FOR OFFICIAL USE

Total for Sections B & C

X275/12/02

NATIONAL QUALIFICATIONS 2014

FRIDAY, 16 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 (30 marks)

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 (100 marks)

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. Stem cells in the red bone marrow give rise to

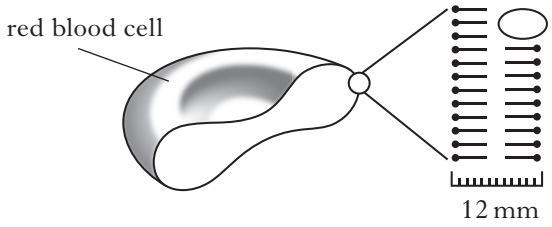
A only platelets

B only red blood cells

C only platelets and red blood cells

D platelets, red blood cells and white blood cells.

2. The diagram below represents part of the plasma membrane of a red blood cell.



The membrane is shown magnified 2 million times.

What is the width of the membrane?
(1 nanometre = 1×10^{-6} mm)

A 0·6 nanometres

B 6 nanometres

C 24 nanometres

D 60 nanometres

3. Which line in the table below matches correctly the cell types with the tissue in which they are found?

	Connective tissue	*Epithelial tissue*
A	blood cell	skin cell
B	bone cell	nerve cell
C	cartilage cell	bone cell
D	muscle cell	cartilage cell

4. A DNA molecule replicates three times during three cell division processes.

How many of the 8 resulting DNA molecules will contain the original DNA strands?

A 0

B 2

C 4

D 8

5. Which of the following processes occurs during RNA splicing?

A Introns are added

B Exons are added

C Introns are removed

D Exons are removed

6. Which line in the table below shows correctly the effects of different types of gene mutations on the protein formed?

	Gene mutation		
	Nonsense	*Missense*	*Frameshift*
A	Shortened protein formed	Protein contains one different amino acid	All amino acids changed from one point
B	Shortened protein formed	All amino acids changed from one point	Protein contains one different amino acid
C	Protein contains one different amino acid	Shortened protein formed	All amino acids changed from one point
D	All amino acids changed from one point	Shortened protein formed	Protein contains one different amino acid

[Turn over

7. As part of a metabolic pathway substrate X is converted into product Y.

Substrate X ⟶ Product Y

Under what circumstances would this reaction be reversed?

A An increase in concentration of both X and Y

B A decrease in concentration of both X and Y

C An increase in concentration of X and removal of Y

D An increase in concentration of Y and removal of X

8. Non-competitive inhibitors affect enzyme action by

A altering the shape of the active site of the enzyme

B altering the shape of the substrate molecule

C competing for the active site of the enzyme

D competing for the substrate molecule.

9. Which line in the table below identifies correctly conditions which would increase the risk of the fetus being harmed by the mother's immune system?

	Pregnancy	*Blood type of Mother*	*Blood type of Fetus*
A	First	Rhesus negative	Rhesus positive
B	Second	Rhesus positive	Rhesus negative
C	First	Rhesus positive	Rhesus negative
D	Second	Rhesus negative	Rhesus positive

10. Huntington's chorea is caused by a single dominant gene which is not sex-linked.

A woman's father is heterozygous for this condition and her mother is unaffected.

What are the chances this woman has inherited the condition?

A 75%

B 67%

C 50%

D 25%

11. A couple have a daughter who has the inherited condition cystic fibrosis.

Neither parent has the condition.

Based on this information it could be concluded that the inheritance of cystic fibrosis is

A sex-linked recessive

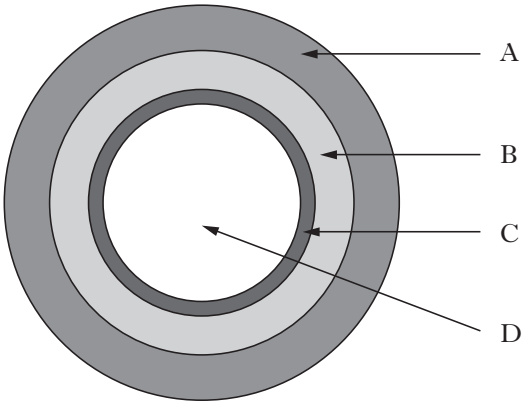
B autosomal dominant

C autosomal recessive

D sex-linked dominant.

12. The diagram below represents a section through an artery.

Which label correctly identifies a region containing smooth muscle tissue?

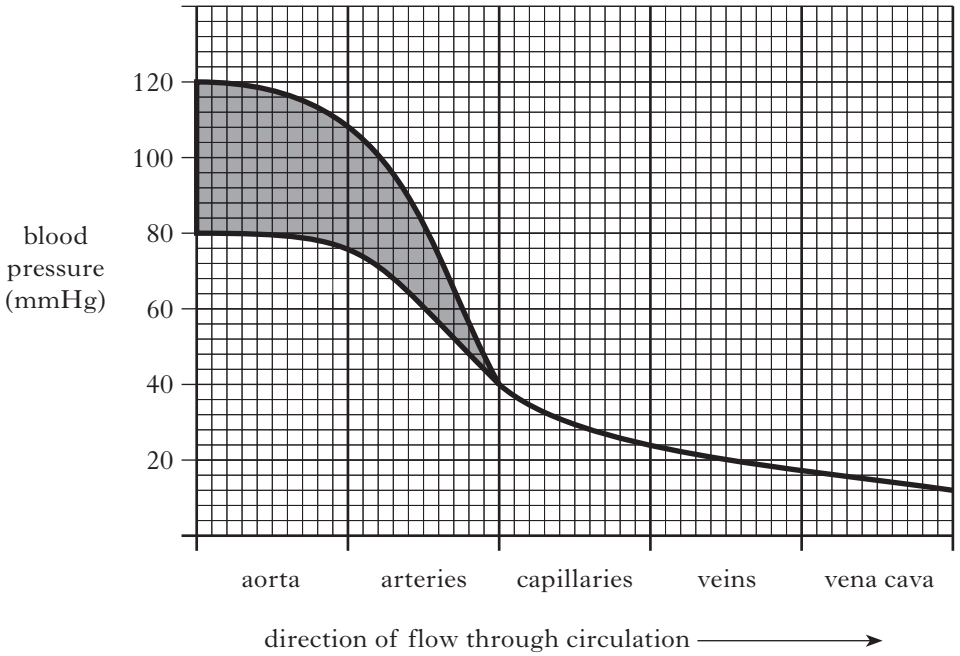


13. Which line in the table below identifies correctly an effect of the autonomic nervous system (ANS) on the sinoatrial node (SAN) in the heart?

	Branch of ANS	*Chemical released*	*Rate of impulse generation by SAN*
A	sympathetic	acetylcholine	increases
B	sympathetic	noradrenaline	decreases
C	parasympathetic	acetylcholine	decreases
D	parasympathetic	noradrenaline	increases

14. The difference between systolic and diastolic blood pressure is often referred to as pulse pressure.

The graph below shows the changes in blood pressure as blood flows through the circulatory system of an individual.



The maximum pulse pressure shown in the graph is

A 40 mmHg

B 80 mmHg

C 100 mmHg

D 120 mmHg.

