FOR OFFICIAL USE

Total for Sections B & C

X275/12/02

NATIONAL QUALIFICATIONS 2012

WEDNESDAY, 23 MAY
1.00 PM – 3.30 PM

HUMAN BIOLOGY
HIGHER (Revised)

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 (Revised) (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. Which of the following is **not** a use of stem cells?

A Skin grafts

B Drug testing

C IVF treatment

D Bone marrow transplant

2. Which line in the table below describes correctly cell division in a specific cell type?

	Cell Type	*Type of cell division*	*Chromosome number in cells produced*
A	somatic	meiosis	diploid
B	somatic	meiosis	haploid
C	germline	mitosis	haploid
D	germline	mitosis	diploid

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. Which of the following statements about DNA replication is correct?

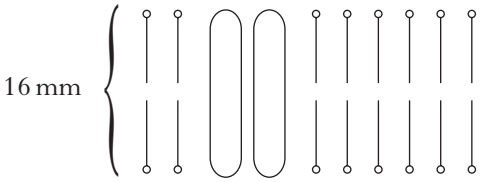
A Polymerase adds nucleotides to the 3' end of a DNA strand

B Polymerase adds nucleotides to the 5' end of a DNA strand

C Ligase adds nucleotides to the 3' end of a DNA strand

D Ligase adds nucleotides to the 5' end of a DNA strand

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. Which type of gene mutation occurs when a codon for an amino acid is replaced by a stop codon?

A Nonsense

B Missense

C Frameshift

D Splice-site

7. Individuals with Cri-du-chat syndrome have a shortened chromosome 5.

No other chromosomes are affected.

Which type of mutation causes Cri-du-chat syndrome?

A Deletion

B Insertion

C Duplication

D Translocation

[Turn over

8. During the polymerase chain reaction (PCR) samples of DNA are repeatedly heated and cooled.

Why are the samples cooled?

A To denature DNA polymerase

B To slow the reaction down

C To allow primers to bind to target sequences

D To separate the DNA strands

9. What is the function of a DNA probe?

A To replicate a particular region of DNA

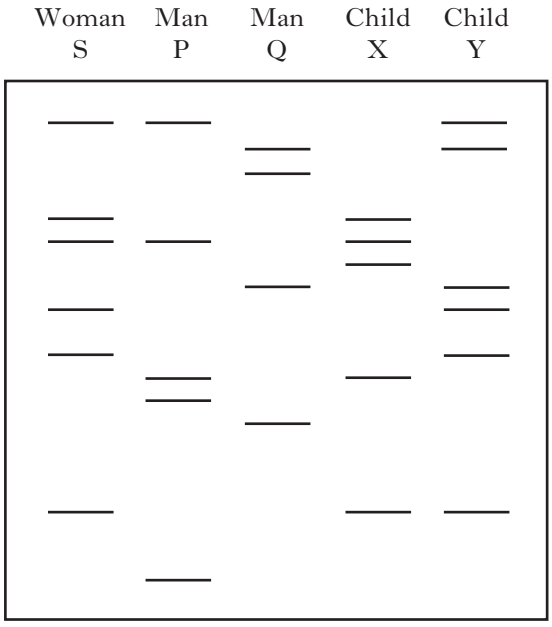
B To join fragments of DNA together

C To remove non-coding sections of DNA

D To detect the presence of specific DNA sequences

10. The diagram below shows the results of a paternity test. It compares DNA samples from five individuals.

Woman S is the mother of child X and child Y. Men P and Q are possible fathers of these children.



Which of the following conclusions can be drawn from these results?

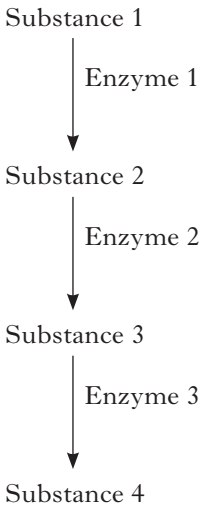
A Man P could be the father of child X

B Man P could be the father of child Y

C Man Q could be the father of child X

D Man Q could be the father of child Y

11. The diagram below shows a metabolic pathway that is controlled by end product inhibition.



For Substance 4 to bring about end product inhibition, with which of the following would it interact?

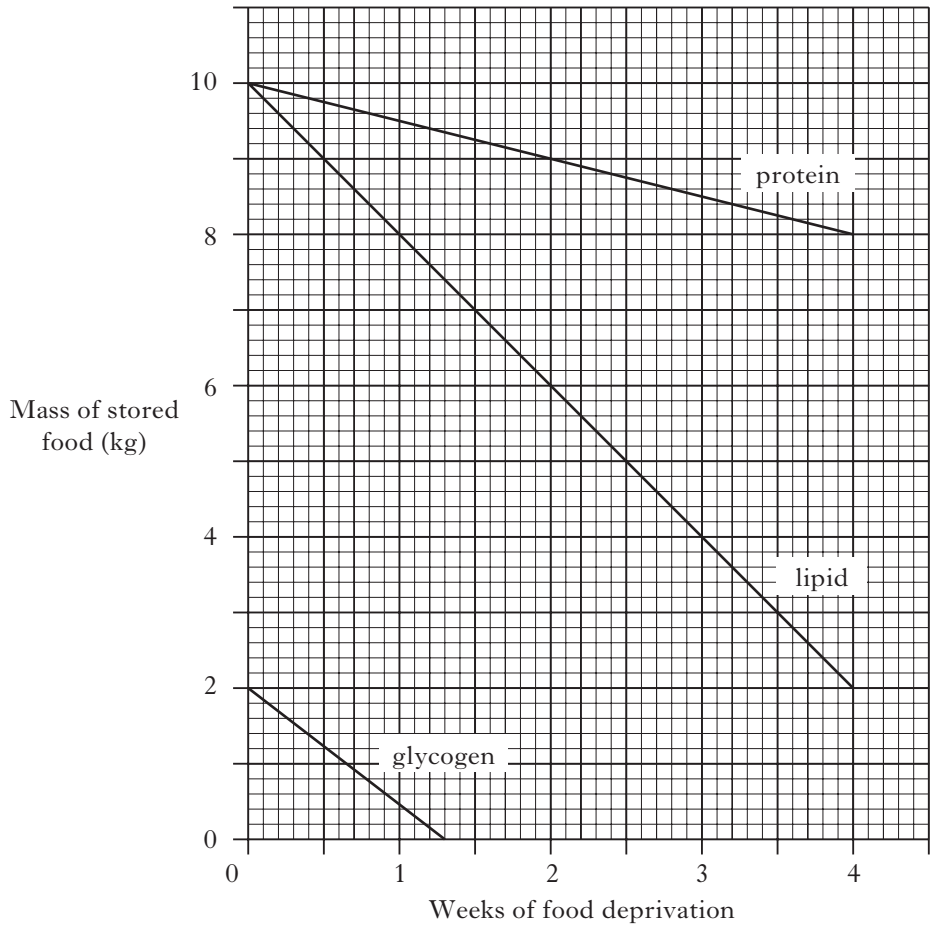
A Enzyme 1

B Enzyme 3

C Substance 1

D Substance 3

12. 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.

