour and told that they would be asked questions about it afterwards.

Instead, after the hour had passed, everyone was again asked to write down, in the correct order, the words that they had been shown in their original list.

The results of the investigation are shown in the table below.

Group	*Meaning of words shown*	*Correct responses immediately after reading the words* (%)	*Correct responses after reading the book for one hour* (%)
1	related	96	54
2	unrelated	96	78

(*a*) List **two** ways in which the investigators could minimise variation between the two groups of people.

1 _____

2 _____ **1**

(*b*) What aspect of memory explains the high percentage of correct responses immediately after reading the words?

_____

_____ **1**

(*c*) Suggest why the groups were asked to read a book during the investigation.

_____

_____ **1**

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Marks

11. (continued)

(*d*) State **two** conclusions that can be drawn from the results of this investigation.

1 _____

_____

2 _____

_____ **2**

[Turn over

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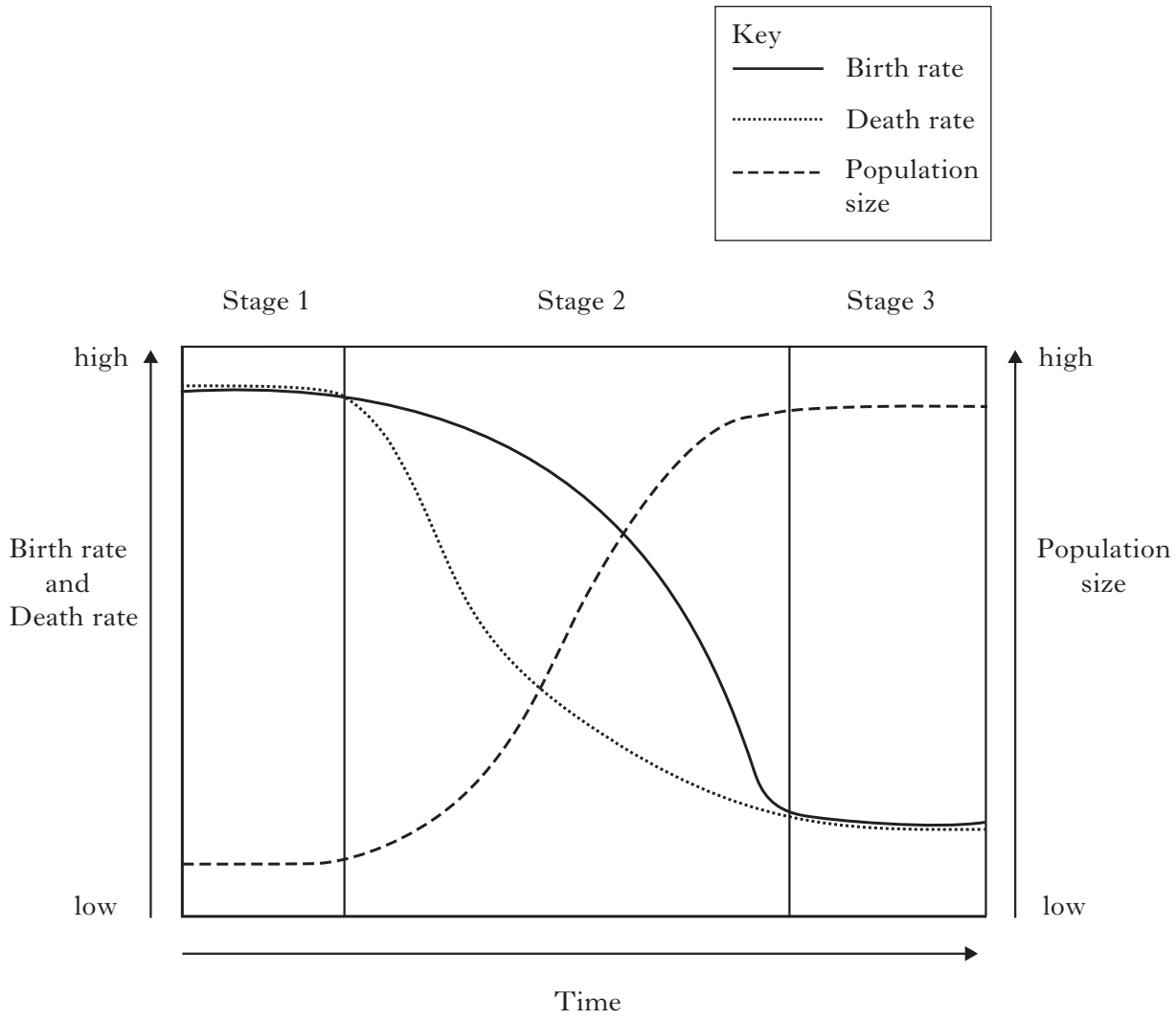
Marks

12. The diagram below shows the changes that affect the population of a country as it undergoes development.



(*a*) (i) Describe the country's birth rate at stage 2 and stage 3 during its development.

_____

_____ **1**

(ii) Use information from the diagram to explain why the population size increases rapidly and then starts to level off during stage 2.

_____

_____

_____

_____ **2**

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Marks

12. (*a*) (continued)

(iii) Suggest **two** factors which may contribute to the change in the death rate during stage 2.

1 _____

2 _____ **1**

(*b*) The increasing world population requires an increased supply of food.

(i) Pesticides are chemicals which can be used to increase food supply. However, their use can lead to instability in food webs.

Explain this effect.

_____

_____

_____ **1**

(ii) Other chemicals, such as fertilisers, are also used to increase food production.

Name another method of increasing food production that does not involve chemicals.

_____ **1**

(*c*) When fertilisers are used in agriculture they can pollute rivers and lochs causing algal blooms.

(i) What is an algal bloom?

_____

_____ **1**

(ii) Describe the effects an algal bloom might have on a loch.

_____

_____

_____

_____

_____ **2**

[Turn over for Section C on *Page thirty-two*

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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 the carbon cycle under the following headings:

(i) natural uptake and release of carbon; **4**

(ii) disruption of the carbon cycle by human activities. **6**

(10)

OR

B Give an account of the nervous system under the following headings:

(i) the role of neurotransmitters at the synapse; **6**

(ii) converging and diverging neural pathways. **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 exchange of substances between plasma and body cells. **(10)**

OR

B Describe involuntary mechanisms of temperature control. **(10)**

[*END OF QUESTION PAPER*]

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SPACE FOR ANSWERS

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SPACE FOR ANSWERS

ADDITIONAL GRAPH FOR QUESTION 4(*a*) (iv)