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Total

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X009/301

NATIONAL
QUALIFICATIONS
2000

MONDAY, 29 MAY
9.00 AM – 11.30 AM

HUMAN BIOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

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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.

SECTIONS B AND C

- 1 (a) All questions should be attempted.
(b) Question 11 is on pages 20, 21 and 22 and Question 12 is on pages 23, 24 and 25—pages 22 and 23 are fold-out pages.
(c) 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 and rough work 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.
- 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.

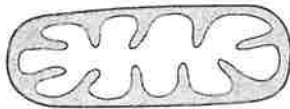


SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. What is the name of the cell structure shown in the diagram below?



- A Golgi body
 B Mitochondrion
 C Lysosome
 D Ribosome
2. Which of the following tissues is rich in both actin and myosin?
 A Muscle tissue
 B Liver tissue
 C Nerve tissue
 D Adipose tissue
3. Endocytosis is best described as
 A the uptake of a substance by a cell by active transport
 B the export of a substance through a cell membrane
 C the uptake of a substance in a vesicle formed by the cell membrane
 D the diffusion of a substance along a concentration gradient.
4. The specificity of an enzyme is determined by the
 A presence of an inhibitor
 B substrate concentration
 C state of equilibrium of the reaction
 D molecular structures of substrate and enzyme.
5. Which of the following cells secrete antibodies?
 A Bacteria
 B Macrophages
 C T lymphocytes
 D B lymphocytes

6. The table refers to the mass of DNA in certain human body cells.

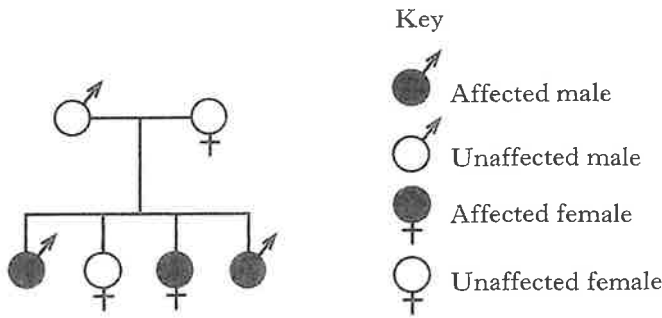
Cell type	Mass of DNA in cell [$\times 10^{-12}$ g]
liver	6.6
lung	6.6
P	3.3
Q	0.0

Which of the following is the most likely identification of cell types P and Q?

	P	Q
A	kidney tubule cell	ovum
B	ovum	mature red blood cell
C	mature red blood cell	sperm
D	nerve cell	mature red blood cell

7. The mRNA codon for the amino acid threonine is ACU. What is the corresponding anti-codon?
 A ACT
 B UCT
 C UGA
 D TGA
8. 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.

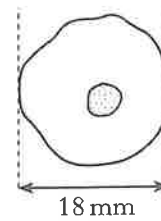
9. The transmission of a gene for deafness is shown in the family tree below.



This condition is controlled by an allele which is

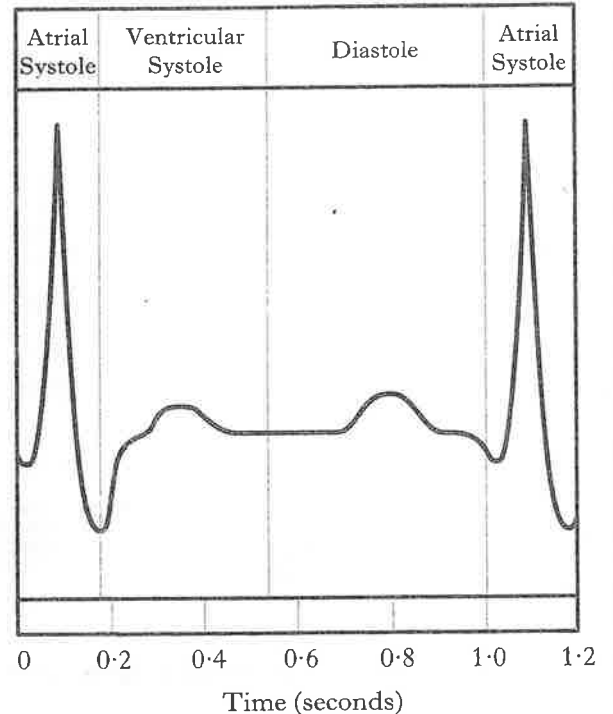
- A dominant and not sex-linked
 B recessive and not sex-linked
 C dominant and sex-linked
 D recessive and sex-linked.
10. Red-green colour blindness is a sex-linked recessive trait. A woman whose father is colour blind marries a man with normal vision. If they have a daughter, what are the chances she will be colour blind?
- A 0%
 B 25%
 C 33%
 D 50%
11. Identical twins can result from
- A two haploid eggs fertilised by two identical sperm
 B a haploid egg fertilised by two identical sperm
 C a diploid egg fertilised by a single sperm
 D a haploid egg fertilised by a single sperm.
12. In a normal individual, which of the following gametes cannot be formed?
- A A sperm with an X chromosome
 B A sperm with a Y chromosome
 C An egg with an X chromosome
 D An egg with a Y chromosome

13. The cell shown is magnified three hundred times. What is the actual size of the cell?



- A $6 \mu\text{m}$
 B $60 \mu\text{m}$
 C $54 \mu\text{m}$
 D $540 \mu\text{m}$

14. The diagram below records the beat of a human heart.



What is the heart rate in beats per minute (bpm)?

- A 50 bpm
 B 60 bpm
 C 70 bpm
 D 120 bpm

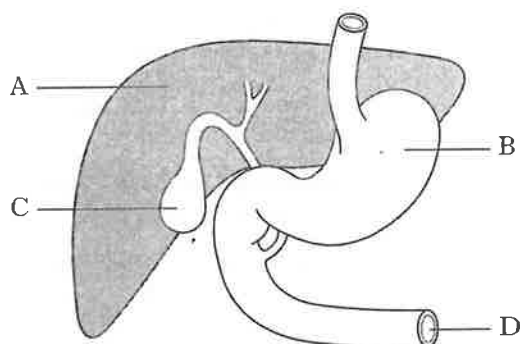
15. Which of the events below produces the normal sounds of heart beat heard through a stethoscope?

