

SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

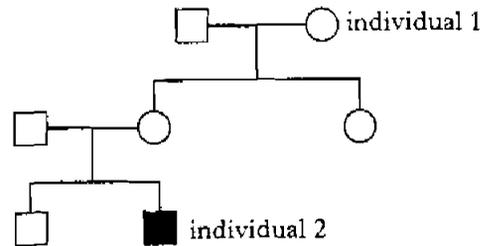
- In respiration, the sequence of reactions resulting in the conversion of glucose to pyruvic acid is called
 - the Krebs cycle
 - the citric acid cycle
 - glycolysis
 - the cytochrome chain.
- Which of the following is an insoluble polysaccharide?
 - Glycogen
 - Glucose
 - Sucrose
 - Maltose
- Which of the following is **not** a function of lipids?
 - Nerve insulation
 - Vitamin transport
 - Energy storage
 - Oxygen transport
- Which of the following processes requires infolding of the cell membrane?
 - Diffusion
 - Phagocytosis
 - Active transport
 - Osmosis
- The formation of new viruses involves the following stages:
 - X viral protein coats are synthesised
 - Y host cell metabolism is taken over by virus
 - Z viral nucleic acid is replicated.

The correct order in which these stages occur is

 - X → Z → Y
 - Y → X → Z
 - Z → X → Y
 - Y → Z → X.

- A sex-linked gene carried on the X-chromosome of a man will be transmitted to
 - 50% of his male children
 - 50% of his female children
 - 100% of his male children
 - 100% of his female children.
- The family tree shows the inheritance of red-green colour blindness in humans. Red-green colour blindness is a recessive, sex-linked condition.

- unaffected female
- affected female
- unaffected male
- affected male



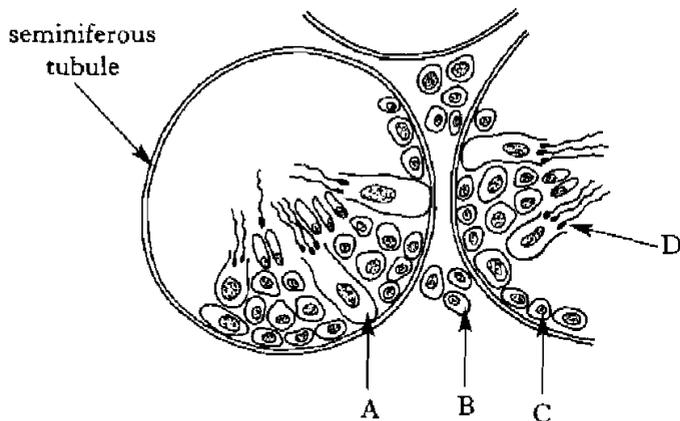
Which line in the table describes correctly the genotypes of individual 1 and individual 2?

	<i>Individual 1</i>	<i>Individual 2</i>
A	$X^R X^R$	$X^R Y$
B	$X^R X^r$	$X^R Y$
C	$X^r X^r$	$X^r Y$
D	$X^R X^r$	$X^r Y$

[Turn over

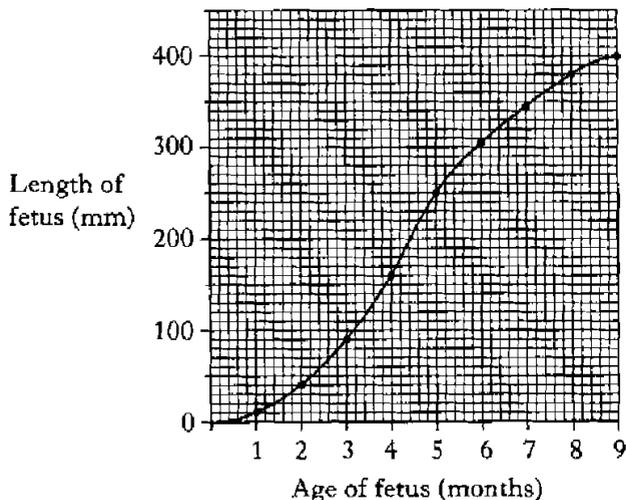
8. Which of the following describes the term non-disjunction?
- A The failure of chromosomes to separate at meiosis
 - B The independent assortment of chromosomes at meiosis
 - C The exchange of genetic information at chiasmata
 - D An error in the replication of DNA before cell division

9. The diagram below shows a cross-section of a testis.



Which cell can produce testosterone?