15. The main blood vessel supplying the heart muscle itself with oxygenated blood is the

A coronary vein

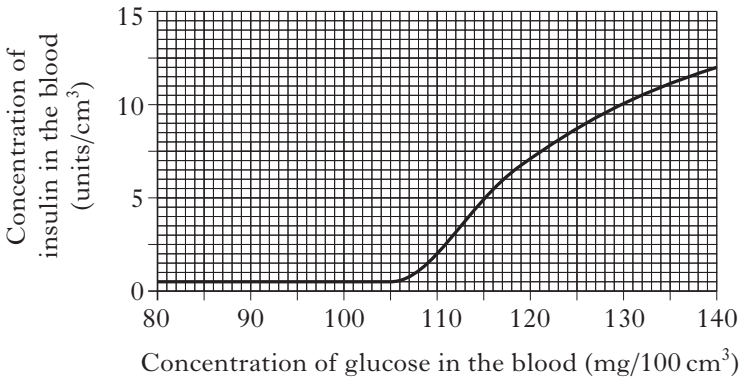
B coronary artery

C pulmonary artery

D pulmonary vein.

[Turn over

16. The graph below shows how the concentration of insulin in the blood is affected by changes in the concentration of glucose in the blood.



What total mass of glucose would be present in an individual with 5 litres of blood and an insulin concentration of 5 units/cm^3?

A 115 mg

B 575 mg

C 1150 mg

D 5750 mg

17. Which of the following statements about diabetes is correct?

A Type 2 diabetes typically develops in overweight individuals during childhood.

B Type 1 diabetes usually develops in childhood and can be treated by dietary management.

C Individuals with Type 1 diabetes are unable to produce insulin and have no insulin receptors within their liver.

D Individuals with Type 2 diabetes are typically overweight and have liver cells which are less sensitive to insulin.

18. The table below contains information about four individuals who lost weight by reducing their daily energy intake through dieting.

A reduction in energy intake of 30 MJ results in the loss of 1 kg.

Individual	*Starting weight* (kg)	*Target weight achieved* (kg)	*Daily energy reduction during diet* (MJ/day)
A	84	78	2
B	90	81	3
C	95	85	4
D	105	90	5

Which individual was first to reach their target weight?

19. By calculating body mass index (BMI), it can be determined whether a person is clinically obese.

The table below contains information about four individuals.

Individual	*Height* (m)	*Mass* (kg)
1	1·60	90
2	2·10	130
3	1·80	100
4	1·30	56

Which of these individuals would be classified as obese?

A 2 only

B 2 and 3

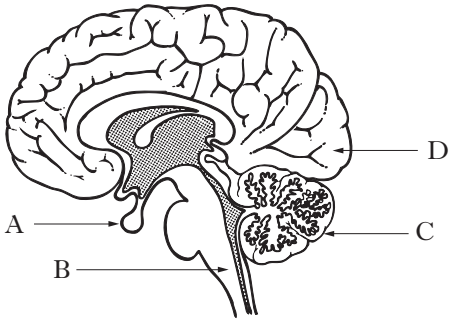
C 1, 3 and 4

D all of them

20. Which line in the table below identifies correctly a pair of antagonistic actions of the autonomic nervous system?

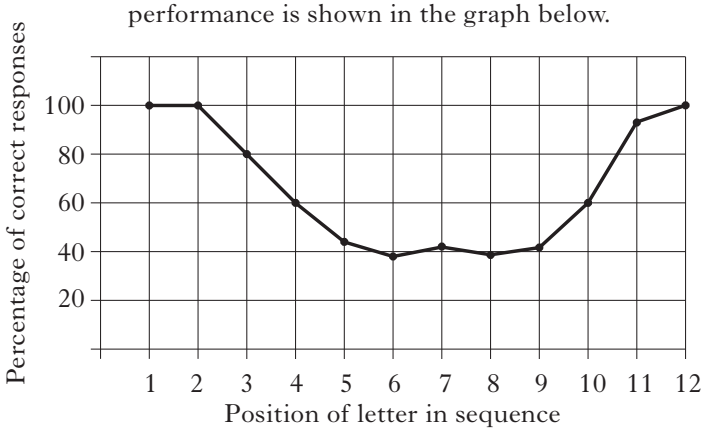
	Sympathetic action	*Parasympathetic action*
A	decreased secretion of digestive enzymes	increased secretion of digestive enzymes
B	decreased heart rate	increased heart rate
C	increased peristalsis	decreased peristalsis
D	decreased breathing rate	increased breathing rate

21. The diagram below represents a section through the brain.



Which letter indicates the part of the brain which controls breathing?

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



On how many occasions was a letter recalled by more than 50% of the students?

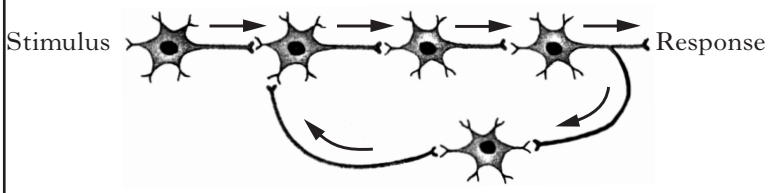
A 4

B 5

C 6

D 7

23. The diagram below represents a neural pathway.



The type of pathway shown is a

A diverging neural pathway

B converging neural pathway

C sensory neural pathway

D reverberating neural pathway.

24. Which of the following chemicals has a major role in a reward pathway?

A Dopamine

B Endorphin

C Epinephrine

D Acetylcholine

25. A young child is scratched by a cat which is ginger in colour.

After this she becomes scared of all ginger cats.

This is an example of a type of behaviour called

A shaping

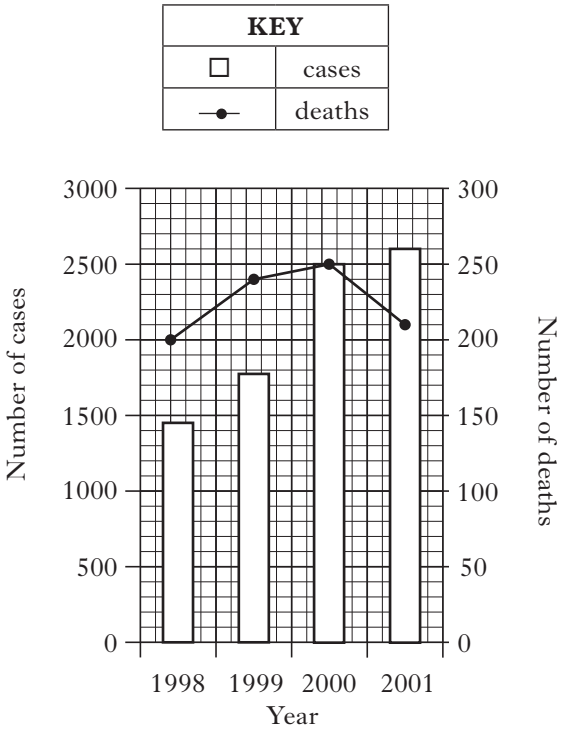
B generalisation

C discrimination

D internalisation.

[Turn over

26. The graph below shows the number of cases of meningitis and deaths due to meningitis in the UK from 1998 to 2001.



In which year was the number of deaths from meningitis less than 10% of the number of cases?

A 1998

B 1999

C 2000

D 2001

27. When a disease occurs regularly in an area it is classified as being

A sporadic

B endemic

C epidemic

D pandemic.

28. Adjuvants are often added to vaccines to

A make the vaccine safer

B enhance the immune response

C make immunity last for a longer time

D ensure the vaccine contains no live pathogens.

29. In a clinical trial of a vaccine, researchers placed volunteers into two groups.

Each group contained individuals of matched ages.

The researchers then gave group A an injection of the vaccine and group B an injection of a dilute sugar solution.

Which of the following protocols was used in this trial?

