

FOR OFFICIAL USE

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Total for
Sections B & C

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X009/301

NATIONAL
QUALIFICATIONS
2011

WEDNESDAY, 1 JUNE
1.00 PM – 3.30 PM

HUMAN BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

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Town

--

Forename(s)

--

Surname

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Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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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

- (a) All questions should be attempted.
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
- 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**.
- 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.
- The numbers of questions must be clearly inserted with any answers written in the additional space.
- 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.
- Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.



Read carefully

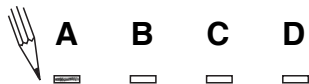
- 1 Check that the answer sheet provided is for **Human Biology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.
Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

The digestive enzyme pepsin is most active in the

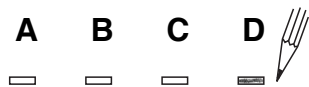
- A stomach
- B mouth
- C duodenum
- D pancreas.

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



Changing an answer

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



SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. A DNA molecule consists of 4000 nucleotides of which 20% contain the base adenine.

How many of the nucleotides in this DNA molecule will contain guanine?

- A 800
- B 1000
- C 1200
- D 1600

2. The function of tRNA in cell metabolism is to

- A transport amino acids to be used in synthesis
- B carry codons to the ribosomes
- C synthesise proteins
- D transcribe the DNA code.

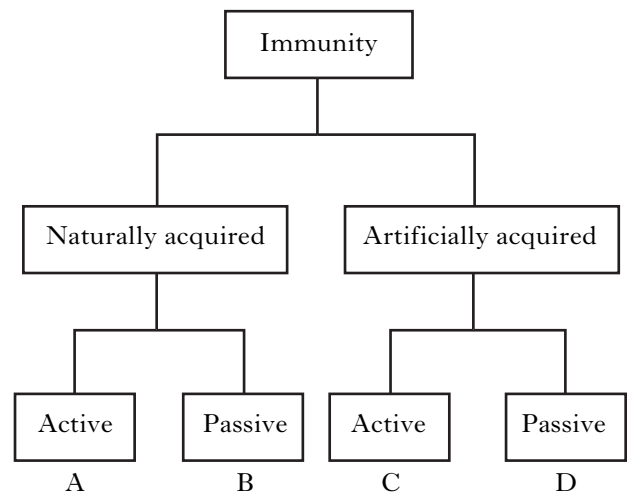
3. The Golgi apparatus is involved in the packaging of

- A ribosomes
- B monosaccharides
- C RNA
- D enzymes.

4. Which of the following cells secrete antibodies?

- A B-lymphocytes
- B T-lymphocytes
- C Red blood cells
- D Macrophages

5. The diagram below summarises different types of immunity.



Which type of immunity would arise from breast feeding?

6. Haemophilia is a sex-linked recessive condition. A woman, who does not have this condition, has a haemophiliac son. The boy's father is also a haemophiliac.

What are the genotypes of the parents?

	Father	Mother
A	X^HY	X^HX^h
B	X^hY	X^hX^h
C	X^hY	X^HX^H
D	X^hY	X^HX^h

[Turn over

7. The table below shows the results of chemical tests on five carbohydrates.

<i>Carbohydrate</i>	<i>Chemical test</i>			
	<i>Iodine solution</i>	<i>Benedict's solution</i>	<i>Barfoed's reagent</i>	<i>Clinistix strip</i>
starch	turns blue-black	stays blue	stays blue	stays pink
sucrose	stays brown	stays blue	stays blue	stays pink
lactose	stays brown	turns orange	stays blue	stays pink
fructose	stays brown	turns orange	turns orange	stays pink
glucose	stays brown	turns orange	turns orange	turns purple

What is the minimum number of tests that would need to be carried out to identify an unknown carbohydrate as lactose?

- A one
- B two
- C three
- D four

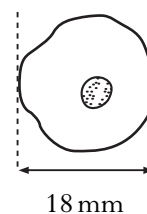
8. Huntington's Disease is an inherited condition in humans caused by a dominant allele which is not sex-linked.

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

What is the chance of the woman having the condition?

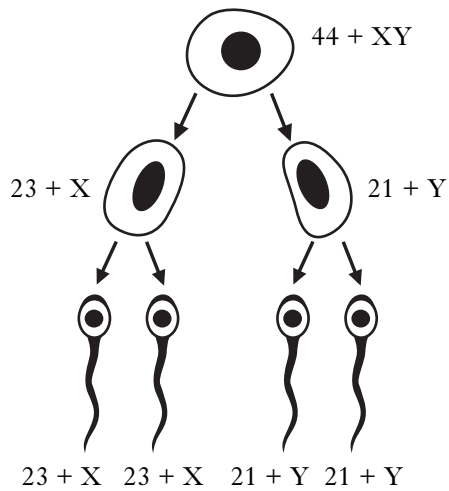
- A 1 in 1
- B 1 in 2
- C 1 in 3
- D 1 in 4

9. The cell shown below is magnified six hundred times. What is the actual size of the cell?



- A 1080 μm
- B 108 μm
- C 30 μm
- D 3 μm

10. The diagram shows the chromosome complement of cells during the development of abnormal human sperm.



A sperm with chromosome complement 23+X fertilises a normal haploid egg. What is the chromosome number and sex of the resulting zygote?

	Chromosome number	Sex of zygote
A	24	female
B	46	female
C	46	male
D	47	female

11. In fertility clinics, samples of semen are collected for testing.

The table below shows the analysis of semen samples taken from five men.

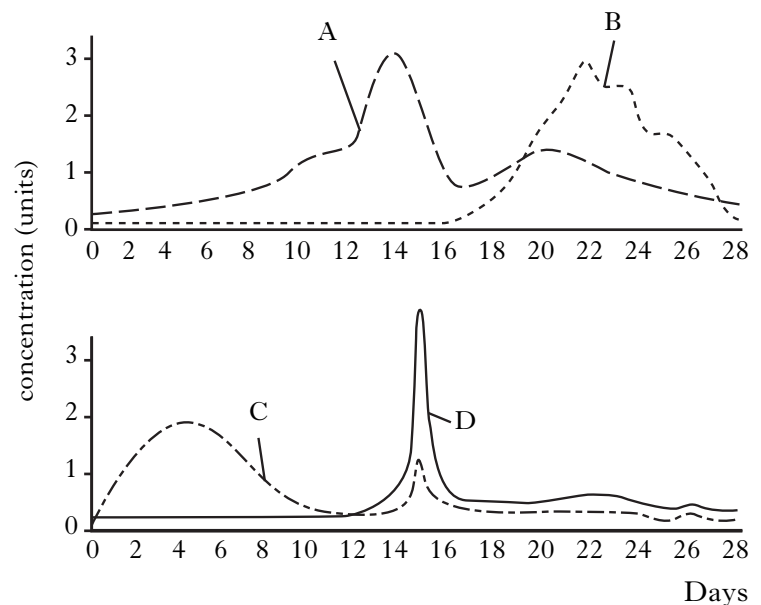
Semen sample	1	2	3	4	5
Number of sperm in sample (millions/cm ³)	40	19	25	45	90
Active sperm (percent)	65	60	75	10	70
Abnormal sperm (percent)	30	20	90	30	10

A man is fertile if his semen contains at least 20 million sperm cells/cm³ and at least 60% of the sperm cells are active and at least 60% of the sperm cells are normal.