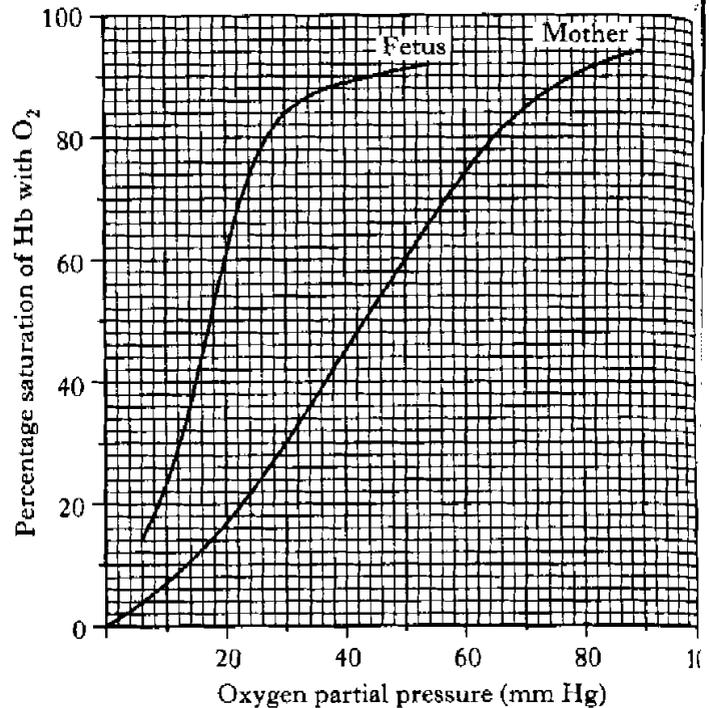
10. The graph below shows the growth, in length, of a human fetus before birth.



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

11. The graph below shows the dissociation curves for fetal and maternal haemoglobin.



What is the difference in percentage saturation of haemoglobin between the mother and the fetus at a partial pressure of 30 mm Hg?

- A 18
- B 19
- C 52
- D 54

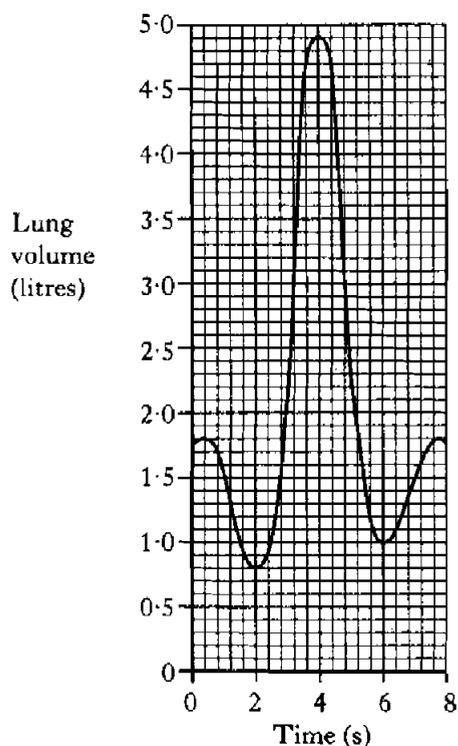
12. Which of the following are required for red blood cell production?

- A Iron and vitamin D
- B Calcium and vitamin B₁₂
- C Iron and vitamin B₁₂
- D Calcium and vitamin D

13. Colostrum provides a baby with

- A antibodies
- B antigens
- C phagocytes
- D lymphocytes.

14. The graph shows changes in lung volume during a breathing exercise.



What is the volume of air inhaled between 2 and 4 seconds?

- A 0.8 litres
 - B 3.9 litres
 - C 4.1 litres
 - D 4.9 litres
15. Which **two** blood vessels are involved in the transport of blood to and from the head?
- A Carotid artery and jugular vein
 - B Renal artery and pulmonary vein
 - C Aorta and renal vein
 - D Hepatic artery and jugular vein

16. The table below shows the relative concentrations of certain substances in blood vessels leading to and from the liver.

(+++ = high, ++ = moderate, + = low)

Blood vessel	Oxygen	Carbon dioxide	Urea	Amino acids
1	+++	+	+	+
2	+	+++	+	+++
3	+	+++	+++	+

Which line of the table below identifies correctly the blood vessels?

	Hepatic vein	Hepatic portal vein	Hepatic artery
A	1	2	3
B	2	3	1
C	3	2	1
D	3	1	2

17. Which line of the table identifies correctly the hormones which stimulate the inter-conversion of glucose and glycogen?

	glucose → glycogen	glycogen → glucose
A	insulin	glucagon and adrenaline
B	glucagon and insulin	adrenaline
C	adrenaline and glucagon	insulin
D	adrenaline	glucagon and insulin

[Turn over

18. Which of the following shows the substance from which urea is produced and the site of urea production?

	<i>Substance</i>	<i>Site of production</i>
A	amino acid	liver
B	amino acid	kidney
C	glycogen	liver
D	glycogen	kidney

19. What is the function of the glomerulus in the production of urine?

- A Collection of filtrate
- B Filtration of blood
- C Reabsorption of glucose
- D Osmoregulation

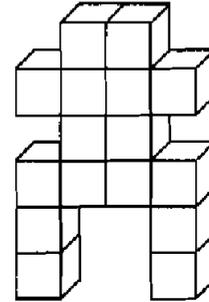
20. The concentration of urea in plasma and urine is given in the table below.

	<i>Plasma</i>	<i>Urine</i>
Urea (g/100 cm ³)	0.3	1.29

By how many times has the urea been concentrated by the activity of the kidney?