13. Which of the following equations describes correctly the role of creatine phosphate?

A ADP + phosphate + creatine ⟶ creatine phosphate + ATP

B creatine phosphate + ADP ⟶ ATP + creatine

C creatine phosphate + ATP ⟶ ADP + phosphate + creatine

D ATP + phosphate ⟶ creatine phosphate + ADP

[Turn over

14. Which line in the following table describes correctly fast-twitch muscle fibres?

	Main storage fuel	*Number of mitochondria compared to slow-twitch muscle fibres*
A	Fat	Fewer
B	Fat	Higher
C	Glycogen	Fewer
D	Glycogen	Higher

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

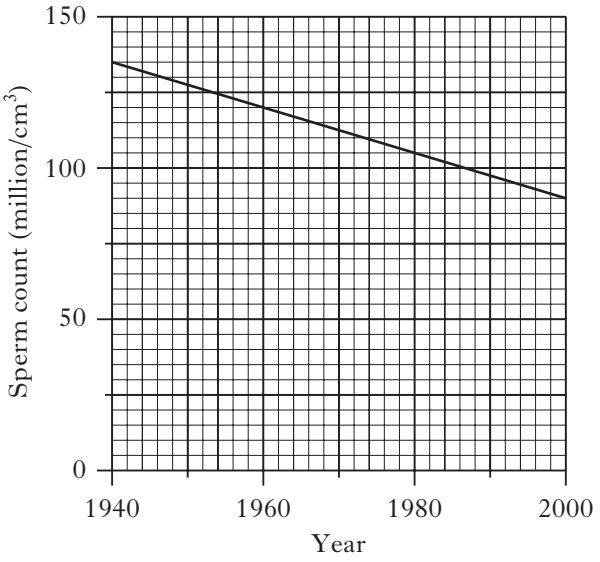
A sperm

B testosterone

C seminal fluid

D follicle stimulating hormone (FSH).

16. 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

17. Which of the following forms of contraception causes thickening of the cervical mucus?

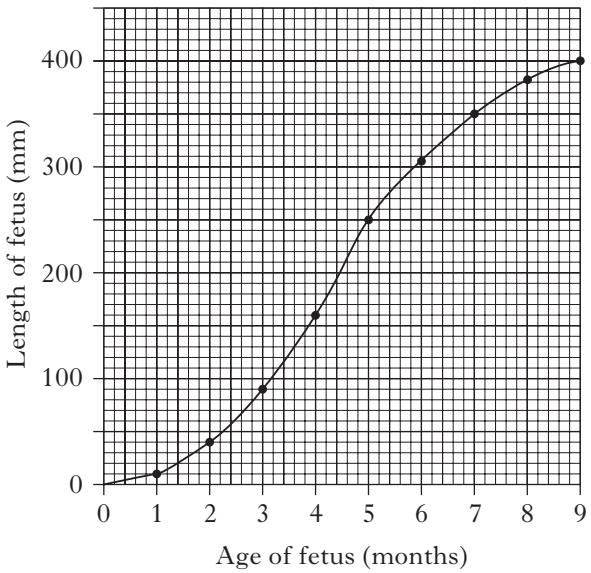
A Mini-pill

B Barrier methods

C Morning-after pill

D Intra-uterine device

18. 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

19. 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%

20. Cardiac output is calculated using the following formula:

Cardiac output = Heart Rate × Stroke Volume

The table below shows the heart rate and cardiac output of four individuals.

Individual	*Heart Rate* (bpm)	*Cardiac Output* (L/min)
A	60	5·8
B	68	6·1
C	72	7·2
D	78	7·6

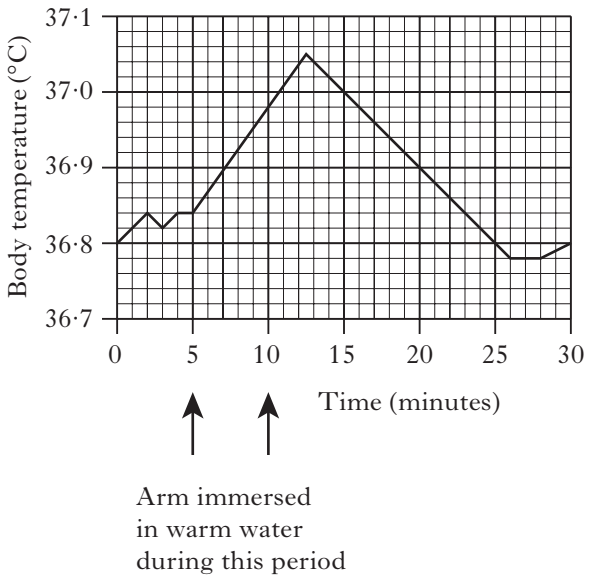
Which individual has the greatest stroke volume?

21. The ratio of high-density lipoproteins to low-density lipoproteins in the blood (HDL:LDL) is related to the level of cholesterol in the blood. This in turn can influence the chances of developing atherosclerosis.

Which line in the table below correctly illustrates these relationships?

