

FOR OFFICIAL USE

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X009/301

Total for
Sections B & C

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NATIONAL
QUALIFICATIONS
2008

TUESDAY, 27 MAY
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

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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.

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

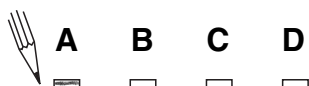
- 1 Check that the answer sheet provided is for **Human Biology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) 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 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. During which of the following chemical conversions is ATP produced?

- A Amino acids → protein
- B Glucose → pyruvic acid
- C Haemoglobin → oxyhaemoglobin
- D Nucleotides → mRNA

2. The following statements relate to respiration and the mitochondrion.

- 1 Glycolysis takes place in the mitochondrion.
- 2 The mitochondrion has two membranes.
- 3 The rate of respiration is affected by temperature.

Which of the above statements are correct?

- A 1 and 2
- B 1 and 3
- C 2 and 3
- D All of them

3. The anaerobic breakdown of glucose splits from the aerobic pathway of respiration

- A after the formation of pyruvic acid
- B after the formation of acetyl CoA
- C after the formation of citric acid
- D at the start of glycolysis.

4. In respiration, the products of the cytochrome system are

- A hydrogen and carbon dioxide
- B water and ATP
- C oxygen and ADP
- D pyruvic acid and water.

5. The key below can be used to identify carbohydrates.

- 1 Soluble..... 2
Insoluble..... glycogen
- 2 Benedict's test positive 3
Benedict's test negative sucrose
- 3 Barfoed's test positive 4
Barfoed's test negative lactose
- 4 Clinistix test positive glucose
Clinistix test negative fructose

Which line in the table of results below is **not** in agreement with the information contained in the key?

	<i>Carbohydrate</i>	<i>Benedict's test</i>	<i>Barfoed's test</i>	<i>Clinistix test</i>
A	lactose	positive	negative	not tested
B	glucose	positive	negative	positive
C	fructose	positive	positive	negative
D	sucrose	negative	not tested	not tested

6. Which of the following is an immune response?

- A T-lymphocytes secreting antigens
- B T-lymphocytes carrying out phagocytosis
- C B-lymphocytes combining with foreign antigens
- D B-lymphocytes producing antibodies

7. Phagocytes contain many lysosomes so that

- A enzymes which destroy bacteria can be stored
- B toxins from bacteria are neutralised
- C antibodies can be released in response to antigens
- D bacteria can be engulfed into the cytoplasm.

8. Which of the following is an example of active immunity?

- A Antibody production following exposure to antigens
- B Antibodies crossing the placenta from mother to fetus
- C Antibodies passing from the mother's milk to a suckling baby
- D Antibody extraction from one mammal to inject into another

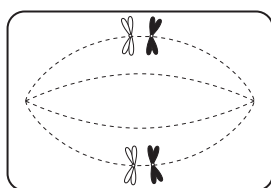
9. The following steps occur during the replication of a virus.

- 1 Alteration of host's cell metabolism
- 2 Production of viral protein coats
- 3 Replication of viral DNA

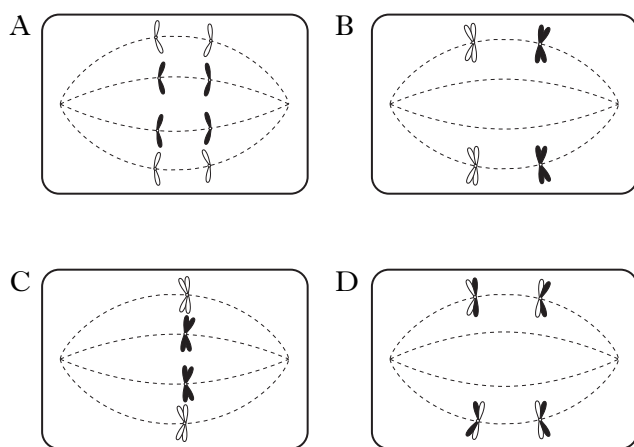
In which sequence do these events occur?

- A 1 → 3 → 2
- B 1 → 2 → 3
- C 2 → 1 → 3
- D 3 → 1 → 2

10. The diagram below shows a stage in meiosis.



Which of the following diagrams shows the next stage in meiosis?



11. Cystic fibrosis is a genetic condition caused by an allele which is not sex-linked.

A child is born with cystic fibrosis despite neither parent having the condition.

The parents are going to have a second child. What is the chance this child will have cystic fibrosis?

