FOR OFFICIAL USE

Total for Sections B & C

X009/301

NATIONAL QUALIFICATIONS 2007

MONDAY, 21 MAY
1.00 PM – 3.30 PM

HUMAN BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

SECTION A—Questions 1–30

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

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

SECTIONS B AND C

1 (a) All questions should be attempted.

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

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

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

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

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

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

Read carefully

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

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

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

Do not change any of these details.

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

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

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

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

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

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

Sample Question

The digestive enzyme pepsin is most active in the

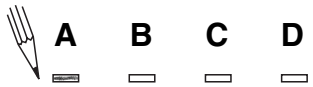
A stomach

B mouth

C duodenum

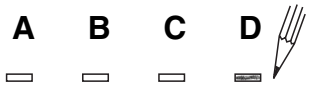
D pancreas.

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



Changing an answer

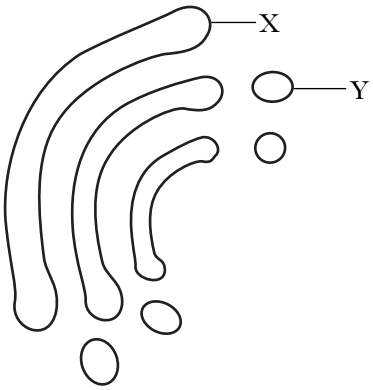
If you decide to change your answer, carefully erase your first answer and, using your pencil, fill in the answer you want. The answer below has been changed to **D**.



SECTION A

All questions in this section should be attempted.
Answers should be given on the separate answer sheet provided.

1. Which line in the table correctly identifies the two cell structures shown in the diagram?



	X	*Y*
A	Endoplasmic reticulum	Vesicle
B	Endoplasmic reticulum	Ribosome
C	Golgi body	Vesicle
D	Golgi body	Ribosome

2. Which of the following correctly describes metabolism?

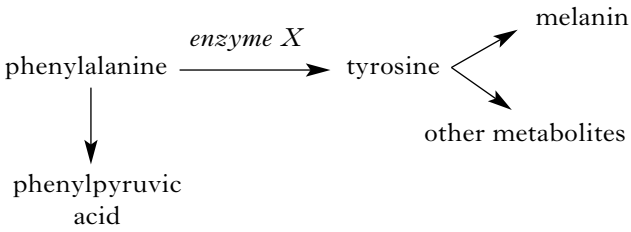
A The breakdown of chemicals to release energy

B The rate at which an organism produces heat energy

C The chemical reactions of organisms

D The breakdown of food molecules

3. Phenylketonuria (PKU) is a metabolic disorder which can be lethal in childhood. It is caused by an inability to make *enzyme X*, shown in the metabolic pathway below.



Which substance would have to be removed from the diet for someone who has this disorder?

A Phenylalanine

B Enzyme X

C Tyrosine

D Melanin

4. A stock solution has a concentration of 1 M. 100 cm^3 of a 0·4 M solution can be prepared by adding

A 40 cm^3 of stock solution to 60 cm^3 of water

B 60 cm^3 of stock solution to 40 cm^3 of water

C 40 cm^3 of stock solution to 100 cm^3 of water

D 100 cm^3 of stock solution to 40 cm^3 of water.

5. Non-competitive inhibitors affect enzyme action by

A acting as a co-enzyme for enzyme action

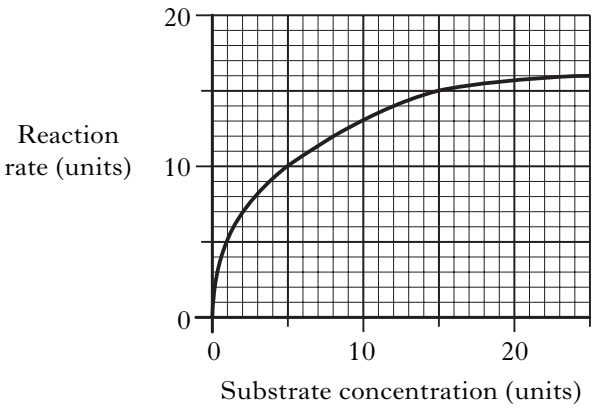
B altering the shape of the substrate molecule

C competing for the active site of the enzyme

D altering the shape of the active site of the enzyme.

[Turn over

6. The graph shows the effect of substrate concentration on the rate of an enzyme-catalysed reaction.



At what substrate concentration is the reaction rate equal to 75% of the maximum rate?

A 6 units

B 8 units

C 12 units

D 18 units

7. Which of the following is **not** a protein?

A Actin

B Insulin

C Amylase

D Ribonucleic acid

8. The phospholipid molecules in a cell membrane allow the

A free passage of glucose molecules

B self-recognition of cells

C active transport of ions

D membrane to be fluid.

9. Red blood cells have a solute concentration of around 0·9%.

Which of the following statements correctly describes the fate of these cells when immersed in a 1% salt solution?

A The cells will burst.

B The cells will shrink.

C The cells will expand but not burst.

D The cells will remain unaffected.

10. The secretion of amylase from a cell is an example of

A endocytosis

B exocytosis

C pinocytosis

D phagocytosis.

11. Lymphocytes act in the defence of the body by

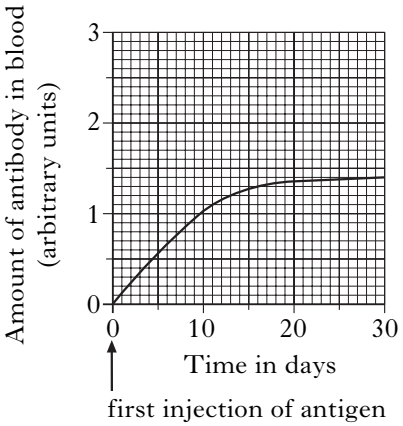
A ingesting toxins

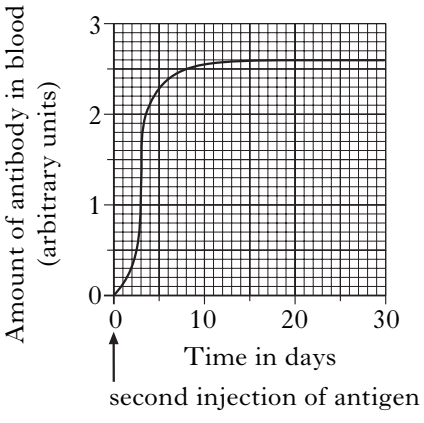
B ingesting pathogens

C producing lysosomes

D producing antibodies.