	HDL:LDL	*Cholesterol level*	*Chance of atherosclerosis*
A	High	Low	Reduced
B	High	High	Increased
C	Low	Low	Increased
D	Low	High	Reduced

22. 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

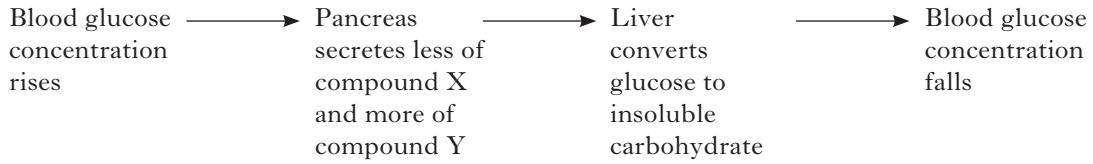
B 0·27 °C

C 2·5 °C

D 0·25 °C

[Turn over

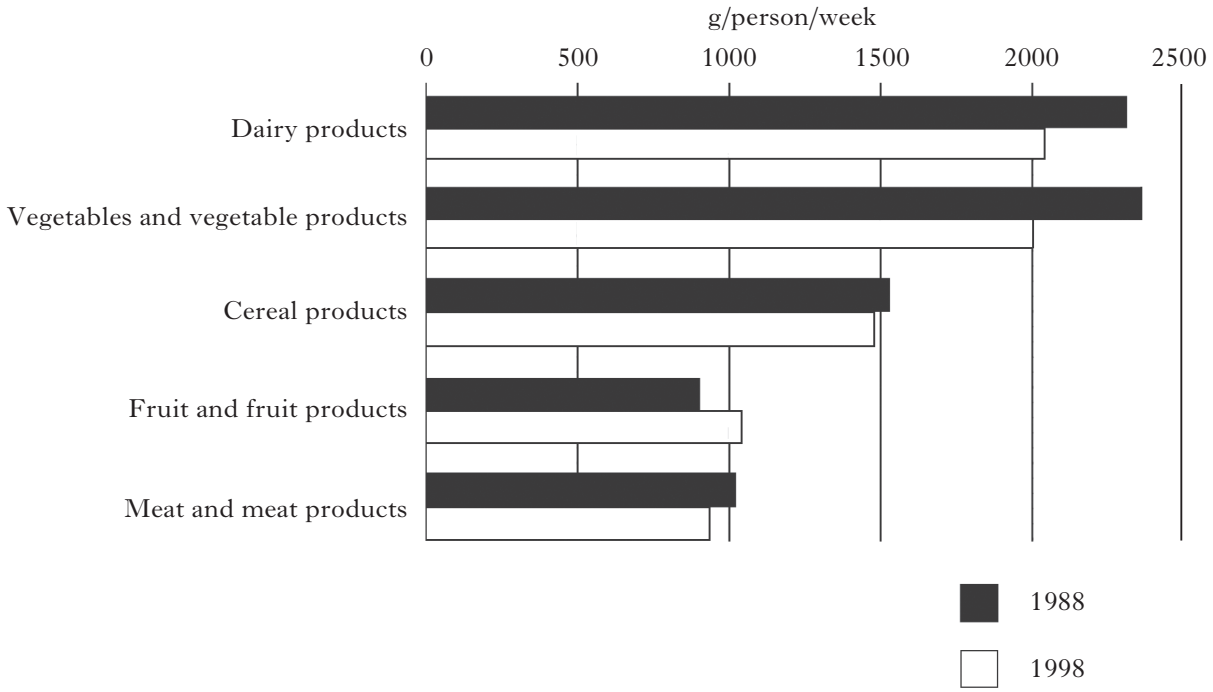
23. The flow chart below shows how the concentration of glucose in the blood is regulated.



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

24. 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.

25. The somatic nervous system controls the

A skeletal muscles

B heart and blood vessels

C pituitary gland

D muscular wall of the gut.

26. 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?

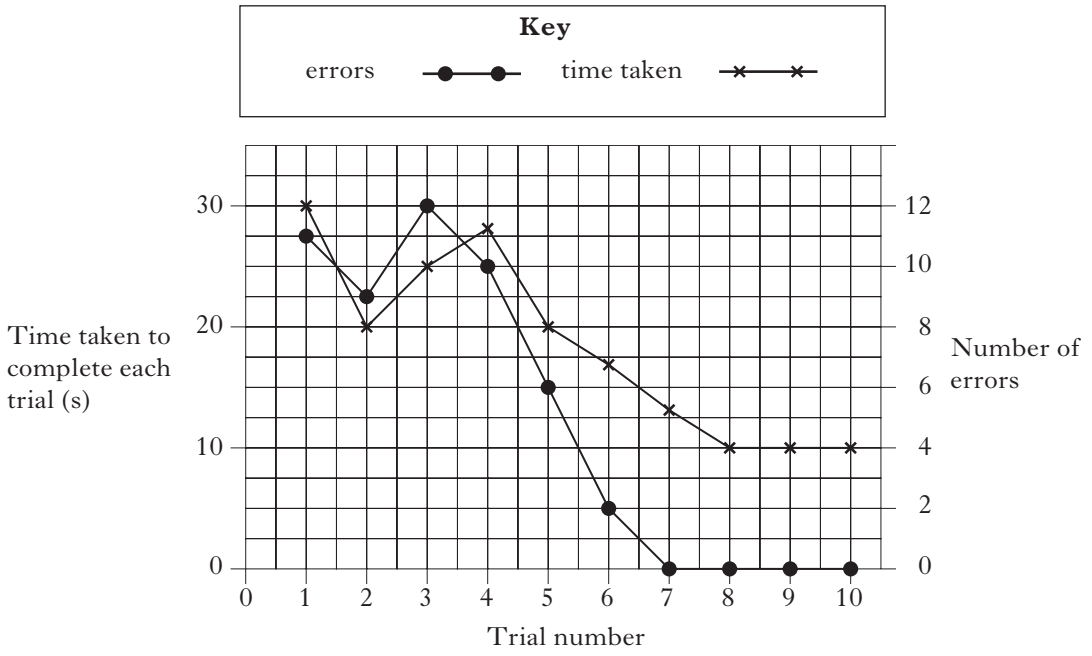
A 3 only

B 2 and 4 only

C 2, 3 and 4 only

D 1, 2, 3 and 4

27. 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.

[Turn over

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

A generalisation

B discrimination

C extinction

D shaping.

29. 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.

30. Which of the following types of white blood cell is involved in a non-specific immune response which causes apoptosis in invading pathogens?