- A Contraction of the atria
- B Contraction of the ventricles
- C Closing of the heart valves
- D Opening of the heart valves

16. A woman with blood group *AB* has a child to a man with blood group *O*. What are the possible phenotypes of the child?

- A *AB* or *O*
- B *A* or *B*
- C *AB* only
- D *AB*, *A* or *B*

17. The diagram below shows certain organs found in the abdomen.



Where is bile active?

18. Which of the following correctly describes the flow of blood in the blood vessels associated with the liver?

	<i>Hepatic vein</i>	<i>Hepatic artery</i>	<i>Hepatic portal vein</i>
A	from liver	to liver	from gut
B	from liver	to gut	from gut
C	to liver	from liver	to gut
D	to liver	to gut	from liver

19. Which of the following pairs of compounds is produced by the pancreas?

- A Glycogen and insulin
- B Insulin and ADH
- C Insulin and glucagon
- D Glycogen and glucagon

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

	<i>Plasma</i>	<i>Urine</i>
Urea [g/100 cm ³]	0.2	1.26

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

- A 0.252 times
- B 1.28 times
- C 6.3 times
- D 63.0 times

21. Which of the following hormones is released by the pituitary gland?

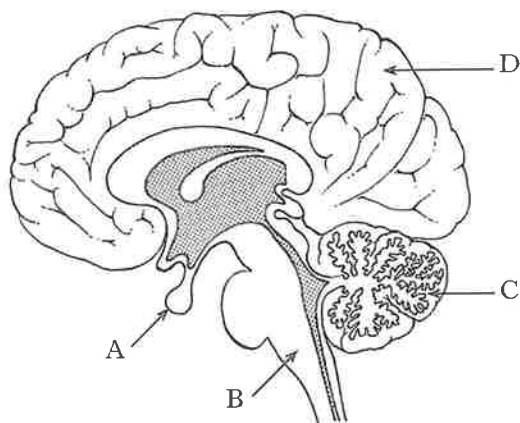
- A Insulin
- B Adrenaline
- C Oestrogen
- D Antidiuretic hormone

22. 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.

[Turn over

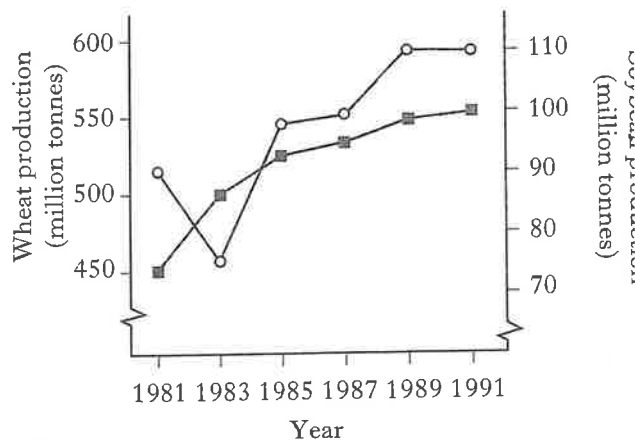
23. The diagram below shows a section through a brain.



Which letter indicates the part of the brain which controls reflex actions?

24. The transformation of information into a form that the memory can accept is called
- A encoding
 - B shaping
 - C rehearsal
 - D storage.
25. The rewarding of patterns of behaviour which approximate to desired behaviour is called
- A generalisation
 - B discrimination
 - C shaping
 - D imitation.

26. The world production of wheat and soybean between 1981 and 1991 is shown on the graph below.



Key

- Wheat production
- Soybean production

Which of the following statements relating to the data is correct?

- A Wheat production is 5 times greater than soybean production in 1991.
 - B Soybean production is 10% greater than wheat production in 1991.
 - C Wheat production is 10% less than soybean production in 1981.
 - D Soybean production is greater than wheat production in 1981 and 1991.
27. A country has a population of 50 million. What is the likely increase in population over a two year period, given a growth rate of 1% per annum?
- A 1 000 000
 - B 1 005 000
 - C 1 050 000
 - D 2 000 000
28. Which two gases contribute most to global warming?
- A Oxygen and carbon dioxide
 - B Ozone and carbon dioxide
 - C Methane and ozone
 - D Methane and carbon dioxide

29. Which of the following processes results in the addition of carbon dioxide to the atmosphere?

- A Decomposition
- B Photosynthesis
- C Ozone depletion
- D Nitrogen fixation

30. Rivers polluted by raw sewage have low oxygen concentrations as a direct result of

- A large numbers of bacteria
- B algal blooms
- C fertiliser run-off
- D low nutrient levels.

Candidates are reminded that the answer sheet **MUST** be returned **INSIDE** this answer book.