12. The graphs below show the effect of two injections of an antigen on the formation of an antibody.





How many days after the second injection does the amount of antibody in the blood reach the maximum achieved after the first injection?

A 3 days

B 6 days

C 20 days

D 30 days

13. Haploid gametes are produced during meiosis as a result of

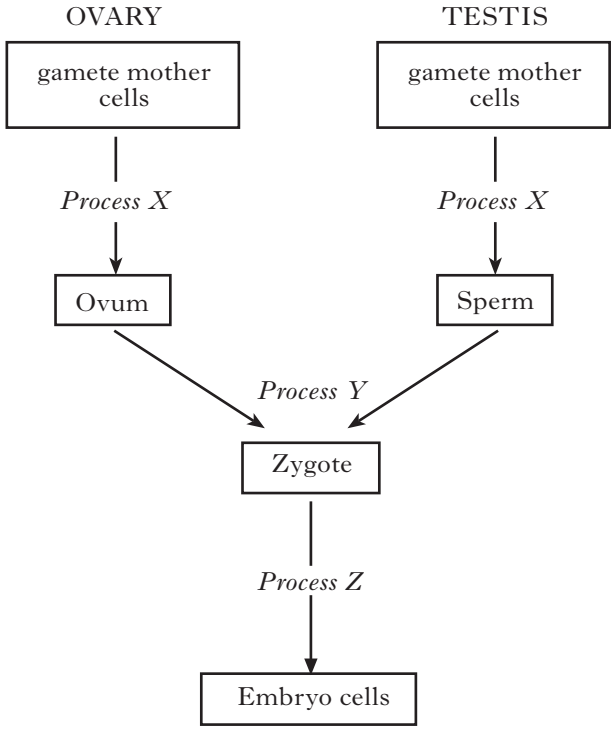
A the separation of homologous chromosomes

B the independent assortment of chromosomes

C the separation of chromosomes into chromatids

D the crossing over of chromatids.

14. The diagram refers to human reproduction.



Which of the following correctly identifies processes X, Y and Z?

	X	*Y*	*Z*
A	mitosis	meiosis	fertilisation
B	meiosis	fertilisation	mitosis
C	meiosis	mitosis	fertilisation
D	mitosis	fertilisation	meiosis

15. The family tree shows the pattern of inheritance of a genetic condition.

Unaffected female × Unaffected male

↓

Affected female

The allele responsible for this condition is both

A sex-linked and recessive

B sex-linked and dominant

C autosomal and recessive

D autosomal and dominant.

16. Non-disjunction can be described as

A a metabolic disorder

B a type of antisocial behaviour

C a condition resulting in memory loss

D a form of chromosome mutation.

17. Which of the following organs monitors body temperature?

A Hypothalamus

B Pituitary gland

C Prostate gland

D Spleen

18. Which line of the table correctly identifies the function and site of production of bile salts?

	Function	*Site of production*
A	digest protein	liver
B	digest protein	gall bladder
C	emulsify fats	liver
D	emulsify fats	gall bladder

[Turn over

19. Which of the following vessels in the circulatory system contains blood at the lowest pressure?

A Jugular vein

B Renal vein

C Vena cava

D Hepatic portal vein

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

	Breathing rate (breaths per minute)	*Volume of one breath*	*Carbon dioxide in exhaled air* (%)
(a) Resting	10	500 ml	5
(b) After race	22	1 litre	5

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

A 1·1 litres

B 2·2 litres

C 22 litres

D 44 litres

21. The table shows the masses of various substances in the glomerular filtrate and in the urine over a period of 24 hours.

Which of the substances has the smallest percentage reabsorption from the glomerular filtrate?

	Substance	*Mass in glomerular filtrate* (g)	*Mass in urine* (g)
A	Sodium	600·0	6·0
B	Potassium	35·0	2·0
C	Uric acid	8·5	0·8
D	Calcium	5·0	0·2

22. Which of the following shows the direction of a nerve impulse in a neurone?

A Axon → cell body → dendrite

B Cell body → dendrite → axon

C Cell body → axon → dendrite

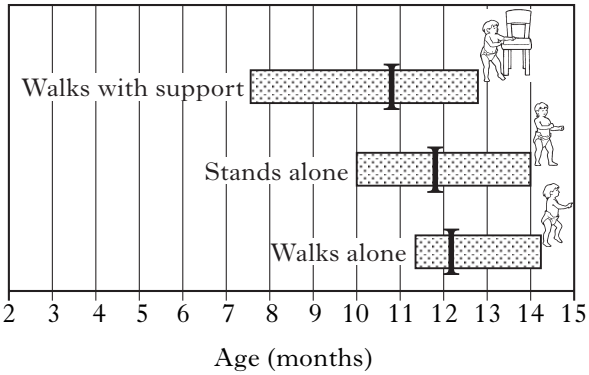
D Dendrite → cell body → axon

23. The diagram below shows the ages (in months) at which children reach various stages in their development.

The left end of each bar indicates the age by which 25% of infants have reached the stated performance.

The right end of each bar indicates the age by which 90% of infants have reached the stated performance.

The vertical bar indicates the age by which 50% of infants have reached the stated performance.



An eight-month old infant can walk with support but cannot stand alone.

In what percentage of the population is this child found?