A Phagocytes

B B lymphocytes

C T lymphocytes

D Natural killer cells

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 twelve*

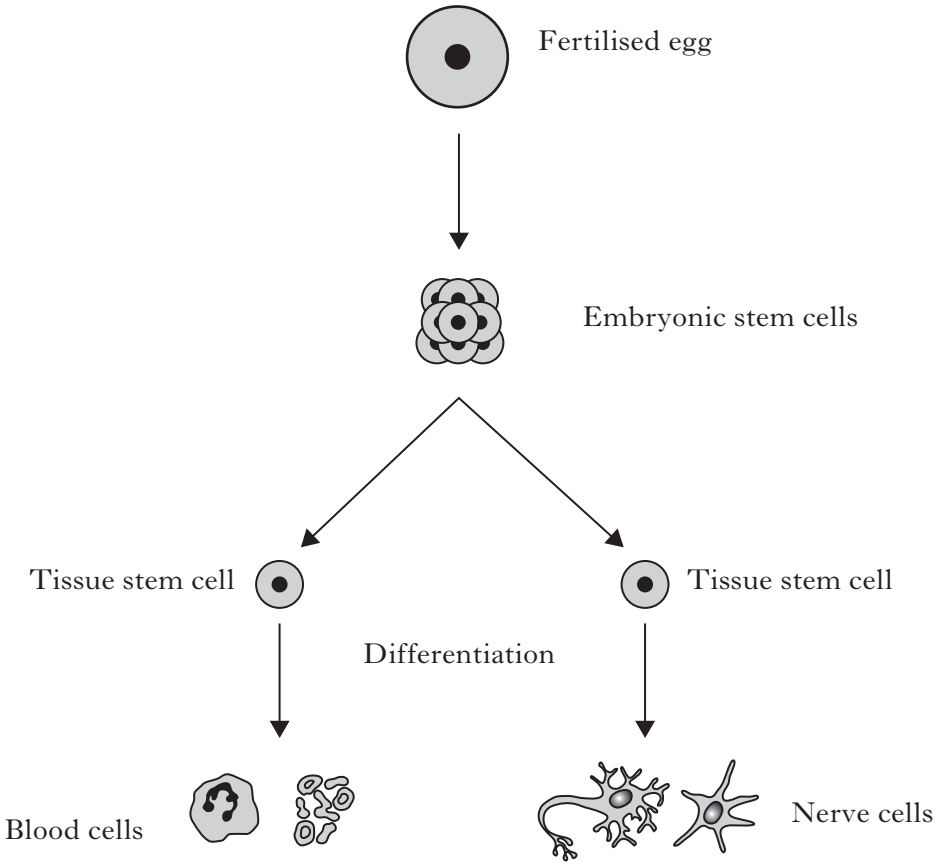
SECTION B

Marks

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram below shows some stages in the development of blood cells and nerve cells.



(*a*) What are stem cells?

_____

_____ **1**

(*b*) State the location of the tissue stem cells which develop into blood cells.

_____ **1**

(*c*) Describe what is meant by the term *differentiation*.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

1. (continued) *Marks*

(*d*) Both embryonic stem cells and tissue stem cells are used in medical research.

Give **one** reason why embryonic stem cells are potentially more useful than tissue stem cells.

_____

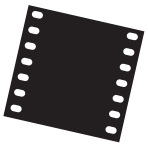
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. 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

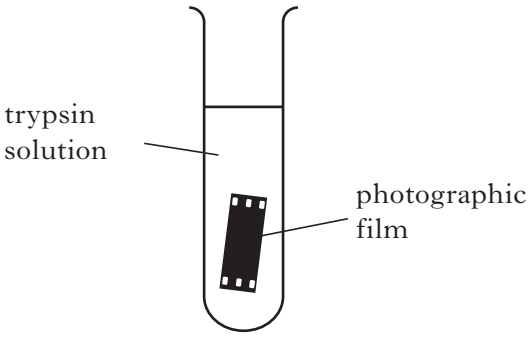


Table 1

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

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

_____

_____ **1**

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

1 _____

2 _____ **2**

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

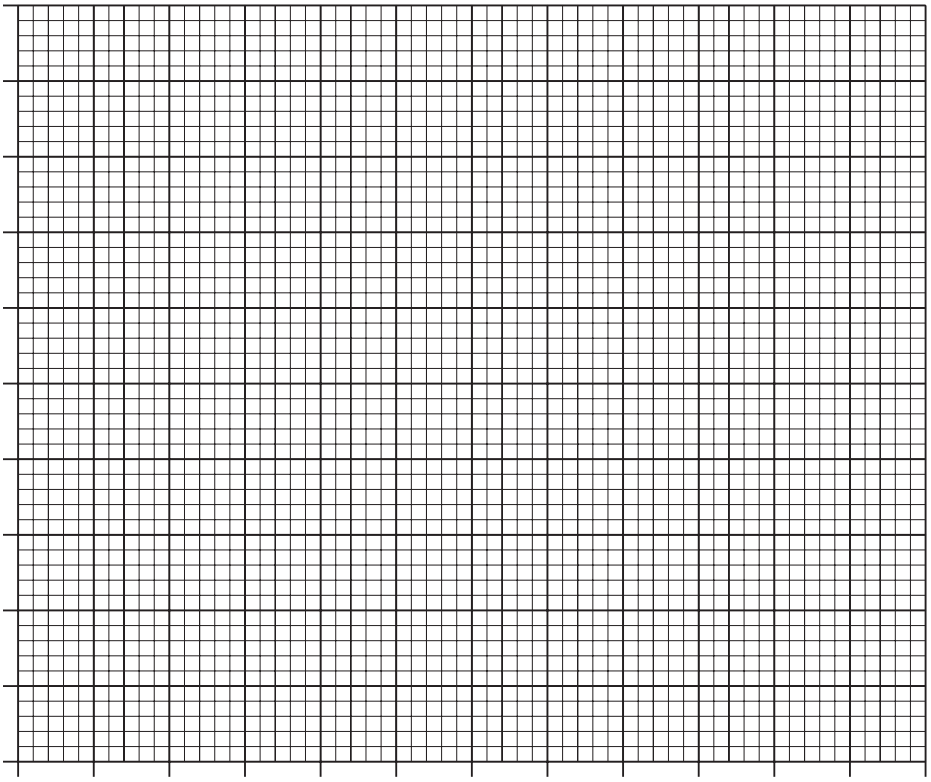
_____

_____ **1**

2. (continued) *Marks*

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

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



70 **2**

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

_____

_____ **1**

(*f*) 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

3. The diagram below shows one gene within a chromosome.

non-coding region of the gene coding region of the gene

(*a*) State what non-coding regions of a gene are called.