The semen samples that were taken from infertile men are

- A samples 3 and 4 only
 B samples 2 and 4 only
 C samples 2, 3 and 4 only
 D samples 1, 2, 4 and 5 only.

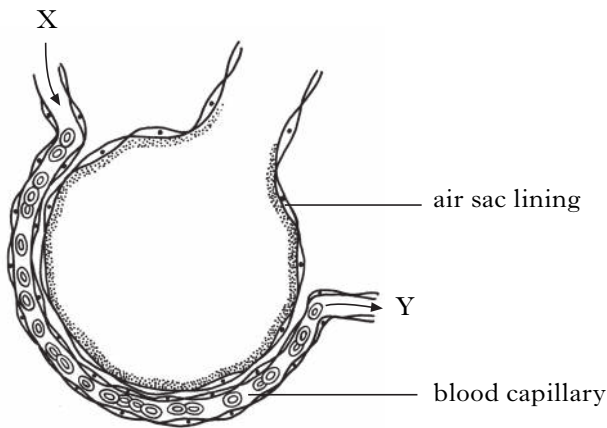
12. The graphs below show the hormones involved in the menstrual cycle.



Which line represents oestrogen?

13. The vein in the umbilical cord carries
- A oxygenated fetal blood
 - B deoxygenated fetal blood
 - C oxygenated maternal blood
 - D deoxygenated maternal blood.
14. A child born to parents with different Rhesus factors can be at risk because
- A anti-D antibodies from the Rh- mother destroy the baby's red blood cells
 - B anti-D antibodies from the Rh+ mother destroy the baby's red blood cells
 - C anti-D antigens from the Rh- mother destroy the baby's red blood cells
 - D anti-D antigens from the Rh+ mother destroy the baby's red blood cells.

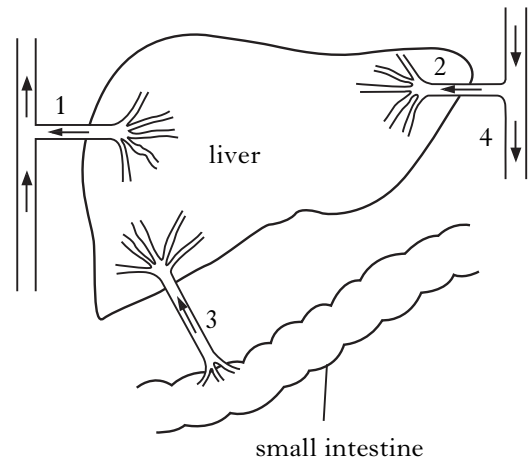
15. The diagram below shows the blood supply to cells lining an air sac in the lungs.



Which line of the table shows correctly the change in concentration of glucose and oxygen as the blood flows from X to Y?

	<i>Glucose</i>	<i>Oxygen</i>
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

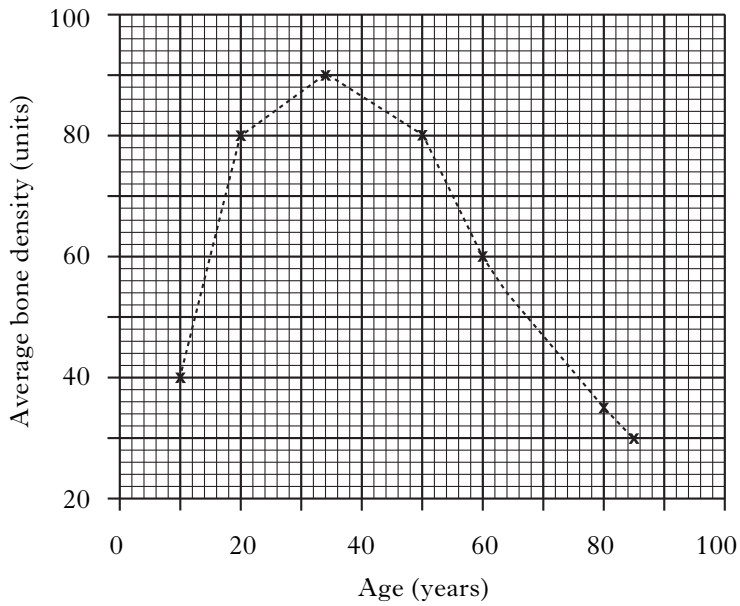
16. The diagram below shows the liver and its associated blood vessels. The arrows show the direction of blood flow.



Which of the blood vessels are veins?

- A 1 and 2
 - B 1 and 3
 - C 2 and 3
 - D 2 and 4
17. Which of the following is **not** a function of the lymphatic system?
- A Production of tissue fluid
 - B Absorption of products from fat digestion
 - C Removal of bacteria
 - D Production of lymphocytes
18. Which of the following statements about red blood cells is true?
- A They are manufactured in the liver.
 - B They have a lifespan of 240 days.
 - C Vitamin B₁₂ is required for their production.
 - D They are broken down in the kidney.

19. The graph below shows how female bone density changes with age.



When a female's bone density falls to 60% of its maximum, there is an increased chance of bone breakage.

This occurs at

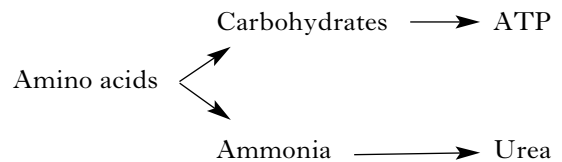
- A 60 years
 B 64 years
 C 76 years
 D 84 years.
20. Mature red blood cells have no nucleus and no mitochondria.
 Which of the following processes can be carried out by a mature red blood cell?
- A Aerobic respiration
 B Protein synthesis
 C Anaerobic respiration
 D Cell division
21. Which of the following blood vessels is likely to contain blood with the lowest concentration of urea?
- A Hepatic artery
 B Hepatic vein
 C Renal artery
 D Renal vein

22. Which of the following correctly identifies the locations of the centres that monitor blood water concentration and temperature in humans?

	<i>Blood water concentration</i>	<i>Temperature</i>
A	Hypothalamus	Hypothalamus
B	Hypothalamus	Pituitary gland
C	Pituitary gland	Hypothalamus
D	Pituitary gland	Pituitary gland

23. Infants are more likely to suffer from hypothermia because they have
- A a low surface area to volume ratio
 B a high surface area to volume ratio
 C a low metabolic rate
 D a high metabolic rate.
24. When the body temperature becomes too high, which of the following sets of changes can occur in the skin?
- A Vasoconstriction and contraction of erector muscles
 B Vasodilation and contraction of erector muscles
 C Vasoconstriction and relaxation of erector muscles
 D Vasodilation and relaxation of erector muscles

25. The diagram below shows reactions involved in deamination.



The reactions shown take place in the

- A small intestine
 B kidney
 C gall bladder
 D liver.