A Less than 25%

B Between 25% and 50%

C Around 50%

D Between 50% and 90%

24. Identical twins are valuable in the study of behaviour because

A genetic and environmental factors can be discounted

B maturation and environmental factors can be discounted

C genetic factors can be discounted

D genetic, maturation and environmental factors can be discounted.

25. Which of the following terms describes the process by which a person learns to distinguish between different but related stimuli?

A Generalisation

B Imitation

C Discrimination

D Identification

26. An investigation was carried out to determine how long it takes students to learn to run a finger maze. A blindfolded student was allowed to run the maze on ten occasions. The results are given in the table below.

Trial	*Time* (s)
1	23
2	20
3	26
4	12
5	18
6	10
7	6
8	7
9	6
10	6

How could the investigation be improved to make the results more reliable?

A Allow other students to try to run the maze ten times, whilst blindfolded

B Allow the same student some additional trials on the same maze

C Change the shape of the maze and allow the same student to repeat ten trials

D Record the times to one decimal place

27. Which of the following is a correct definition of demography?

A Calculation of the difference between birth rates and death rates

B A count of the number of individuals in a population

C The rate at which a population replaces itself

D The study of population numbers

28. Which of the following processes increases directly the concentration of nitrogen gas in the atmosphere?

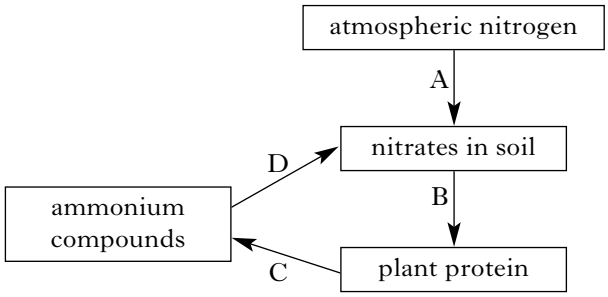
A Decomposition

B Denitrification

C Detoxification

D Deamination

29. The diagram below shows part of the nitrogen cycle.



Which letter represents nitrogen fixation?

30. Over-application of which of the following substances on agricultural land is likely to induce algal blooms in adjacent lakes?

A Fertiliser

B Insecticide

C Fungicide

D Herbicide

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

[Turn over for Section B

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DO NOT WRITE IN THIS MARGIN

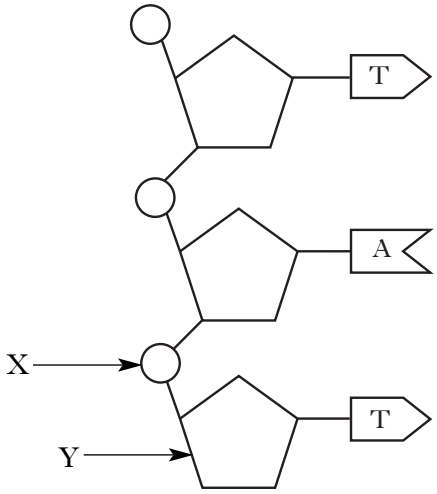
Marks

SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram below shows part of a DNA molecule.



(*a*) (i) On the diagram, draw a circle around **one** nucleotide. **1**

(ii) Name parts X and Y.

X _____

Y _____ **1**

(*b*) Name the **two** DNA bases **not** shown in the diagram.

_____ and _____ **1**

(*c*) (i) State the mRNA codon which would be formed from the triplet of DNA bases shown.

_____ **1**

(ii) Apart from nucleotides, name another molecule needed for the synthesis of mRNA.

_____ **1**

(*d*) A DNA molecule was found to contain 15 000 nucleotides.

What is the maximum number of amino acids which could be coded for by this molecule?

_____ **1**

[Turn over

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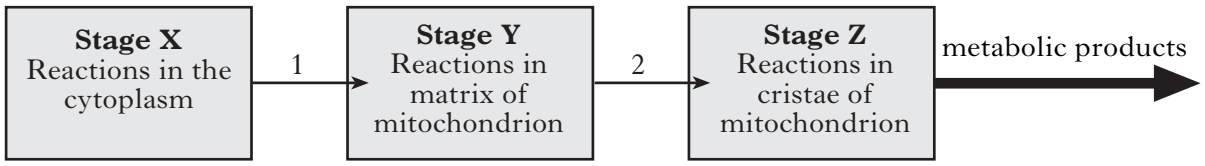
2. The diagram below shows three stages that occur during aerobic respiration.



(*a*) Name each stage.

X _____

Y _____

Z _____ **2**

(*b*) (i) Arrows 1 and 2 represent the transfer of molecules from one stage to another. Complete the table to identify these molecules.

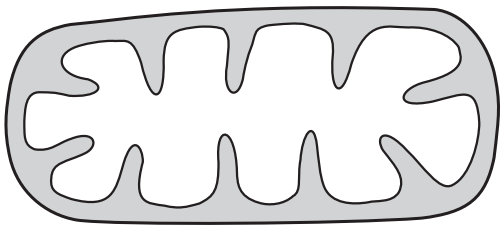
Arrow	*Name of molecule*
1	
2	

2

(ii) Name the **two** metabolic products of stage Z.

_____ and _____ **1**

(*c*) The diagram below shows a mitochondrion from a skin cell.



Describe how the structure of a mitochondrion from an active muscle cell would differ from the one shown. Give a reason for your answer.