A Placebo controls

B Pedigree analysis

C Double blind design

D Randomised allocation

30. On which of the following does the herd immunity threshold **not** depend?

A Type of disease

B Population density

C Effectiveness of the vaccine

D Quarantine of non-immune individuals

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

SECTION B

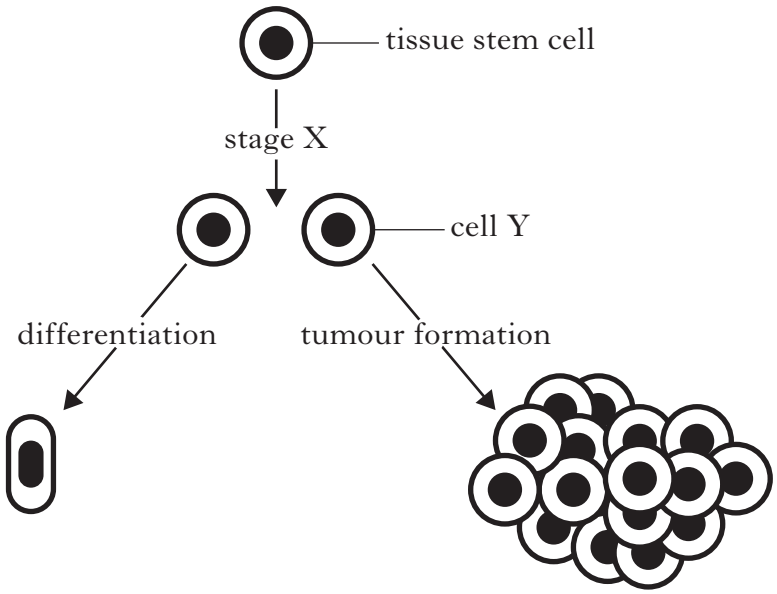
Marks

DO NOT WRITE IN THIS MARGIN

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram below shows two possible pathways involving tissue stem cells.



(*a*) Name the type of cell division occurring during stage X.

_____ **1**

(*b*) Describe what happens to the genes of a cell as differentiation occurs.

_____

_____ **1**

(*c*) (i) Explain what happens to cell Y which leads to the formation of a tumour.

_____

_____

_____

_____ **2**

(ii) Describe how secondary tumours can arise from a tumour.

_____

_____ **1**

(*d*) Describe a therapeutic use of stem cells.

_____

_____ **1**

Marks

2. Yeast is a single-celled fungus which produces enzymes, one of which catalyses the release of hydrogen during respiration.

An investigation was carried out to compare three sugars as respiratory substrates for yeast. Methylene blue dye was used to measure the rate of respiration because it turns clear in the presence of hydrogen.

A colorimeter was used to measure the colour intensity of the dye during the investigation.

The investigation setup is shown in **Figure 1**.

Table 1 shows the range of colorimeter readings recorded.

Figure 1

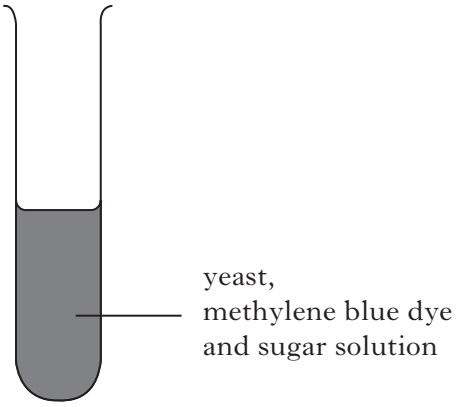


Table 1

Colour intensity of dye	*Colorimeter reading* (units)
maximum	63
minimum	0

Three test tubes were set up, each containing a different sugar. The colour intensity of the dye was measured at four-minute intervals for twenty minutes.

The results of the investigation are shown in **Table 2** below.

Table 2

Time (min)	*Colorimeter reading* (units)		
	glucose sugar	*maltose sugar*	*lactose sugar*
0	63	63	63
4	46	61	63
8	28	56	63
12	10	35	63
16	0	10	63
20	0	0	63

(*a*) When setting up the test tubes as shown in **Figure 1**, state which substance should be added last.

Give a reason for your choice of substance.

Substance _____

Reason _____

_____ **1**

2. (continued) *Marks* DO NOT WRITE IN THIS MARGIN

(*b*) List **three** variables which would have to be kept constant during this investigation.

1 _____

2 _____

3 _____ **2**

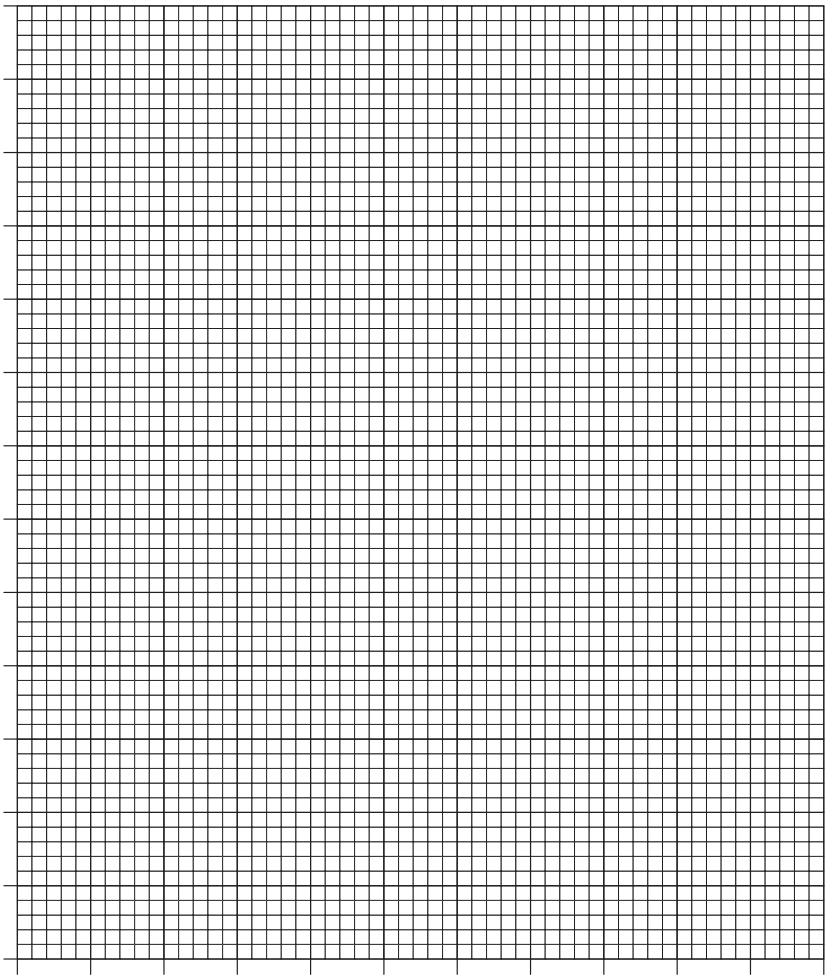
(*c*) State how the reliability of the results from this investigation could be improved.

_____

_____ **1**

(*d*) (i) Construct a line graph to show all the data in **Table 2**.

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



3

(ii) State a conclusion that can be drawn from the results of this investigation.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

2. (continued)

(*e*) (i) Maltose is a disaccharide sugar which is composed of two glucose molecules joined together.

Use this information to explain why the colour intensity of the dye in the test tube containing maltose decreased more slowly than the intensity of the dye in the test tube containing glucose.

_____

_____ **1**

(ii) Lactose is also a disaccharide sugar.