_____ **1**

(*b*) Explain why it is important that non-coding regions are removed from the primary transcript of this gene before translation.

_____

_____ **1**

(*c*) The diagram below shows part of one coding region of the mRNA from this gene.

How many different types of amino acid are coded for by this region of the mRNA strand?

_____ **1**

(*d*) Describe **two** ways in which the structure of a molecule of mRNA differs from that of DNA.

1 _____

_____

2 _____

_____ **2**

3. (continued) *Marks*

(*e*) The following table shows the number of differences in the amino acid sequence for haemoglobin from three animals compared to that of human haemoglobin.

The number of differences gives an indication of evolutionary relationships between species.

Animal	*Number of differences in the haemoglobin amino acid sequence compared to human haemoglobin*
Frog	67
Mouse	27
Dog	32

Which of these animal's haemoglobin is most closely related to human haemoglobin?

_____ **1**

(*f*) What term describes all the DNA of a species?

_____ **1**

[Turn over

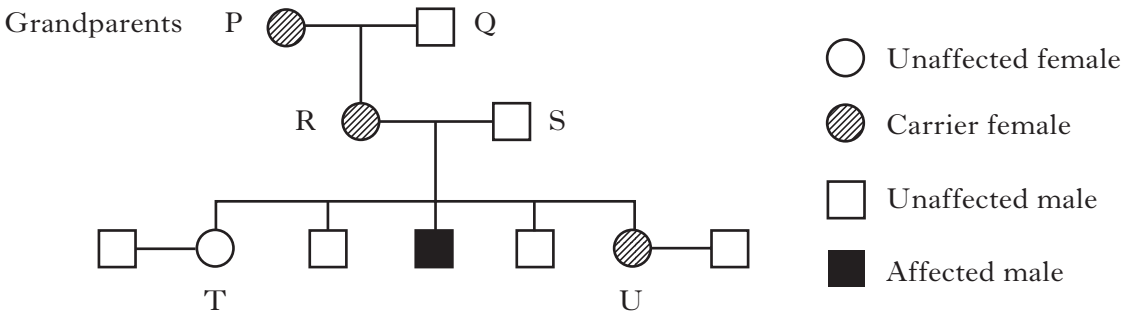
DO NOT WRITE IN THIS MARGIN

Marks

4. 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

4. (continued) *Marks*

(*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**

(*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?

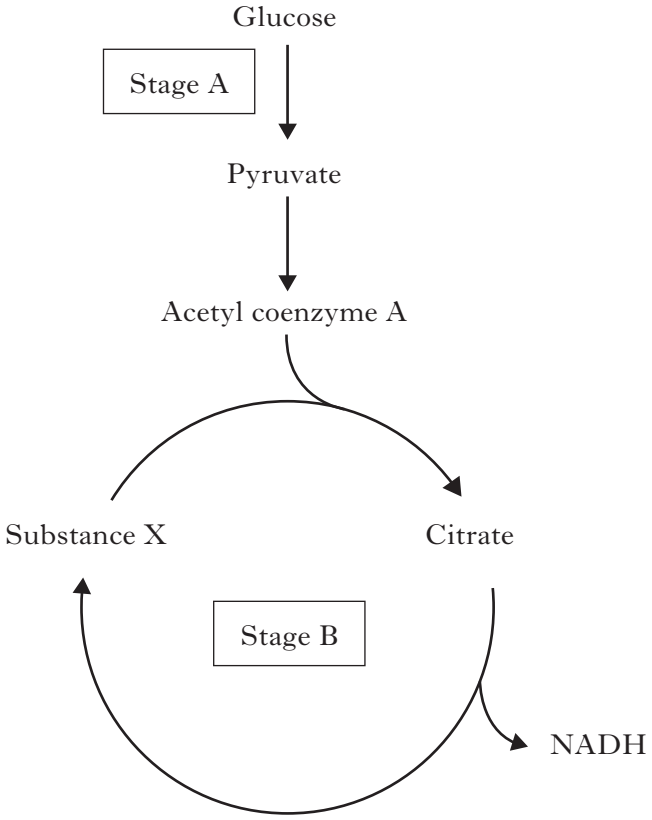
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

5. The diagram below shows two stages of respiration.



(*a*) (i) Identify stages A and B.

Stage A _____

Stage B _____ **1**

(ii) Name Substance X.

_____ **1**

(*b*) During Stage A, glucose is converted to pyruvate.

Name the molecule that provides phosphate for this conversion.

_____ **1**

(*c*) The conversion of citrate to substance X in Stage B involves several reactions.

Name **two** molecules, apart from NADH, which are produced during these reactions.

1 _____

2 _____ **1**

5. (continued) *Marks*

(*d*) Phosphofructokinase is an enzyme involved in Stage A.

The presence of excess citrate inhibits this enzyme.

Explain why this is important in the conservation of resources in the cell.

_____

_____ **1**

(*e*) NADH is also produced during Stage A.

Explain the role of NADH when cells do not get sufficient oxygen for aerobic respiration.