Structural difference _____

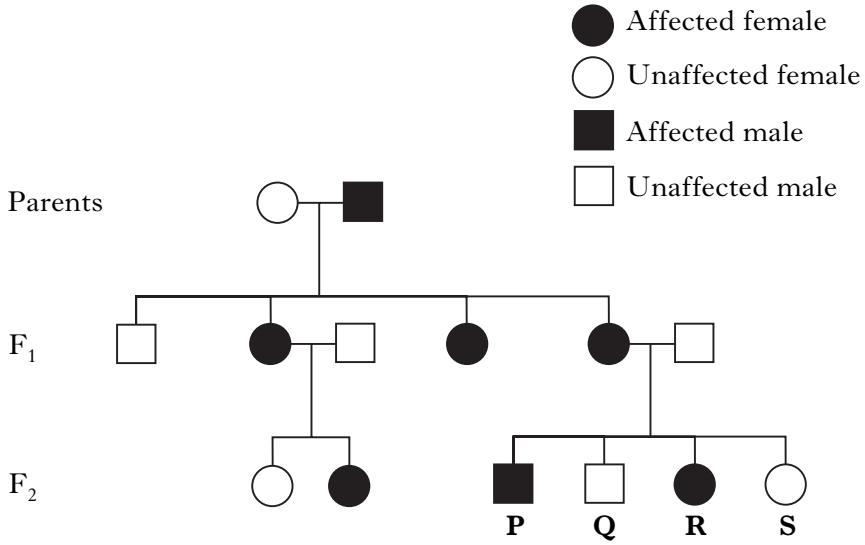
_____ **1**

Reason _____

_____ **1**

3. The family tree shows the inheritance of a bone disorder.

Marks



The disorder is caused by a dominant sex-linked allele (**B**).

(*a*) Using appropriate symbols, give the genotypes of individuals **P**, **Q**, **R** and **S**.

P _____ **Q** _____ **R** _____ **S** _____ **2**

(*b*) (i) Explain why all the F_1 females in this family are affected.

_____

_____

_____ **1**

(ii) Explain why only some of the F_2 females in this family are affected.

_____

_____

_____ **1**

(*c*) Is the ratio of affected offspring to unaffected offspring in the F_1 generation as expected? Give a reason for your answer.

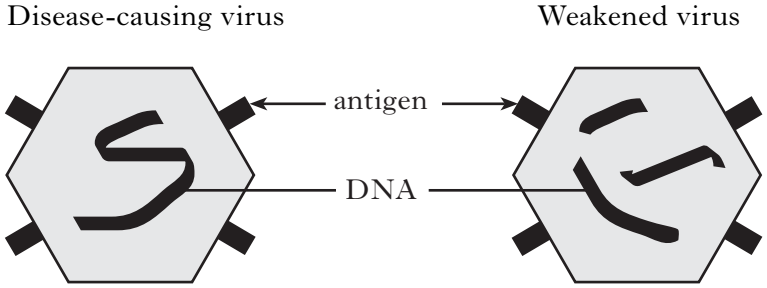
Yes/No _____

Reason _____

_____ **1**

4. The diagrams below show a disease-causing virus and one of the same type which has been weakened to make it less harmful.

Marks



(*a*) A woman is vaccinated with the weakened form of the virus.

(i) Explain why she does not develop the disease from the vaccination.

_____

_____ **1**

(ii) What feature of the weakened virus results in her gaining immunity from the disease?

_____

_____ **1**

(iii) Explain why this form of immunity is described as being both artificial and active.

Artificial _____

_____ **1**

Active _____

_____ **1**

(*b*) The table contains information about viruses.

Tick (✓) the appropriate boxes to show characteristics which apply to all viruses.

Characteristic	*Tick* (✓)
Contains a nucleus	
Surrounded by a protein coat	
Can be seen under a light microscope	
Contains nucleic acid	
Can only reproduce inside other cells	

2

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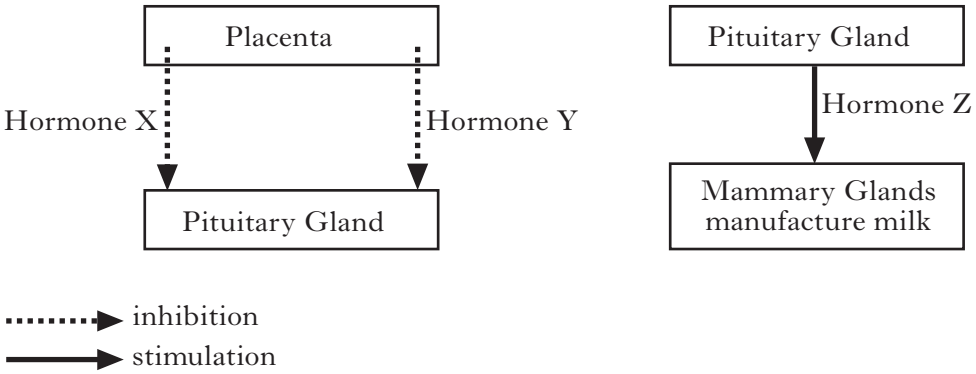
5. (*a*) The diagrams below contain information about three hormones involved in the control of milk production.



(i) Names hormones X, Y and Z.

X _____

Y _____

Z _____ **2**

(ii) Placental hormones inhibit the production of hormone Z by the pituitary gland. With reference to the diagrams, explain why milk production starts after birth.

_____

_____

_____ **2**

(*b*) (i) What name is given to the first milk produced by the mammary glands?

_____ **1**

(ii) State **one** difference in the content of this first milk compared with breast milk which is produced later.

_____ **1**

(*c*) Complete the following table which contains information about hormones produced by the pituitary gland.