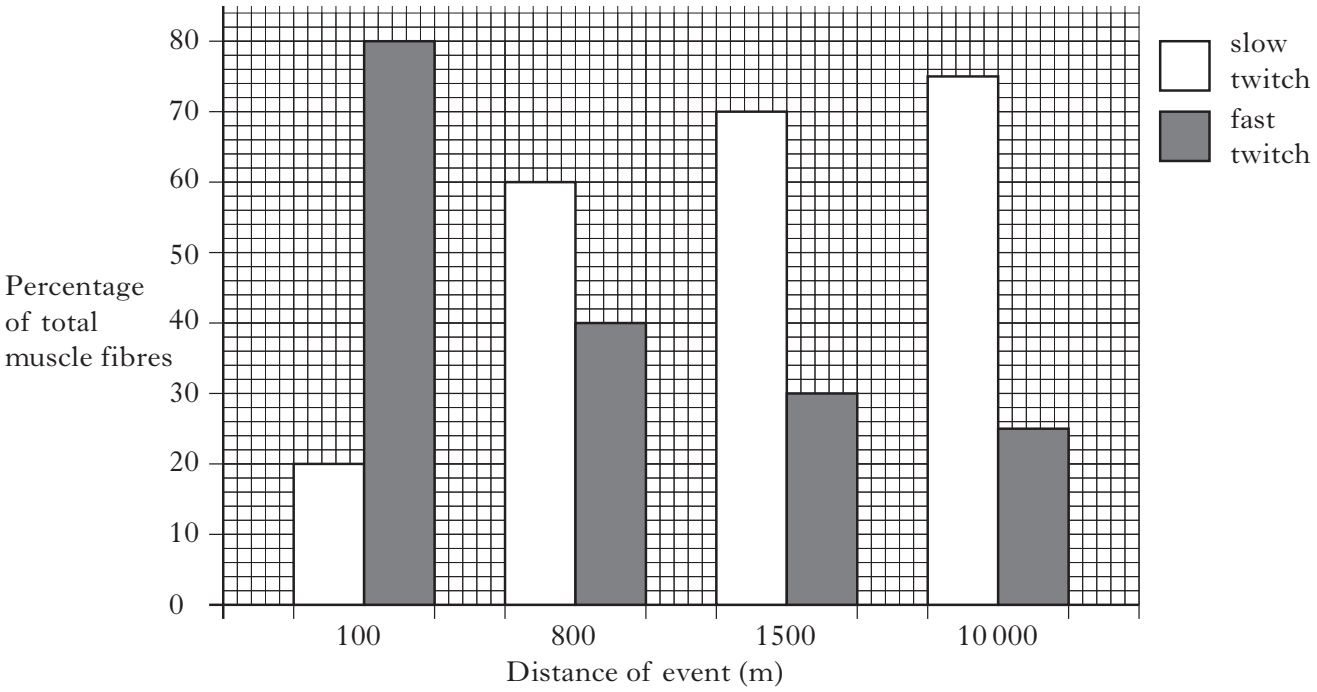
Suggest why the colour intensity of the dye in the test tube containing lactose remained the same throughout the investigation.

_____

_____ **1**

3. The graph below compares the percentage of slow twitch and fast twitch muscle fibres found in Commonwealth Games athletes competing in track events of different distances.

Marks



(*a*) (i) Express, as a simple whole number ratio, the percentage of slow twitch to fast twitch muscle fibres found in the 10 000 metre runner.

Space for calculation

_____ : _____ **1**

slow twitch fast twitch

(ii) Explain why the 10 000 metre runner requires a high percentage of slow twitch muscle fibres.

_____

_____ **1**

(*b*) Describe the trends shown in the graph.

_____

_____

_____ **1**

(*c*) Describe **two** structural differences between slow twitch and fast twitch muscle fibres.

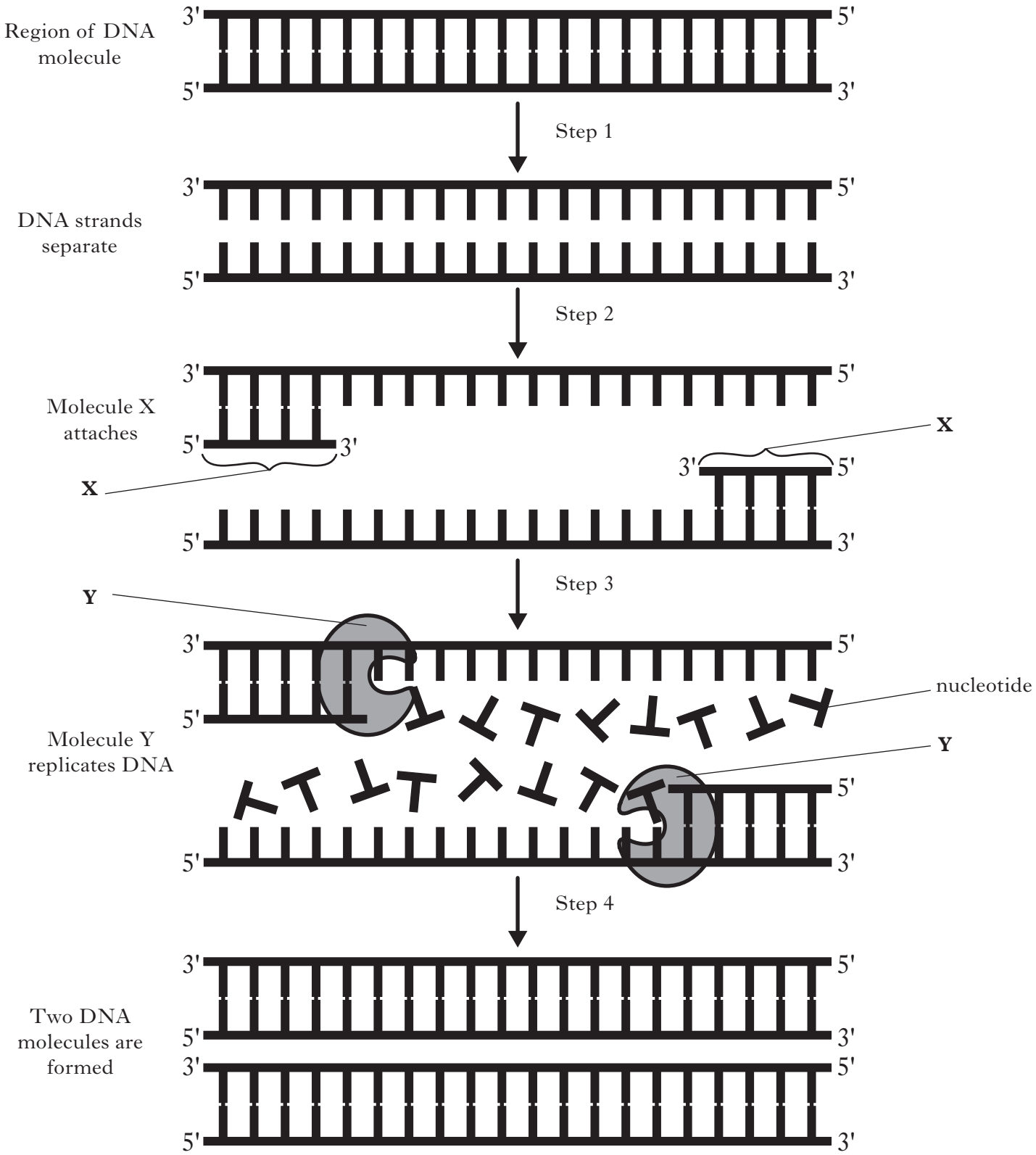
1 _____

_____

2 _____

_____ **2**

4. The diagram below represents steps in one cycle of the polymerase chain reaction (PCR).



DO NOT WRITE IN THIS MARGIN

Marks

4. (continued)

(*a*) (i) State the structural difference between the 3' and 5' end of a DNA strand.

_____

_____ **1**

(ii) Describe how the DNA is treated during step 1.

_____ **1**

(iii) Name molecule X.

_____ **1**

(iv) Name molecule Y and describe its role in the replication of DNA.

Name _____

Role _____

_____ **2**

(*b*) State the term which describes the production of multiple copies of DNA using PCR.