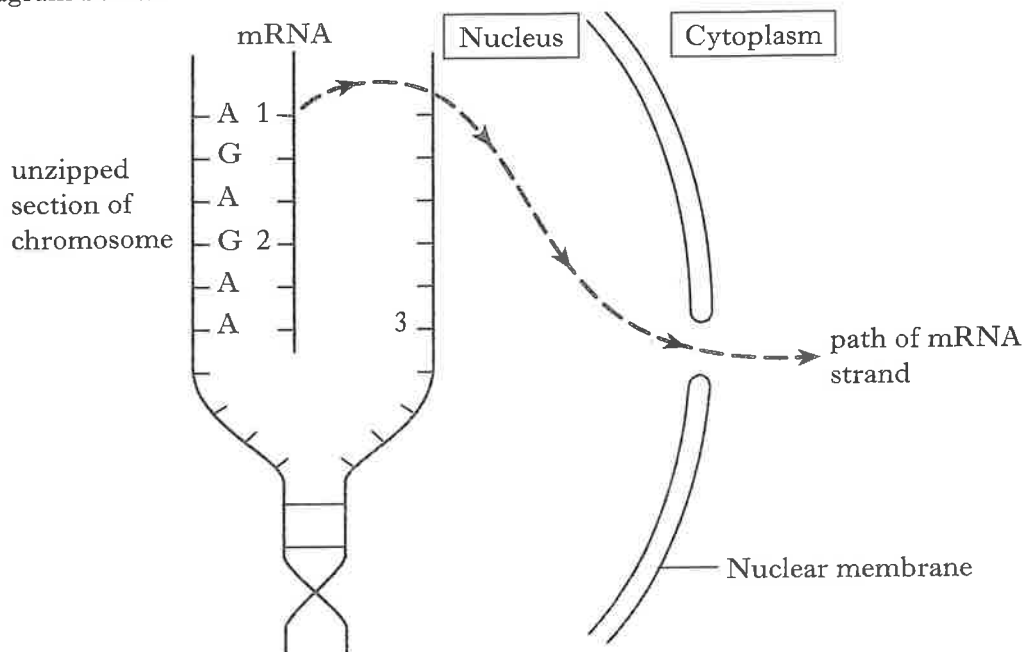
[Turn over for Section B on *Page eight*]

SECTION B

Marks

All questions in this section should be attempted.

1. The formation of a mRNA strand on a section of a chromosome is shown in the diagram below.



- (a) Give the names of bases 1, 2 and 3.

1 _____ 2 _____ 3 _____ 1

- (b) The mRNA strand is constructed from free nucleotides.

Name the **two** molecules which combine with a base to form a mRNA nucleotide.

1 _____ 2 _____ 1

- (c) Once completed, the mRNA strand moves into the cytoplasm.

What is its destination?

_____ 1

- (d) Explain why the formation of mRNA strands is essential to cell metabolism.

_____ 2

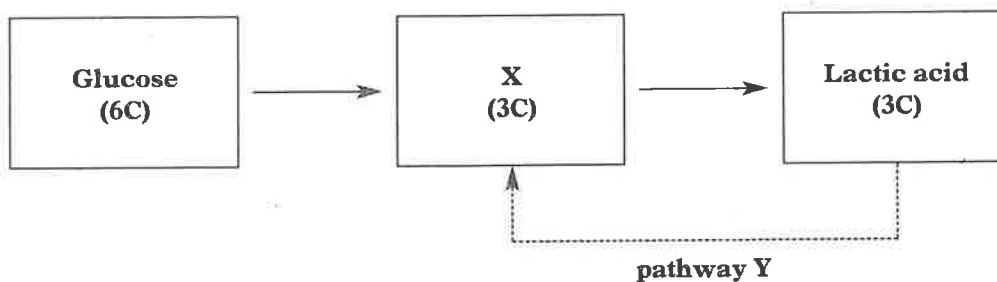
2. (a) The table below contains three statements about two stages of cellular respiration. Marks

Complete the table to indicate whether the statements are True (T) or False (F) for each stage.

Statement	Stages of Respiration	
	Glycolysis	Cytochrome System
Occurs in the mitochondrion		T
Releases carbon dioxide	F	
Uses oxygen		

2

- (b) The diagram below summarises anaerobic respiration in a muscle cell.



- (i) Name substance X.
- _____
- (ii) Which substance would need to be present for pathway Y to occur?
- _____
- (iii) Why is anaerobic respiration considered to be a less efficient process than aerobic respiration?
- _____
- (iv) Glucose is not stored in muscle cells.
Name the carbohydrate which is stored in muscle cells.
- _____

1

1

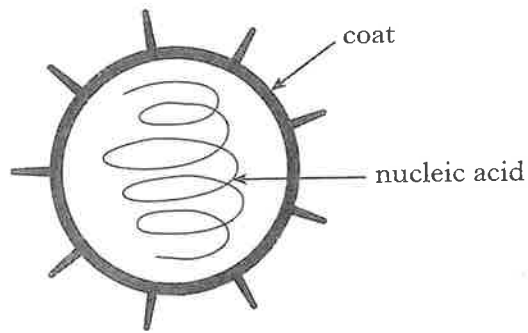
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[Turn over

3. The diagram below represents the structure of the virus which causes influenza.

Marks



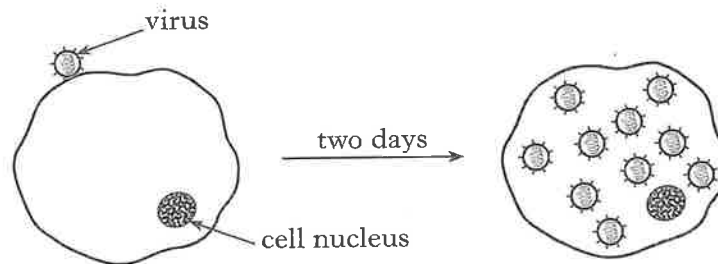
(a) (i) Name the substance which makes up the coat of this virus.

1

(ii) Describe how a virus from an influenza vaccine might differ in structure from the virus shown in the diagram.

1

(b) The following diagrams show a cell being attacked by the influenza virus.



(i) Describe how the virus reproduces over the two day period.

2

(ii) State how viruses are released from the infected cell.

1

(c) There are three main types of influenza virus.

