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.

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

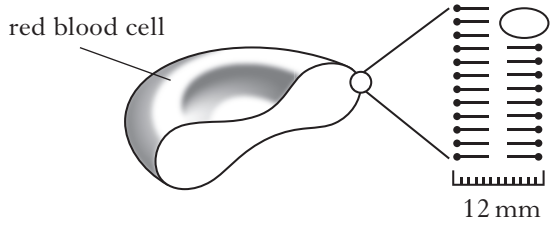
A only platelets

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

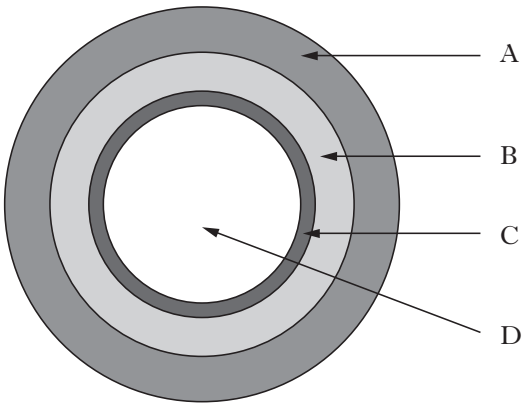
B autosomal dominant

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?

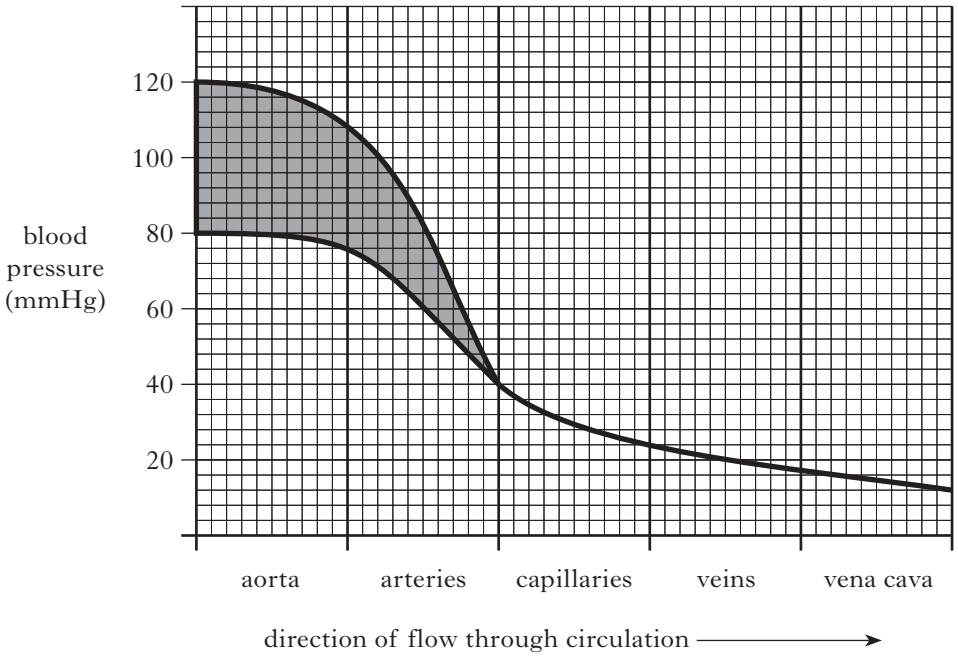


13. Which line in the table below identifies correctly an effect of the autonomic nervous system (ANS) on the sinoatrial node (SAN) in the heart?

	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

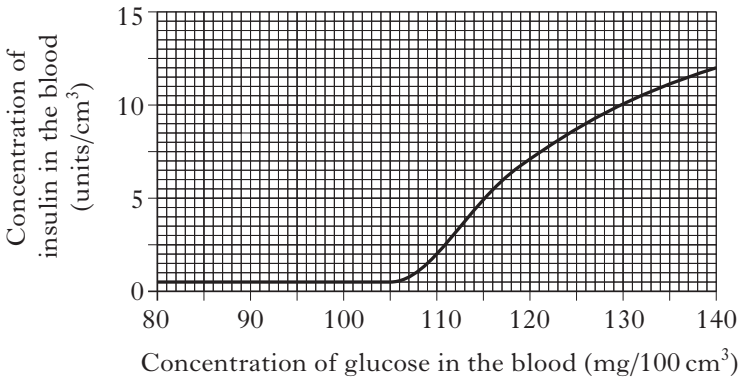
B coronary artery

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

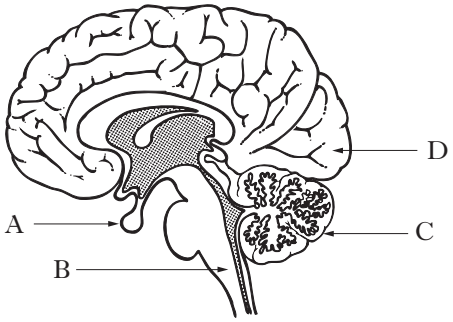
C 1, 3 and 4

D all of them

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

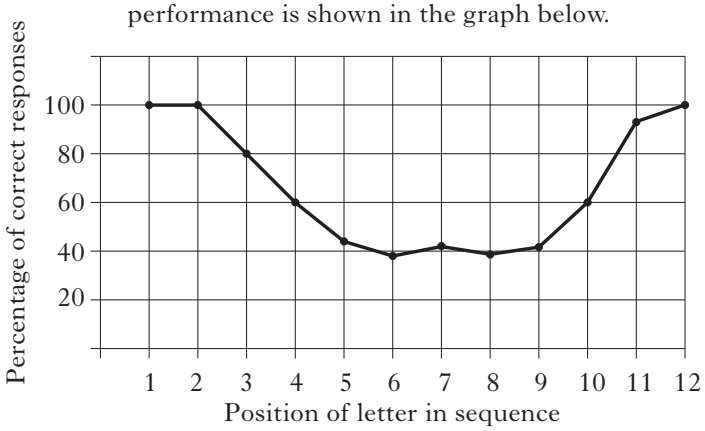
	Sympathetic action	*Parasympathetic action*
A	decreased secretion of digestive enzymes	increased secretion of digestive enzymes
B	decreased heart rate	increased heart rate
C	increased peristalsis	decreased peristalsis
D	decreased breathing rate	increased breathing rate

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?

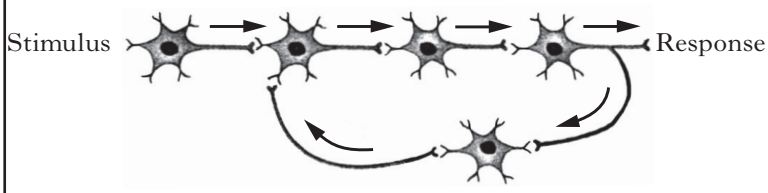
A 4

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

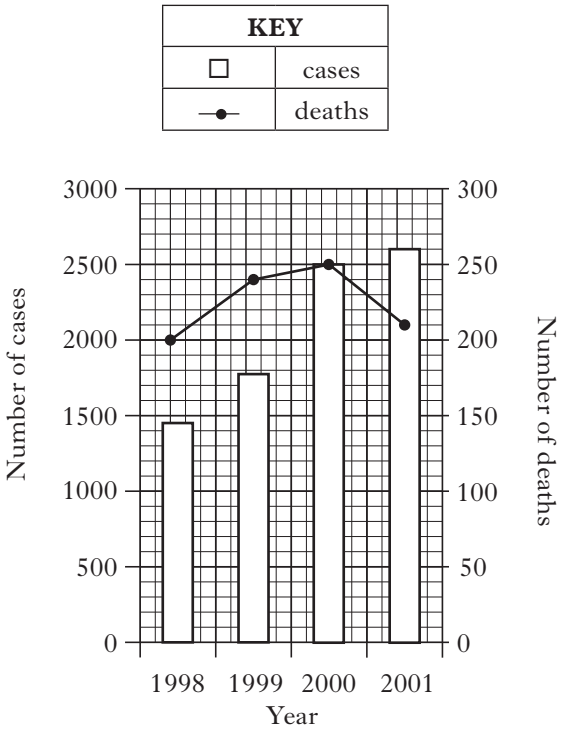
B generalisation

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

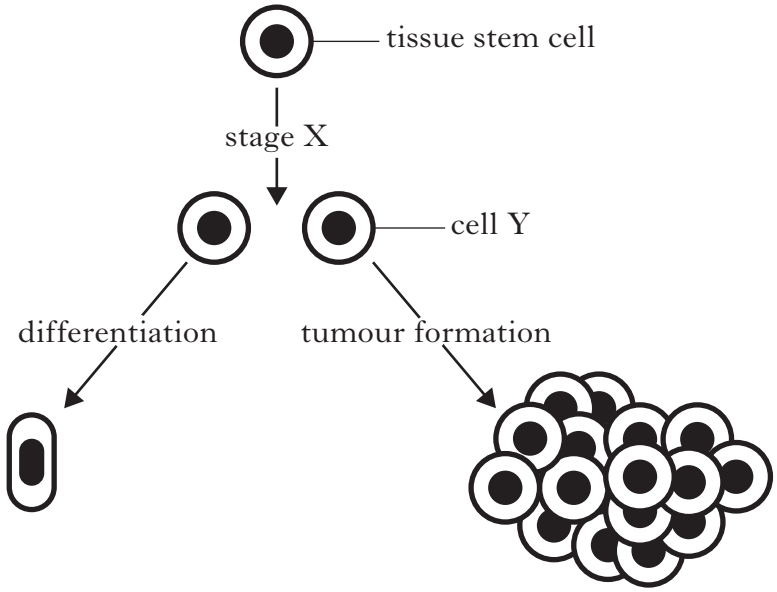
Marks

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

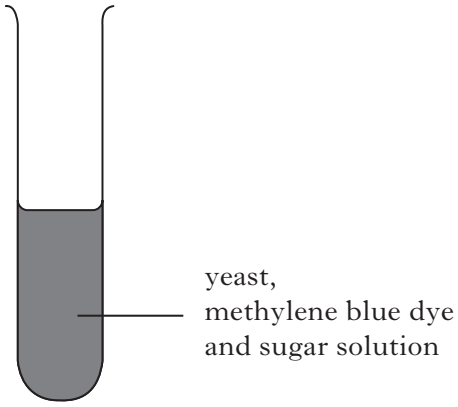


Table 1

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**

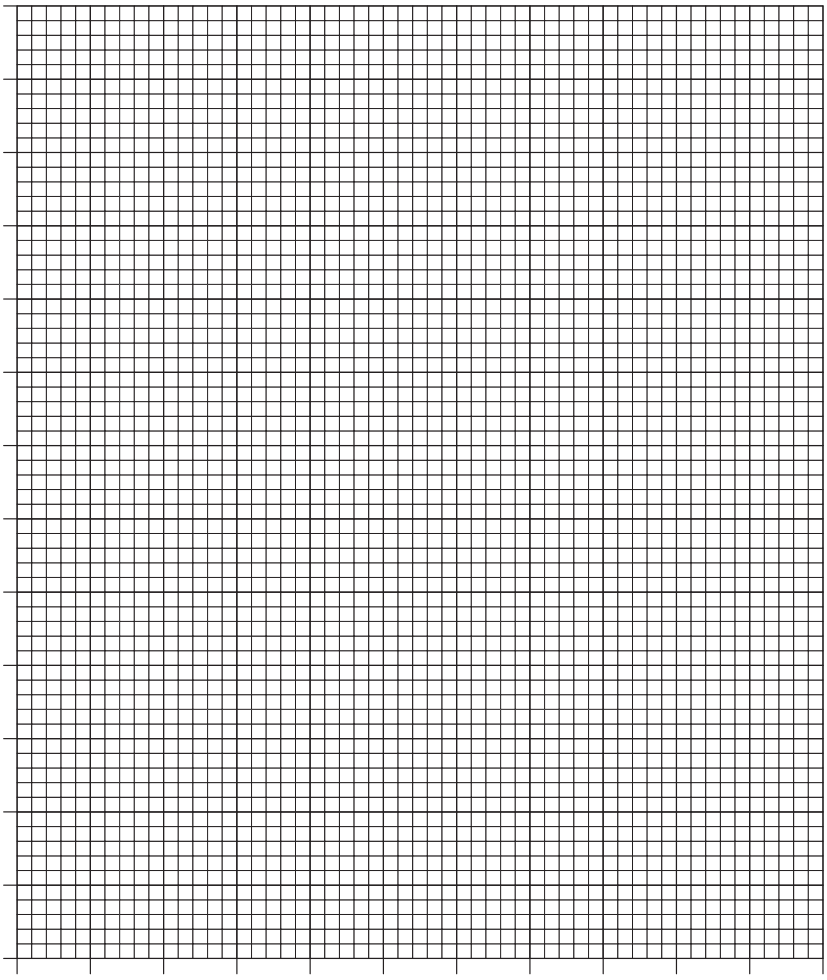
(*c*) State how the reliability of the results from this investigation could be improved.

_____

_____ **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.

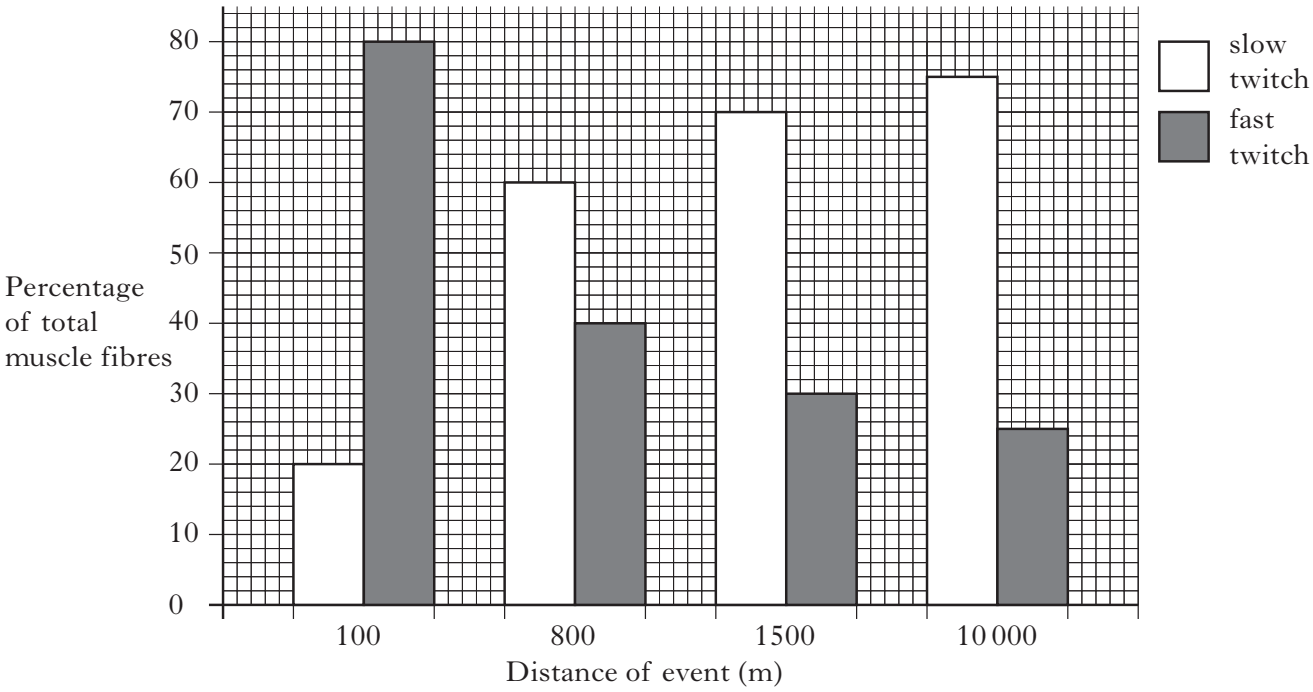
Suggest why the colour intensity of the dye in the test tube containing lactose remained the same throughout the investigation.