- A 0.23 times
- B 0.39 times
- C 4.3 times
- D 43 times

21. The diagram below shows a body shape made up of cubes.



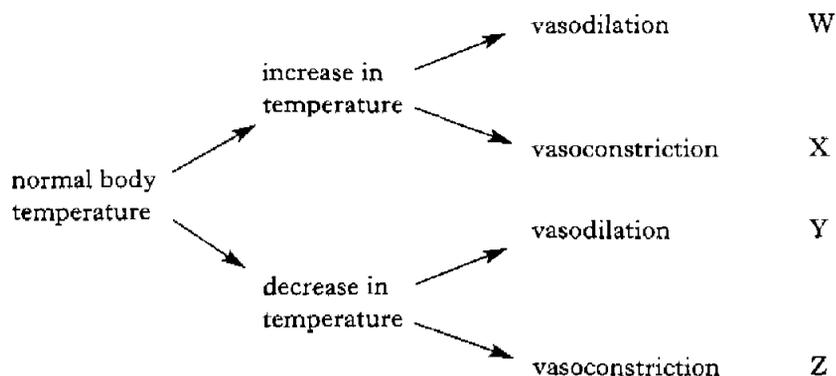
The surface area to volume ratio of this body is

- A 4 : 1
- B 6 : 1
- C 15 : 4
- D 29 : 8

22. The temperature monitoring centre of the brain is in the

- A medulla oblongata
- B cerebellum
- C pituitary gland
- D hypothalamus.

23. The diagram below shows the body's response to temperature change.



Which letters indicate negative feedback control of body temperature?

- A W and Y
- B W and Z
- C X and Y
- D X and Z

24. The peripheral nervous system contains the

- A brain and spinal cord
- B brain and somatic system
- C spinal cord and autonomic system
- D somatic system and autonomic system.

25. An investigation was carried out to determine how long it takes a student to learn the pathway through a finger maze. The student was allowed to complete the maze ten times. Which of the following pairs of factors would have to be kept the same each time?

- A The time taken to complete the maze and the shape of the maze
- B The number of errors made and the finger used
- C The finger used and the shape of the maze
- D The time taken to complete the maze and the finger used

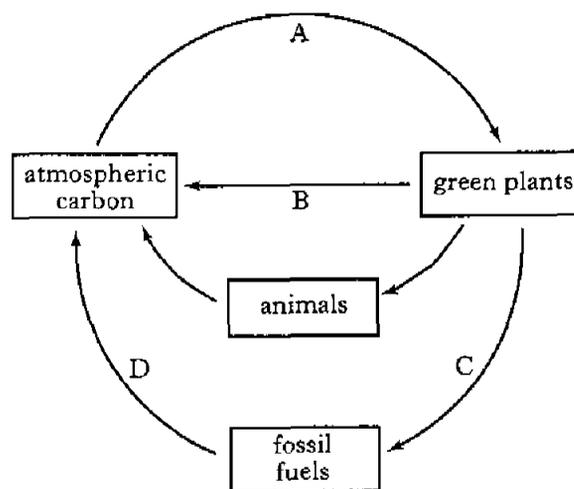
26. Which of the following best describes social facilitation?

- A Improved performance in the presence of others
- B Deindividuation in competitive situations
- C Discrimination behaviour shown by groups of individuals
- D Shaping behaviour as seen in trial and error learning

27. Why do humans have a long period of dependency?

- A To allow for learning and the development of language
- B To allow bonding to take place between mother and child
- C To allow for the learning of motor and sensory skills
- D To allow for the growth of the brain and other major body organs

28. The diagram below shows the carbon cycle.



Which letter represents respiration?

[Turn over

29. In the nitrogen cycle, which of the following processes is carried out by nitrifying bacteria?

The conversion of

- A nitrate to ammonia
- B ammonia to nitrate
- C nitrogen gas to ammonia
- D nitrogen gas to nitrate.

30. An algal bloom in a loch may result from

- A lack of oxygen
- B lack of sunlight
- C excess phosphates
- D excess herbicide.

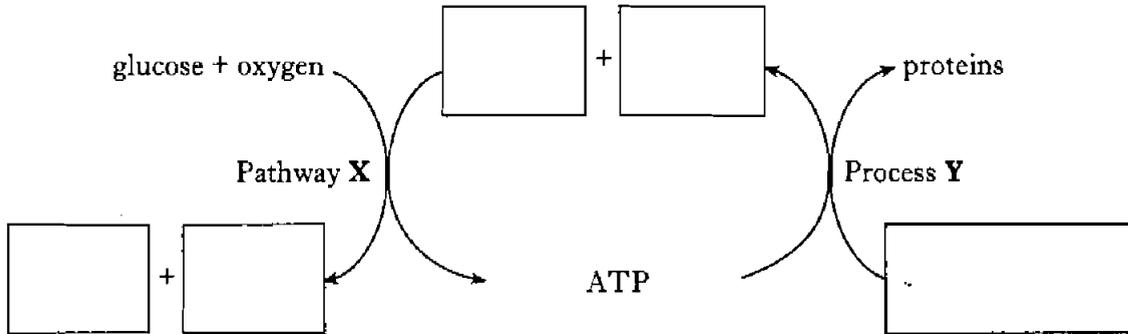
Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of this answer booklet.

SECTION B

Marks

All questions in this section should be attempted.

1. The diagram shows the role of ATP in cell metabolism.



(a) Complete the diagram by entering the names of the appropriate substances. 3

(b) (i) Name **one** stage of pathway **X** and state where it occurs in the cell.

Stage _____ Location _____ 1

(ii) Name the organelle where process **Y** occurs.

_____ 1

(c) Describe **two** ways in which the diagram would be different under anaerobic conditions.