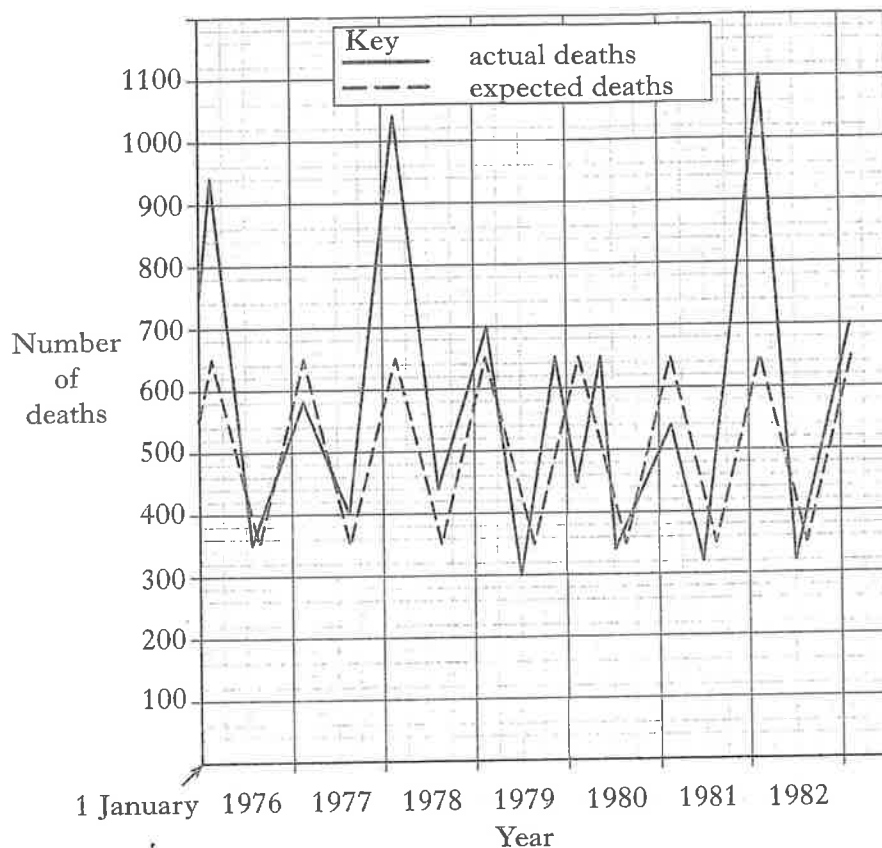
Why are the antibodies produced against one type not effective against the others?

1

Marks

3. (continued)

(d) The deaths in Scotland caused by influenza, pneumonia and bronchitis, between 1976 and 1982 are shown on the graph below.



(i) What is the expected range of deaths in any year?

_____ to _____

1

(ii) Suggest in which years influenza epidemics occurred in Scotland.

1

(iii) Chilling reduces the action of the cilia in the windpipe.

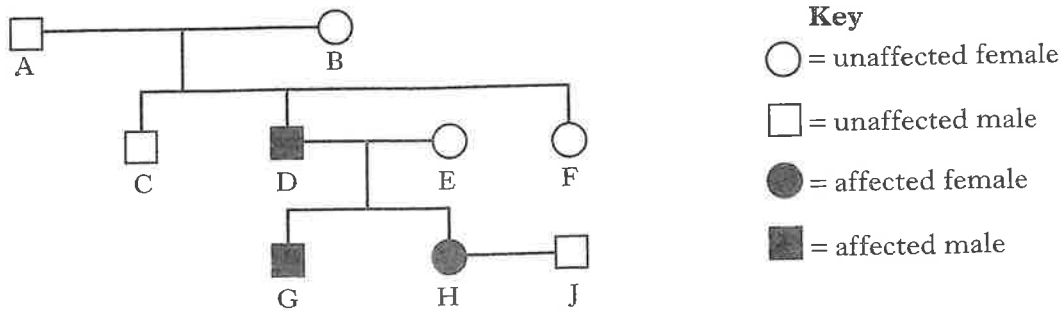
Explain why this makes people more vulnerable to influenza in the winter.

1

(iv) Suggest why the actual deaths in 1980 did not have the same pattern as seen in other years.

1

4. Achondroplasia is an autosomal disorder of bone growth that is caused by a gene mutation. A person with this condition has relatively short arms and legs. The incidence of achondroplasia in a family is shown in the diagram below. Marks



- (a) (i) In this family, the mutation occurred in an ovum. In which individual did the mutation take place?

1

- (ii) Describe a change which takes place in a gene when it mutates.

1

- (b) The allele which causes achondroplasia is dominant.

What is the percentage chance that a child of H and J would inherit achondroplasia?

Space for calculation

_____ %

1

- (c) People who are affected by achondroplasia do not produce enough growth hormone. State the site of growth hormone production.

1

- (d) The list below contains a number of inherited disorders.

Phenylketonuria	Down's syndrome	Huntington's chorea
Haemophilia	Cystic fibrosis	

Select a disorder from this list which is:

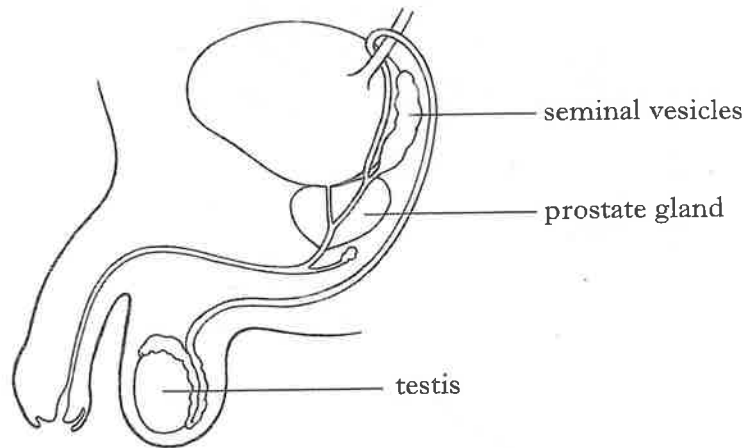
- (i) the result of non-disjunction; _____

- (ii) a sex-linked condition. _____

2

5. The diagram shows a section through the reproductive organs of a man.

Marks



(a) (i) State the site of sperm production within the testis.