- A 75%
- B 67%
- C 50%
- D 25%

12. A sex-linked condition in humans is caused by a recessive allele. What is the chance of an unaffected man and a carrier woman having an unaffected male child?

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

13. One function of the seminal vesicles is to

- A produce testosterone
- B allow sperm to mature
- C store sperm temporarily
- D produce nutrients for sperm.

14. Which fertility treatment would be appropriate for a woman with blocked uterine tubes?

- A Provision of fertility drugs
- B *In vitro* fertilisation
- C Artificial insemination
- D Calculation of fertile period

15. A 30 g serving of breakfast cereal contains 1.5 mg of iron. Only 25% of this iron is absorbed into the bloodstream.

If a pregnant woman requires 6 mg of iron per day, how much cereal would she have to eat each day to meet this requirement?

- A 60 g
- B 120 g
- C 240 g
- D 480 g

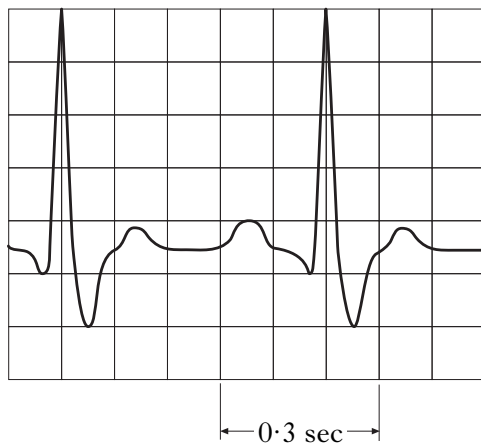
16. Which of the following blood vessels carries oxygenated blood?

- A Renal vein
- B Hepatic vein
- C Pulmonary vein
- D Hepatic portal vein

17. In which of the following situations might a fetus be at risk from Rhesus antibodies produced by the mother?

	<i>Father</i>	<i>Mother</i>
A	Rhesus positive	Rhesus negative
B	Rhesus positive	Rhesus positive
C	Rhesus negative	Rhesus negative
D	Rhesus negative	Rhesus positive

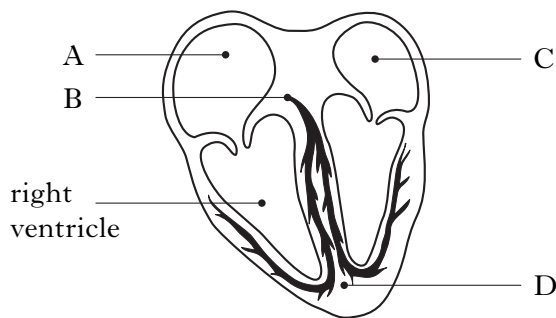
18. The diagram below shows an ECG trace taken during exercise.



The person's heart rate is

- A 80 bpm
 B 100 bpm
 C 120 bpm
 D 140 bpm.
19. The diagram below shows a section through the human heart.

What is the correct position of the pacemaker?

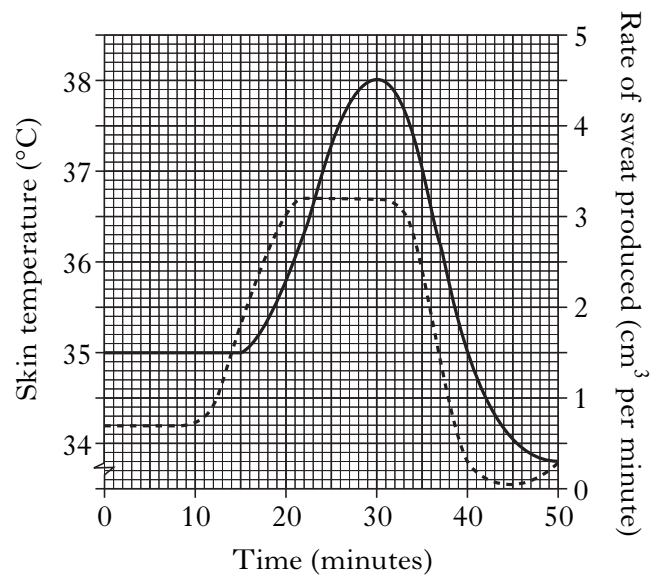


20. The vessel by which blood leaves the liver is the
- A renal vein
 B hepatic portal vein
 C renal artery
 D hepatic vein.