Name of hormone	*Target organ*	*Effect of hormone on target organ*
ADH	kidney	
	testes	testosterone production
oxytocin		muscular contraction

2

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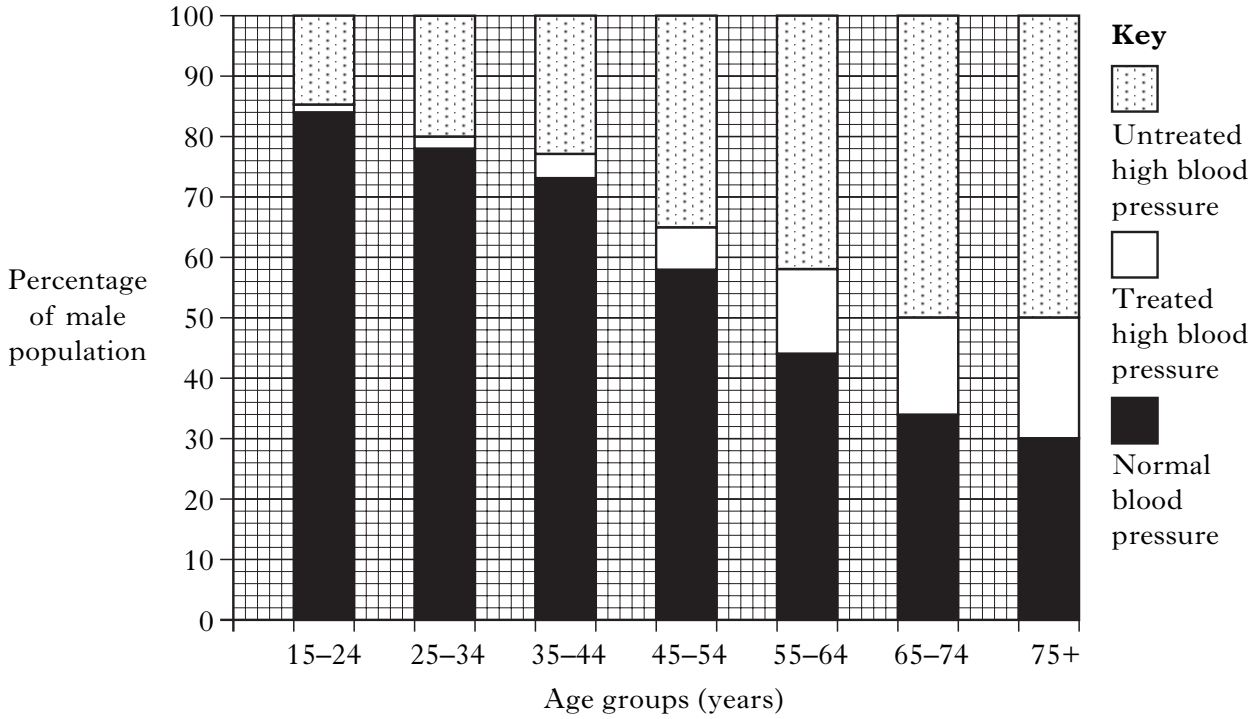
6. The graph below shows the occurrence of high blood pressure in British men of different ages.



(*a*) (i) What percentage of British men aged between 25 and 34 have high blood pressure?

_____ **1**

(ii) In men aged 55–64 who have high blood pressure, what is the percentage of treated to untreated individuals expressed as a simple ratio?

Space for working

_____ : _____ **1**
treated untreated

(iii) Describe **one** trend shown by the graph and suggest an explanation for it.

Trend _____ **1**

Explanation _____

_____

_____ **1**

6. (continued)

Marks

(*b*) A blood pressure reading that is greater than 160/90 mmHg is regarded as being too high.

Why are blood pressure readings given as two figures?

_____

_____

_____

_____ **1**

(*c*) Beta-blockers are drugs often used in the treatment of high blood pressure.

(i) Beta-blockers cause vasodilation. Explain how this lowers blood pressure.

_____

_____

_____

_____ **1**

(ii) Beta-blockers also slow heart rate. Suggest which region of the heart is likely to be affected by beta-blockers.

_____ **1**

[Turn over

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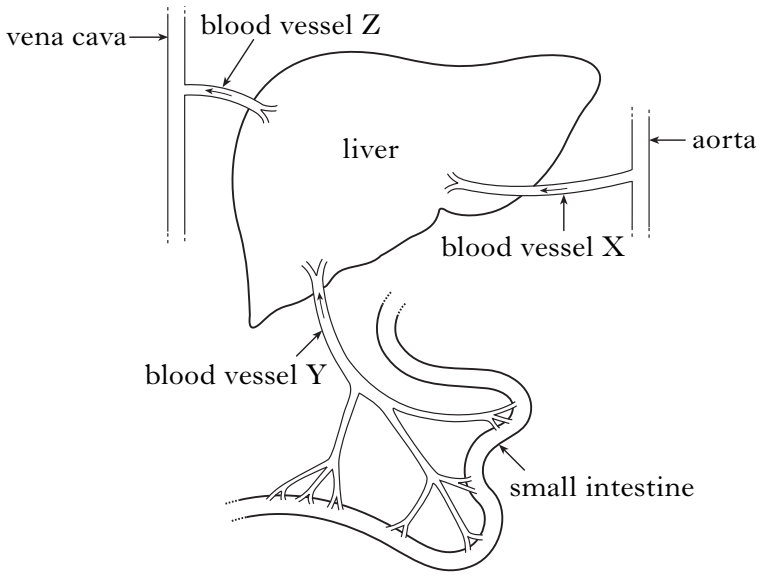
Marks

7. The diagram below shows the liver, intestine and associated blood vessels.



(*a*) (i) Identify blood vessels X, Y and Z.

X _____

Y _____

Z _____ **2**

(ii) Describe the differences in oxygen and carbon dioxide concentrations between blood vessel X and blood vessel Z.

_____

_____

_____ **1**

(*b*) (i) Glucose is absorbed into the blood stream from the small intestine.

Describe **two** ways in which the small intestine is designed to maximise glucose absorption.

1 _____

_____

2 _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

7. (*b*) (continued)

(ii) Describe **two** possible fates of the absorbed glucose when it reaches the liver.

1 _____

_____

2 _____

_____ **1**

(*c*) The liver metabolises a large number of substances.

(i) Name a substance excreted from the liver when red blood cells are broken down.

_____ **1**

(ii) What compounds are broken down in the liver to produce urea?