_____

_____

_____

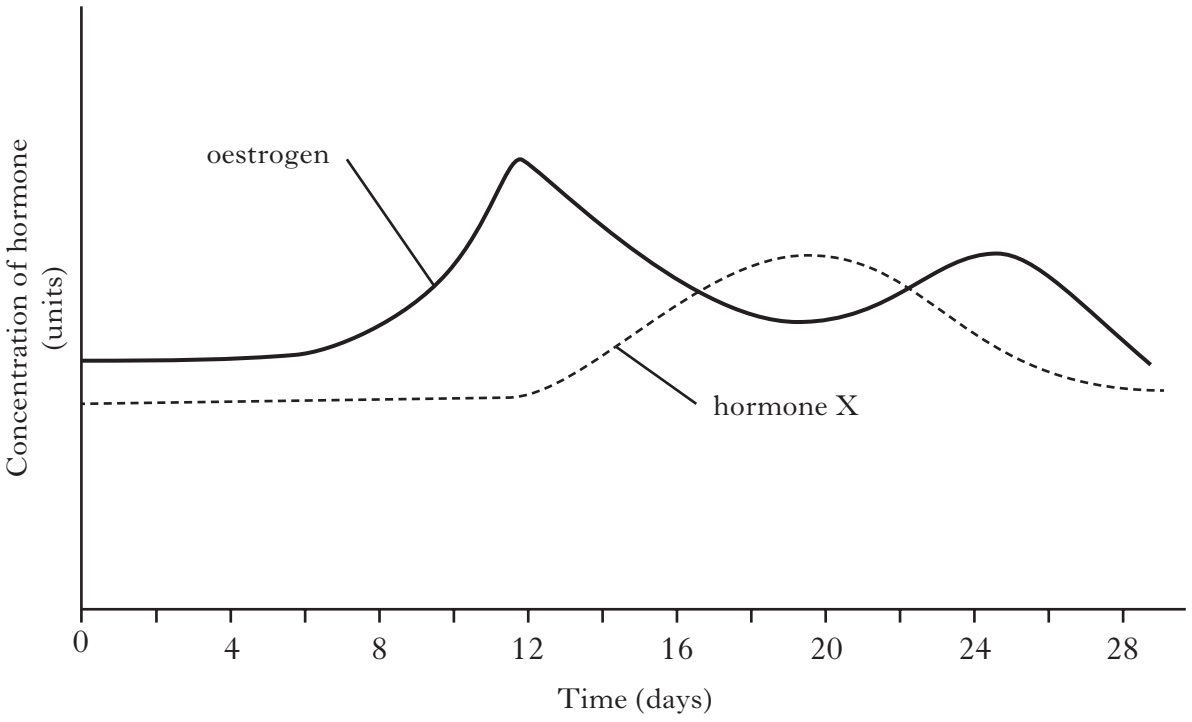
_____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. The graph below shows the concentration 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**

6. (continued) *Marks*

(*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?

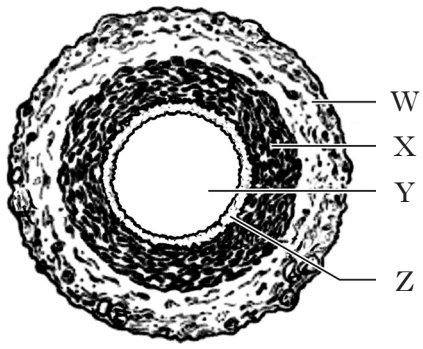
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. (*a*) The diagram shows a section through an artery.



(i) Name the parts of the artery labelled Y and Z.

Y _____ Z _____ **1**

(ii) Layer X contains elastic fibres.

Name **one** other type of tissue found in layer X.

_____ **1**

(iii) Describe the role of the elastic fibres in the wall of an artery.

_____

_____ **1**

(*b*) Veins are another type of blood vessel.

Name a structural feature of a vein and describe its function.

Name _____

Function _____

_____ **1**

(*c*) Name the **two** blood vessels which carry blood away from the heart.

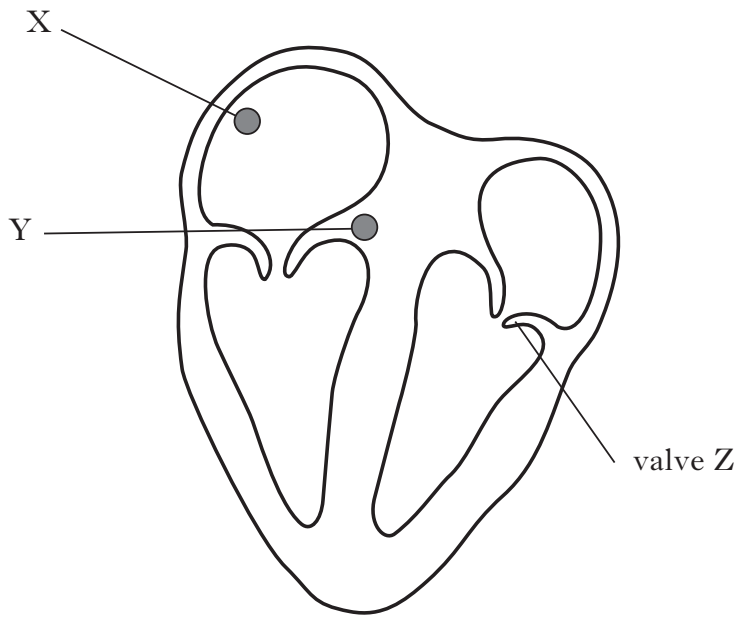
1 _____

2 _____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

8. 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?

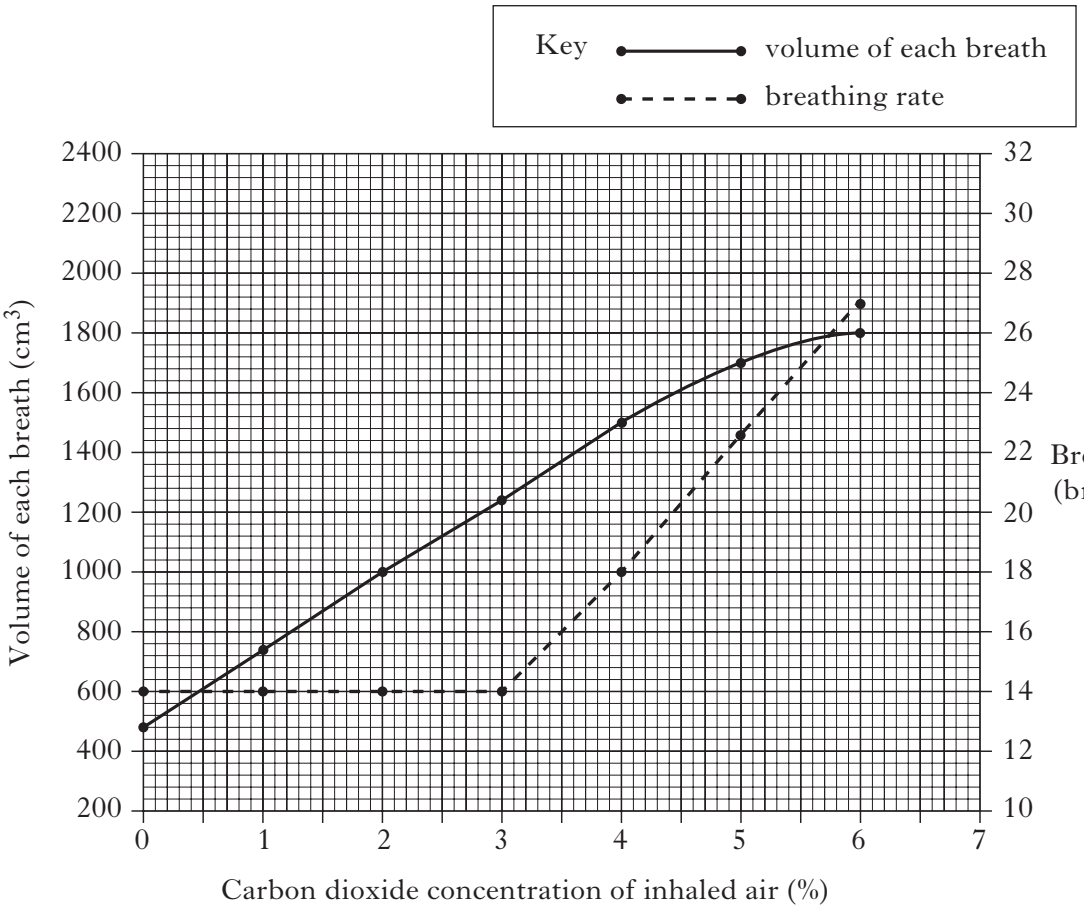
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