1 _____

2 _____
_____ 2

(d) Name a respiratory substrate other than glucose.

_____ 1

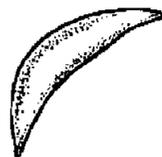
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Marks

2. Sickle-cell anaemia is a blood disorder in which haemoglobin is malformed. The diagram below shows the effect of this disorder on a red blood cell.



Normal red blood cell



Sickled red blood cell

The condition is not sex-linked. The allele for normal haemoglobin (**H**) is incompletely dominant to the sickle-cell allele (**h**).

Heterozygous individuals are mildly affected, whereas those with genotype **hh** are severely affected.

Two mildly affected parents have two children who are mildly affected like their parents. The parents are expecting a third child.

- (a) Complete the Punnett square to show the possible genotypes of this child.

2

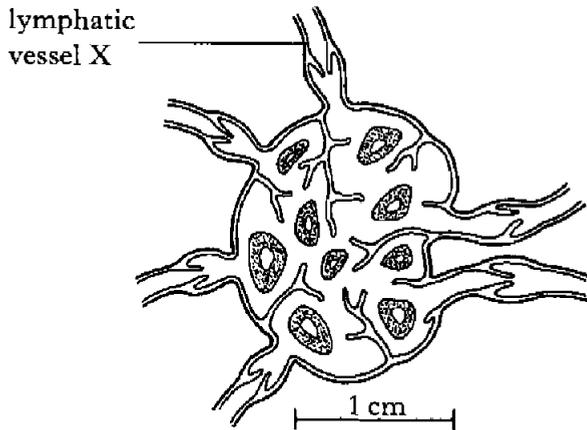
- (b) From the Punnett square calculate the percentage chance of the child being

- 1 unaffected _____
- 2 mildly affected _____
- 3 severely affected. _____

1

3. The diagram below shows a section through a lymph node.

Marks



(a) Complete the table to name the cells found in the node, and to describe their functions.

Type of cell	Secretion of antibodies (yes/no)	Type of response
B-lymphocyte		
	no	cell-mediated response
		non-specific response

3

(b) Add an arrow to the diagram to indicate the direction of flow of lymph in vessel X. Give a reason for your choice.

Reason _____

1

(c) Describe **one** way in which the composition of lymph differs from plasma.

1

(d) What eventually happens to the lymph after it leaves the gland?

1

(e) Describe **one** function of the lymphatic system, apart from protecting the body from infection.

1

4. An investigation was carried out into the effect of caffeine on blood pressure, using coffee as the source of caffeine.

Marks

The systolic and diastolic blood pressures of six students were measured using a digital sphygmomanometer. Each student was then given a cup of coffee to drink. After one hour their blood pressure was measured again.

The results are shown in the table below.

<i>Student</i>	<i>Initial blood pressure (mmHg)</i>	<i>Final blood pressure (mmHg)</i>
1	120/75	134/82
2	127/79	145/88
3	118/70	124/72
4	134/81	143/83
5	122/73	133/77
6	129/84	137/90
<i>Average</i>	<i>125/77</i>	

- (a) Calculate the average final blood pressure and write your answer in the table above.

Space for calculation

1

- (b) What conclusion can be drawn from these results?

1

- (c) Describe an appropriate control for this investigation.

1

- (d) Apart from leaving one hour between readings, list **two** other variables which would need to be kept constant during this investigation.

1 _____

2 _____

1

4. (continued)

Marks

(e) What is meant by systolic and diastolic blood pressure?

Systolic _____

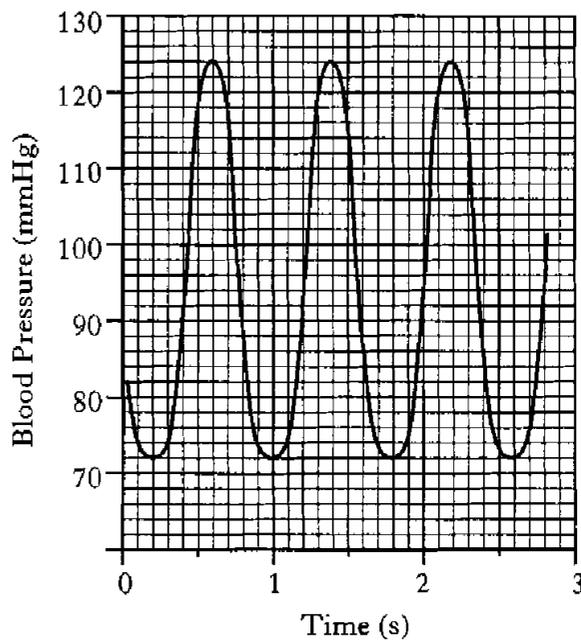
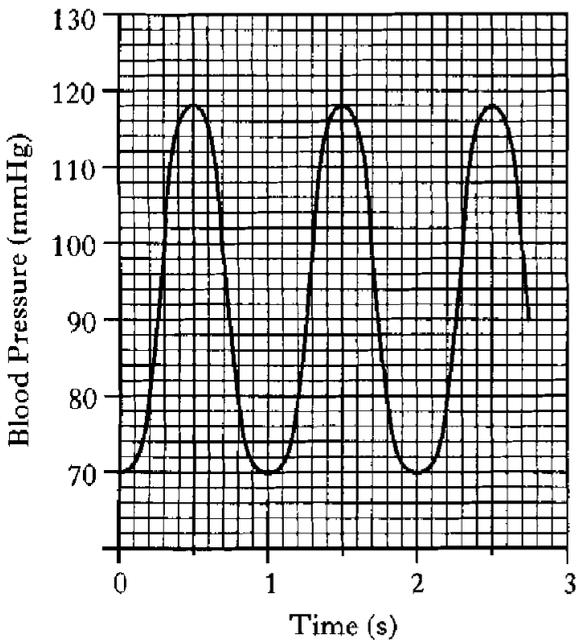
Diastolic _____

2

(f) The graphs below show initial and final blood pressures of one of the students.