_____ **1**

[Turn over

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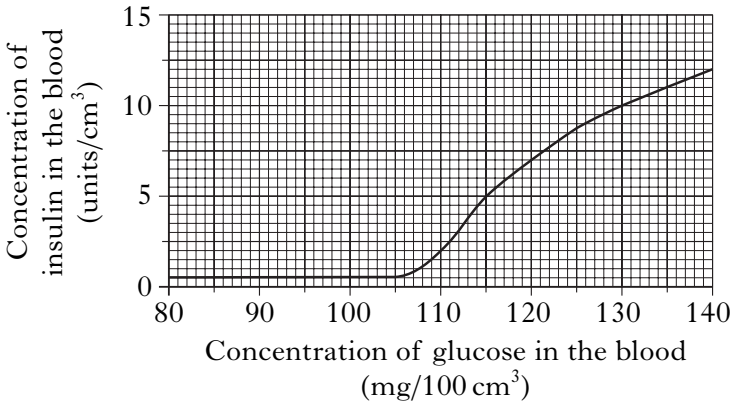
8. The graphs below contain information about the regulation of blood sugar.

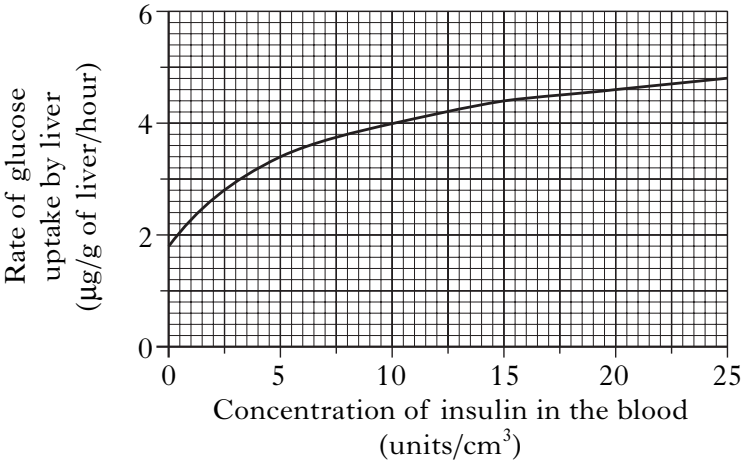
Graph 1 shows how the concentration of glucose in the blood affects the concentration of insulin.

Graph 2 shows how the concentration of insulin in the blood affects the rate of glucose uptake by the liver.

Graph 1



Graph 2



(*a*) (i) From **Graph 1**, state the glucose concentration which triggers an increase in insulin production.

_____ **1**

(ii) Name the organ which produces insulin.

_____ **1**

(*b*) From **Graph 2**, calculate the percentage increase in the rate of glucose uptake by the liver when the concentration of insulin in the blood rises from 10 to 15 units/cm^3.

Space for calculation

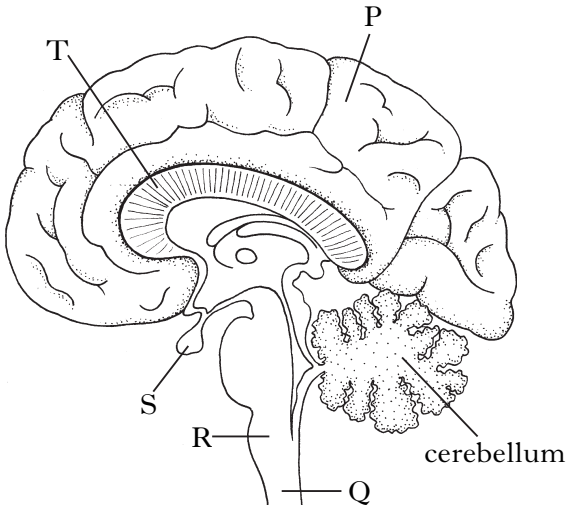
_____ **1**

(*c*) From **Graphs 1** and **2**, state the rate of glucose uptake by the liver when the concentration of glucose in the blood is 130 mg/100 cm^3.

_____ µg/g of liver/hour **1**

Marks

9. The diagram shows a section through part of the central nervous system.



(*a*) The table contains information about three parts of the central nervous system. Complete the table to identify the parts and their functions.

Label	*Name*	*Function*
		Controls voluntary actions
T		Links left and right side of brain
	Spinal cord	

3

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

The parasympathetic nervous system is part of the **autonomic** / **somatic**

nervous system which originates in the **medulla** / **cerebellum**.

Parasympathetic nerves **speed up** / **slow down** heart rate. **1**

(*c*) What structural feature of motor and sensory neurones speeds up the transmission of nerve impulses?