_____ **1**

(*c*) PCR is used to produce multiple copies of DNA for DNA profiling.

State the feature of DNA which allows profiling to identify different individuals.

_____

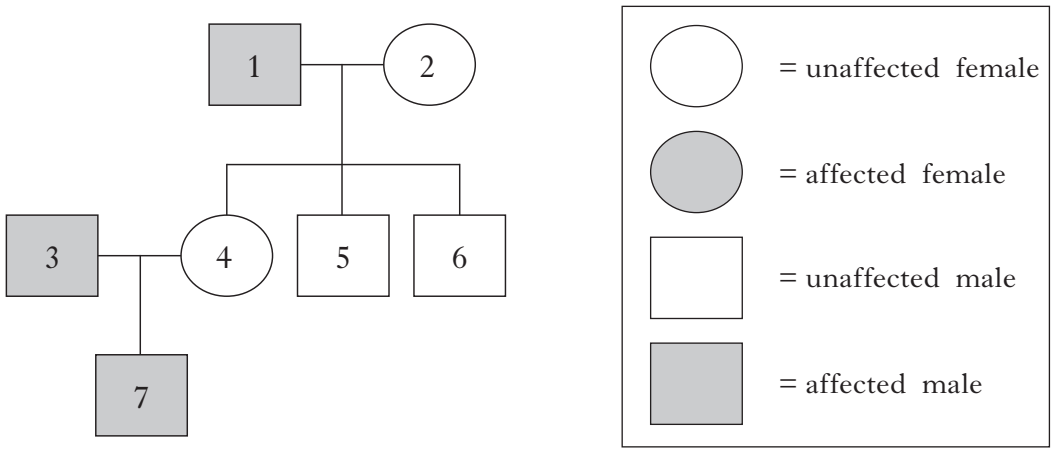
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

5. The diagram below shows the inheritance of a sex-linked condition in a family.



(*a*) The condition is caused by a recessive sex-linked allele represented by the letter **d**.

(i) State the genotypes of individuals 3 and 4.

Individual 3 _____

Individual 4 _____ **1**

(ii) Explain why individual 1 could not pass the condition to his sons.

_____

_____

_____ **1**

(iii) Individual 6 has a son with a woman who is a carrier of the condition.
Calculate the percentage chance of their son having this condition.
Space for calculation

_____ % **1**

DO NOT WRITE IN THIS MARGIN

Marks

5. (continued)

(*b*) The condition is caused by a mutation in which an extra nucleotide is inserted into the gene that codes for an enzyme.

Explain the likely effect of this mutation on the structure of the enzyme.

2

(*c*) The condition occurs with a frequency of 1 in 350 males.

Assuming an equal proportion of males and females, calculate how many males are likely to have the condition in a town with a population of 175 000.

Space for calculation

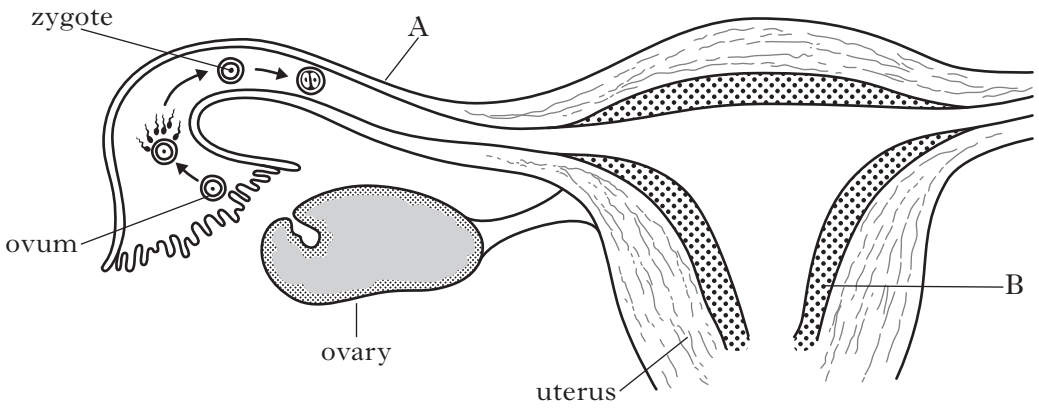
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. The diagram below shows the fertilisation of an ovum and its subsequent early development.



(*a*) Name structures A and B.

A _____

B _____ **2**

(*b*) The ovum is released from a follicle in the ovary which then becomes the corpus luteum. These structures are affected by pituitary hormones.

Complete the table below to describe the effect of these hormones on the structures.

Structure	*Pituitary hormone*	*Effect on structure*
Follicle	FSH	
Corpus luteum	LH	

2

(*c*) Explain what prevents the further development of follicles when an embryo is developing in the uterus.

_____

_____

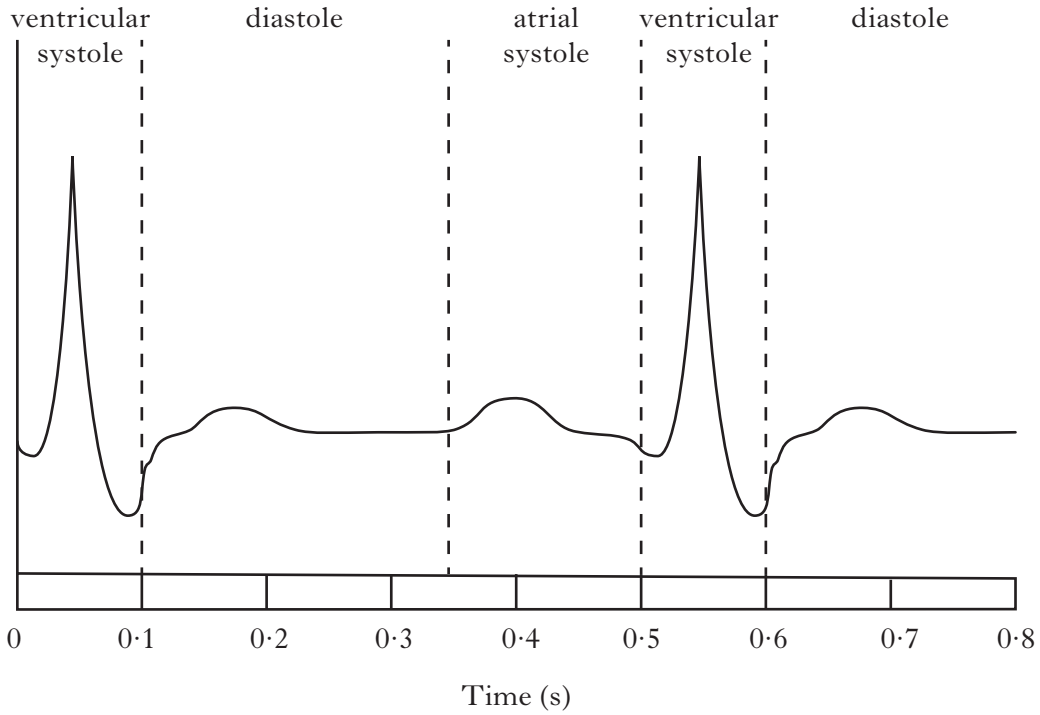
_____

_____ **2**

DO NOT WRITE IN THIS MARGIN

Marks

7. The diagram below shows an electrocardiogram (ECG) trace of an individual's heartbeat.



(*a*) Calculate the heart rate of this individual.

Space for calculation

_____ bpm **1**

(*b*) Complete the following sentence by underlining one option from each pair of options shown in **bold**.

During the diastolic stage of the cardiac cycle, the atrial muscles are **contracted** / **relaxed** and the ventricular muscles are **contracted** / **relaxed**. **1**

(*c*) Name the valves which will be open and closed in the left side of the heart during ventricular systole.