21. The graph below shows an individual's skin temperature and rate of sweat production over a period of 50 minutes.

Key

- sweat production
 - - - - skin temperature

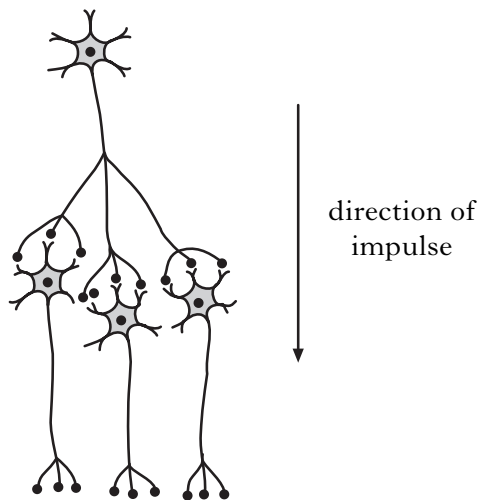


What is the skin temperature when the rate of sweat production is at a maximum?

- A 3.2°C
 B 4.5°C
 C 36.7°C
 D 38.0°C

[Turn over

22. The following diagram represents four neurones in a neural pathway.



Which line in the table describes the pathway correctly?

Type of pathway		
A	motor	divergent
B	motor	convergent
C	sensory	divergent
D	sensory	convergent

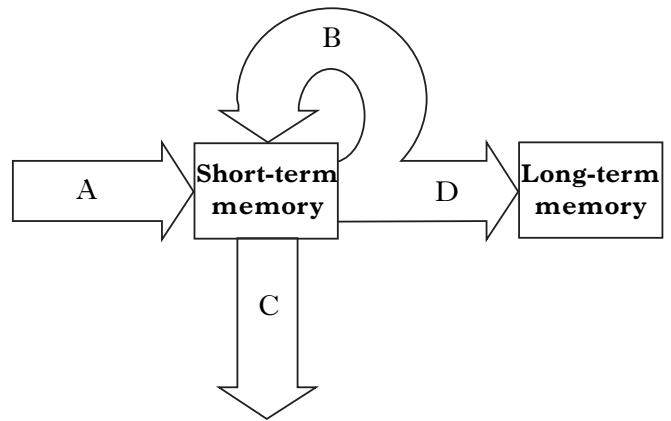
23. Which of the following carries an impulse towards a nerve cell body?

- A Dendrite
- B Axon
- C Myelin
- D Myosin

24. Which of the following statements describes a neurotransmitter and its method of removal?

- A Adrenaline is removed by reabsorption.
- B Adrenaline is removed by enzyme degradation.
- C Noradrenaline is removed by enzyme degradation.
- D Noradrenaline is removed by reabsorption.

25. The diagram below illustrates the relationship between short and long-term memory.



Which arrow represents the process of rehearsal?

26. The behavioural term *generalisation* is defined correctly as the ability to

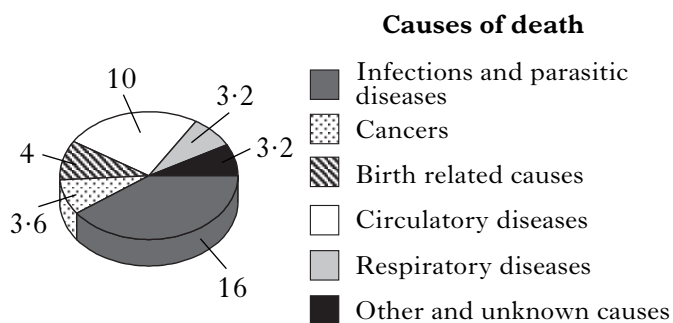
- A make appropriate different responses to different but related stimuli
- B make the same appropriate response to different but related stimuli
- C submerge one's personal identity in the anonymity of a group
- D improve performance in competitive situations.

27. The table below contains information about the populations of four countries in the year 2000.

In which country did the population decrease?

Country	Number per 1000 inhabitants			
	Births	Deaths	Immigrants	Emigrants
A	9.3	10.1	1.0	0.1
B	9.7	10.3	1.3	0.4
C	10.1	9.9	0.2	0.5
D	10.8	10.5	0.1	0.3

28. The diagram below shows the number of people dying from different causes in a developing country. (Figures are in millions.)



What percentage of deaths is due to birth related causes?