_____

_____ **1**

[Turn over

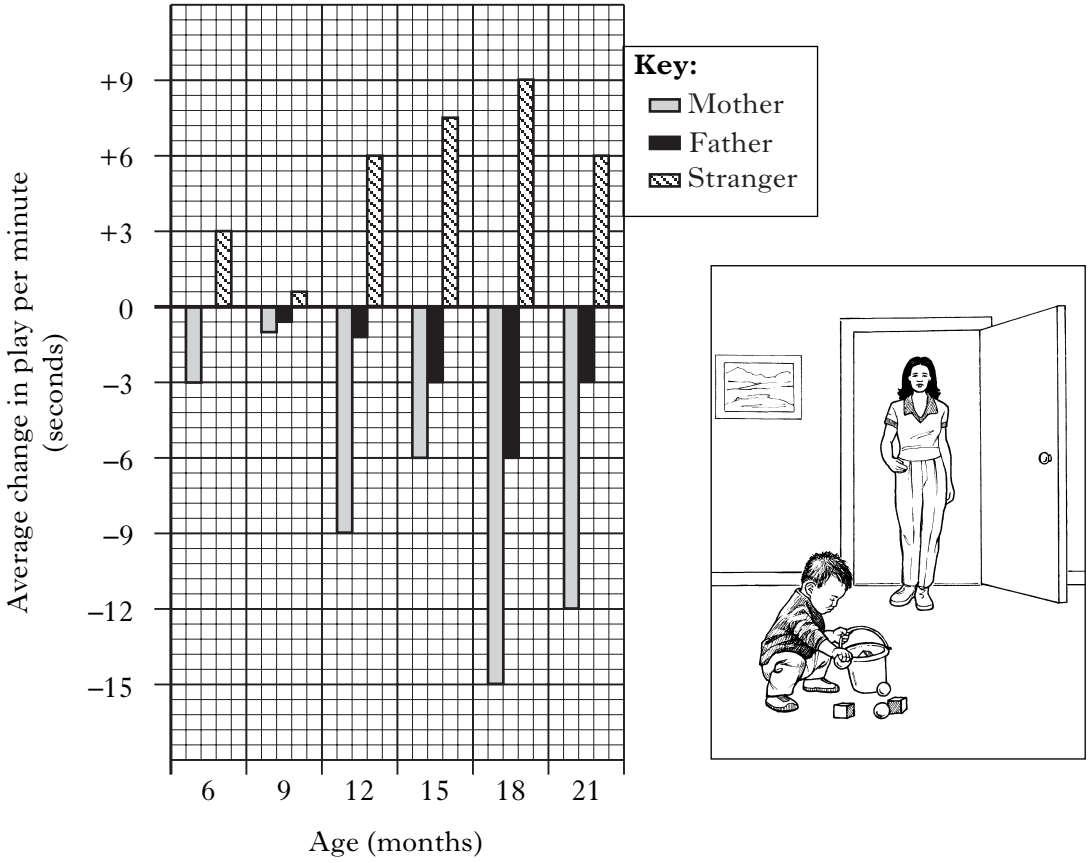
Marks

10. An investigation was carried out to find out how an infant's play was affected by the presence or absence of an adult. The infant was tested at three-month intervals using the following procedure.

1 The infant was placed in a room with an adult and some toys.
2 The infant was allowed to play with the toys for five minutes, then the adult left the room.
3 The infant was allowed to continue to play with the toys for another five minutes alone.

Playing time was measured by the number of seconds the infant spent playing per minute.

The graph shows the change in time spent playing, at each age, after the adult left the room.



(*a*) At what ages does the departure of any adult have the **greatest** and **least** effect on the length of play time?

Greatest effect _____ months Least effect _____ months **1**

(*b*) When the child was 21 months old, what was the total increase in playing time, over the 5-minute period, when the stranger left the room?

_____ seconds **1**

DO NOT WRITE IN THIS MARGIN

10. (continued)

Marks

(*c*) (i) Compare the effect of the departure of the mother with the departure of the father.

1

(ii) Suggest a reason for this difference.

1

(*d*) (i) Compare the effect of the departure of the stranger with the departure of the parents.

1

(ii) Suggest reasons for this difference.

2

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

1

[Turn over

Marks

11. An investigation was carried out on the effect of strobe lighting and loud noise on the ability of students to perform calculations.

Twenty students were divided into two equal groups, A and B. Each group was given 20 calculations to complete.

Group A sat in an evenly lit, quiet room.
Group B sat in a room where there was strobe lighting and loud noise.

The numbers of errors the students made, while doing the calculations, are shown in **Table 1**.

Table 1

Group A		*Group B*	
Student	*Number of errors*	*Student*	*Number of errors*
1	2	**1**	8
2	4	**2**	5
3	3	**3**	9
4	1	**4**	4
5	3	**5**	6
6	0	**6**	3
7	2	**7**	4
8	3	**8**	7
9	1	**9**	6
10	1	**10**	8

(*a*) By how many times has the average number of errors increased as a result of the distractions?

Space for calculation

_____ **1**

(*b*) State **three** factors which would need to be kept constant during this investigation.

1 _____

2 _____

3 _____ **2**

11. (continued)

Marks

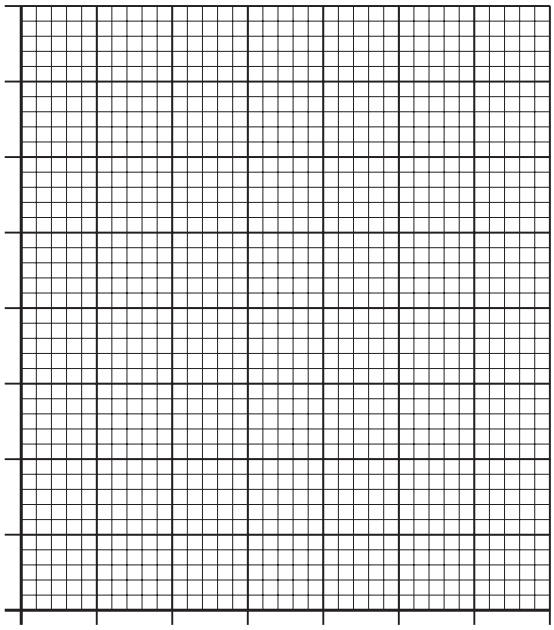
(*c*) A third group of ten students carried out the investigation under the same conditions as group B, but were tested six times instead of only once. Each test comprised different calculations. The average percentage of errors is shown in **Table 2**.

Table 2

Trial	*1*	*2*	*3*	*4*	*5*	*6*
Average percentage error	34	30	24	20	20	19

(i) Construct a line graph to show the data in the table.

(Additional graph paper, if required, can be found on page 32.)



2

(ii) Suggest an explanation for the shape of the graph.

_____

_____ **1**

(*d*) How could the design of the investigation be altered to demonstrate the effect of social facilitation?