_____

_____ **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.

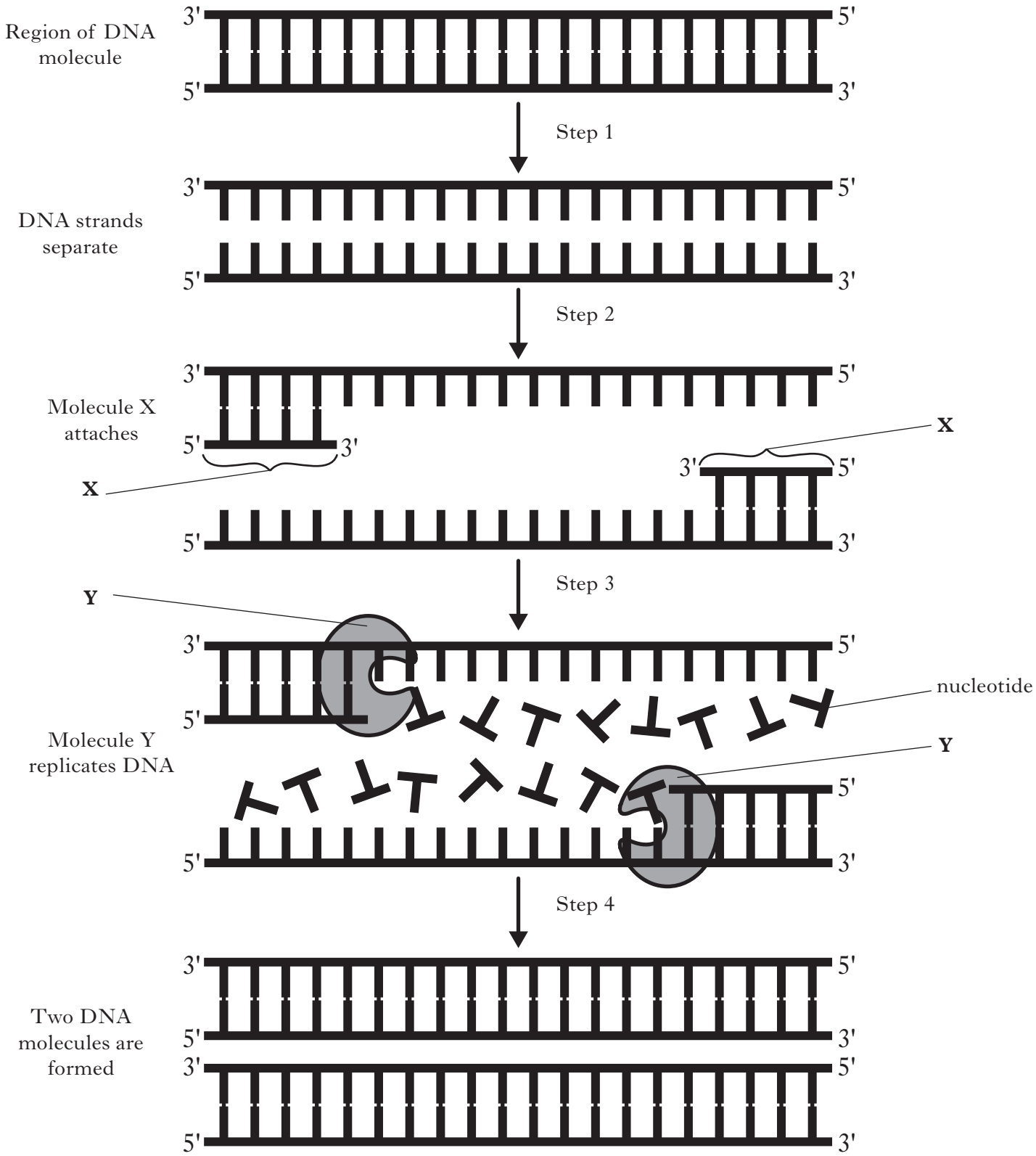
1 _____

_____

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.

_____

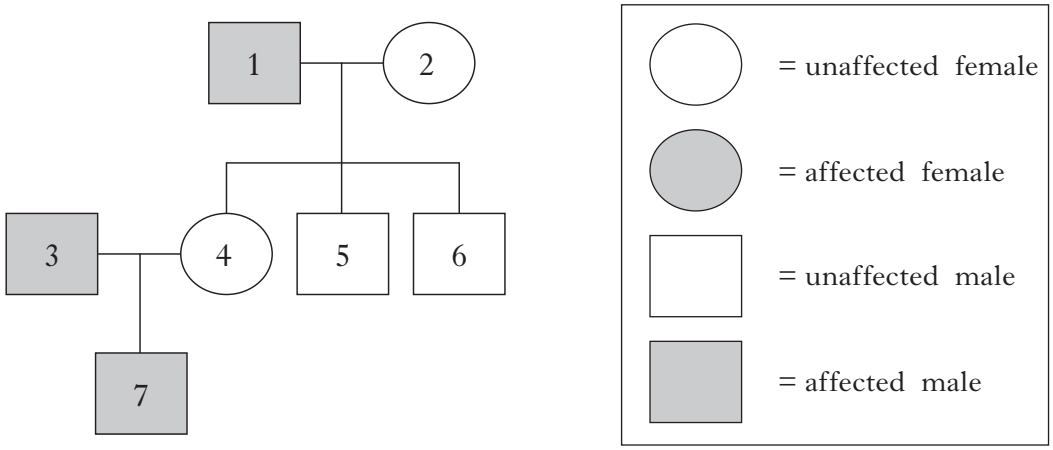
_____ **1**

[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

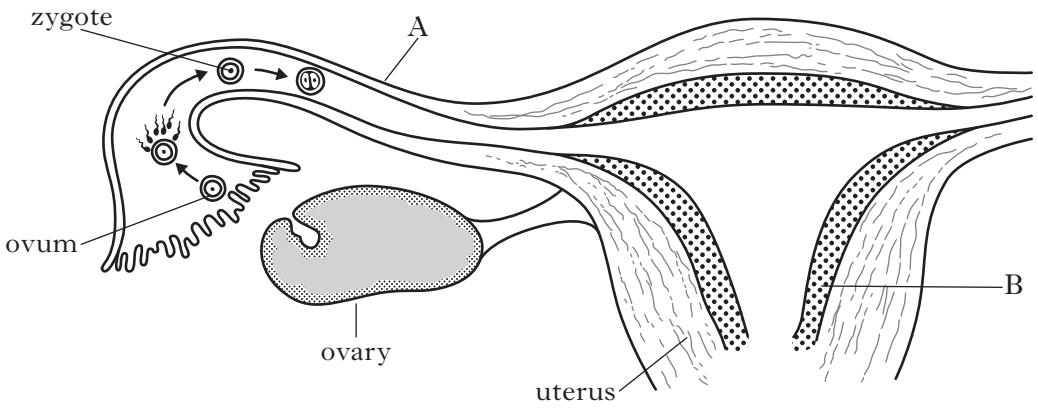
1

[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.

_____

_____

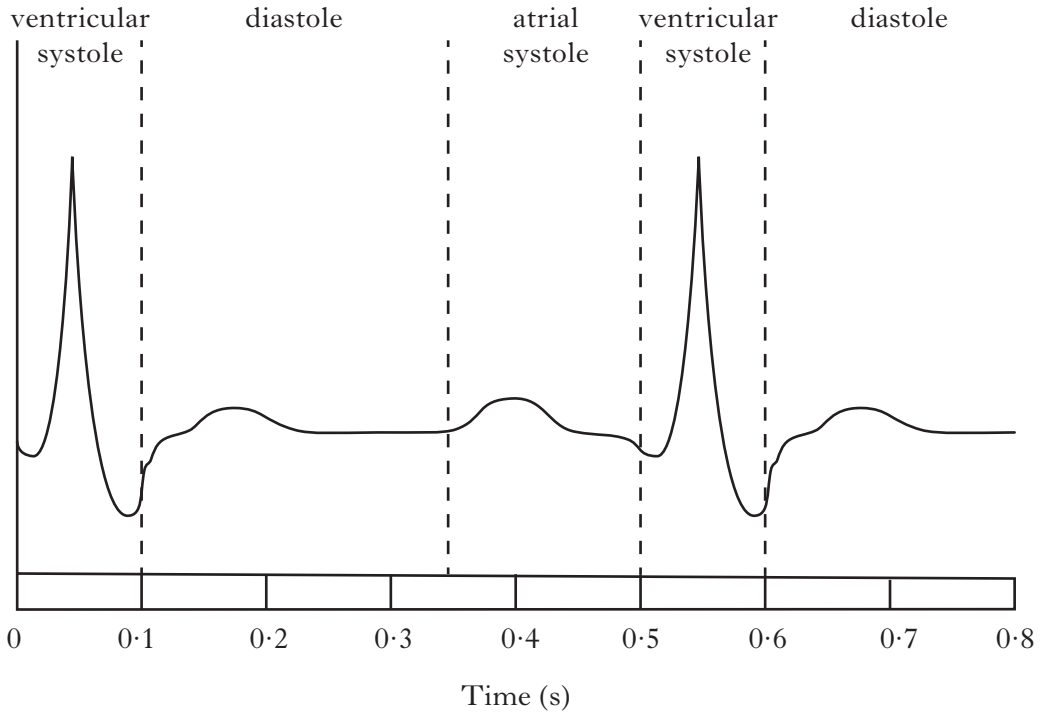
_____

_____ **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.

_____

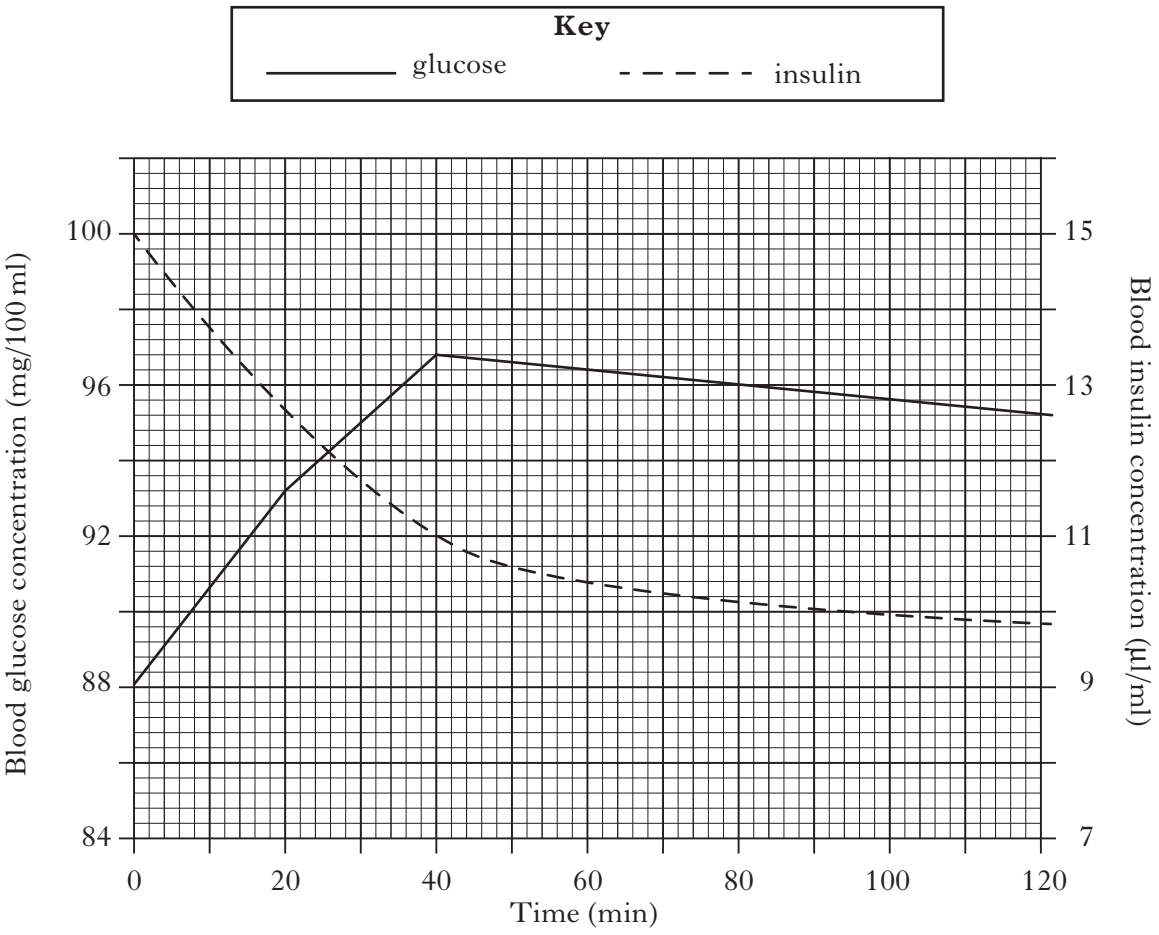
_____ **1**

[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.