9. 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

9. (continued) *Marks*

(*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.

_____

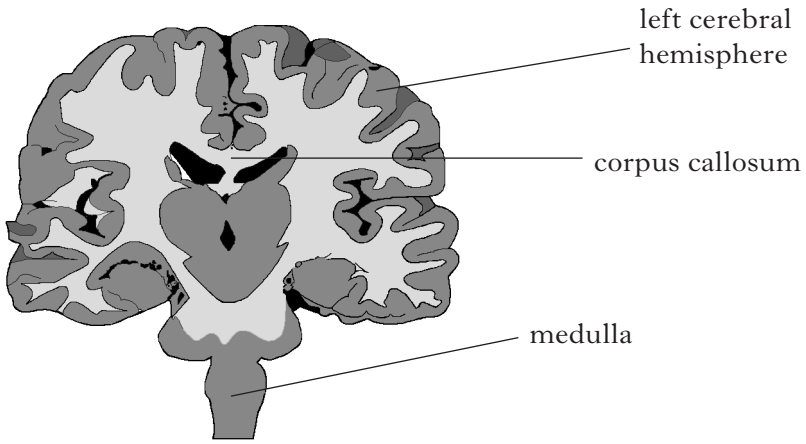
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

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



(*a*) State the function of the motor area in the left cerebral hemisphere.

_____

_____ **1**

(*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**

DO NOT WRITE IN THIS MARGIN

Marks

11. 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*) 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*) Myelination of the nervous system leads to the development of walking.

(i) Name the cells that produce the myelin sheath.

_____ **1**

(ii) Explain why it is important that axons are surrounded by a myelin sheath.

_____

_____ **1**

Marks

12. 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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12. (continued) *Marks*

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

1 _____

_____

2 _____

_____ **2**

[Turn over

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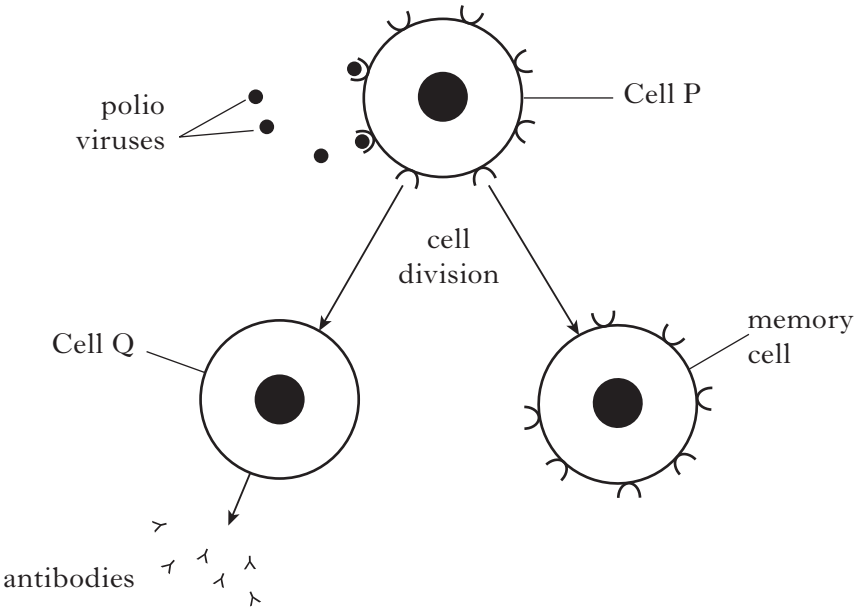
Marks

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



(*a*) Name the type of immunity which results from vaccination with infectious pathogens such as the polio virus

_____ **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**

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13. (continued) *Marks*

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

_____

_____ **1**

(*e*) When producing a vaccine an adjuvant is usually mixed with the pathogen.

Explain why an adjuvant is added.

_____

_____ **1**

(*f*) Clinical trials of vaccines often use a double-blind protocol.

Describe what is meant by the term double-blind.