26. Which of the following statements is correct?
- A The somatic nervous system controls mainly involuntary actions using sensory nerves.
 - B The somatic nervous system controls mainly voluntary actions using sympathetic nerves.
 - C The autonomic nervous system controls some involuntary actions using parasympathetic nerves.
 - D The autonomic nervous system controls some voluntary actions using motor nerves.

27. A young person does not smoke because she has seen an advertising campaign showing pictures of famous sports stars who do not smoke.

This is an example of a behaviour called

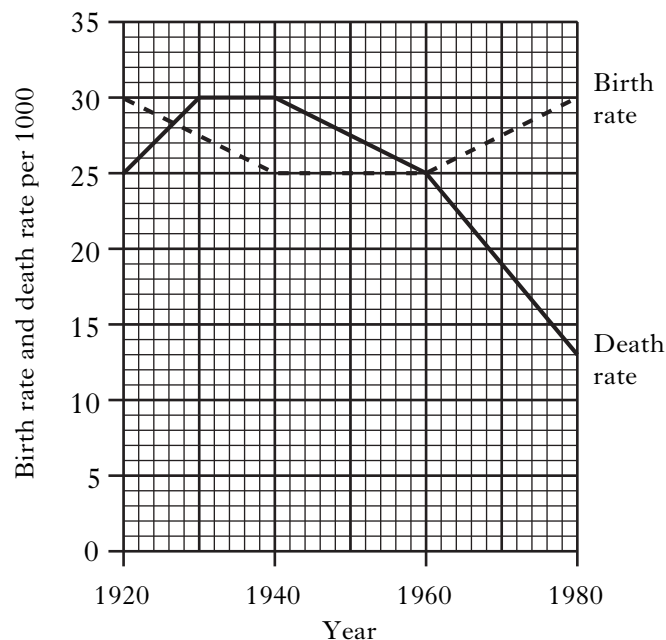
- A identification
- B discrimination
- C generalisation
- D deindividuation.

28. Which of the following best describes shaping behaviour?

The reward of behaviour which

- A improves performance in competitive situations
- B approximates to the desired behaviour
- C results in the learning of motor skills
- D results in deindividuation taking place.

29. The graph below shows the birth rate and death rate of a population.



The year of greatest increase in population was

- A 1920
- B 1940
- C 1960
- D 1980.

30. When fertilisers enter a loch, the population of bacteria often increases dramatically.

Which line in the table below describes correctly the cause of the increase in the bacterial population and the result of the increase in the bacterial population?

	<i>Cause of the increase in population of bacteria</i>	<i>Result of the increase in population of bacteria</i>
A	death of plants	increase in nitrates
B	decrease in oxygen levels	increase in organic matter
C	increase in nitrates	algal blooms
D	increase in organic matter	decrease in oxygen levels

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*

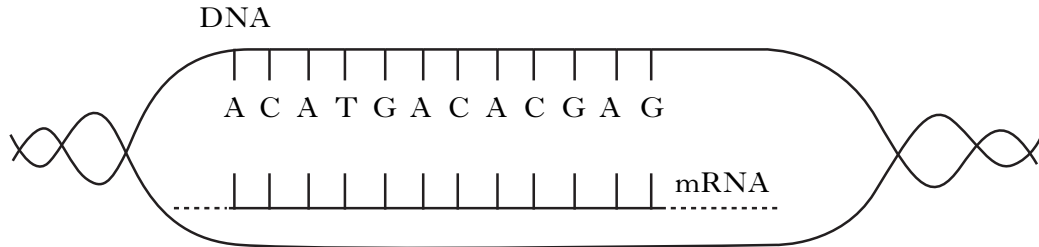
Marks

SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. (a) The diagram shows part of an mRNA molecule being formed on a strand of DNA.



- (i) In which part of the cell is mRNA formed?

1

- (ii) Complete the mRNA molecule by filling in the correct base sequence **on the diagram**.

1

- (iii) How many amino acids are coded for by this section of mRNA?

1

- (b) Some diseases are caused when cells in the body produce a harmful protein. Recent research has led to the development of antisense drugs to treat such diseases. These drugs carry a short strand of RNA nucleotides designed to attach to a small part of the mRNA molecule that codes for the harmful protein.

- (i) Suggest how these drugs may prevent the production of a harmful protein.

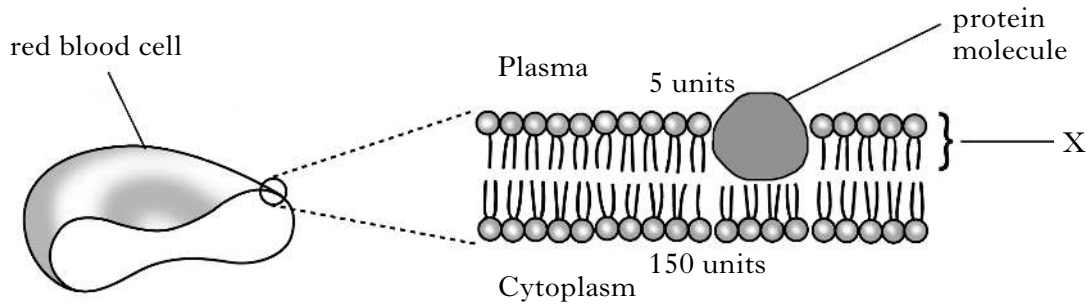
1

- (ii) Antisense drugs can be used to treat autoimmune diseases. Describe what is meant by an autoimmune disease.

1

Marks

2. The diagram below shows a magnified section of the cell membrane of a red blood cell. The numbers show the relative concentrations of potassium ions that are maintained on either side of the membrane.



- (a) Name molecule X.

1

- (b) State **one** possible function of the protein molecule shown in the diagram.

1

- (c) Express, as a simple whole number ratio, the concentration of potassium ions inside and outside the cell.

Space for calculation

_____ : _____
inside outside

1

- (d) Use the information in the diagram to name the process by which potassium ions would leave the cell.

1

- (e) A sample of blood was treated with a chemical that inhibits respiration.

- (i) Describe how this treatment would change the relative concentrations of potassium ions on each side of the membrane.

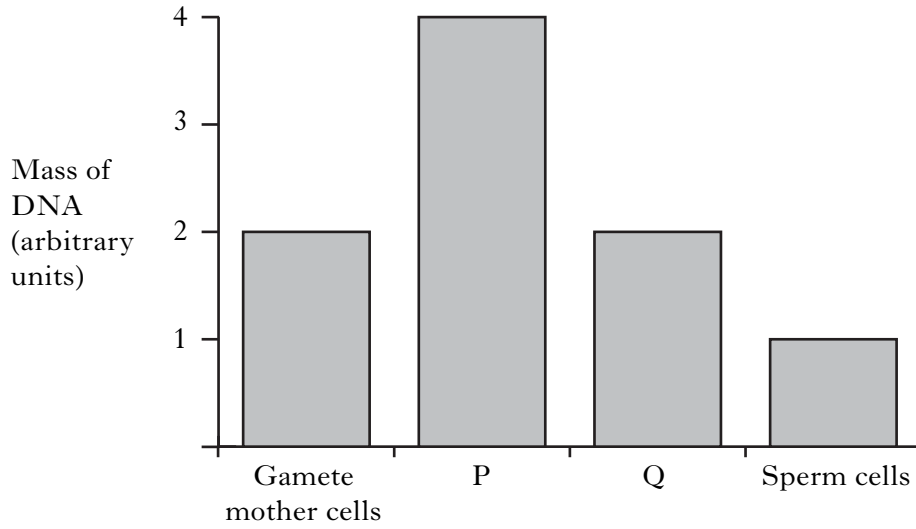
1

- (ii) Explain why the relative concentrations would change.