Open _____ Closed _____ **1**

(*d*) Predict how this individual's ECG trace would change under the influence of the parasympathetic nervous system.

_____

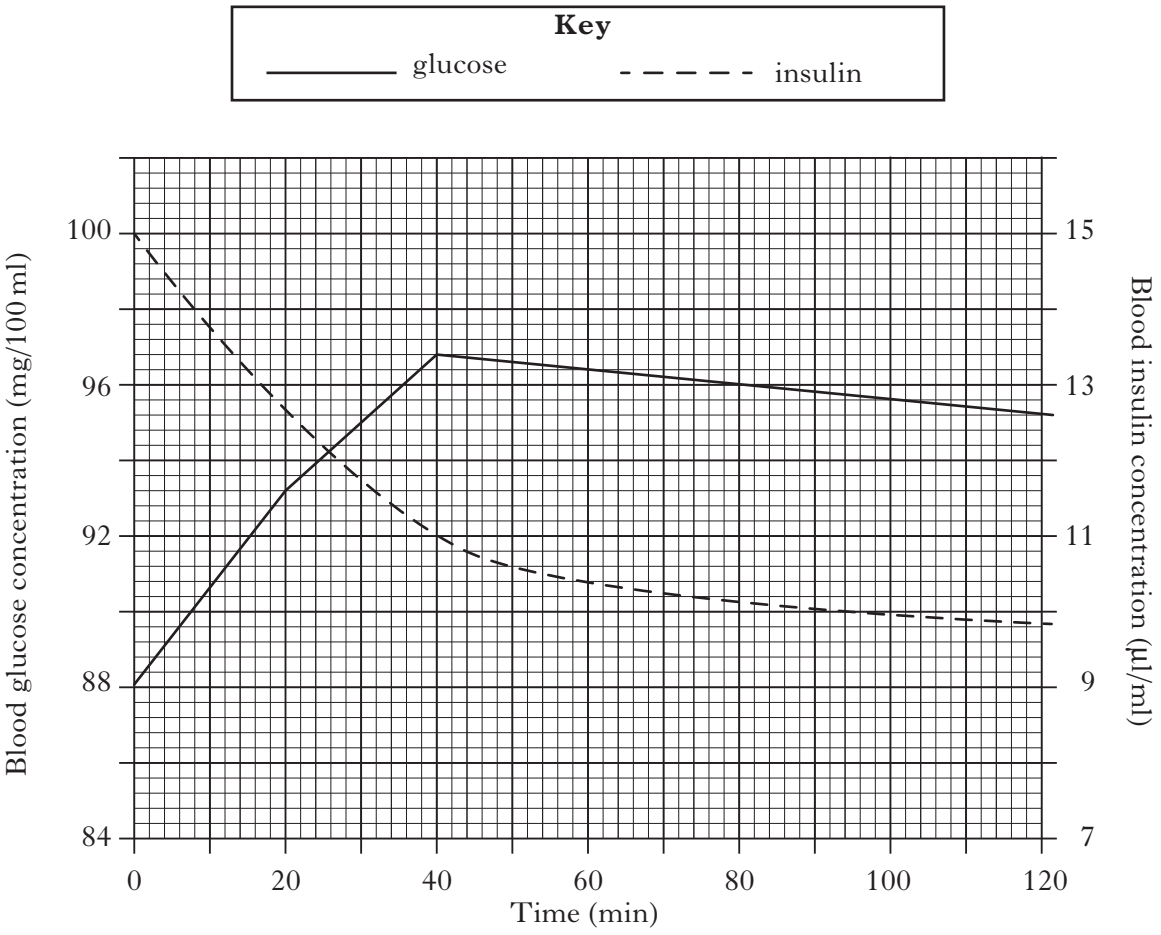
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

8. The graph below shows the changes in the concentration of glucose and insulin in a cyclist's blood while he cycled at a constant rate for two hours.



(*a*) (i) State the cyclist's blood insulin concentration after he had been cycling for 10 minutes.

_____ **1**

(ii) State the cyclist's blood glucose concentration when his blood insulin concentration was 11 µl/ml.

_____ mg/100 ml **1**

(*b*) During exercise, adrenaline is released which inhibits the production of insulin.

Explain why this is important to the cyclist.

_____

_____

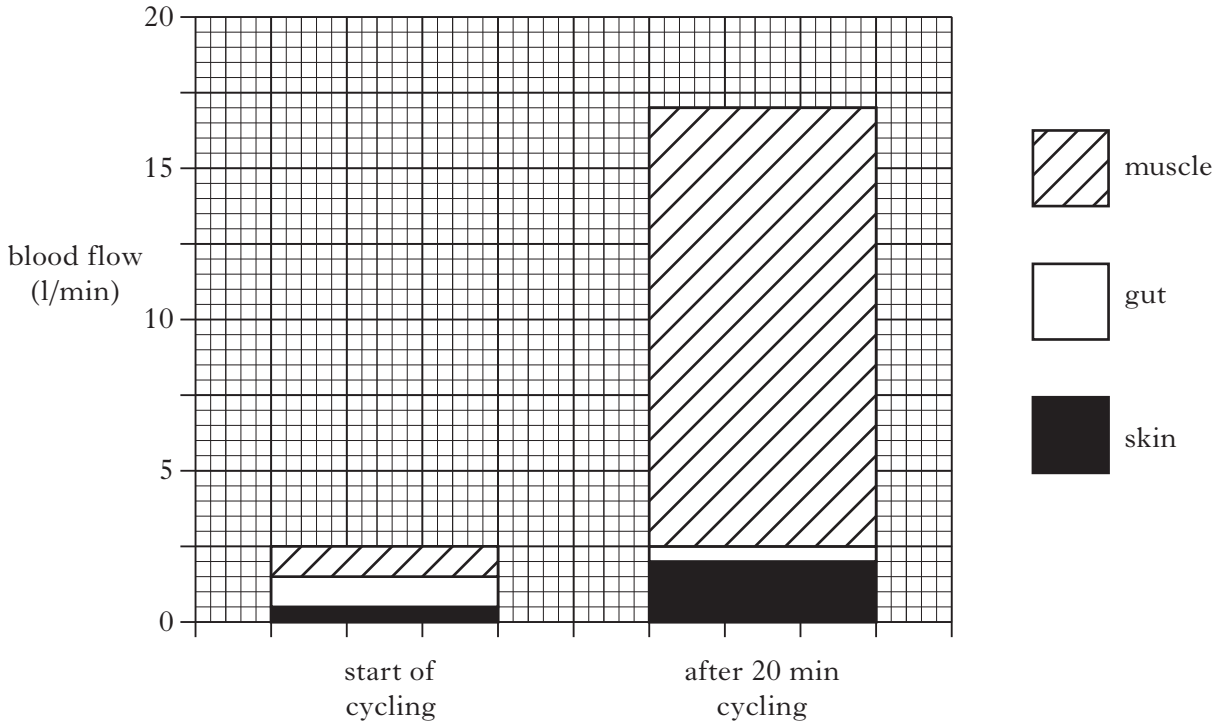
_____

_____ **2**

8. (continued)

Marks

(*c*) The graph below shows the changes that occurred in the distribution of blood to some parts of the cyclist's body after he had been cycling for 20 minutes.



(i) Calculate the percentage increase that occurred in blood flow to his skin after he had been cycling for 20 minutes.

Space for calculation

_____ % **1**

(ii) Calculate the whole number ratio of muscle to gut blood flow after 20 minutes of cycling.

Space for calculation

_____ : _____ **1**
muscle gut

(iii) Describe how changes in the volume and distribution of blood to the muscles occur during cycling.