_____

_____

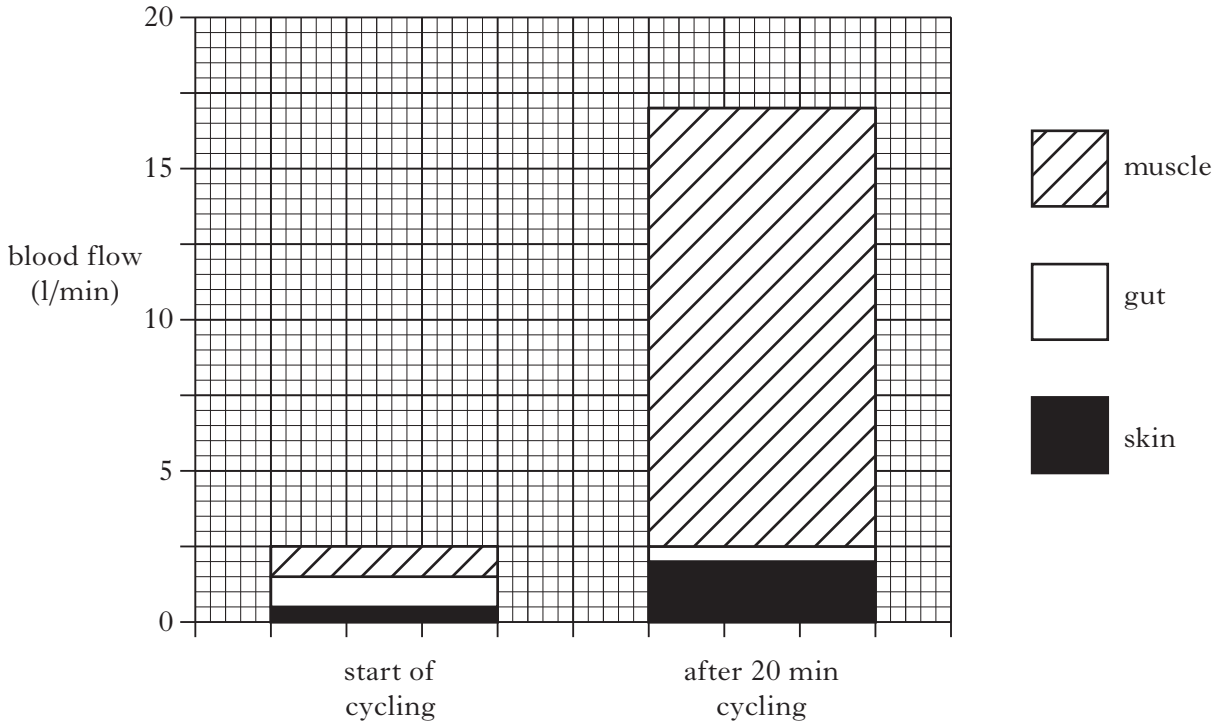
_____

_____ **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 _____

_____

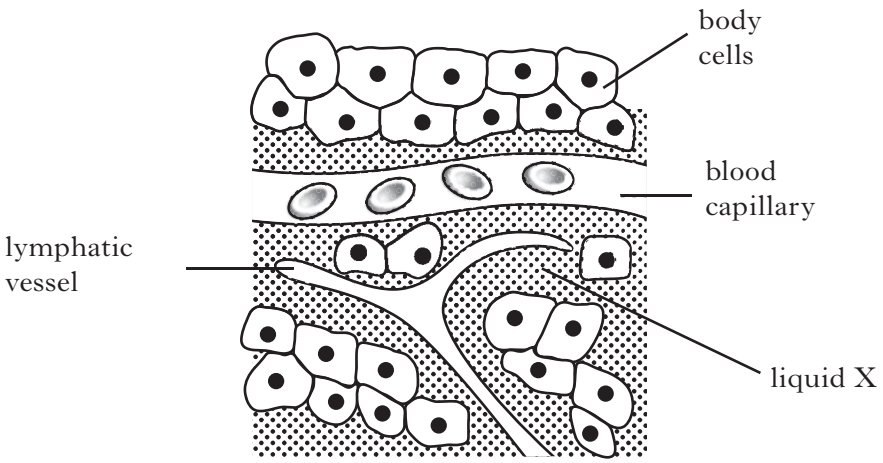
Distribution _____

_____ **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

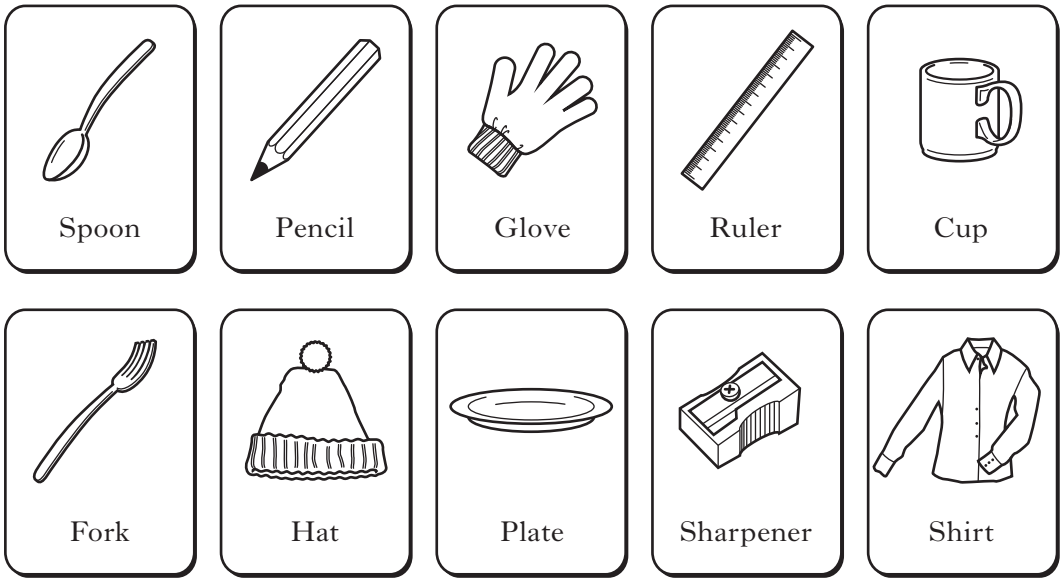
(*c*) Describe the function of lymphatic vessels.

_____

_____ **1**

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.

_____

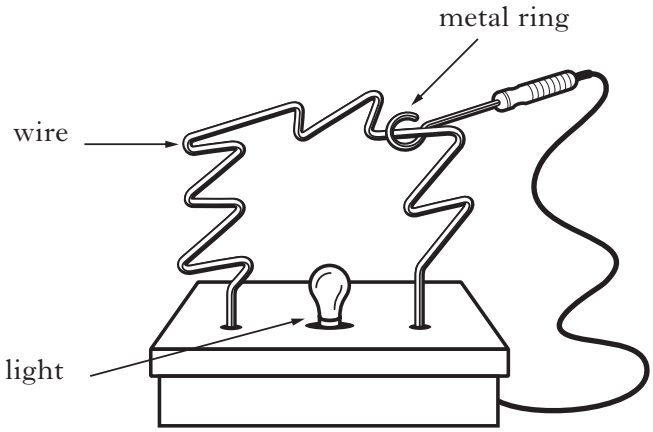
_____ **1**

[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.

_____

_____

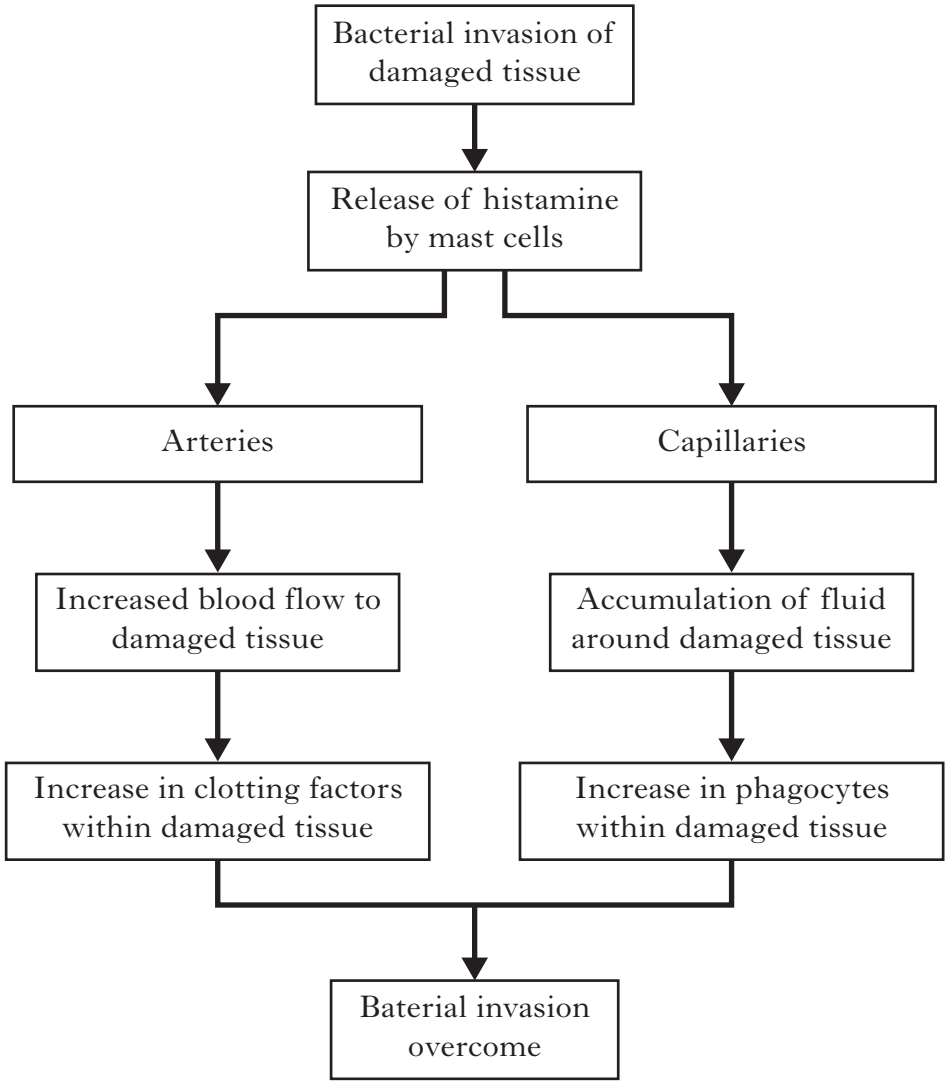
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

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*]

FOR OFFICIAL USE

Total for Sections B & C

X275/12/02

NATIONAL QUALIFICATIONS 2013

WEDNESDAY, 15 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.

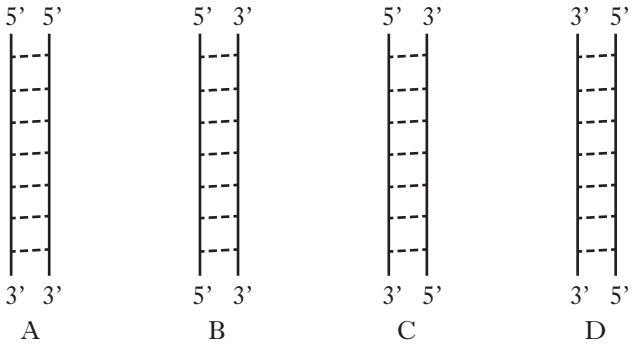
6 Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.

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 diagrams correctly shows the structure of DNA?



2. If ten percent of the bases in a molecule of DNA are adenine, what is the ratio of adenine to guanine in the same molecule?

A 1:1

B 1:2

C 1:3

D 1:4

3. The table below contains statements which may be **True** or **False** with regard to DNA replication and mRNA synthesis.

Which line in the table is correct?

	Statement	*DNA Replication*	*mRNA synthesis*
A	Occurs in the nucleus	True	False
B	Involved in protein synthesis	True	True
C	Requires free nucleotides	True	False
D	Involves specific base pairing	True	True

4. A variety of proteins can be expressed from the same gene by post-translational modification.

This may involve

A cutting polypeptide chains and adding carbohydrate to the protein

B cutting polypeptide chains and removing carbohydrate from the protein

C cutting mRNA molecules and adding phosphate to the nucleic acid

D cutting mRNA molecules and removing phosphate from the nucleic acid.

5. Which of the following terms describes types of mutation which occur in both genes and chromosomes?

A Deletion

B Insertion

C Duplication

D Translocation

6. The following is a list of single gene mutations.

1 Nonsense

2 Missense

3 Frameshift

Which of these gene mutations is the result of a single-nucleotide substitution?

A 1, 2 and 3

B 1 and 2 only

C 3 only

D 1 only

7. Metabolic pathways can be controlled by feedback inhibition where

A an end product binds to an enzyme found at the start of the pathway

B an end product binds to an enzyme found at the end of the pathway

C an enzyme binds to a substrate found at the start of the pathway

D an enzyme binds to a substrate found at the end of the pathway.

8. High-energy electrons from NADH are used in the final stage of respiration.

Which of the following statements about the role of these electrons is **not** correct?

A They are involved in ATP synthesis.

B They are involved in pumping hydrogen.

C They are involved in the release of energy.

D They are involved in the formation of carbon dioxide.

9. A build-up of which of the following combinations of substances would inhibit the activity of phosphofructokinase?

A Citric acid and ATP

B ATP and lactic acid

C Citric acid and creatine phosphate

D Creatine phosphate and lactic acid

10. The table contains information about the genome of four different species.

Genome size is measured in megabase pairs (Mb). 1 Mb = 1 000 000 base pairs.

Species	*Estimated Genome Size* (Mb)	*Estimated Number of Genes*
Chimpanzee	3100	25 000
Human	2900	25 000
Mouse	2750	30 000
Rat	2600	21 000

Which organism has the highest number of genes per megabase pair (Mb)?

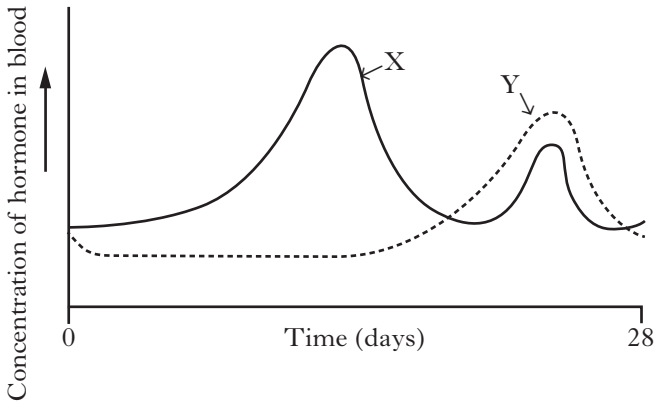
A Chimpanzee

B Human

C Mouse

D Rat

11. The graph below shows changes in the concentration of hormones X and Y in the blood during the menstrual cycle.



Which of the following correctly identifies hormones X and Y?

	Hormone X	*Hormone Y*
A	LH	Oestrogen
B	Oestrogen	FSH
C	Oestrogen	Progesterone
D	Progesterone	Oestrogen

12. Changes in the ovary during the menstrual cycle are described below.

1 Corpus luteum forms

2 Ovulation occurs

3 Progesterone is produced

4 Corpus luteum degenerates

5 Follicle develops

The sequence in which these changes occur following menstruation is

A 2, 3, 1, 5, 4

B 2, 1, 3, 4, 5

C 5, 3, 2, 1, 4

D 5, 2, 1, 3, 4.

13. Which of the following may need to receive anti-Rhesus antibodies?

A A Rhesus positive mother after the birth of her Rhesus negative baby

B A Rhesus positive mother after the birth of her Rhesus positive baby

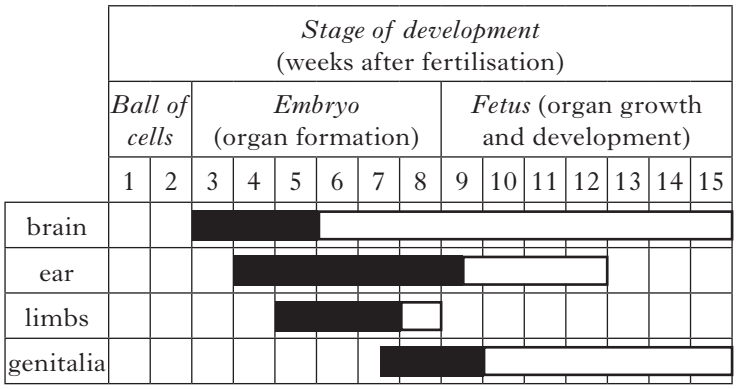
C A Rhesus negative mother after the birth of her Rhesus negative baby

D A Rhesus negative mother after the birth of her Rhesus positive baby.

14. Nicotine is a chemical which may affect ante-natal development.

The diagram shows the stages of development when major and minor malformations of organs may occur if there is exposure to nicotine.

Key – major malformation
minor malformation



For how many weeks during pregnancy is there a possibility of major malformations to organs during development?

A 6

B 7

C 9

D 13

15. The morning after pill works by

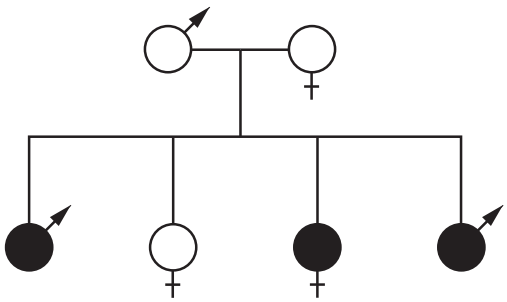
A causing thickening of cervical mucus

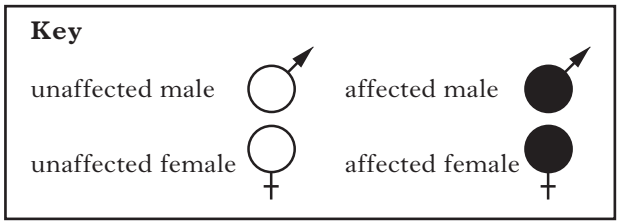
B preventing release of oestrogen

C preventing implantation

D causing menstruation.

16. The diagram below shows the transmission of the gene for albinism.





This condition is inherited as a characteristic which is

A dominant and not sex-linked

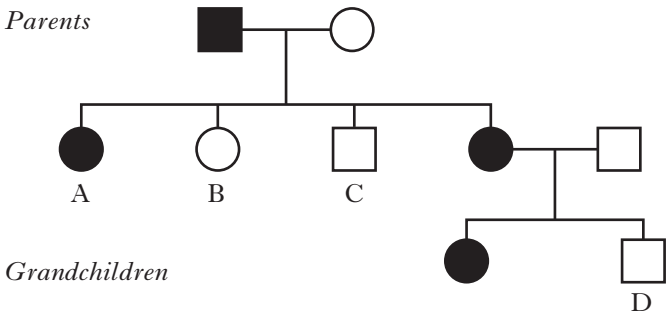
B recessive and not sex-linked

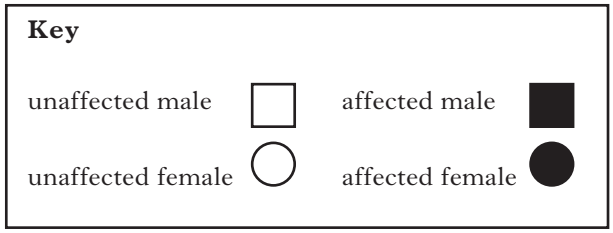
C dominant and sex-linked

D recessive and sex-linked.