1

Marks

3. The graph below shows the mass of DNA present as gamete mother cells develop into sperm cells during meiosis in the testes. P and Q represent cells at intermediate stages in this process.



(a) Explain why the mass of DNA changes between

(i) the gamete mother cells and cell type P _____

1

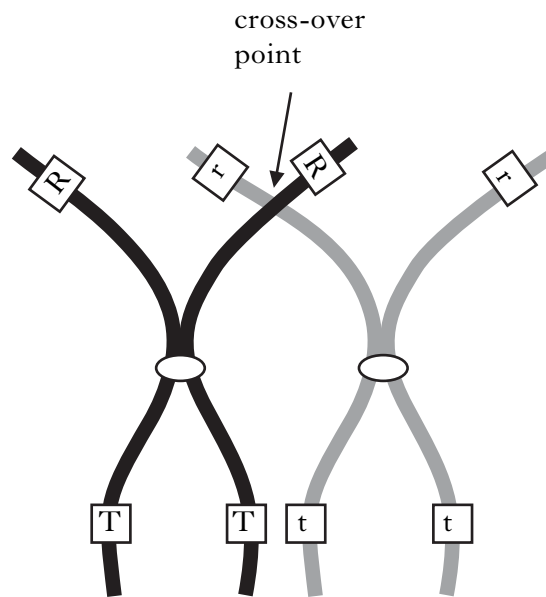
(ii) cell types P and Q. _____

1

Marks

3. (continued)

(b) The diagram below shows a pair of chromosomes in a cell undergoing meiosis.



Letters R and T represent dominant alleles of two different genes.

(i) What name is given to the point on the chromosomes where crossing over occurs?

1

(ii) Assuming that crossing over does occur, give all the combinations of alleles that would be present in the resulting gametes.

1

(iii) Crossing over leads to genetic variation.

Name **one** other way in which meiosis increases variation.

1

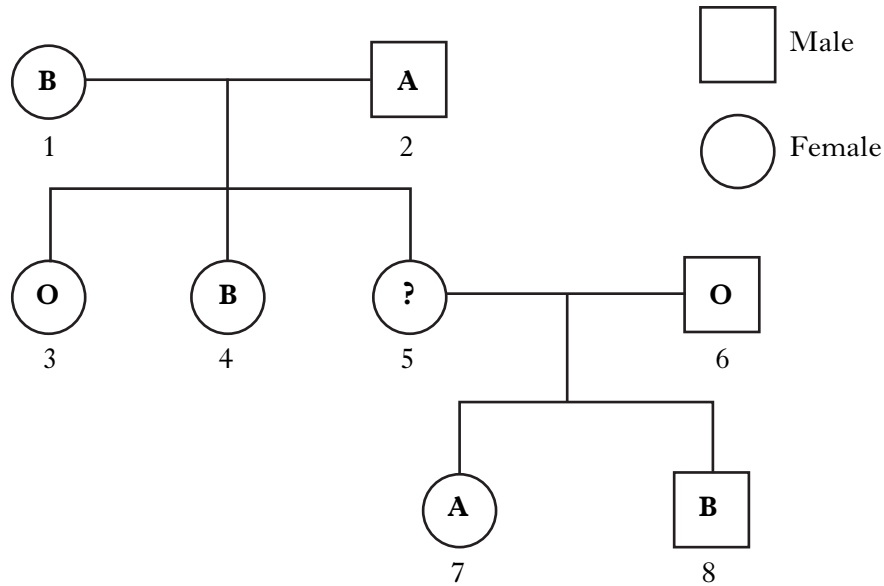
(c) State the exact location of meiosis in the testes.

1

[Turn over

Marks

4. The diagram below shows inheritance of the ABO blood group over three generations of a family. The letters represent the blood group of each individual.



- (a) The ABO blood group system is controlled by three alleles: *A*, *B* and *O*. Alleles *A* and *B* are co-dominant and both are completely dominant to allele *O*.

- (i) State the genotypes of the following:

Individual 1 _____

Individual 3 _____

1

- (ii) What is the blood group of individual 5? Give a reason for your answer.

Blood group _____

Reason _____

2

- (iii) How many of the individuals shown in the family tree have a genotype which is heterozygous?

1

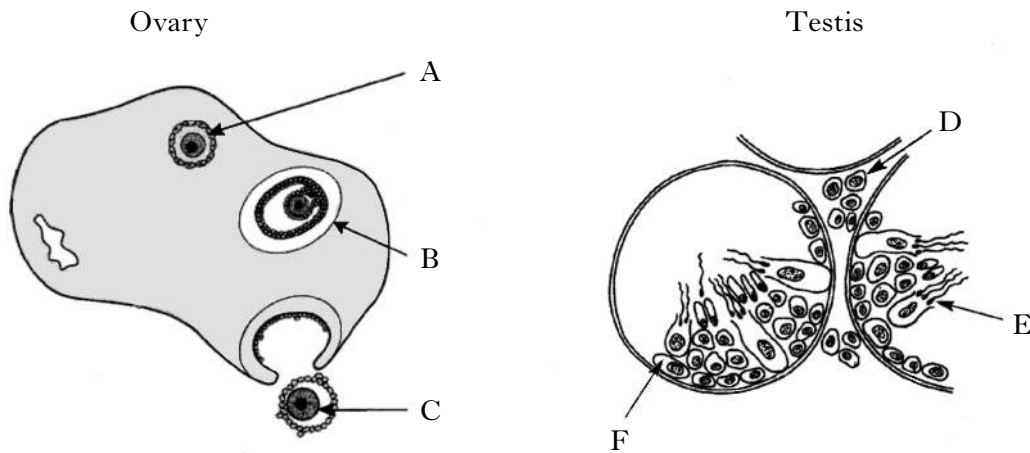
- (b) During an operation, individual 4 needed a blood transfusion.

Identify all the individuals in the family tree who could safely donate blood to her.

1

Marks

5. The diagrams represent gamete production in an ovary and part of a testis.



(a) (i) Which letter represents a mature ovum?

1

(ii) Identify **one** labelled part of each organ which is affected by FSH.

<i>Letter</i>	<i>Name</i>

2

(iii) Describe the effect of testosterone on the testes of an adult.

1

(b) Oxytocin is a hormone which is secreted during and after childbirth.

(i) State where oxytocin is produced in the body.

1

(ii) Synthetic oxytocin can be used to induce labour.