Graph 1 Initial Blood Pressure

Graph 2 Final Blood Pressure



(i) Use the information in the table and the graphs to identify the student.

Student number _____

1

(ii) Calculate the increase in the pulse rate of this student over the period of the investigation.

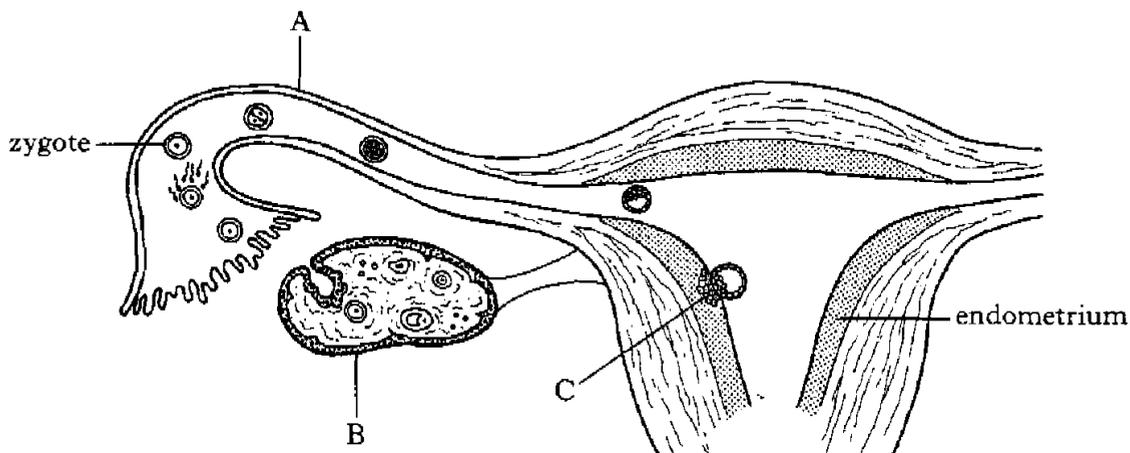
Space for calculation

_____ bpm 1

[Turn over

5. The diagram shows stages in the development of a human embryo from fertilisation to implantation.

Marks



- (a) Name the parts labelled **A** and **B**.

A _____ B _____ 1

- (b) What term is used to describe the first few divisions of the zygote?

_____ 1

- (c) Name a hormone which is involved in preparing the endometrium for implantation and state where it is produced.

Hormone _____ Produced by _____ 1

- (d) What organ will develop from the tissue labelled **C**?

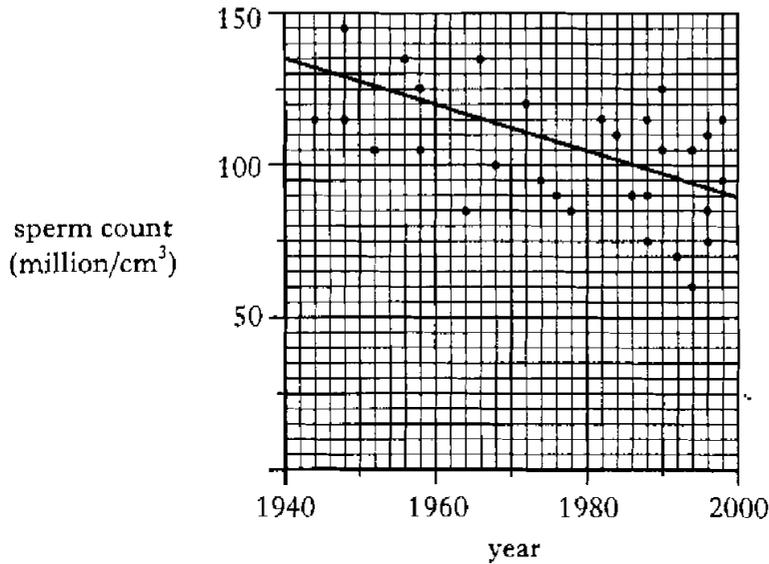
_____ 1

- (e) Sometimes twins develop in the uterus. Distinguish between the formation of monozygotic and dizygotic twins.

_____ 3

Marks

6. The sperm counts of 30 men taken between 1940 and 2000 are shown in the graph below. A line of best-fit has been drawn, to indicate the trend over the 60-year period.



- (a) Using the line of best-fit, calculate the percentage decline in sperm count over the 60-year period.

Space for calculation

_____ % 1

- (b) From the graph, what is the maximum sperm count for any one individual recorded during this period?

_____ million/cm³ 1

- (c) Some insecticides are thought to influence sperm production. Explain why animals at the end of food chains are more likely to be affected by insecticides.