17. Familial hypercholesterolaemia (FH) is caused by an autosomal dominant allele.

The family history below shows the inheritance of FH through three generations.





Which individual confirms that this condition is autosomal?

18. The following procedures can be used in the treatment of infertility:

1 artificial insemination

2 intracytoplasmic sperm injection

3 pre-implantation genetic screening.

Which of these procedures involve *in vitro* fertilisation (IVF)?

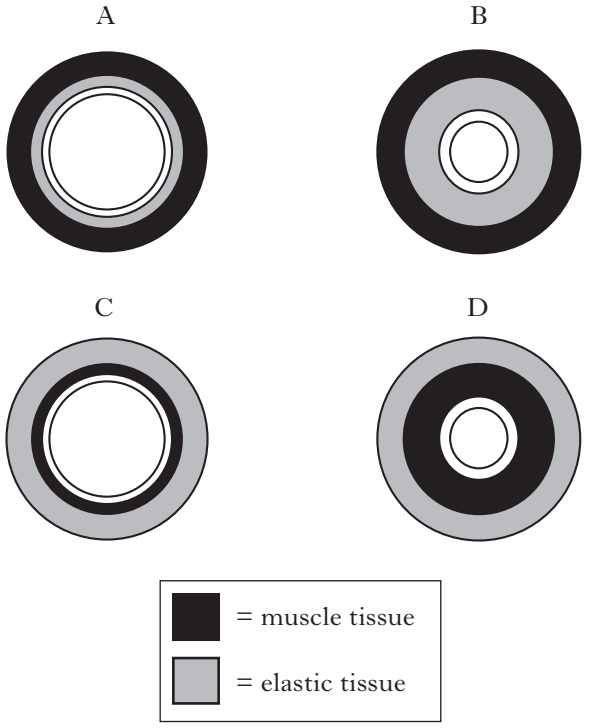
A 1 and 2

B 2 and 3

C 1 and 3

D 1, 2 and 3.

19. Which of these cross sections through a blood vessel represents a vein?



20. Which line in the table below describes correctly the state of the heart valves during ventricular systole?

	Atrio-ventricular	*Semi-lunar*
A	open	open
B	closed	closed
C	open	closed
D	closed	open

21. During a competition, a trained athlete can increase his cardiac output by 7 times.

If an athlete has a resting heart rate of 60 beats/min and a resting stroke volume of 70 cm^3/beat, his maximum cardiac output is

A 8·2 cm^3/min

B 4200 cm^3/min

C 29 400 cm^3/min

D 36 000 cm^3/min.

22. Mean arterial pressure (MAP) is a measure of blood pressure in the arteries.

Pulse pressure is the difference between systolic and diastolic blood pressure.

MAP is calculated using the following formula:

$$\text{MAP} = \text{diastolic pressure} + \left(\frac{\text{pulse pressure}}{3}\right)$$

Using this formula, the MAP of an individual with a blood pressure reading of 122/80 mmHg is

A 42 mmHg

B 56 mmHg

C 94 mmHg

D 136 mmHg.

23. Statins are drugs which are used to control blood

A pressure

B insulin level

C glucose level

D cholesterol level.

24. Chronic elevation of blood glucose levels is **not** responsible for which of the following conditions?

A Renal failure

B Retinal damage

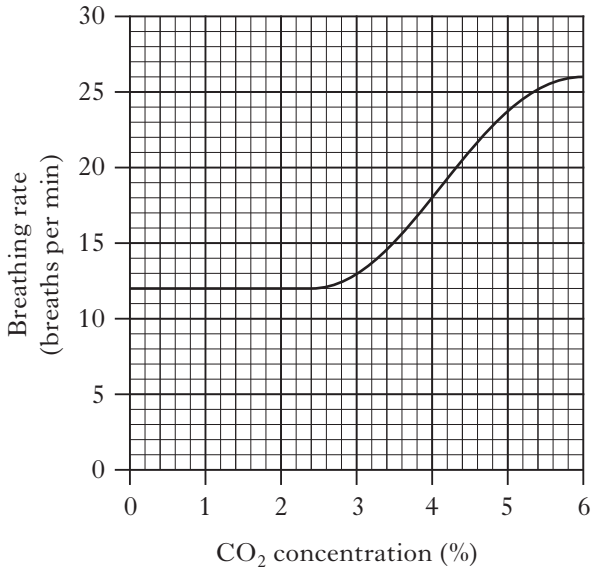
C Phenylketonuria

D Peripheral nerve dysfunction.

25. Which line in the table below identifies correctly the effects of Type 1 and Type 2 diabetes?

	Type 1 diabetes	*Type 2 diabetes*
A	develops mainly in children	develops mainly in adults
B	cells become insensitive to insulin	cells remain sensitive to insulin
C	no glucose lost in urine	some glucose lost in urine
D	reduced insulin production	no insulin production

26. The graph below shows the effect of the carbon dioxide concentration of inhaled air on the breathing rate of an individual.



If the volume of one breath is 0·5 litre, what volume of air will be breathed in one minute when the CO_2 concentration is 4%?

A 6 litres

B 9 litres

C 18 litres

D 36 litres

27. Which of the following statements about Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) is correct?

A LDL deposits cholesterol in the arteries.

B LDL transports cholesterol to the liver.

C HDL transports cholesterol to body cells.

D HDL releases cholesterol in the body cells.

28. The table below contains information about the number of cases of influenza in a city over five years.

Year	*Influenza cases in January*	*Influenza cases in July*
2001	580	120
2002	620	345
2003	1200	350
2004	120	145
2005	400	100

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

A There are always more cases of influenza in January than in July.

B The number of cases of influenza decreased by 75% between January and July of 2005.

C The greatest percentage decrease in influenza cases occurred between January and July of 2003.

D The greatest percentage increase in influenza cases occurred between July 2002 and January 2003.

29. Which of the following describes an adjuvant correctly?

A An inactivated pathogen

B A weakened pathogen

C A molecule that inhibits the immune response

D A molecule that enhances the immune response

30. Which line in the table below classifies correctly the terms which describe the spread of infectious diseases?

	Regular cases in an area	*Occasional cases in an area*	*High number of cases in an area*	*Cases occur in many countries*
A	Endemic	Sporadic	Epidemic	Pandemic
B	Epidemic	Sporadic	Pandemic	Epidemic
C	Endemic	Epidemic	Sporadic	Pandemic
D	Pandemic	Endemic	Epidemic	Sporadic

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

Marks

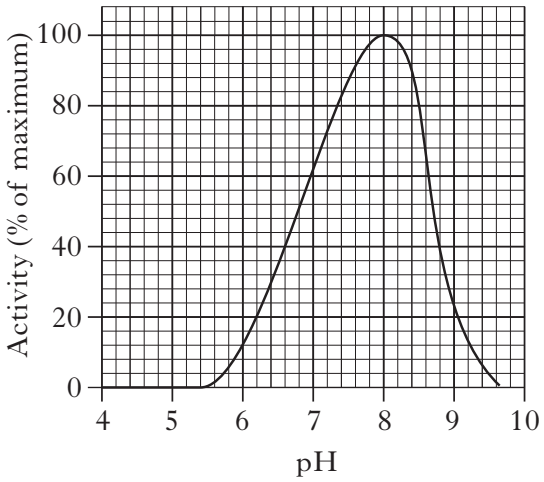
All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

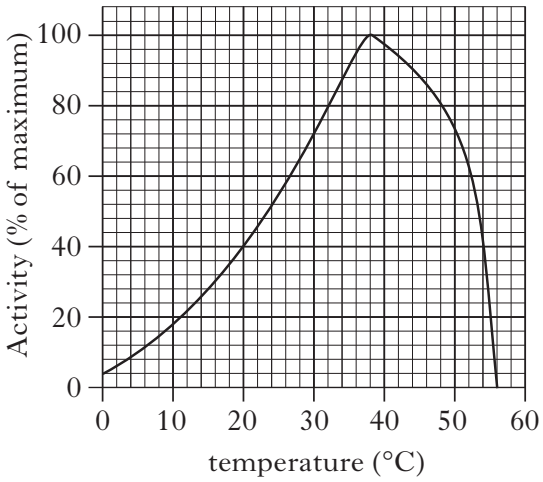
1. Trypsin is an enzyme which catalyses the breakdown of proteins in the small intestine.

The graphs below show how pH and temperature affect the activity of trypsin.

Graph 1—effect of pH on trypsin activity



Graph 2—effect of temperature on trypsin activity



(*a*) (i) State the optimum conditions for trypsin activity.

pH _____ temperature _____ °C **1**

(ii) State the range of conditions over which trypsin shows at least 40% of its maximum activity.

_____

_____ **1**

(*b*) Explain the role of the active site in enzyme-catalysed reactions.

_____

_____

_____

_____

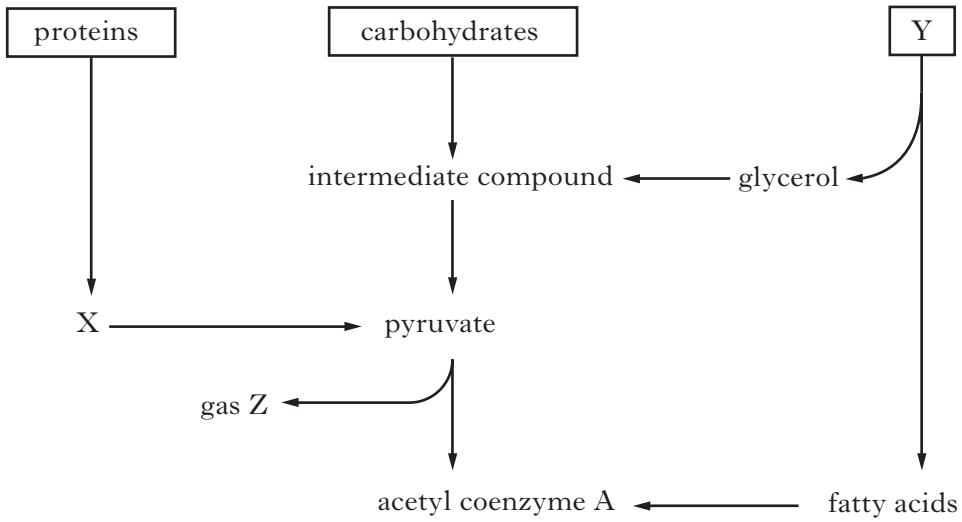
_____

_____ **3**

DO NOT WRITE IN THIS MARGIN

Marks

2. The diagram below shows the metabolism of three energy sources in a cell.



(*a*) Name X, Y and Z.

X_____

Y_____

Z_____ **2**

(*b*) What term describes the breakdown of carbohydrate into pyruvate during respiration?

_____ **1**

(*c*) Describe what happens to acetyl coenzyme A during respiration.

_____

_____ **1**

(*d*) When might the body obtain most of its energy from proteins?

_____ **1**

(*e*) Carbohydrate is stored in the body.

State the form in which carbohydrate is stored and where it is stored.

Storage form _____

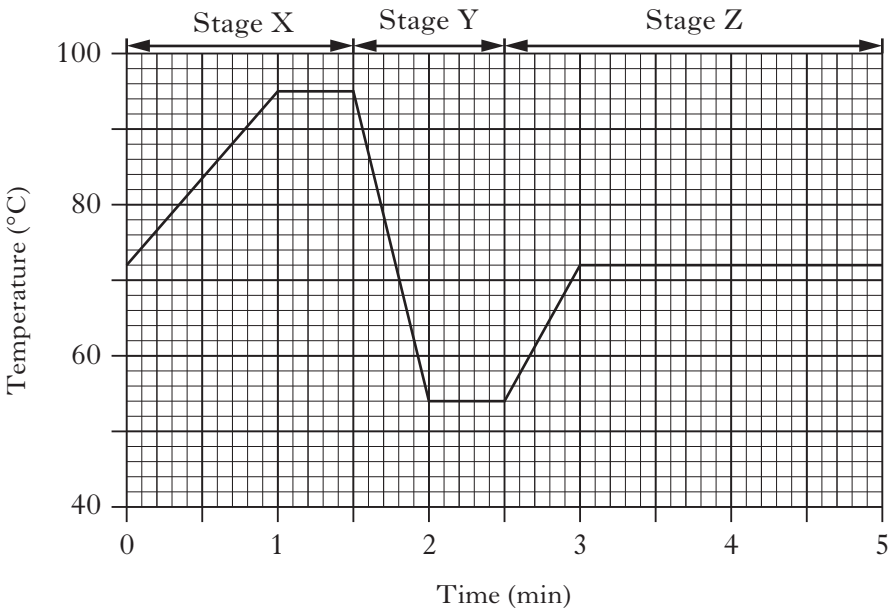
Storage location _____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

3. The graph below shows how the temperature of the DNA in a reaction tube is changed during one cycle of the polymerase chain reaction (PCR).



(*a*) Calculate the maximum change in temperature that the reaction tube experiences during one cycle of PCR.

Space for calculation

_____ °C **1**

(*b*) State the function of PCR.

_____

_____ **1**

(*c*) Describe what happens to the DNA during stage X.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

3. (continued)

(*d*) Short sections of DNA called primers are involved in Stage Y.

State what happens to these primers during Stage Y.

_____

_____ **1**

(*e*) Suggest why the temperature is increased during Stage Z.

_____

_____ **1**

(*f*) (i) A forensic scientist discovered a tiny spot of blood at a crime scene.

A sample taken from this spot contained 100 molecules of DNA.

The sample underwent PCR cycles for 40 minutes.

Use the graph to calculate how many molecules of DNA would be present after this time.

Space for calculation

_____ molecules **1**

(ii) What process would then allow an individual to be identified from the DNA?

_____ **1**

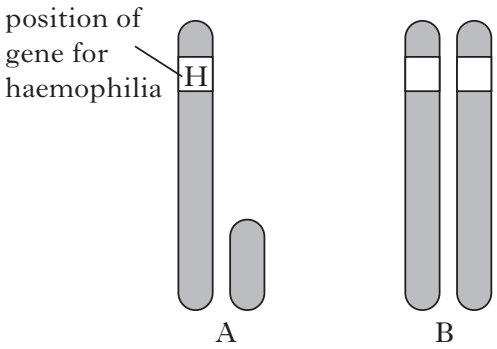
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

4. Haemophilia is a sex-linked disorder caused by a recessive allele (h) which results in an individual producing a faulty blood clotting protein.

The diagram below shows the sex chromosomes from two individuals.



(*a*) Individual A is male while individual B is a female carrier of the allele for haemophilia.

(i) **Complete the diagram** by labelling the alleles on the sex chromosomes of individual B. **1**

(ii) State the genotypes of individuals A and B.

A _____ B _____ **1**

(iii) What is the chance that a daughter produced by this couple will have haemophilia?

Explain your answer.

Space for calculation

Chance _____ %

Explanation _____

_____ **1**

(*b*) Damage to blood vessels sets in motion a series of events which results in the formation of a blood clot.

A plasma protein is converted into a meshwork of threads, causing the blood to clot.

Name this plasma protein and describe how it is converted into threads.