_____

_____ **1**

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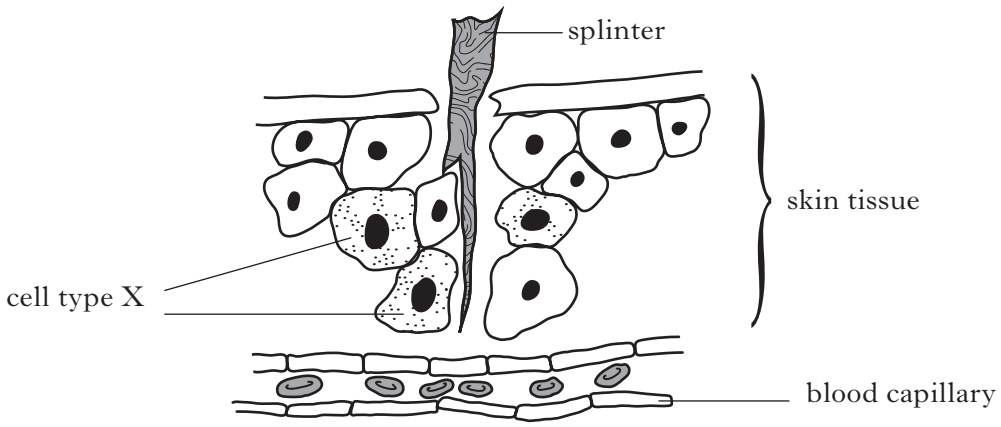
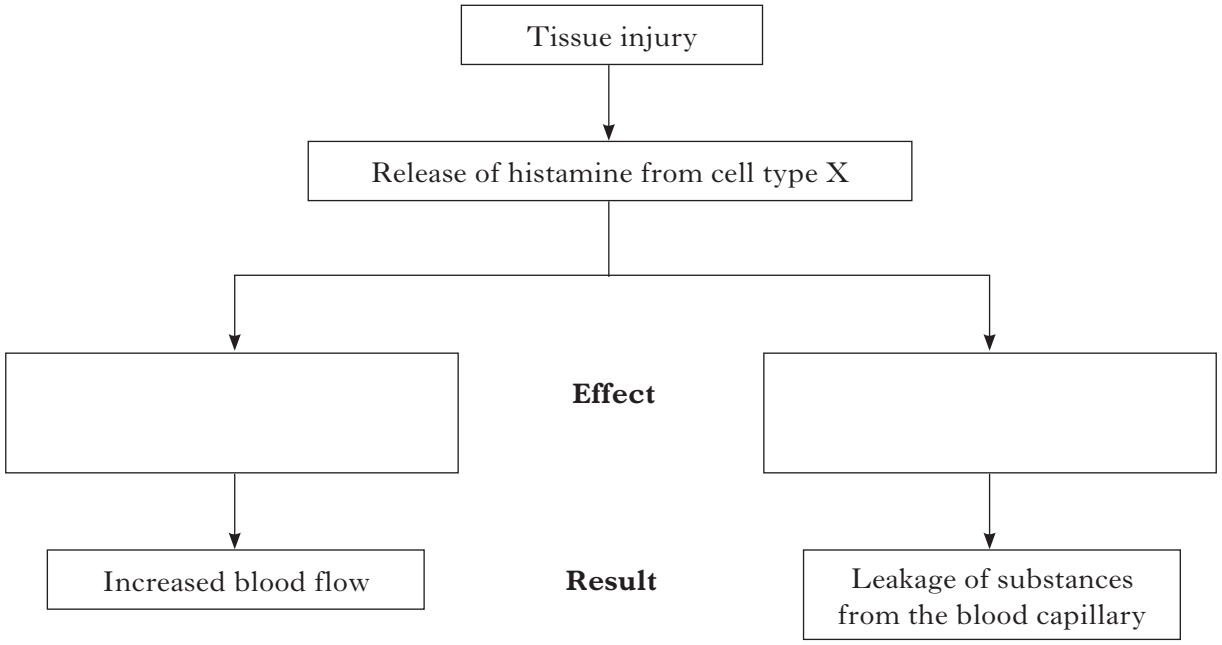
Marks

14. The diagram below shows an injury in which skin is pierced by a splinter.



The flow diagram shows some of the events which result from this injury.



(*a*) Identify cell type X.

_____ **1**

(*b*) Complete the flow diagram to show the effects of histamine release. **2**

(*c*) Name **one** substance which leaks from the blood capillary and describe how it protects against infection.

Substance _____ **1**

Description _____

_____ **1**

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 infectious diseases under the following headings:

(i) the classification of the spread of diseases; **3**

(ii) the transmission of disease; **3**

(iii) the control of disease transmission. **4**

(10)

OR

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

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

(ii) the structure and function of 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. Discuss the exchange of substances between plasma and body cells. **(10)**

OR

B. Discuss the screening and testing procedures which may be carried out as part of antenatal care. **(10)**

[*END OF QUESTION PAPER*]

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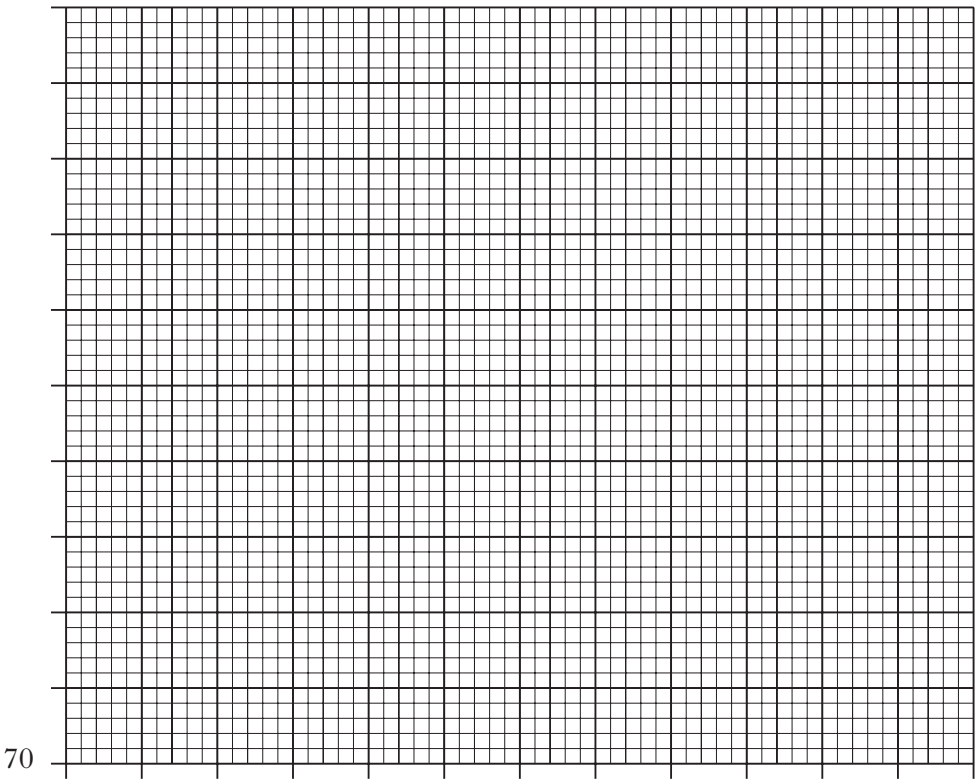
ADDITIONAL GRAPH FOR QUESTION 2(*d*)



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