Volume _____

_____

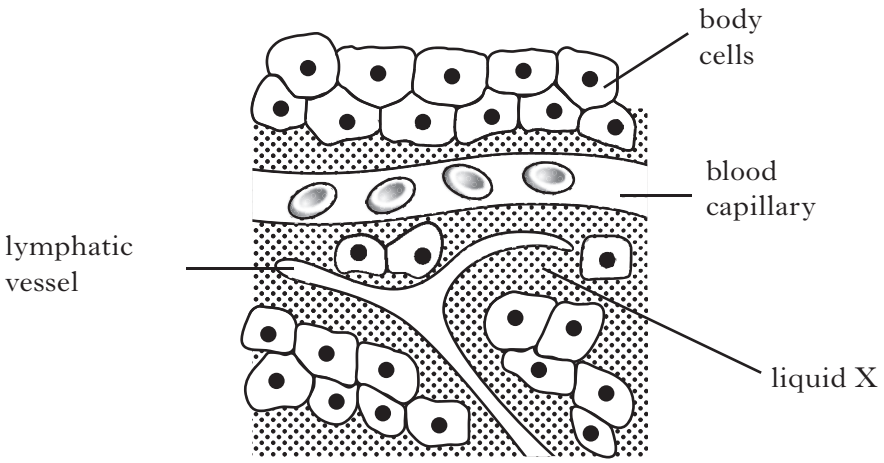
Distribution _____

_____ **2**

DO NOT WRITE IN THIS MARGIN

Marks

9. The diagram below shows the relationship between a blood capillary, body cells and a lymphatic vessel.



(*a*) (i) Name liquid X.

_____ **1**

(ii) State **one** way in which the composition of this liquid is different from blood plasma.

_____ **1**

(*b*) Complete the table below by naming **one** substance, apart from carbon dioxide and water, which is passed from the cells in each of the following tissues into blood capillaries.

Tissue	*Substance*
Interstitial cells	
Pancreas	
Leg muscle (after a sprint)	

2

(*c*) Describe the function of lymphatic vessels.

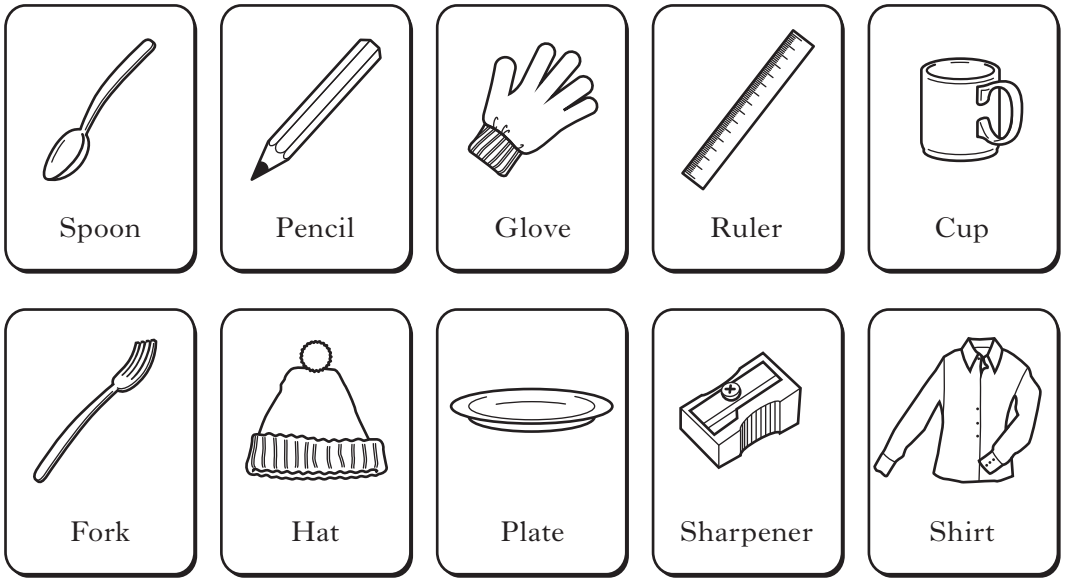
_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

10. Three groups of children were shown cards of the following objects.



(*a*) Each group of children was given a different method to use in order to memorise the objects. The methods used by each group are shown below.

Group 1 — making up a story to include the objects
Group 2 — sorting the objects into related categories
Group 3 — saying the names of the objects to themselves several times

(i) State the term that describes the method used by each group to transfer the objects into long-term memory.

Group 1 _____

Group 2 _____

Group 3 _____ **2**

(ii) Several days later, the children were asked to recall the list of objects. Suggest an appropriate contextual cue that the children could use.

Explain how this cue would aid their recall.

Contextual cue _____

Explanation _____

_____ **1**

(*b*) In order to recall the objects, the children used semantic memory.

State the area of the brain in which semantic memories are stored.

_____ **1**

DO NOT WRITE IN THIS MARGIN

11. Use of recreational drugs can lead to drug addiction. *Marks*

(*a*) Recreational drugs cause changes to the neurochemistry of the brain.

State **two** different ways in which these neurochemical changes can affect an individual.

1 _____

2 _____ **1**

(*b*) Recreational drugs can affect neurotransmitter function at a synapse.

(i) State the function of neurotransmitters.

_____

_____ **1**

(ii) Describe **two** ways in which recreational drugs can affect the synapse.

1 _____

2 _____ **1**

(*c*) Sensitisation is thought to underlie many cases of drug addiction.

Explain what sensitisation is and what causes it.

Explanation _____

_____

Cause _____

_____ **2**

(*d*) Describe why anti-drug posters often feature an image of a celebrity.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

12. (*a*) Concerns about the MMR vaccine caused the percentage of children in the UK immunised against measles, mumps and rubella to fall below the critical level of 80% between 2000 and 2005. As a result, outbreaks of these viral diseases occurred in various parts of the country.

(i) State what is present in an injection of vaccine.

_____

_____ **1**

(ii) Explain how the process of vaccination prevents a child from showing symptoms of mumps during future outbreaks of the disease.

_____

_____

_____ **1**

(iii) Suggest why these diseases spread more rapidly when the vaccination level falls below 80%.

_____

_____

_____ **1**

(*b*) Unlike the MMR vaccine, a vaccine against influenza should be given annually.

State the reason for this.

_____

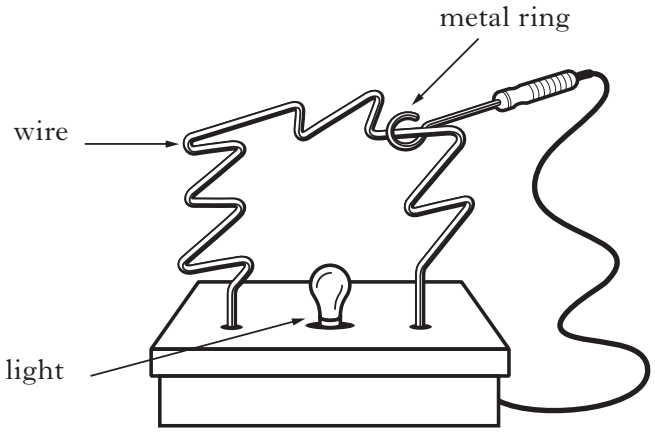
_____ **1**

[Turn over

Marks

13. A student carried out an investigation to determine the effect an audience has on the performance of a task.

In the investigation, each individual had to move a metal ring along a curved wire, without touching the wire. Whenever the wire was touched a light would come on. The diagram below shows the apparatus used.



The student started by asking each individual to carry out the task without an audience.
She then asked them to repeat the task with an audience present.