- A 4%
- B 8%
- C 10%
- D 11%

29. Which of the following processes is carried out by bacteria found in root nodules?

- A Denitrification
- B Nitrification
- C Nitrogen fixation
- D Deamination

30. Which of the following does **not** play a part in global warming?

- A The cutting down of forests
- B Methane production by cattle
- C The increase in use of motor vehicles
- D The increased use of fertilisers on farmland

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

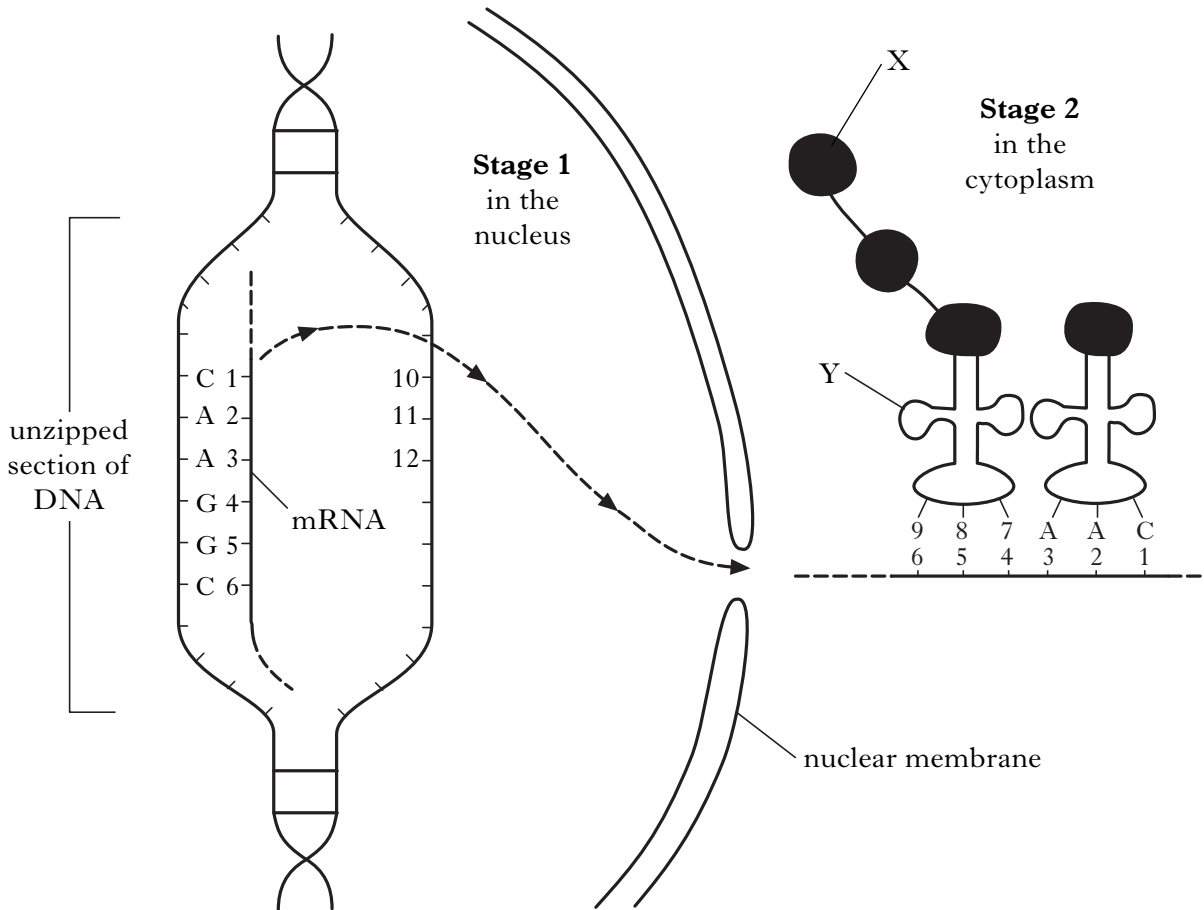
[Turn over for Section B

SECTION B

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram below illustrates the two main stages of protein synthesis.



- (a) Describe **three** differences between DNA and mRNA.

1 _____

2 _____

3 _____

1. (continued)

Marks

(b) Name bases 3, 8 and 11.

Base 3 _____

Base 8 _____

Base 11 _____

2

(c) **Circle** a codon in the diagram opposite.

1

(d) Where in the cytoplasm does stage 2 take place?

1

(e) Name molecules X and Y.

X _____ Y _____

1

(f) The newly synthesised protein may be secreted from the cell.

(i) Name the cell structure where the protein would be found just before it enters a secretory vesicle.