1

- (d) Name the pituitary hormone which stimulates the production of sperm.

1

[Turn over

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MARGIN

6. (continued)

Marks

- (e) Name a gland which adds fluid to sperm during ejaculation and describe **one** function of this fluid.

Gland _____

1

Function of fluid _____

1

- (f) Two treatments sometimes used for infertility are artificial insemination and *in vitro* fertilisation. Describe briefly what is meant by these terms.

artificial insemination _____

in vitro fertilisation _____

2

Marks

7. The Rhesus blood group system is determined by three pairs of alleles: **Cc**, **Dd** and **Ee**. However, only the **D** allele is important in blood transfusion and pregnancy. People with the dominant allele **D** are Rhesus positive and those with genotype **dd** are Rhesus negative.

(a) What term is used to describe characteristics controlled by many pairs of alleles?

1

(b) Name another blood group system which has to be matched for blood transfusion to be successful.

1

(c) What part of a cell carries the Rhesus antigen?

1

(d) A Rhesus negative woman and a Rhesus positive man are planning to have a child. They consult a genetics counsellor to find out whether their child is likely to be Rhesus positive or Rhesus negative.

What genetic information could they be given?

2

(e) Describe a treatment which can be used to protect a child at risk from the Rhesus reaction.

1

[Turn over

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MARGIN

8. The table below gives data on kidney transplants for the UK in the year 2001.

Marks

<i>Category of patient</i>	<i>Number</i>
On waiting list at beginning of 2001	6052
Received transplants during the year	
Removed from the list during the year	293
Died during the year	203
Added to the list during the year	1921
On waiting list at end of 2001	6241

(a) Complete the table by calculating the number of patients who received a transplant during the year 2001.

Space for calculation

1

(b) Assuming the same trend for the year 2002, predict the number of patients on the waiting list at the end of that year.

Space for calculation

1

(c) Drugs which suppress the immune system are given to transplant patients. Explain how this treatment reduces the chance of rejection of the transplanted kidney.

2

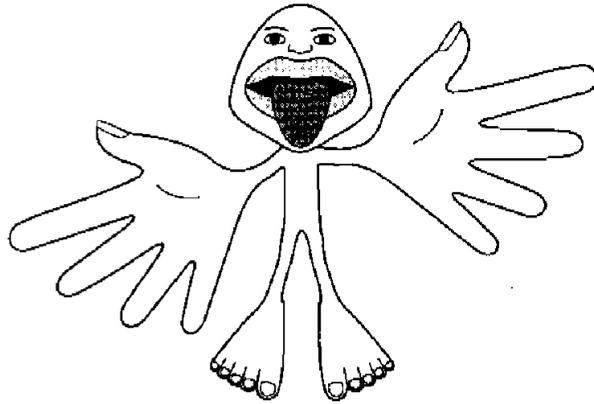
(d) Name the **two** blood vessels which would have to be cut and reconnected during a kidney operation.

_____ and _____

1

Marks

9. The diagram below is of a motor homunculus which represents the relative sizes of parts of the brain associated with motor control.



- (a) In which part of the brain is the motor area located?

1

- (b) What is the function of the motor area of the brain?

1

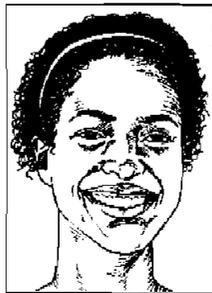
- (c) Explain why the hands have such a large area of the brain devoted to their control in comparison to the feet.

1

- (d) What type of neural pathway is used to co-ordinate movements of the fingers?

1

- (e) Three facial expressions are shown below.

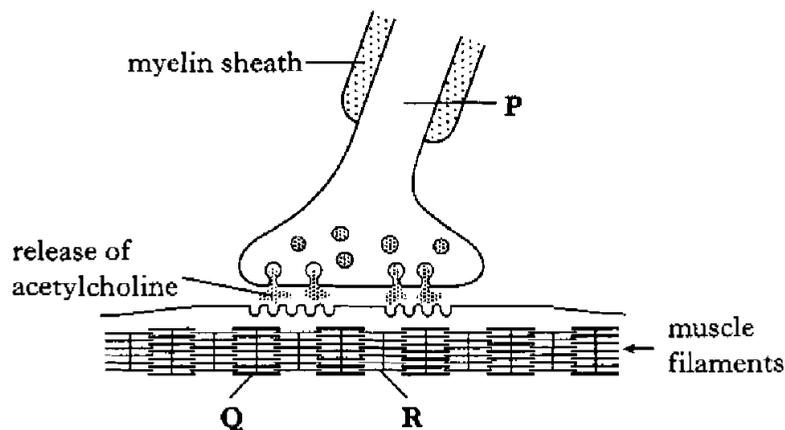


What term describes this type of communication?

1

10. The diagram shows a neuromuscular junction.

Marks



(a) Name the part of the nerve cell labelled **P**.

1

(b) (i) What kind of substance is acetylcholine?

1

(ii) What triggers the release of acetylcholine?

1

(iii) State what happens to acetylcholine after it has acted on the muscle.

1

(c) Name the **two** muscle proteins labelled **Q** and **R**.