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

Individual	*Performance* (*Number of times the ring touched the wire when carrying out the task*)	
	Without an audience	With an audience
1	3	3
2	5	2
3	6	3
4	5	0
5	2	3
6	1	1
7	5	3
8	3	1
9	5	0
10	3	2

(*a*) Calculate the average improvement in performance caused by the presence of an audience.

Space for calculation

1

DO NOT WRITE IN THIS MARGIN

Marks

13. (continued)

(*b*) State the term which describes the improvement in performance caused by the presence of an audience.

_____ **1**

(*c*) It is possible that the improvement in performance in this investigation resulted from practice and not the presence of the audience.

Without changing the apparatus, suggest how the design of the investigation could be improved to remove this possibility.

_____

_____

_____ **1**

(*d*) Describe how this investigation could be redesigned to investigate the effects of practice on performance.

_____

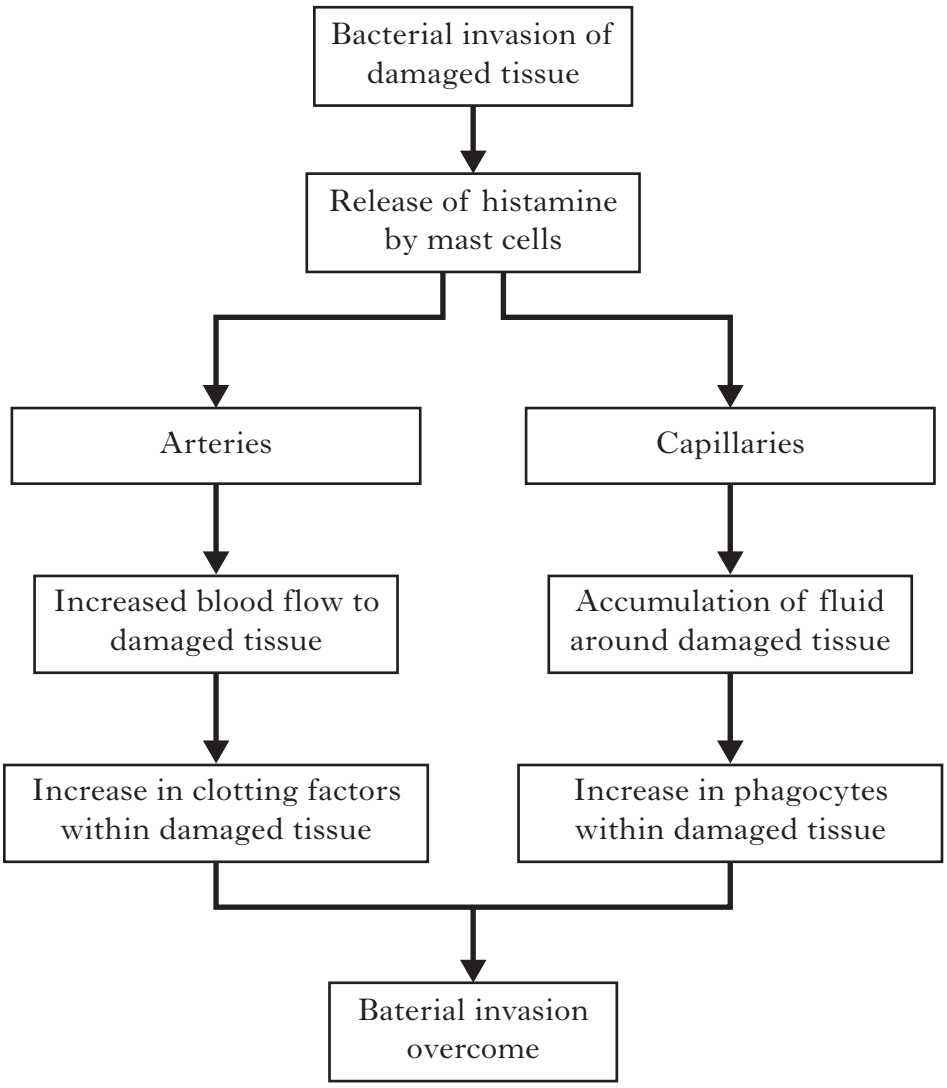
_____

_____ **1**

[Turn over

Marks

14. The flow chart below outlines some non-specific defence responses which occur when tissue is damaged and invaded by bacteria.



(*a*) Describe how histamine changes the arteries and capillaries to bring about the effects shown in the flow chart.

Arteries _____

_____

Capillaries _____

_____ **2**

(*b*) Name the active enzyme that is produced by the action of clotting factors.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

14. (continued)

(*c*) Describe the role of phagocytes in overcoming bacterial invasion.

_____

_____

_____

_____

_____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

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 Describe protein synthesis under the following headings:

(i) Transcription of DNA; **4**

(ii) Translation of mRNA. **6**

(10)

OR

B Describe aerobic respiration under the following headings:

(i) The citric acid cycle; **5**

(ii) The electron transport chain. **5**

(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 procedures that can be used to treat infertility. **(10)**

OR

B Discuss how cardiovascular disease occurs. **(10)**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

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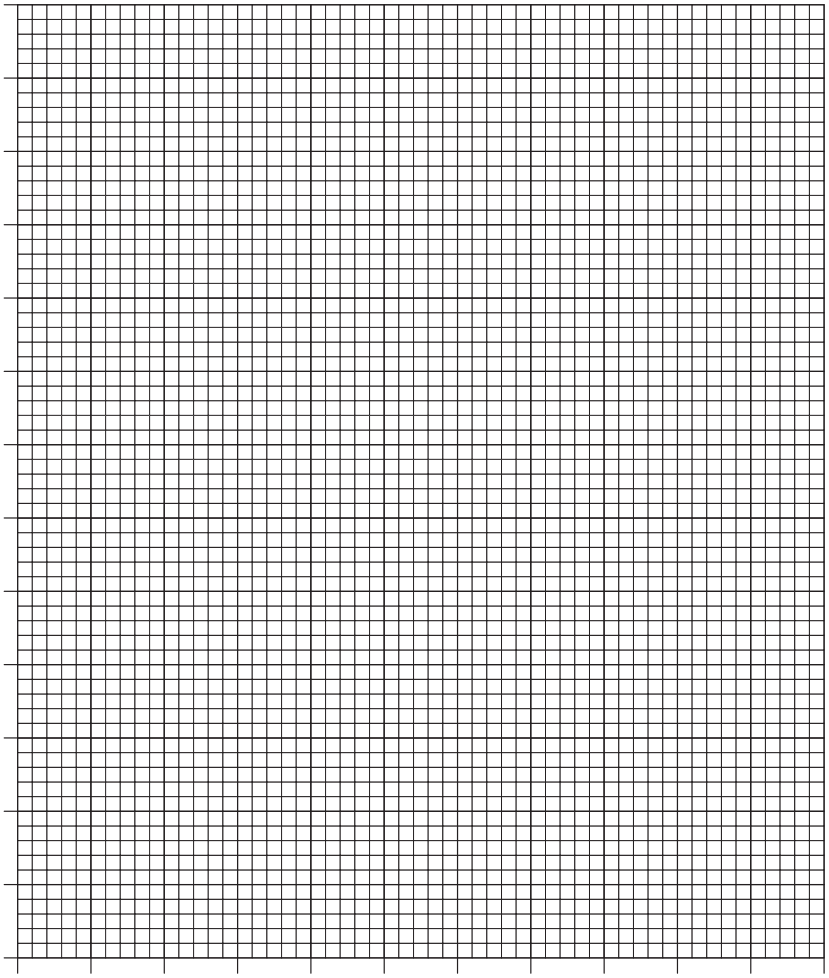
SPACE FOR ANSWERS

ADDITIONAL GRAPH FOR QUESTION 2(*d*)(i)



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