Protein _____

Description _____

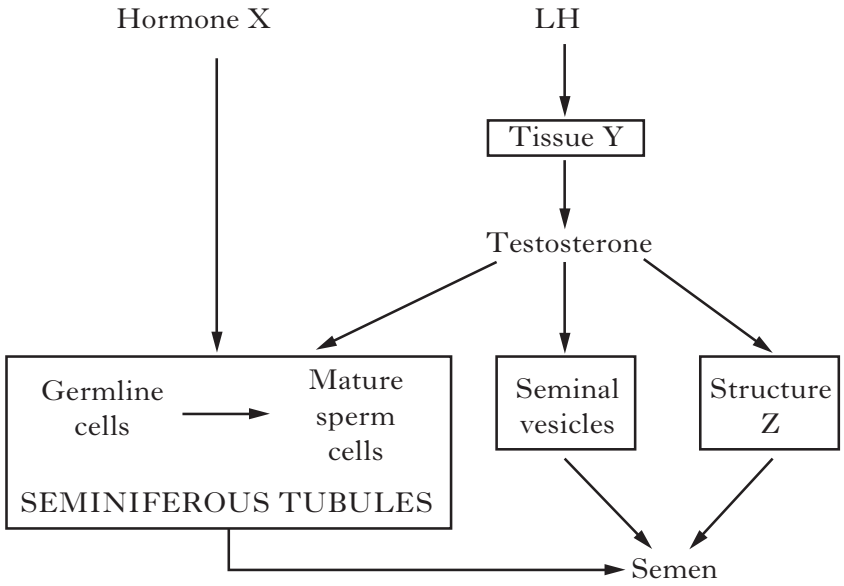
_____

_____ **2**

DO NOT WRITE IN THIS MARGIN

Marks

5. The flowchart summarises the processes involved in the production of semen.



(*a*) Name hormone X and tissue Y.

Hormone X _____

Tissue Y _____ **2**

(*b*) Semen contains substances secreted by structure Z.

(i) Identify structure Z.

_____ **1**

(ii) Describe the role of the secretions from the seminal vesicles and structure Z.

_____

_____ **1**

(*c*) Complete the table to show the percentage of each type of cell which would contain a Y chromosome.

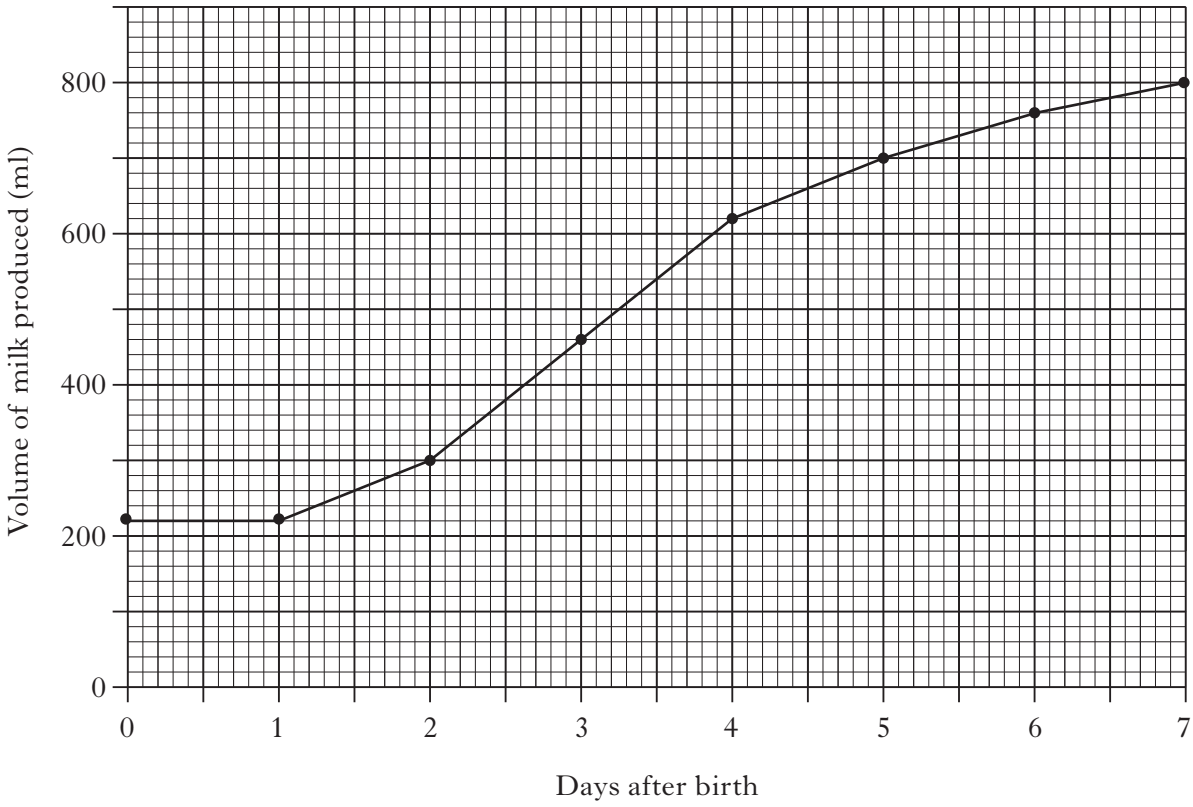
Cells	*Percentage of cells containing a Y chromosome*
Germline cells	
Mature sperm cells	

1

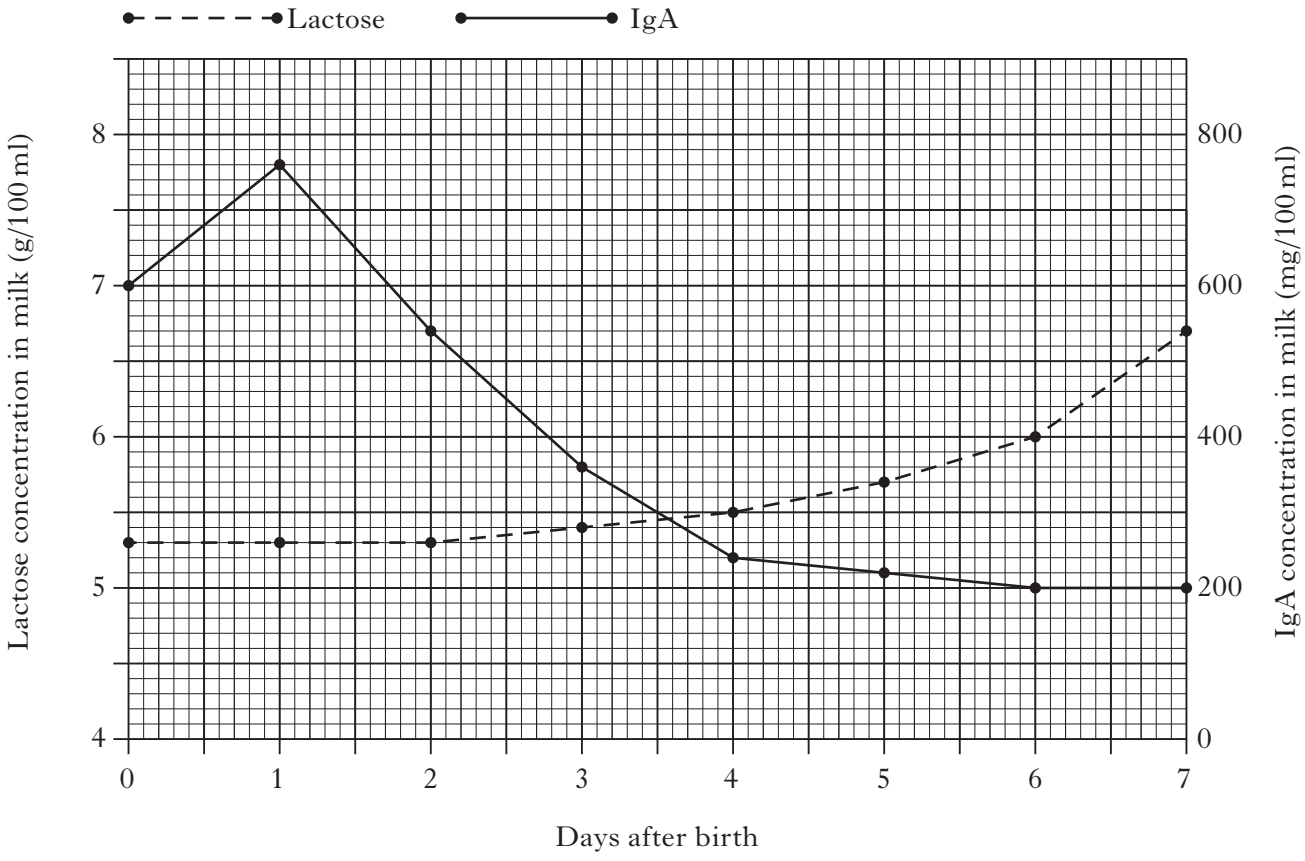
[Turn over

6. The graphs below show changes in the volume and composition of milk produced by a woman in the first week following the birth of her child.

Graph 1— changes in the volume of milk produced



Graph 2— changes in the concentration of lactose sugar and IgA antibody in milk



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Marks

6. (continued)

(*a*) From **Graph 2**, describe **two** ways in which the composition of milk produced in the first three days after birth differs from milk produced later.

1 _____

2 _____ **1**

(*b*) What was the volume of milk produced on day 3?

_____ **1**

(*c*) (i) Between days 2 and 3 this woman produced a constant mass of IgA.

Explain why the concentration of IgA in her milk decreased during this time.

_____

_____ **1**

(ii) Express, as a simple whole number ratio, the concentration of IgA compared to the concentration of lactose produced on day 6.

(1g = 1000 mg)

Space for calculation

_____ : _____ **1**
IgA Lactose

(*d*) Using **Graphs 1** and **2**, calculate the mass of lactose produced on day 5.

Space for calculation

_____ g **1**

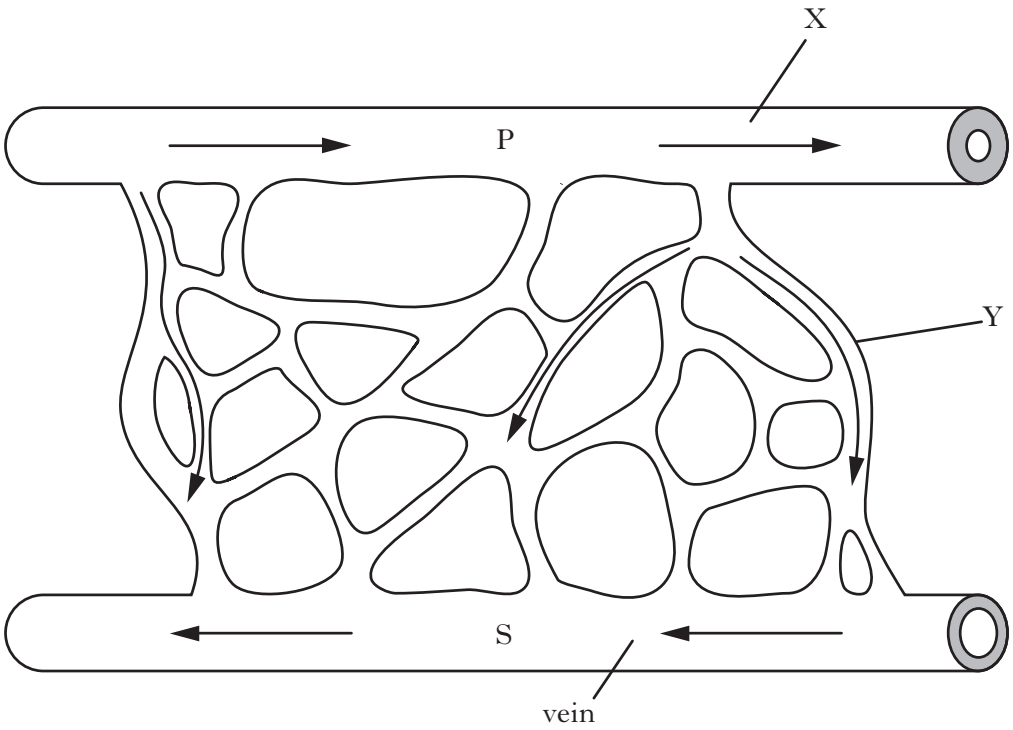
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. The diagram below shows some blood vessels within muscle tissue of an athlete.

The direction of blood flow is indicated by the arrows.



(*a*) Name the type of blood vessels labelled X and Y.

X _____

Y _____ **1**

(*b*) Name **two** substances which are at a higher concentration in the blood at point P than at point S.

1 _____

2 _____ **1**

(*c*) The athlete ran on a treadmill at high speed for ten minutes.

Explain why the concentration of lactic acid in his blood increased during this time.

_____

_____ **1**

(*d*) Tissue fluid surrounds the muscle cells.

Some of this fluid is reabsorbed into the bloodstream.

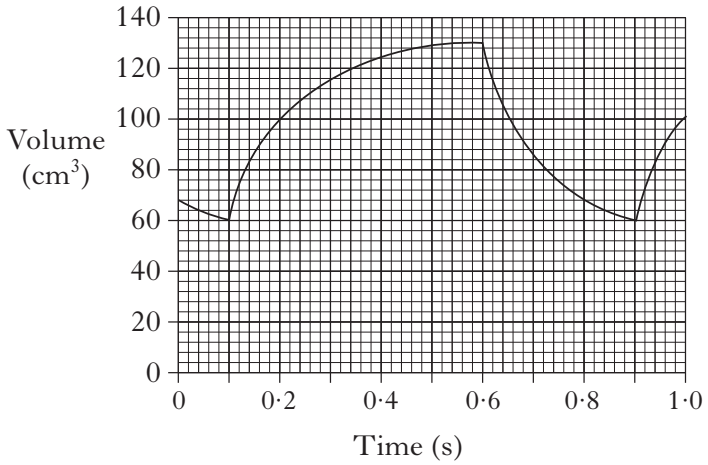
How else is tissue fluid removed from around the muscle cells?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

8. The graph below shows changes in the volume of blood in the left ventricle of a man's heart.



(*a*) How long does ventricular systole last?

_____ s **1**

(*b*) (i) What is the heart rate of this man?

_____ beats per minute **1**

(ii) Calculate the volume of blood leaving this man's left ventricle every minute.

Space for calculation

_____ cm^3 **1**

(*c*) When this man exercises, the volume of blood leaving his heart increases significantly.

Describe how the nervous system and hormones cause this increase.

_____

_____

_____

_____

_____

_____ **3**

DO NOT WRITE IN THIS MARGIN

Marks

9. Rising levels of obesity are a major concern in modern Scottish society. Successive governments have tried to promote healthy eating and exercise in an attempt to address this problem.

(*a*) (i) One measure of obesity is the body mass index (BMI).

What measurements are taken to calculate BMI?

_____ **1**

(ii) What is the minimum value of BMI that is generally used to indicate that an individual is obese?

_____ **1**

(*b*) Why should the dietary intake of carbohydrate in the form of free sugar be limited?

_____

_____ **1**

(*c*) Describe how exercise reduces the risk of an individual becoming obese.

_____

_____ **1**

(*d*) State **two** ways that exercise reduces the risk factors for cardiovascular disease (CVD).

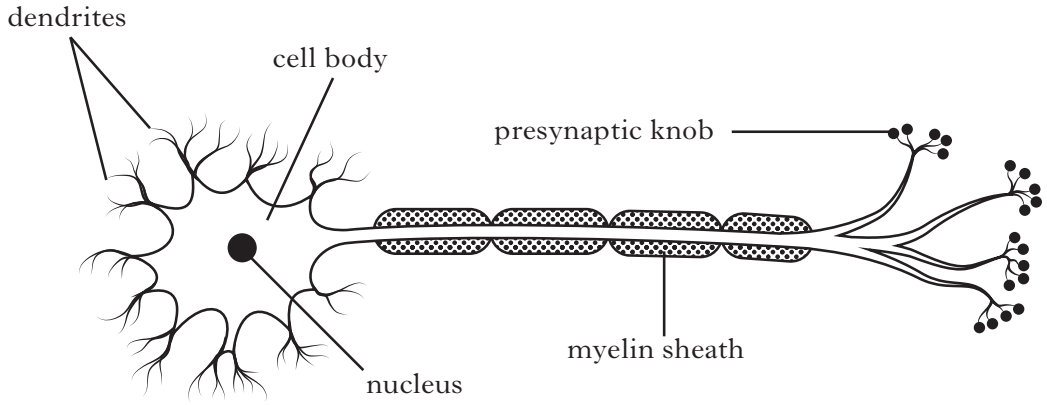
1 _____

2 _____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

10. The diagram below shows a neurone from an adult.



(*a*) Draw an arrow **on the diagram** to show the direction in which an impulse would travel. **1**

(*b*) Suggest a possible role of the nucleus in the transfer of information across a synapse.