Q _____ **R** _____

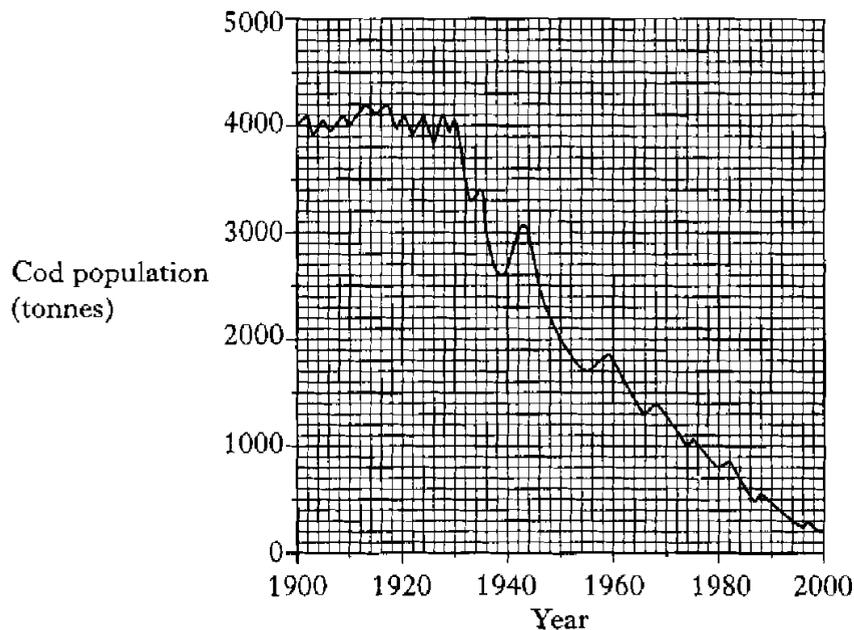
1

(d) Describe what happens to these protein filaments when a muscle contracts.

1

11. Cod have been caught off the coast of Scotland for many years. The graph below shows the estimated population of cod in an area of the North Sea over the last hundred years.

Marks



- (a) Between the years 1900 and 1930 this area of the North Sea was at its carrying capacity for the cod population.

Explain what is meant by the term "carrying capacity".

1

- (b) (i) Express, as a simple whole number ratio, the size of the cod population in 1950 to its size in 2000.

Space for calculation

_____ : _____

1

- (ii) Suggest **two** reasons for the decline of the cod population over the last 50 years.

1 _____

2 _____

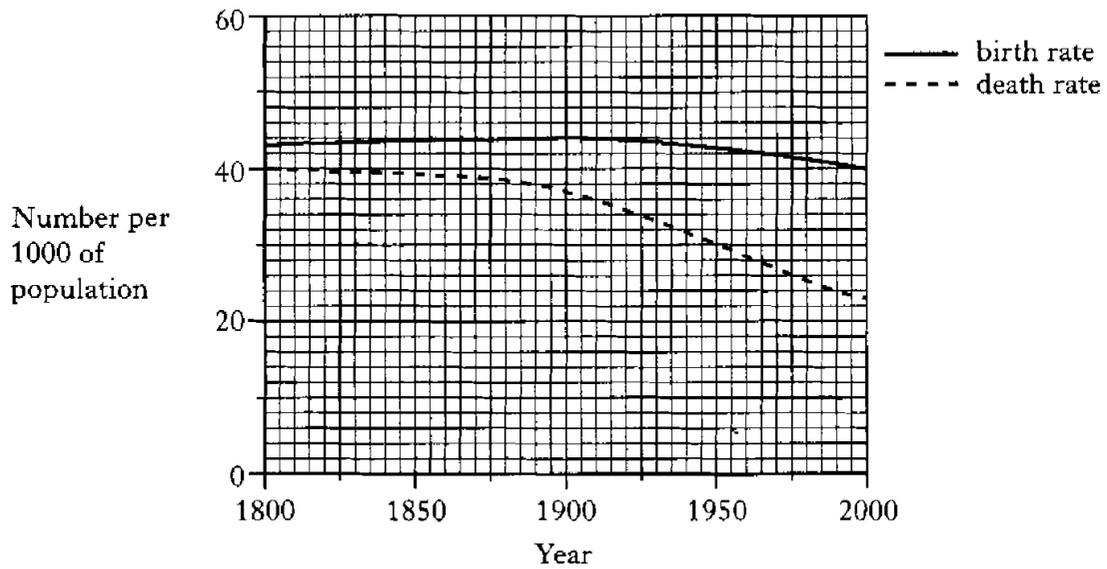
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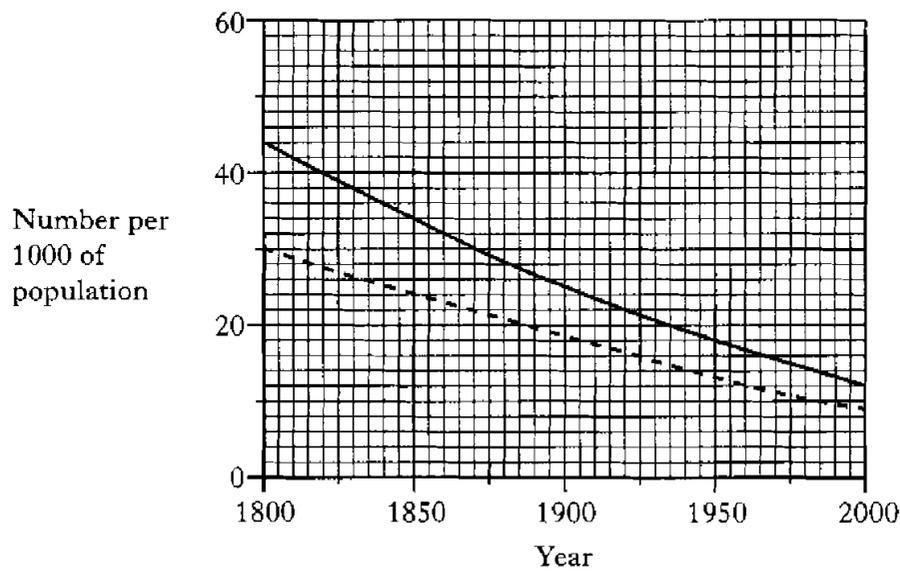
12. The graphs show the changes in birth and death rates of two countries **A** and **B**.