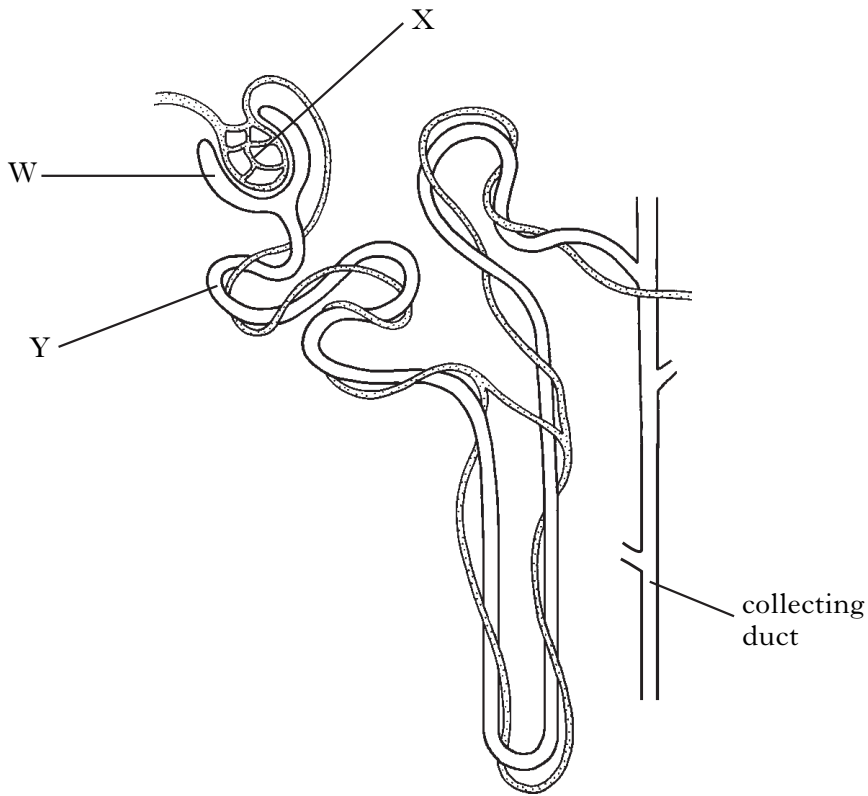
Describe how it brings about birth.

1

[Turn over

Marks

6. The diagram shows a kidney nephron.



(a) (i) Name structure W.

1

(ii) High blood pressure causes fluid to move from X to W.

Name this process and explain what causes the high blood pressure within X.

Process _____

1

Explanation _____

1

(b) (i) Name structure Y.

1

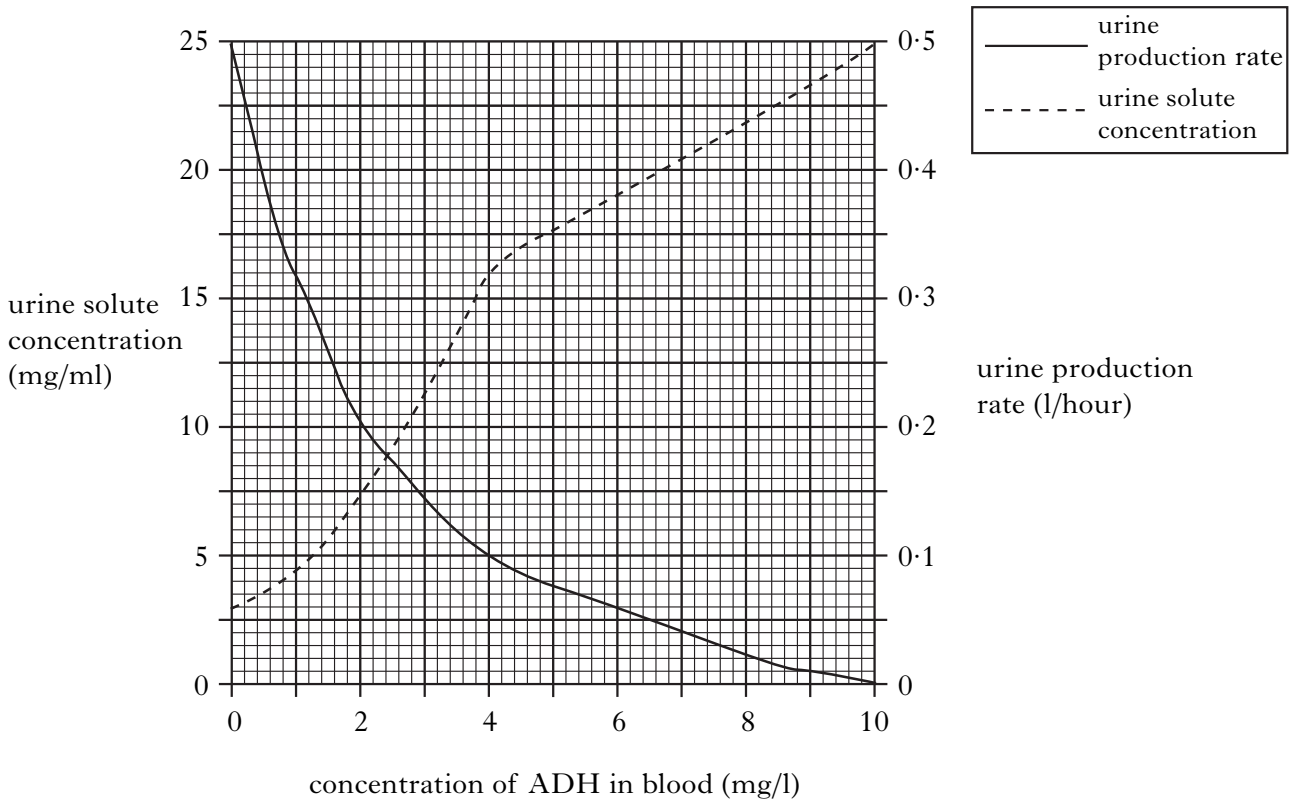
(ii) Describe the main process that occurs in structure Y.

1

6. (continued)

Marks

(c) The graph below shows how changes in the concentration of ADH in the blood affect the production rate and solute concentration of urine.



(i) Use the graph to describe two effects of increasing the concentration of ADH in the blood.

1 _____

 2 _____

1

(ii) What is the urine solute concentration when the ADH concentration in the blood is 6 mg/l?

1

(iii) What is the urine production rate when the urine solute concentration is 4 mg/ml?

_____ litres/hour

1

(iv) If the ADH concentration in the blood remains constant at 4 mg/l, calculate the mass of solute excreted in the urine in one hour.