_____

_____ **1**

(*c*) Complete the table below which contains information about structures found in the presynaptic knob.

Structure	*Function*
	Provides ATP for synthesis reactions
Vesicle	

1

(*d*) (i) How might a neurone in a newly-born child differ from the one in the diagram?

_____ **1**

(ii) In what way would this affect how the neurone functions?

_____

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

11. Split brain patients cannot transfer information between their left and right cerebral hemispheres because the band of nerve fibres connecting these areas of the brain has been cut.

(*a*) Name the band of fibres which connects the two hemispheres.

_____ **1**

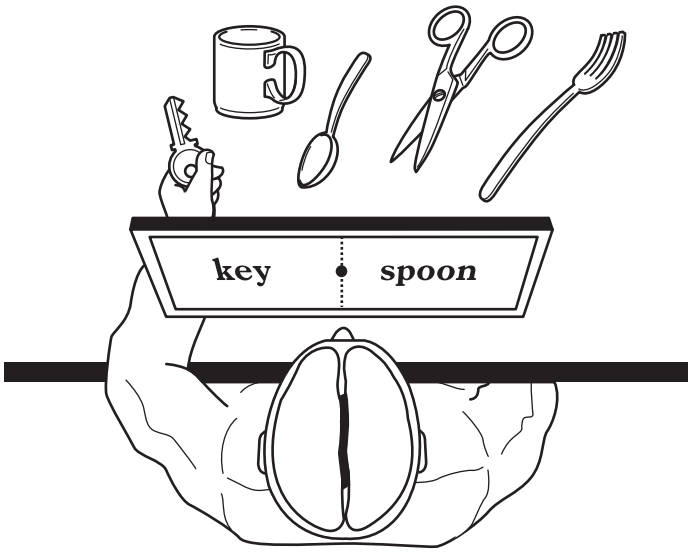
(*b*) Some of the functions of each hemisphere are described in the table below.

These functions are unaffected in split brain patients.

Left cerebral hemisphere	*Right cerebral hemisphere*
processes information from right eye	processes information from left eye
controls language production	controls movements of left hand

The diagram below shows an experiment on a split brain patient.

The patient was asked to stare at a spot in the centre of a screen and the words "key" and "spoon" were flashed briefly onto the screen in the positions shown.



(i) The patient was then told to use his left hand to pick up the objects he saw named on the screen.

Explain why the patient picked up the key but not the spoon.

_____

_____

_____

_____ **2**

DO NOT WRITE IN THIS MARGIN

Marks

11. (*b*) (continued)

(ii) The patient was then asked to say what he saw written on the screen. Predict what he would have said and give a reason for your answer.

Prediction _____ **1**

Reason _____

_____

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

12. An investigation was carried out to determine the effects of a distraction task on the ability to recall words in a list.

A group of 20 students listened to a list of words being read aloud.

Immediately after the last word had been read out, the students were distracted by being asked to recite the alphabet backwards from Z to A.

They were then asked to write down all the words from the list that they could remember.

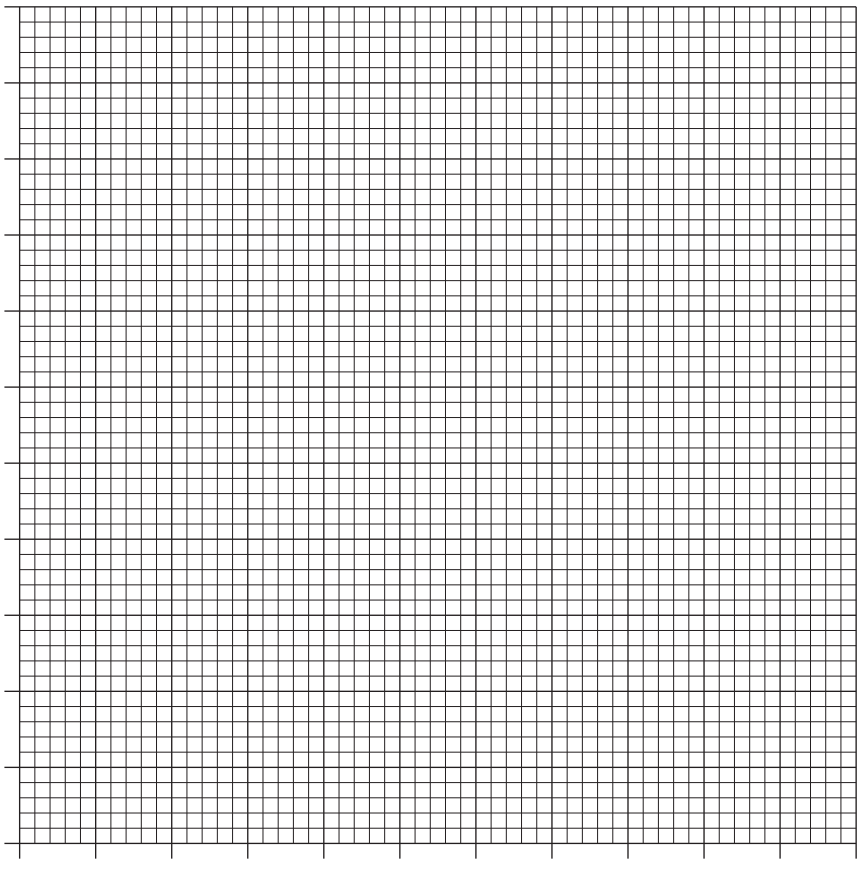
The results of this investigation are shown in the table below.

Position of word in list	*Number of students remembering word*	*Position of word in list*	*Number of students remembering word*
1	20	11	2
2	19	12	3
3	18	13	4
4	17	14	2
5	15	15	3
6	10	16	4
7	8	17	3
8	6	18	3
9	4	19	2
10	3	20	3

Marks

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

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



2

12. (continued) *Marks*

(*b*) Calculate the percentage decrease in recall between the first and last words read out.

Space for calculation

_____% **1**

(*c*) In order to improve the reliability of the results the procedure was repeated with another group of students.

State **three** variables that would have to be kept the same.

1 _____

2 _____

3 _____ **2**

(*d*) A control group of students should have been used in this investigation.

(i) Describe how the procedure used with the control group should differ from the procedure outlined.

_____

_____ **1**

(ii) Suggest how the expected pattern of results from the control group would differ from the results shown in the table.

_____

_____ **1**

(*e*) Explain the effect of the distraction task on memory in this investigation.

_____

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

13. The following question relates to aspects of learning associated with guitar playing.

(*a*) What effect does practising a motor skill, such as repeatedly playing chords, have on the nervous system?

_____

_____ **1**

(*b*) Suggest how "shaping" might be used by a teacher to help students improve their guitar playing over the course of a year.

_____

_____

_____

_____ **2**

(*c*) (i) A teenager decides that she dislikes all of a band's music after hearing just one song.

What form of learning is this?

_____ **1**

(ii) As she grows older this teenager's opinion about the band's music could be altered by internalisation.

Explain how this may happen.

_____

_____ **1**

Marks

13. (continued)

(*d*) Anti-social behaviour can occur when people are together in a group such as at a music festival.

What is the name of this effect and why does it occur?

Name _____ **1**

Cause _____

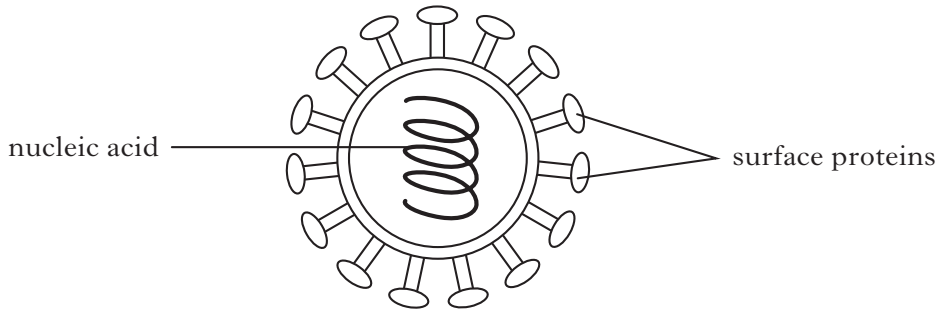
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

14. The diagram below shows the structure of one strain of the influenza virus.

Marks



(*a*) This virus can be used to prepare a flu vaccine. In order to do this the nucleic acid must be broken up but the surface proteins left intact.

Explain why it is necessary to:

(i) break up the nucleic acid _____

_____

(ii) leave the surface proteins intact _____

_____ **2**

(*b*) A different vaccine is required against each strain of the influenza virus.

Suggest why different vaccines are required.

_____

_____ **1**

(*c*) Researchers are attempting to develop a new vaccine which will be effective against **all** strains of the influenza virus. Trials of this new vaccine have shown that it increases the activity of T-lymphocytes in the body.

Describe **two** ways in which T-lymphocytes combat infection.

1 _____

_____

2 _____

_____ **2**

(*d*) Clinical trials of vaccines use randomised, placebo-controlled protocols.

Describe how these protocols are set up by the researchers.

_____

_____

_____

_____ **2**

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 cell differentiation under the following headings.

(i) Stem cells; **4**

(ii) Somatic cells; **4**

(iii) Germline cells. **2**

(10)

OR

B Give an account of skeletal muscle cells under the following headings.

(i) Lactic acid metabolism; **4**

(ii) Slow twitch muscle fibres; **3**

(iii) Fast twitch muscle fibres. **3**

(10)

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

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

A Describe how recreational drugs can affect the brain. **(10)**

OR

B Describe non-specific defences that the body uses to protect itself from pathogens. **(10)**

[*END OF QUESTION PAPER*]

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.

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?

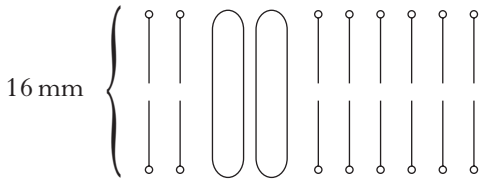
A Polymerase adds nucleotides to the 3' end of a DNA strand

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

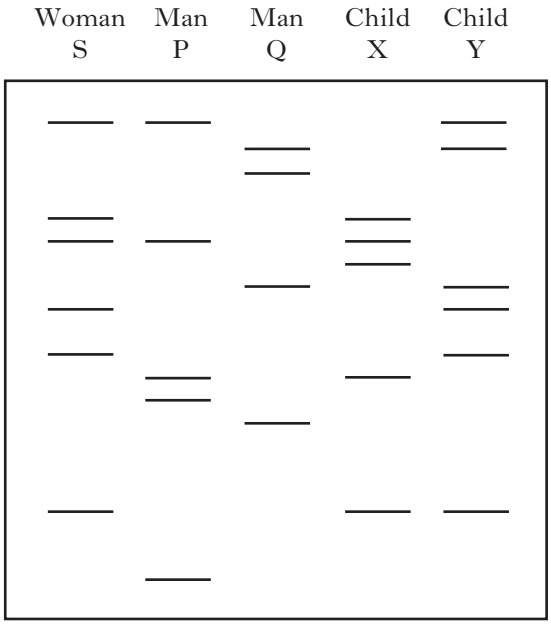
B To join fragments of DNA together

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?

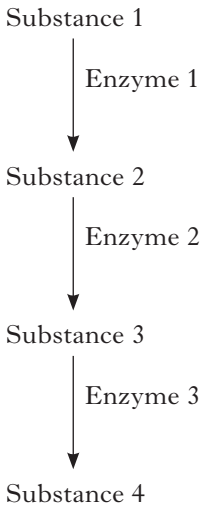
A Man P could be the father of child X

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?

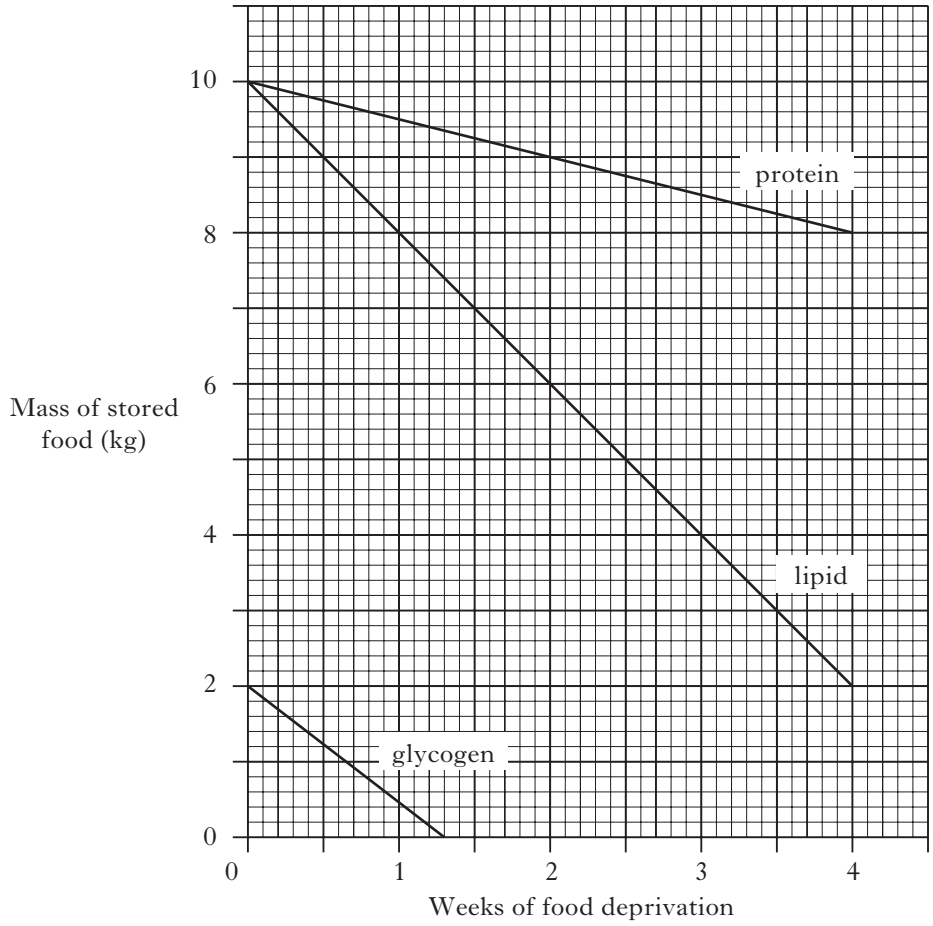
A Enzyme 1

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

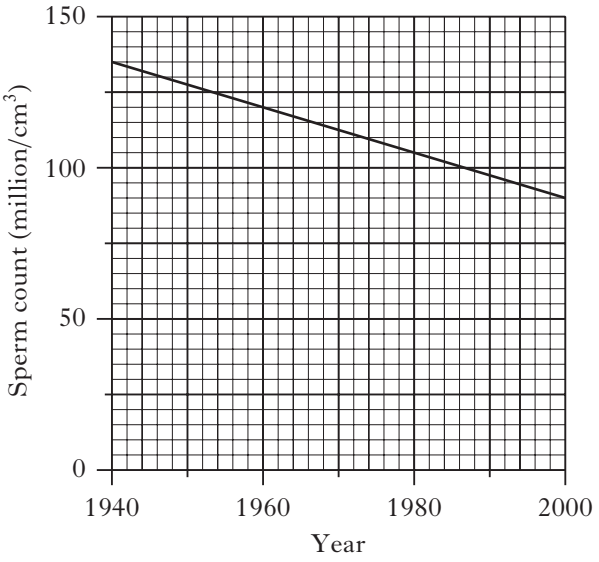
A sperm

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?