Marks

Country A



Country B



(a) (i) State the birth rate and death rate in country **A** in the year 1900.

Birth rate _____ Death rate _____ number per 1000 1

(ii) Suggest **one** reason for the decline in birth rate of country **A** over the last fifty years.

 _____ 1

(iii) Suggest **one** reason for the decline in death rate of country **A** over the last fifty years.

 _____ 1

12. (continued)

Marks

(b) Is the population of country **B** increasing or decreasing over the period of time shown?

Give a reason for your answer.

Change _____

Reason _____

1

(c) Which of the **two** countries is likely to be a developing country?

Give a reason for your answer.

Country _____

Reason _____

1

[Turn over

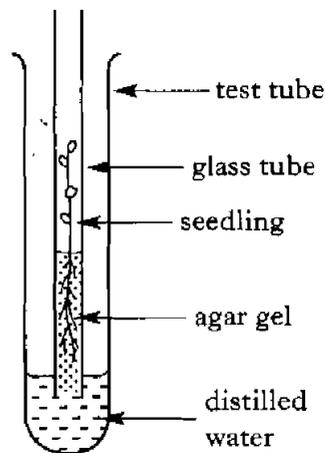
13. An investigation was carried out into the effect of lack of nitrates on the growth of cress seedlings. Two equal batches of seeds were grown in agar gel containing: Marks

- A all necessary mineral salts
- B all mineral salts except nitrate.

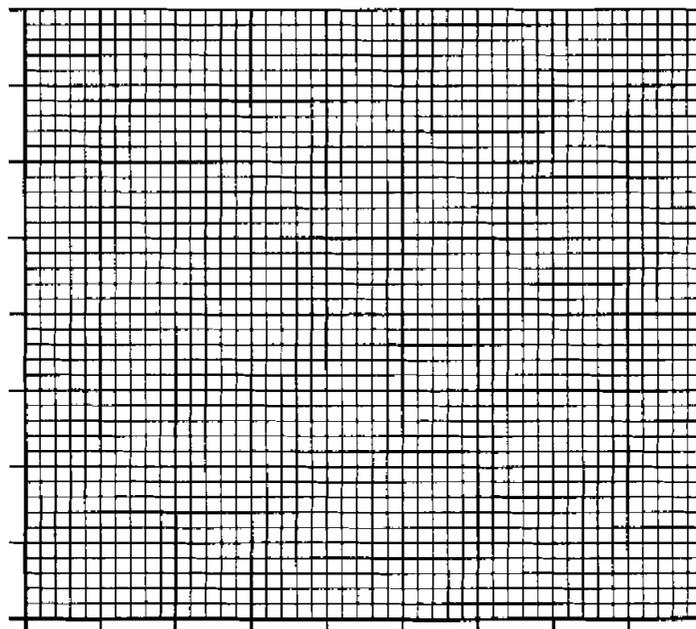
Each seed was placed on the surface of the agar in a glass tube as shown in the diagram below.

The heights of the seedlings were measured every day for eight days and the results are shown in the table.

Day	Average height of seedlings in gel A (mm)	Average height of seedlings in gel B (mm)
0	0	0
1	1	1
2	3	3
3	6	4
4	9	5
5	13	6
6	18	7
7	23	8
8	29	8



- (a) Construct a line graph to illustrate the data in the table.
(Additional graph paper, if required, can be found on page 32.)



3

- (b) State **one** conclusion which can be drawn from these results.

1

13. (continued)

Marks

(c) Identify the control and explain your choice.

Control _____

Explanation _____

1

(d) What feature of this investigation makes the results reliable?

1

(e) Suggest why distilled water is used in the test-tube rather than tap water.

1

(f) Phosphates are also necessary for good plant growth. Name **one** compound, other than ADP and ATP, which contains phosphate.

1

[Turn over

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 memory under the following headings:

- (i) short term memory; 4
- (ii) methods of transfer to long term memory. 6

(10)

OR

B. Describe ways in which food production has been increased in the last fifty years under the following headings:

- (i) land use; 4
- (ii) the use of chemicals. 6

(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 the events in meiosis which give rise to variation in gametes. (10)

OR

B. Describe how proteins are assembled from the code on a mRNA strand. (10)

[END OF QUESTION PAPER]