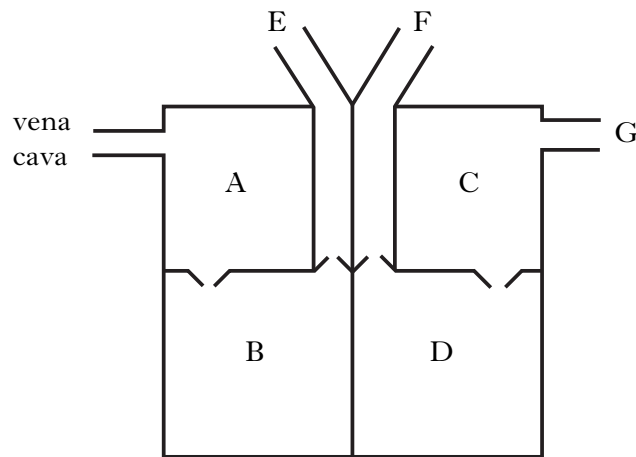
Space for calculation

_____ mg

1

Marks

7. (a) The diagram represents a section through the heart.



(i) Name blood vessels E and F.

Vessel E _____

Vessel F _____

1

(ii) State **two** differences between the composition of the blood in chambers B and D.

1 _____

2 _____

1

(iii) Place a cross (X) on the diagram to indicate the position of the sinoatrial node (SAN).

1

(iv) Describe the effect of the autonomic nervous system on the sinoatrial node (SAN).

2

(b) State the function of the coronary artery.

1

Marks

8. The table below contains information about diagnosed cases of diabetes in the four countries of the UK in 2008.

<i>Country</i>	<i>Population (million)</i>	<i>Individuals diagnosed with diabetes (% of population)</i>
England	51.3	3.9
Scotland	5.4	3.7
Wales	3.2	4.4
Northern Ireland	1.8	3.4
Total	61.7	

- (a) Use the data in the table to calculate the number of individuals in the Scottish population who had diabetes in 2008.

Space for calculation

_____ 1

- (b) A student calculated the percentage of the UK population that had been diagnosed with diabetes by averaging the percentage values in the table. Suggest why this average is likely to misrepresent the true percentage of people in the UK who have been diagnosed with diabetes.

_____ 1

- (c) It has been suggested that the number of people in the UK with diabetes will double by the year 2030.

Suggest **two** different ways in which the current UK government might use this information to plan for the future.

1 _____

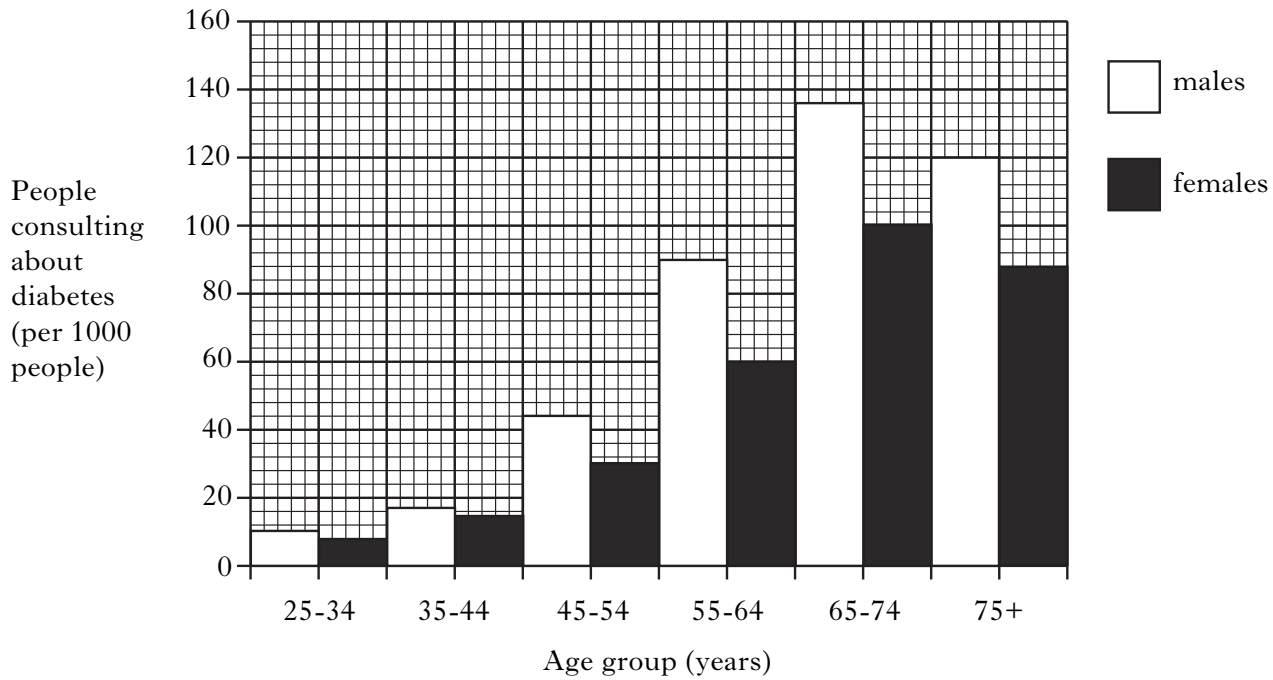
2 _____
_____ 1

[Turn over

Marks

8. (continued)

(d) The graph below contains information about the number of people in Scotland who consulted their doctor about diabetes in 2008.



(i) For people aged between 25 and 74 describe **one** trend shown by the graph which relates to

age _____

gender _____

1

(ii) In a Scottish city 2500 men between 45 and 54 years of age visited their doctor in 2008.

Use the graph to calculate how many of these men would be consulting their doctor about diabetes.

Space for calculation

1

(iii) Calculate the percentage decrease in the number of men consulting their doctor between the 65-74 age group and the 75+ age group.

Space for calculation

_____ %

1

Marks

8. (continued)

- (e) (i) Type 1 diabetics are unable to produce enough insulin.
Where is insulin produced in the body?

1

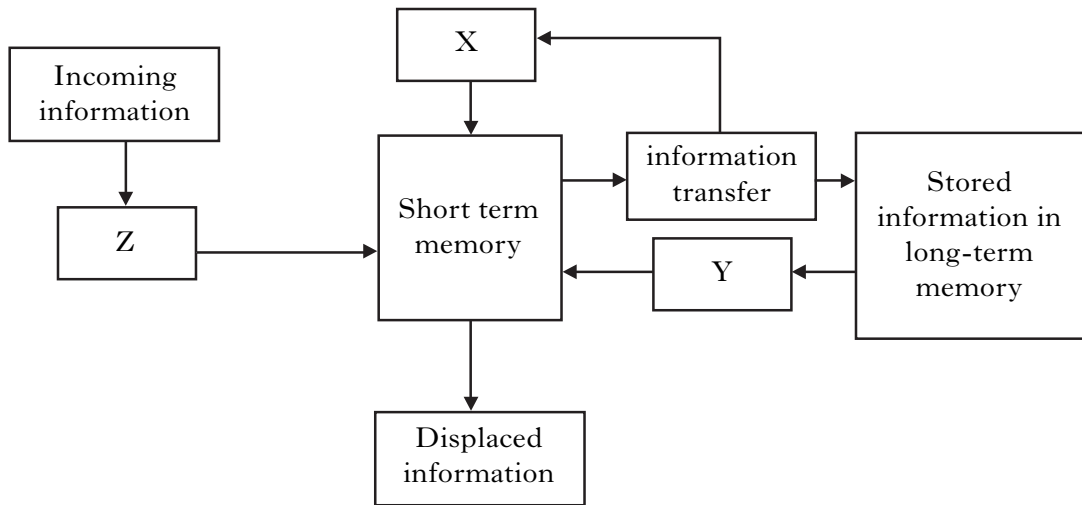
- (ii) Describe the role of insulin in the liver.