1

(ii) State **one** function of the secretions from the seminal vesicles and prostate gland.

1

(b) (i) During a male sterilisation operation (vasectomy), a tube is cut. Draw a letter X on the diagram to indicate the likely position of the cut.

1

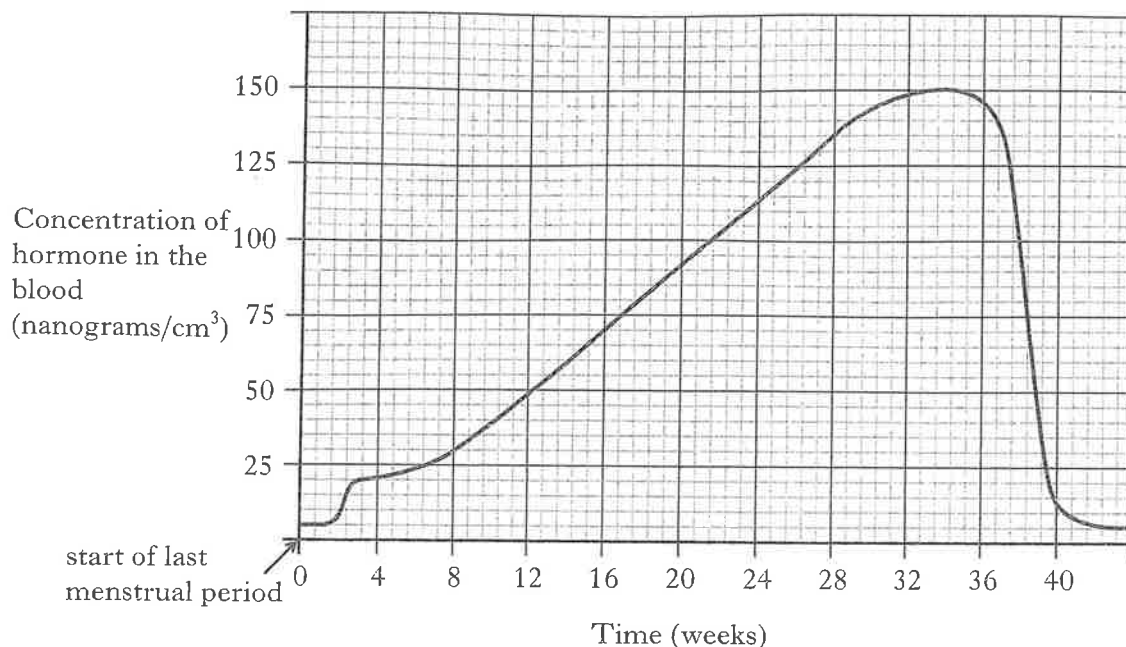
(ii) Why is the transport of testosterone from the testes unaffected by this operation?

1

[Turn over

6. The concentration of progesterone in the blood of a woman over a 40 week period of time during which she became pregnant is shown on the graph below.

Marks



- (a) Draw a vertical line on the graph to indicate the time of ovulation. 1
- (b) Describe the changes in progesterone concentration during the first 32 weeks.

2

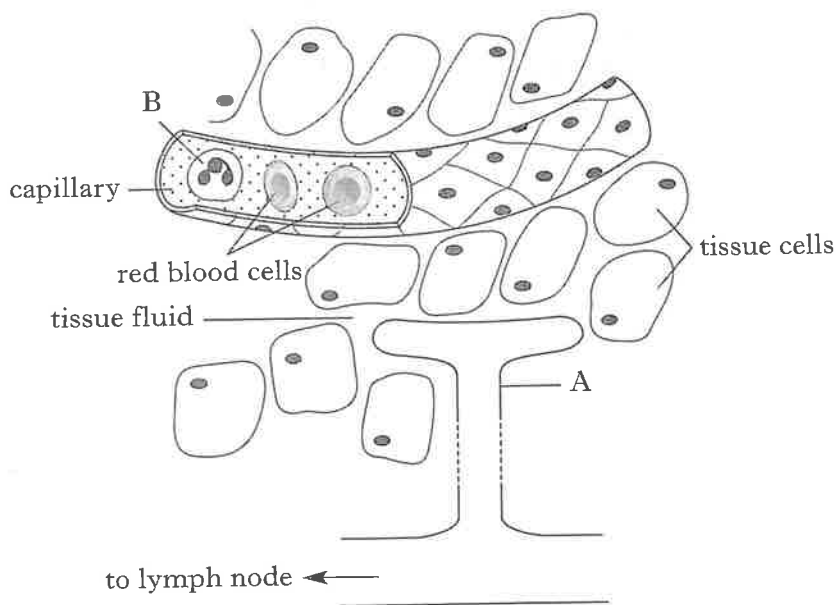
- (c) Where is progesterone produced
- (i) during the first weeks of pregnancy? _____ 1
- (ii) during the later stages of pregnancy? _____ 1

- (d) The decrease in the level of progesterone shown on the graph stimulates the production of prolactin.
What is the effect of prolactin?

1

7. The diagram below shows the relationship between blood, tissue fluid and lymph.

Marks



(a) What is the function of vessel A?

1

(b) Describe how the flow of fluid in vessel A is maintained.

2

(c) Explain why the lymph node may become swollen if the tissues are invaded by bacteria.

1

(d) Cell B contains many lysosomes. What is the function of cell B?

1

(e) How does oxygen from the red blood cells reach the tissue cells?