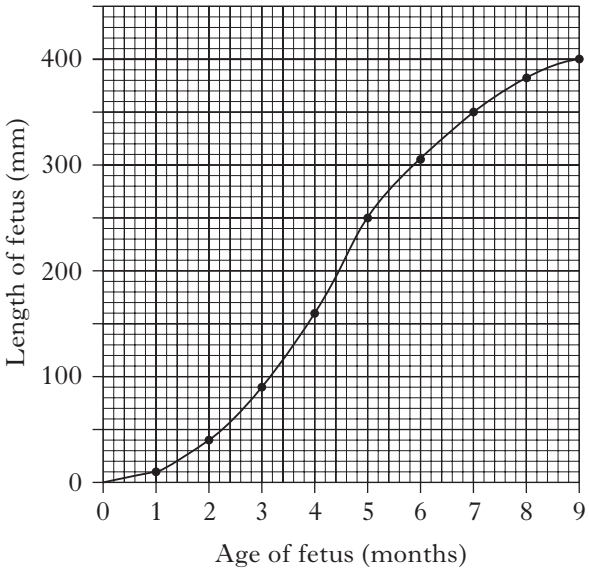
A Mini-pill

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

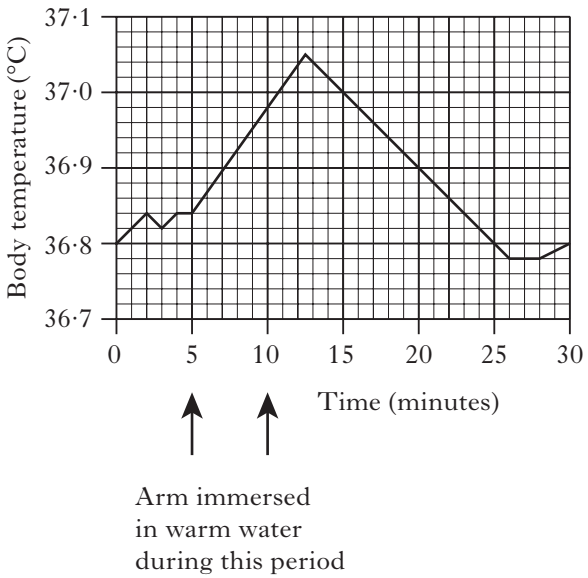
Which individual has the greatest stroke volume?

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

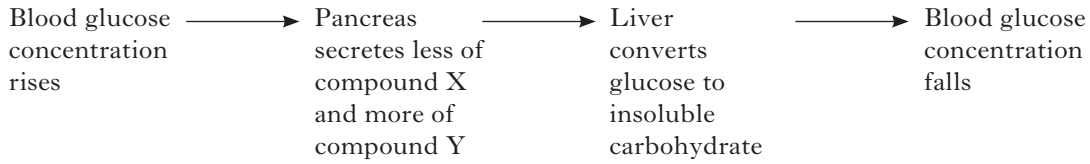
B 0·27 °C

C 2·5 °C

D 0·25 °C

[Turn over

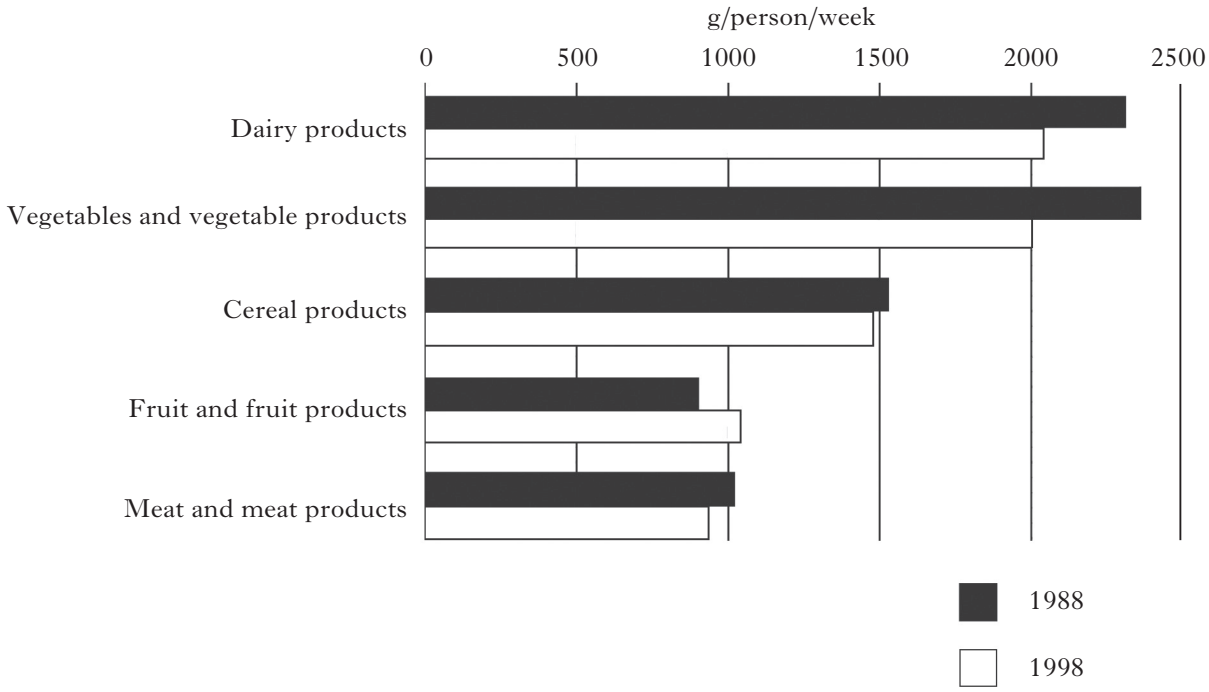
23. The flow chart below shows how the concentration of glucose in the blood is regulated.



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?

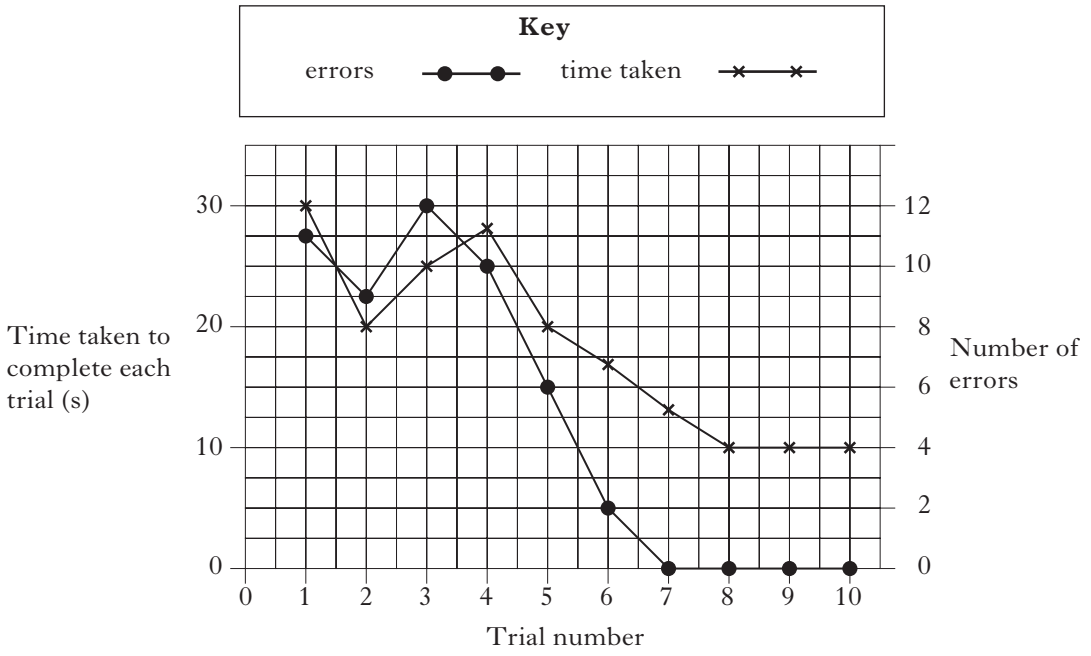
A 3 only

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*

DO NOT WRITE IN THIS MARGIN

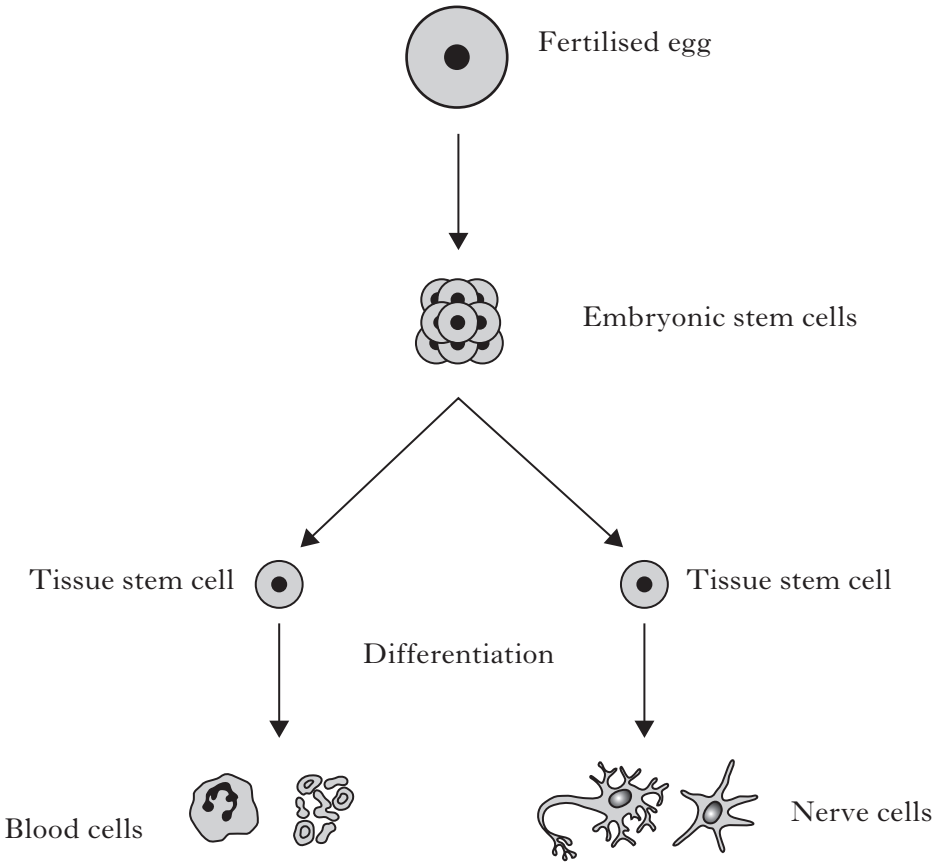
SECTION B

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.

_____

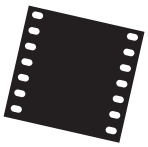
_____ **1**

[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

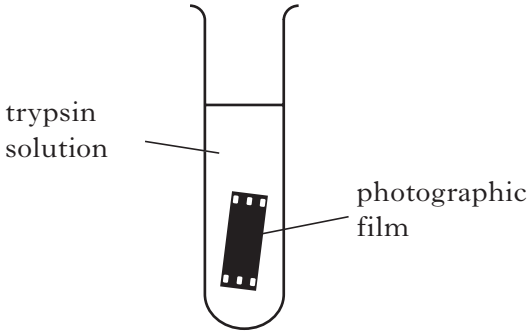


Table 1

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?

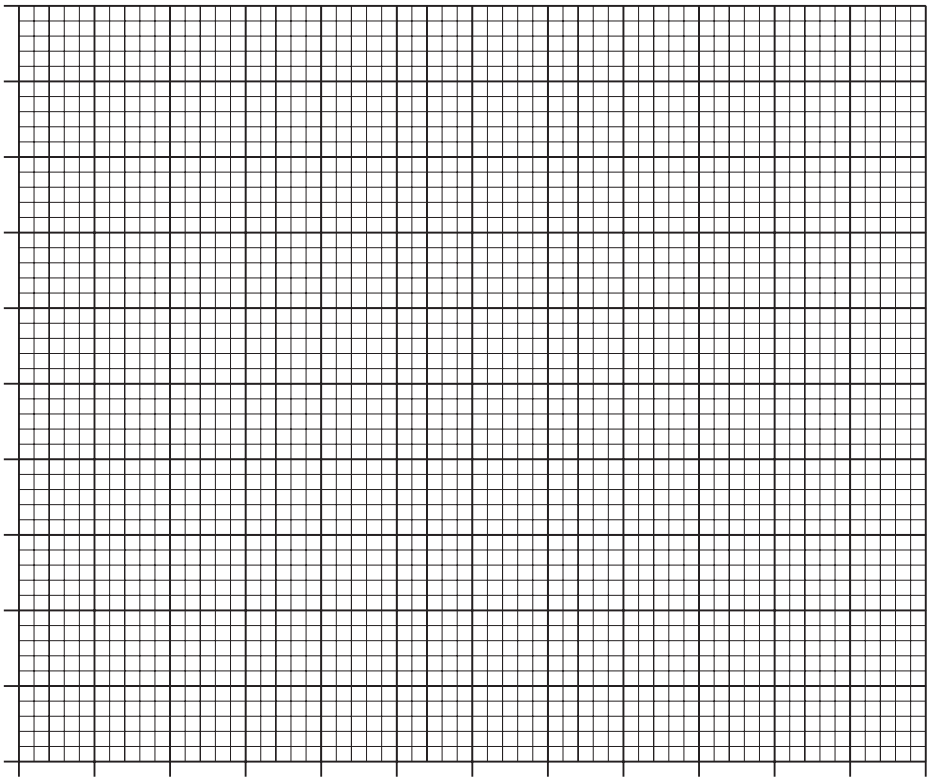
_____

_____ **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*)



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

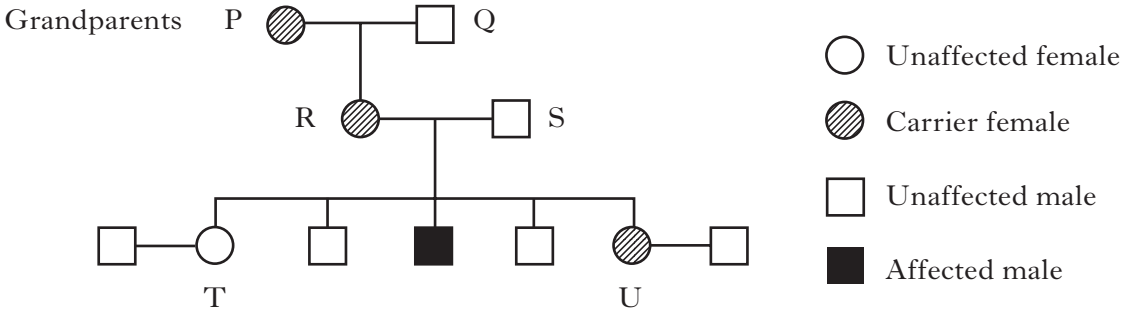
DO NOT WRITE IN THIS MARGIN

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?

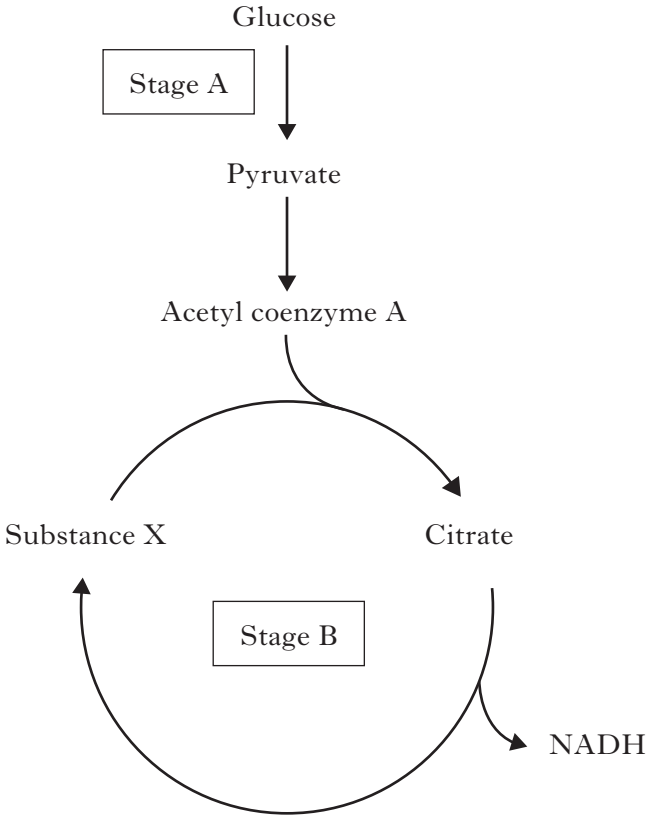
_____ **1**

[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**

DO NOT WRITE IN THIS MARGIN

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.