1

[Turn over

Marks

9. The diagram below represents the passage of information through memory.



(a) (i) Identify processes X, Y and Z.

X _____

Y _____

Z _____

2

(ii) State **two** forms of information which can enter short term memory.

1 _____

2 _____

1

(iii) Describe how contextual cues help recall from long-term memory.

1

(b) A student had to learn her SQA candidate number which contained 9 digits. She was advised to use chunking to help her memorise it.

Explain why the process of chunking would help her memorise this number.

1

Marks

9. (continued)

- (c) (i) Patients with Alzheimer's disease find it difficult to form new memories. Which part of the brain is affected by Alzheimer's disease?

1

- (ii) Name the receptor thought to be important in the process of memory storage.

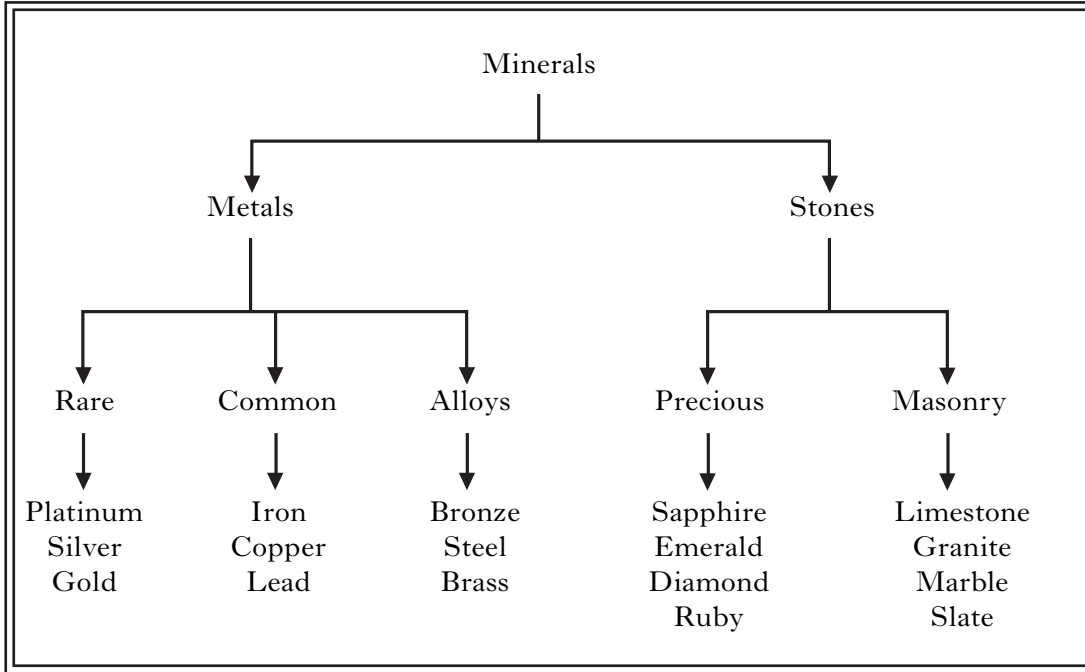
1

[Turn over

Marks

10. An investigation was carried out into the effects of organisation on improving the recall of information.

Four students were each asked to look at a card containing 25 words organised into a branching diagram. The card is shown below.



The card was removed after three minutes and each student had to write down as many words as he or she could recall. A score out of 25 was recorded for each student and these were added together to give a total score out of 100 for the group. The procedure was repeated twice. Each time the students were given cards containing 25 different words also organised into branching diagrams. Another group of four students took part in the control for this investigation. The words on their cards were not organised.

The results are shown in the table below.

Student Group	Total number of words recalled (out of 100)			
	1 st card	2 nd card	3 rd card	average
Experimental	75	78	72	
Control	53	57	55	

- (a) Complete the table by calculating the average number of words recalled by each student group.

Space for calculation

Marks

10. (continued)

(b) In what way would the content of the control cards be similar to the experimental cards? _____

different from the experimental cards? _____

1

(c) Suggest **two** variables, not already mentioned in the description of this investigation, which would have to be kept constant to ensure that a valid comparison could be made between the two groups.

1 _____

2 _____

2

(d) State a conclusion that can be drawn from the results.

1

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

1

(f) At the start of the investigation the students were told that the person in each group who recalled most words would be given a prize.

Why did the design of this investigation include a prize?

1

(g) In a further investigation into recall, students were given the same card to memorise on three successive occasions.

Predict what would happen to the number of words recalled on each successive attempt. Explain your prediction.

Prediction _____

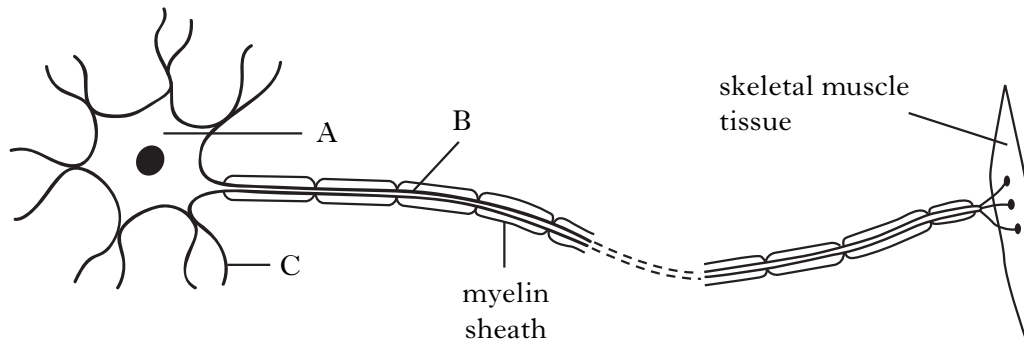
Explanation _____

1

[Turn over

Marks

11. The diagram below shows a motor neurone and its junction with skeletal muscle tissue.



- (a) Name the parts of the neurone labelled A, B and C on the diagram.

A _____

B _____

C _____

2

- (b) Neurotransmitters bind to receptors on skeletal muscle tissue triggering contraction.

- (i) Name **two** neurotransmitters.

1 _____

2 _____

1

- (ii) Explain why the release of neurotransmitter into a synaptic cleft may sometimes fail to trigger muscle contraction.

1

- (iii) Name the structural proteins in skeletal muscle tissue and describe how they interact to bring about muscle contraction.

Proteins _____

1

Description _____

1

Marks

11. (continued)

- (c) (i) State the importance of the myelin sheath in the transmission of impulses.

1

- (ii) Post-natal myelination is necessary for a child to go through the sequence of developmental stages leading to walking.

What term describes this sequence of developmental stages?