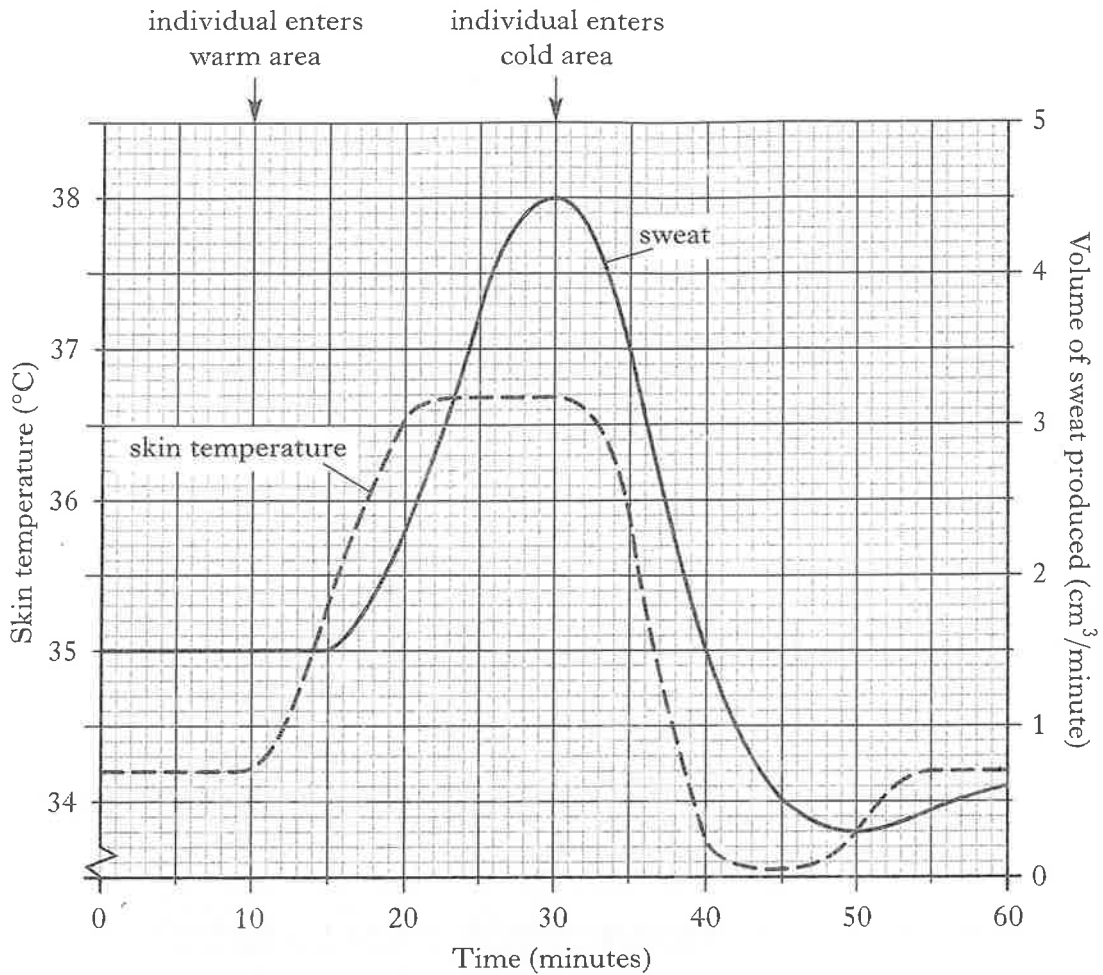
1

(f) Explain why blood pressure falls as the blood flows through the capillaries.

1

8. The relationship between skin temperature and sweating rates of an individual in different environmental conditions is shown on the graph below.

Marks



- (a) (i) Express, as a simple ratio, the volume of sweat produced when entering the warm area to the volume of sweat produced when leaving the warm area.

Ratio _____ : _____
 entering warm area leaving warm area

1

- (ii) What is the relationship between skin temperature and sweat production?

1

- (iii) If the individual had remained within the warm area, predict the skin temperature at 45 minutes.

1

8. (a) (continued)

Marks

(iv) What evidence from the graph suggests that sweat is produced as a result of changes in the skin temperature?

1

(b) Apart from sweating, state **one** other involuntary response to an increase in body temperature.

1

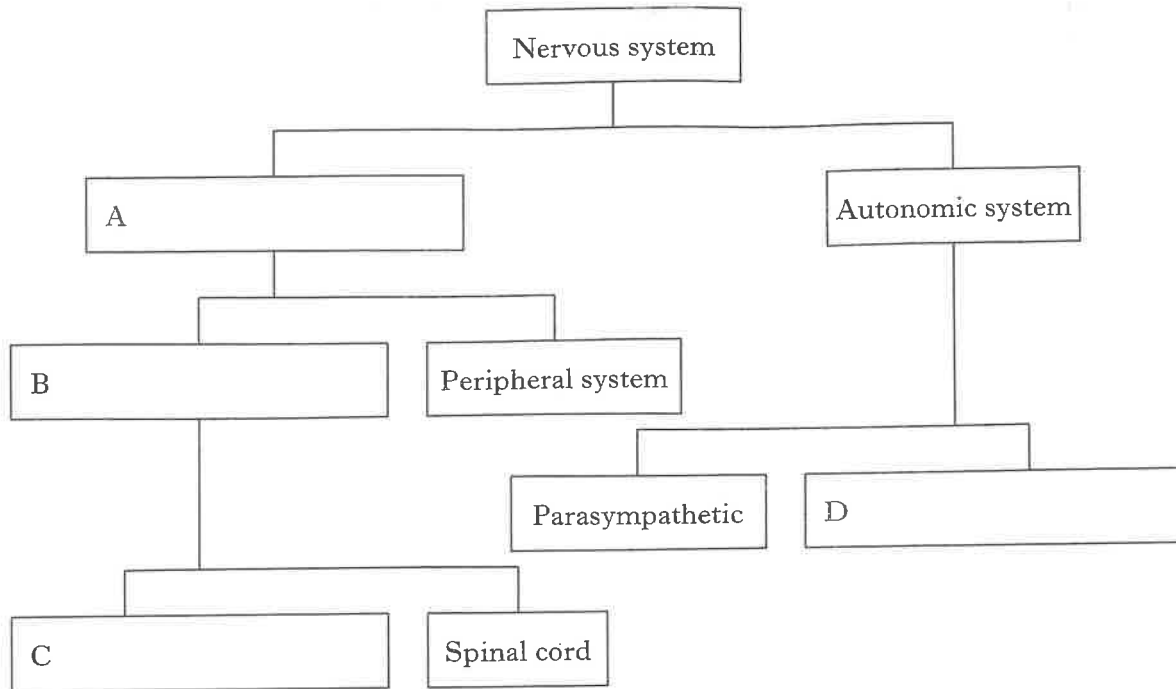
(c) Where in the brain is the temperature monitoring centre located?