_____

_____

_____

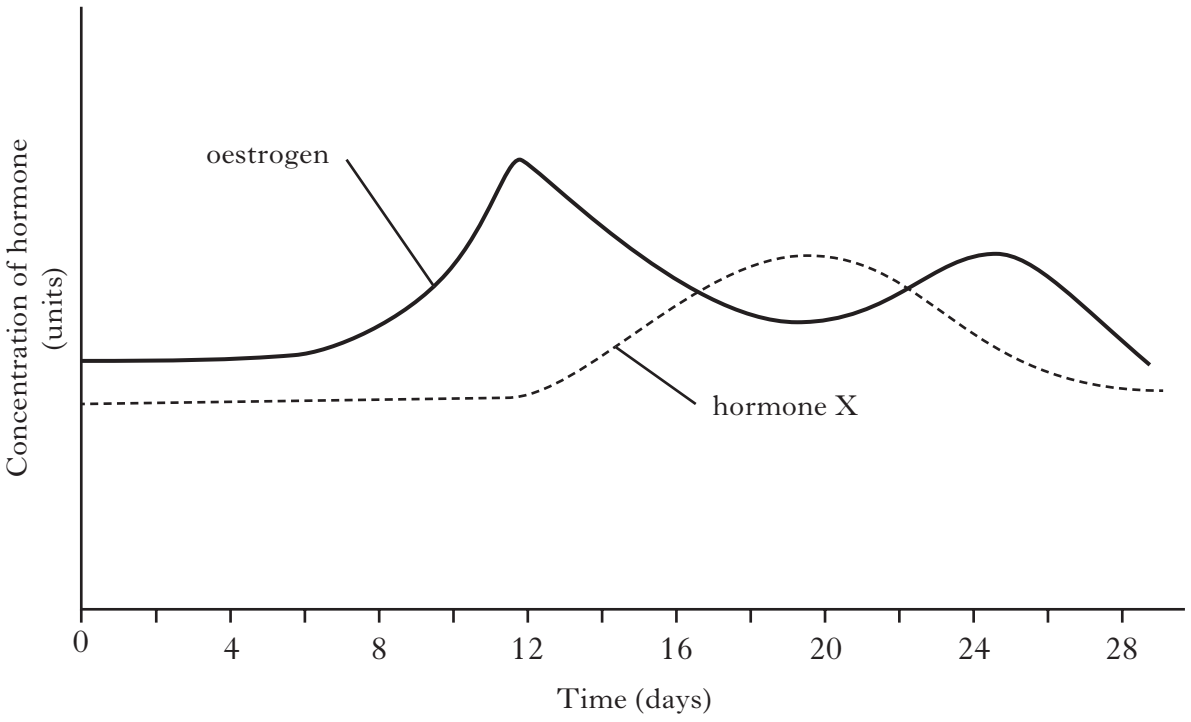
_____ **2**

[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.

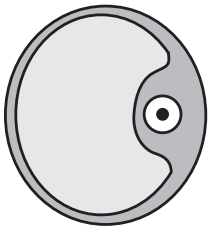
_____

_____ **1**

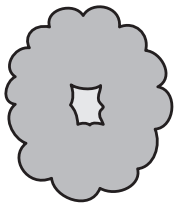
6. (continued) *Marks*

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

P



Q



(i) Name structures P and Q.

P _____ Q _____ **1**

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

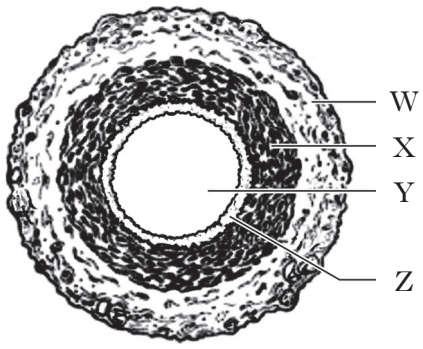
_____ **1**

[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.

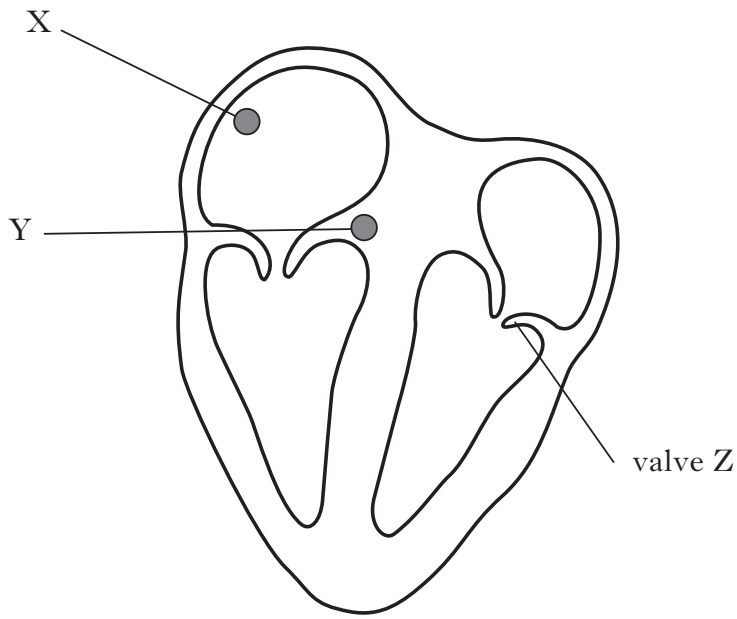
1 _____

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?

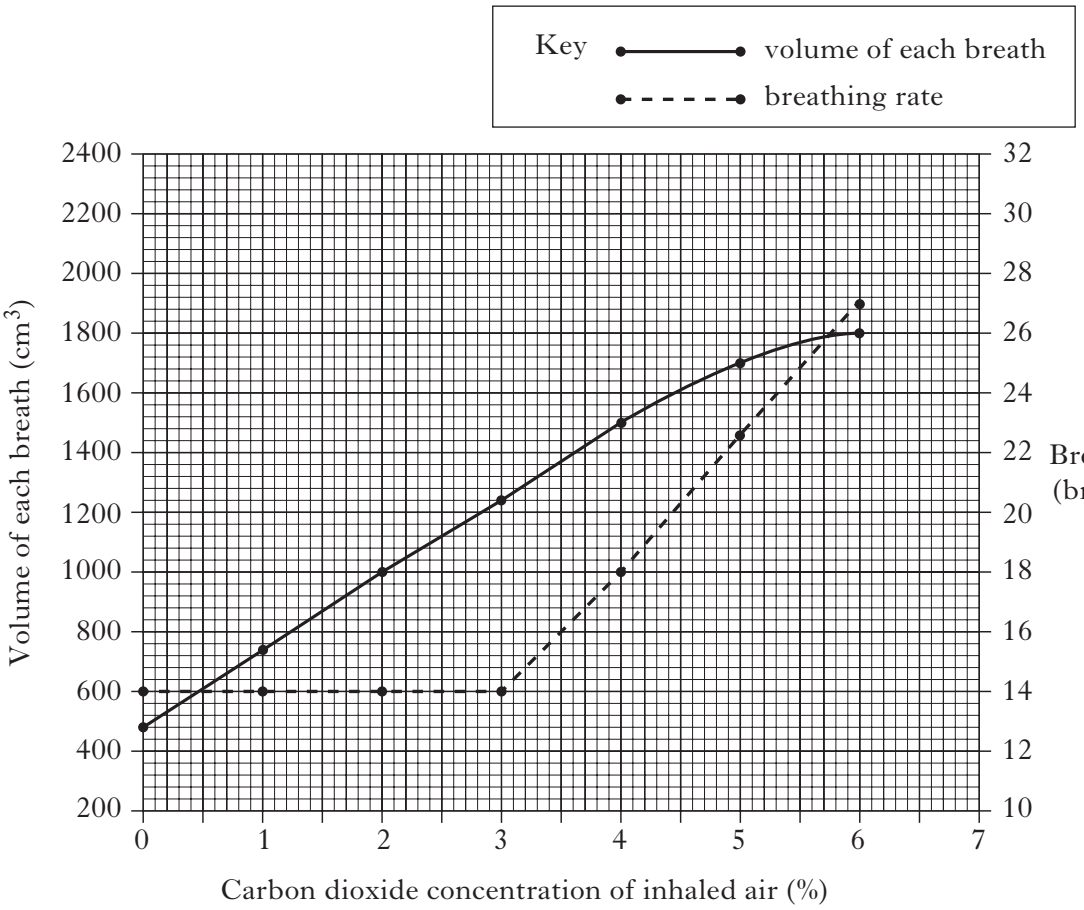
_____ **1**

[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.

_____

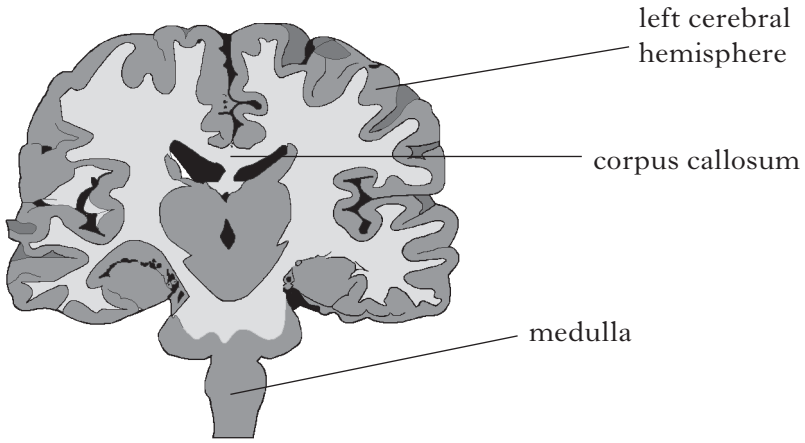
_____ **1**

[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**

DO NOT WRITE IN THIS MARGIN

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**

DO NOT WRITE IN THIS MARGIN

12. (continued) *Marks*

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

1 _____

_____

2 _____

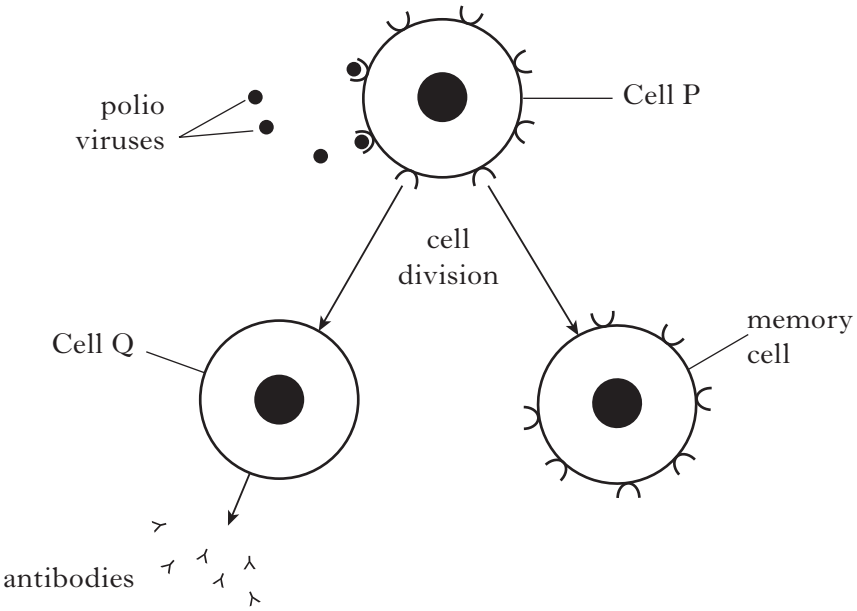
_____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

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**

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.

_____

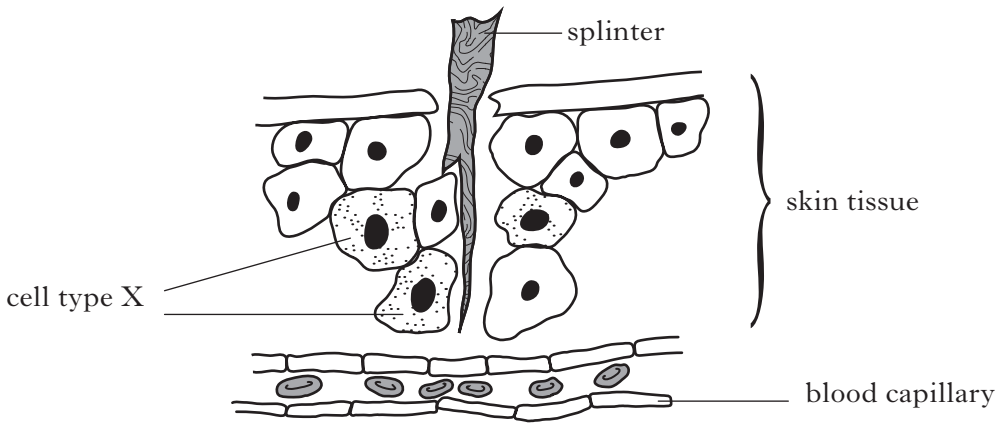
_____ **1**

[Turn over

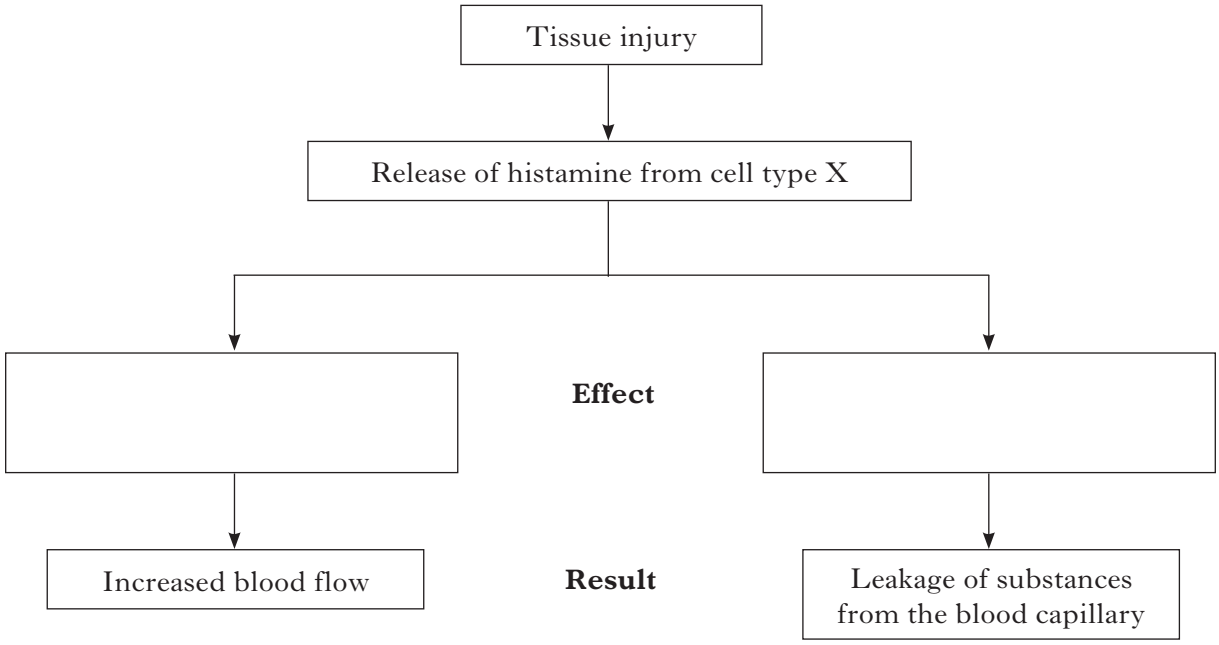
DO NOT WRITE IN THIS MARGIN

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*]