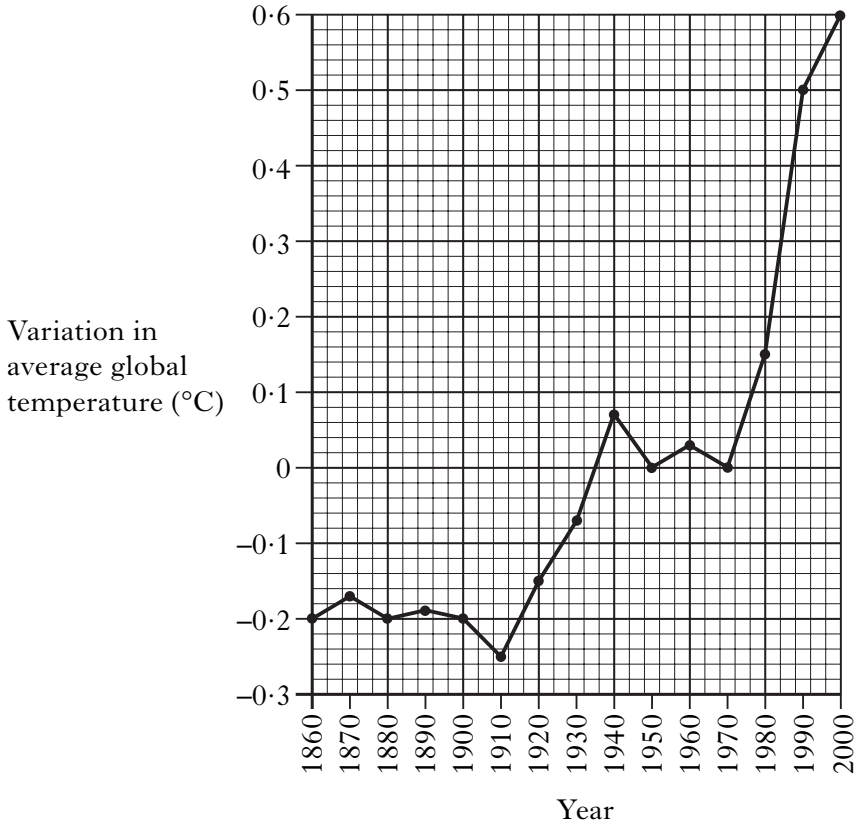
_____

_____

_____ **1**

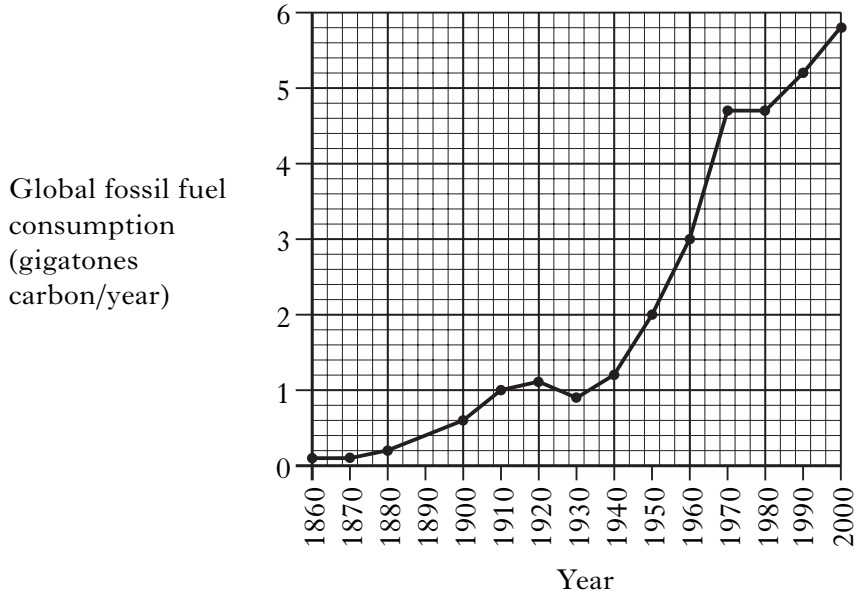
12. **Graph A** shows how the average global temperature, between 1860 and 2000, varied from that in 1970.

Graph A



Graph B shows the global fossil fuel consumption, between 1860 and 2000.

Graph B



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12. (continued)

Marks

(*a*) What was the increase in average global temperature between 1900 and 2000?

_____ **1**

(*b*) State **two** reasons for the increased use of fossil fuels.

1 _____

2 _____ **1**

(*c*) Discuss the extent to which the graphs support the theory that rising global temperatures are due to increasing use of fossil fuels.

Quote data from the graph in your answer.

_____

_____

_____

_____

_____

_____

_____

_____ **2**

(*d*) Name a greenhouse gas other than carbon dioxide.

_____ **1**

[Turn over

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Marks

13. The photograph below shows the effect of deforestation on an area of tropical rainforest.

(*a*) (i) State **two** reasons why humans remove forest from the land.

1 _____

_____

2 _____

_____ **2**

(ii) Deforestation can result in desertification. Explain how this can happen.

_____

_____

_____

_____

_____ **2**

(*b*) Describe **one** other effect of deforestation on the local environment.

_____

_____

_____ **1**

Marks

SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Questions 1 and 2 should be attempted on the blank pages which follow.

Supplementary sheets, if required, may be obtained from the invigilator.

Labelled diagrams may be used where appropriate.

1. Answer **either** A **or** B.

A. Give an account of the function of a synapse under the following headings:

(i) release of neurotransmitter; **3**

(ii) action of neurotransmitter; **3**

(iii) removal of neurotransmitter. **4**

(10)

OR

B. Give an account of memory under the following headings:

(i) encoding into short-term memory; **2**

(ii) transfer from short-term to long-term memory; **6**

(iii) retrieval from long-term memory. **2**

(10)

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

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

A. Give an account of the causes and treatment of female infertility. **(10)**

OR

B. Give an account of how the structure of a red blood cell relates to its function. **(10)**

[*END OF QUESTION PAPER*]

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SPACE FOR ANSWERS

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ADDITIONAL GRAPH PAPER FOR QUESTION 11(*c*)(i)