1

[Turn over

Marks

9. The diagram shows how the nervous system is organised.



- (a) Complete the diagram by entering the names of parts A to D. 2
- (b) The parts of the autonomic nervous system are described as antagonistic.
- (i) What is meant by the term *antagonistic*?

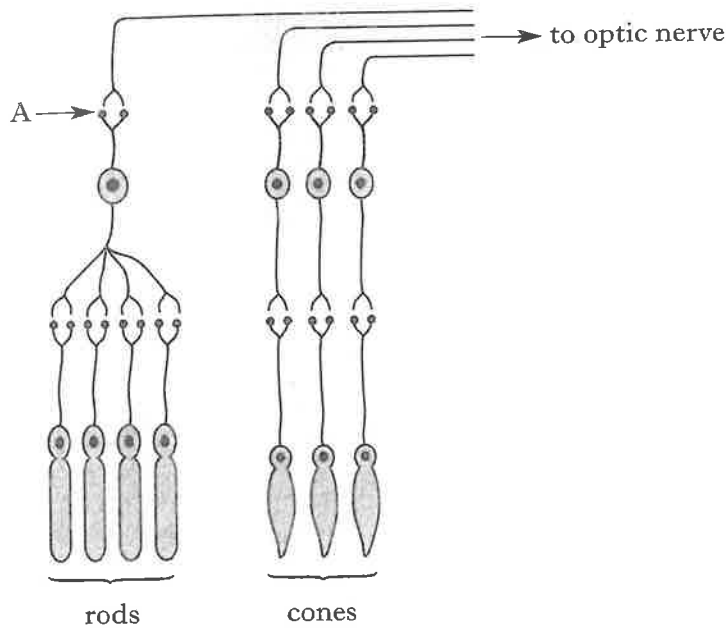
1

- (ii) Explain how this antagonistic action controls the activity of the digestive system.

2

Marks

10. Rods and cones are light receptor cells found in the eye.
The diagram below represents the arrangement of these cells.



- (a) In which region of the eye are rods and cones located?

1

- (b) (i) What type of neural pathway links the rod cells to the optic nerve?

1

- (ii) Name gap A.

1

- (iii) Explain how the arrangement of rod cells increases the chances of a nerve impulse crossing gap A.

2

- (c) The optic nerve carries nerve impulses to the visual area of the brain.
In which region of the brain is the visual area found?

1

[Turn over

Marks

11. An experiment was carried out to investigate the transfer of information between short-term and long-term memory. Two groups of ten students were shown word lists for 30 seconds. The students then watched a video for 20 minutes, before being asked individually to recall as many words as possible from the list. The two lists and the results of the investigation are shown below.

Experiment one

<i>List 1 (shown to group 1)</i>	<i>List 2 (shown to group 2)</i>
spoon fork knife plate pencil ruler rubber pen bus train plane car potato carrot beetroot turnip	spoon pen car turnip ruler plane knife beetroot plate train pencil potato bus fork rubber carrot
Average number of words recalled 13.6	Average number of words recalled 7.8

- (a) What feature of this investigation ensures that the results are reliable?

1

- (b) Why did the students recall more words from list 1 than list 2?

1

[Question 11 continues on Page twenty-one and fold-out Page twenty-two

11. (continued)

- (c) In another experiment, list 2 was read out, without pauses, to a third group of 10 students who were then asked to recall the words.

The results are shown in the table below.

Experiment two

<i>Position of word in the series</i>	<i>Percentage of correct responses</i>
1	100
2	90
3	100
4	90
5	80
6	80
7	50
8	40
9	60
10	70
11	80
12	100
13	90
14	100
15	100
16	100

[Question 11 continues on *Page twenty-two*]

Marks

11. (c) (continued)

- (i) Construct a line graph to illustrate the data in the table.
(Additional graph paper, if required, will be found on page 27)

2

- (ii) Explain why words at the **beginning** of the list were remembered better than those in the middle of the list.

1

- (iii) Explain why words at the **end** of the list were remembered better than those in the middle of the list.

1

- (iv) What term is used to describe the results obtained in experiment two?

1

- (d) What aspects of experimental design limit rehearsal in experiment one and experiment two?

Experiment one _____

Experiment two _____

2

[Question 12 begins on Page twenty-three

12. This question relates to causes of death in developed and developing countries in 1997.

Figure 1 Main causes of death in 1997.