1

[Turn over

Marks

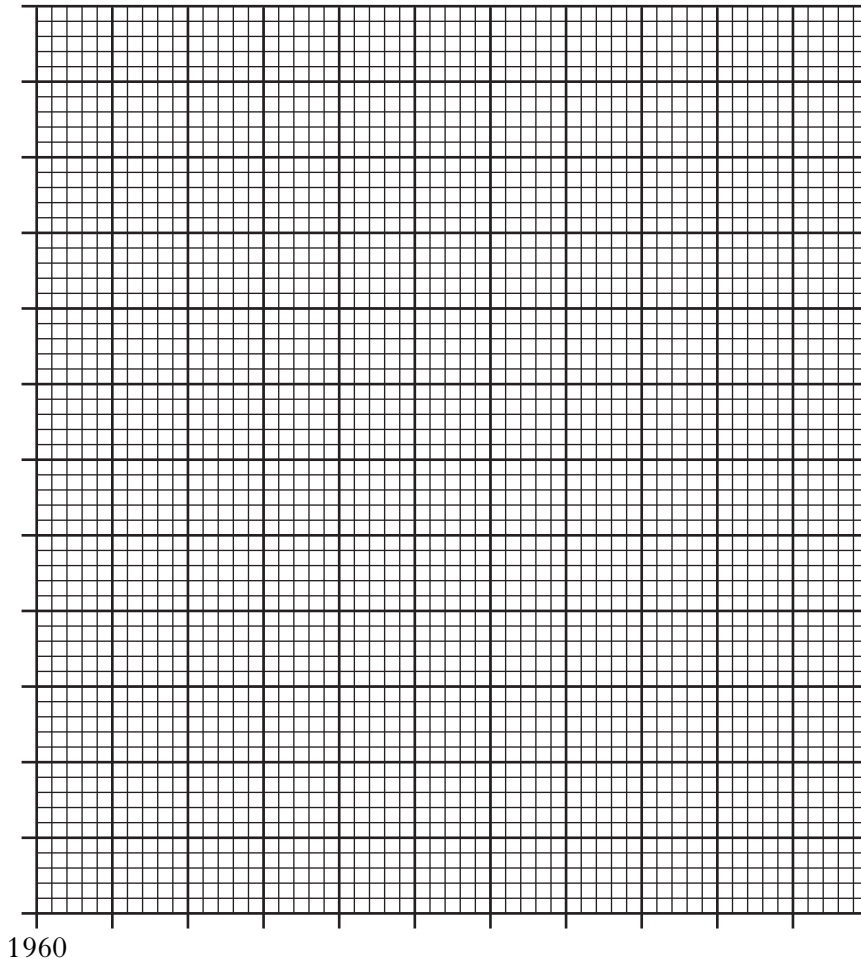
12. The table below shows the biomass of cod and herring stocks in the North Sea between 1967 and 2004.

The biomass figures are estimates of the total mass of each species present in the North Sea during that year. The critical biomass indicates the mass of each species that must be maintained to prevent it becoming endangered.

<i>Fish species</i>	<i>Estimated Biomass per year (thousand tonnes)</i>					<i>Critical biomass (thousand tonnes)</i>
	<i>1967</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>	<i>2004</i>	
Cod	235	170	75	50	45	150
Herring	920	130	1170	825	1890	1300

- (a) (i) Construct a line graph to illustrate the data for cod.

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



2

- (ii) For how many years between 1967 and 2004 was the cod endangered?

Space for calculation

_____ years

1

Marks

12. (continued)

- (b) (i) Calculate the percentage increase in the estimated biomass of herring between 1980 and 1990.

Space for calculation

1

- (ii) Suggest a reason for the increase in herring biomass between 1980 and 1990.

1

- (c) What term describes the maximum size of a population which can be sustained by a particular environment?

1

[Turn over for Section C on Page thirty

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 communication under the following headings:

- (i) the use of language; 4
(ii) non-verbal communication. 6

(10)

OR

B. Give an account of the environmental effects of an increasing human population under the following headings:

- (i) deforestation; 6
(ii) increasing atmospheric methane levels. 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 factors that affect enzyme activity. (10)

OR

B. Discuss the production and use of ATP in the body. (10)

[END OF QUESTION PAPER]

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SPACE FOR ANSWERS

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SPACE FOR ANSWERS

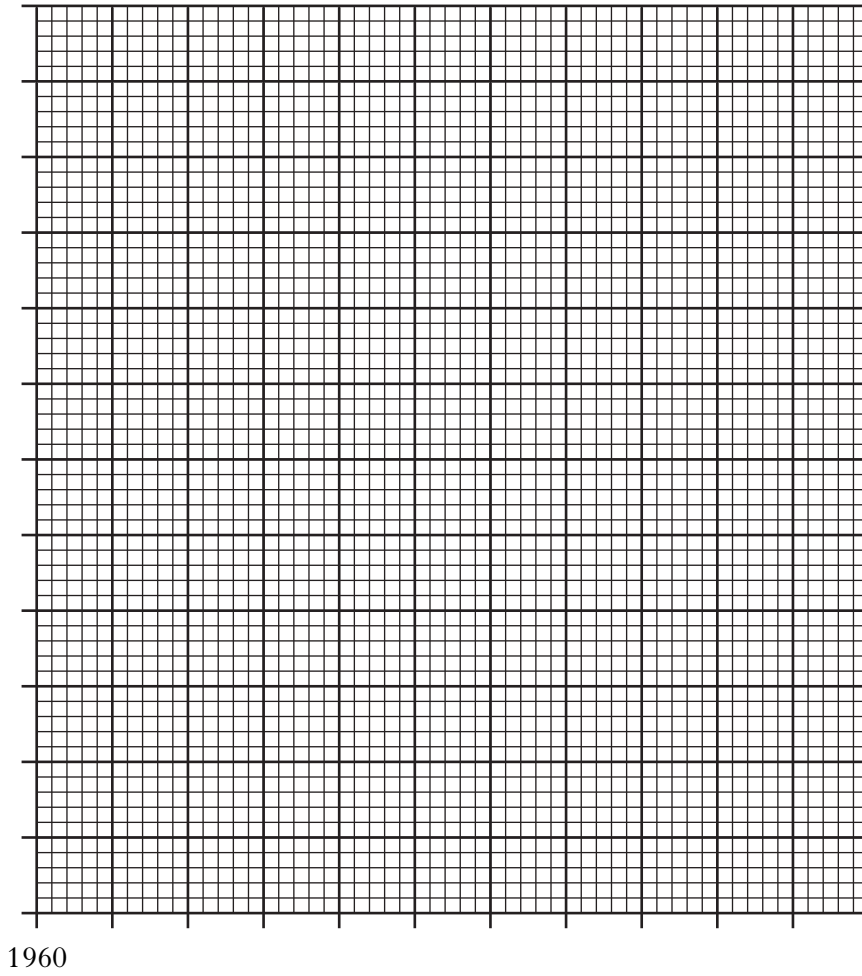
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ADDITIONAL GRAPH FOR QUESTION 12(a)(i)



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