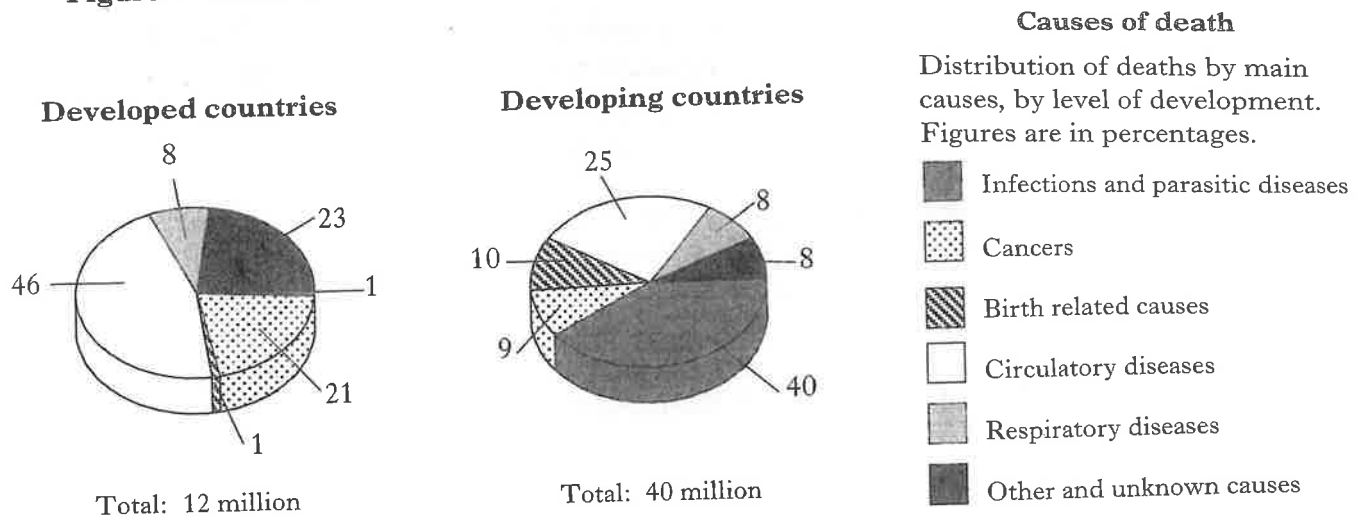
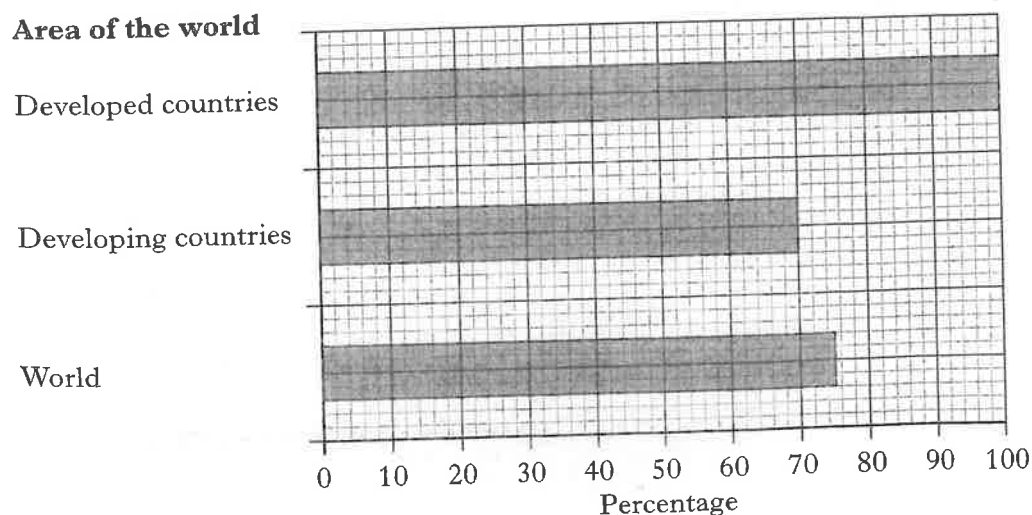


Figure 2 Main causes of death of children aged under three years in developing countries.

Cause of death	Specific cause	Percentage of total deaths
Respiratory diseases	Infections such as pneumonia or bronchitis	20.0
Infections and parasitic diseases	Diarrhoea	19.1
	Measles	10.4
	Malaria	6.7
	Whooping cough	3.8
Birth related causes	Prematurity	9.5
	Birth asphyxia	8.6
	Congenital abnormalities	4.8
	Birth trauma	3.8
	Others	7.6
Other	Malnutrition	2.8
	Other, including tuberculosis	2.9

Figure 3 Percentage of the population with access to safe drinking water.



[Question 12 continues on Pages twenty-four and twenty-five

Marks

12. (continued)

- (a) Using the information from **Figure 1**, state the cause of death most similar in the developed and developing countries.

1

- (b) (i) Using the information from **Figure 1**, state the cause of death which differs most between developed and developing countries.

1

- (ii) Suggest an explanation for this difference.

1

- (c) Using the information from **Figure 1**, calculate the number of deaths which resulted from circulatory diseases in the developing countries.

1

- (d) With reference to **Figure 2**, which of the following results in the greatest percentage of child deaths?

<i>Cause of death</i>	<i>Tick</i>
Respiratory diseases	
Infections and parasitic diseases	
Birth related causes	
Other causes	

1

- (e) (i) Using the information about **developing countries** in **Figures 1** and **2**, indicate which causes of death do not significantly affect children under the age of three.

1

- (ii) Suggest an explanation for this.

1

[Question 12 continues on Page twenty-five

12. (continued)

Marks

- (f) **Figure 2** shows that the incidence of child death due to malnutrition is low in developing countries. Suggest a reason for this.

1

- (g) Using the data in **Figure 3**, suggest an explanation for the incidence of diarrhoea as a cause of child deaths in the developing countries.

1

- (h) **Figure 3** shows that the percentage of the world population with access to safe drinking water is much closer to the percentage for developing countries than that of developed countries.

With reference to **Figure 1**, suggest a reason for this.

1

[Section C begins on Page twenty-six

SECTION C

Marks

Answer BOTH questions 1 and 2 on the blank pages provided.

You may use labelled diagrams where appropriate.

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

A. Give an account of the circulation of the blood, under the following headings:

(i) Pulmonary circulation (through heart and lungs);

5

(ii) Systemic circulation (through heart and rest of the body).

5

(10)

OR

B. Give an account of filtration and reabsorption in the kidney, under the following headings:

(i) Bowman's capsule and glomerulus;

4

(ii) Kidney tubules.

6

(10)

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

A. Give an account of the roles of lipids in the body.

(10)

OR

B. Describe how human activities disrupt the carbon cycle.

(10)

[END OF QUESTION PAPER]