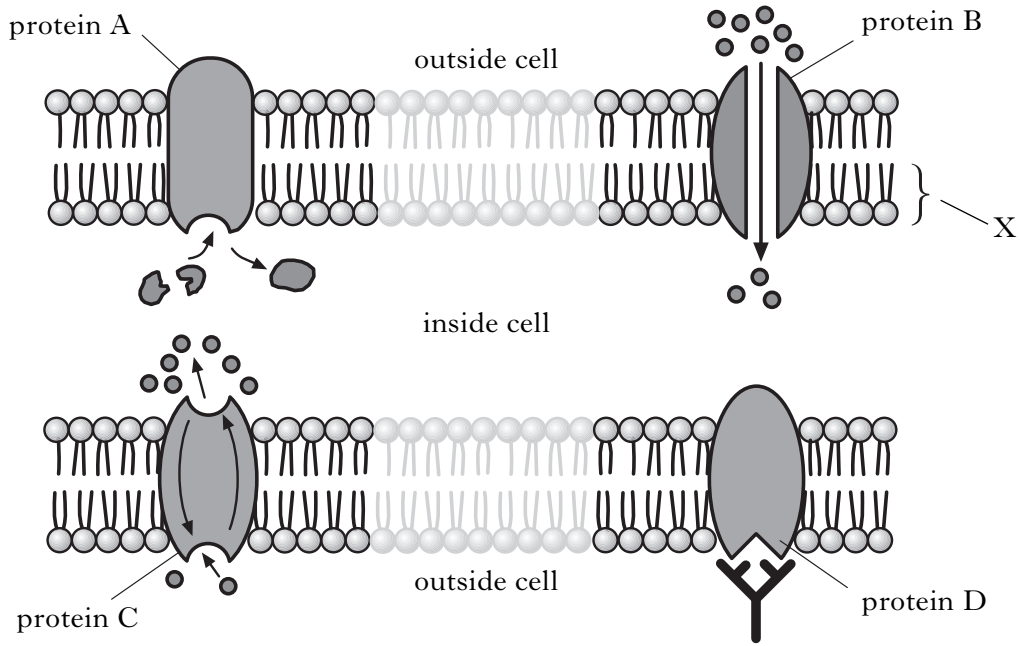
1

(ii) Describe what happens to the protein while it is in this cell structure.

1

[Turn over

2. (a) The diagram below shows some of the functions of proteins in the cell membrane. Marks



(i) Use the information from the diagram to complete the table below.

<i>Protein</i>	<i>Function</i>
	Transports molecules by diffusion
A	
D	
	Transports molecules by active transport

3

(ii) Identify molecule X and describe its function within the membrane.

Molecule X _____

Function _____

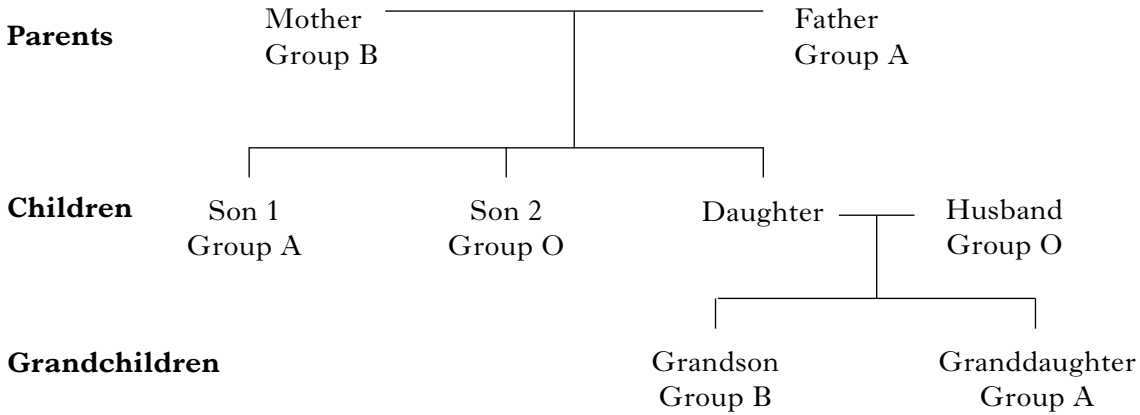
2

(b) Describe what happens to the cell membrane during the process of endocytosis.

2

Marks

3. The blood group of an individual is controlled by three alleles A , B and O .
Alleles A and B are co-dominant and completely dominant to allele O .
The diagram below shows the blood groups of three generations of a family.



- (a) What is the blood group of the daughter?

1

- (b) State the genotypes of the grandchildren.

Grandson _____

Granddaughter _____

1

- (c) How many of the three children are homozygous?

1

- (d) Explain the meaning of the term *co-dominant*.

1

- (e) Only one of the sons can safely receive a blood transfusion from his brother. Indicate whether this statement is true or false and explain your decision.

True/False _____

Explanation _____

2

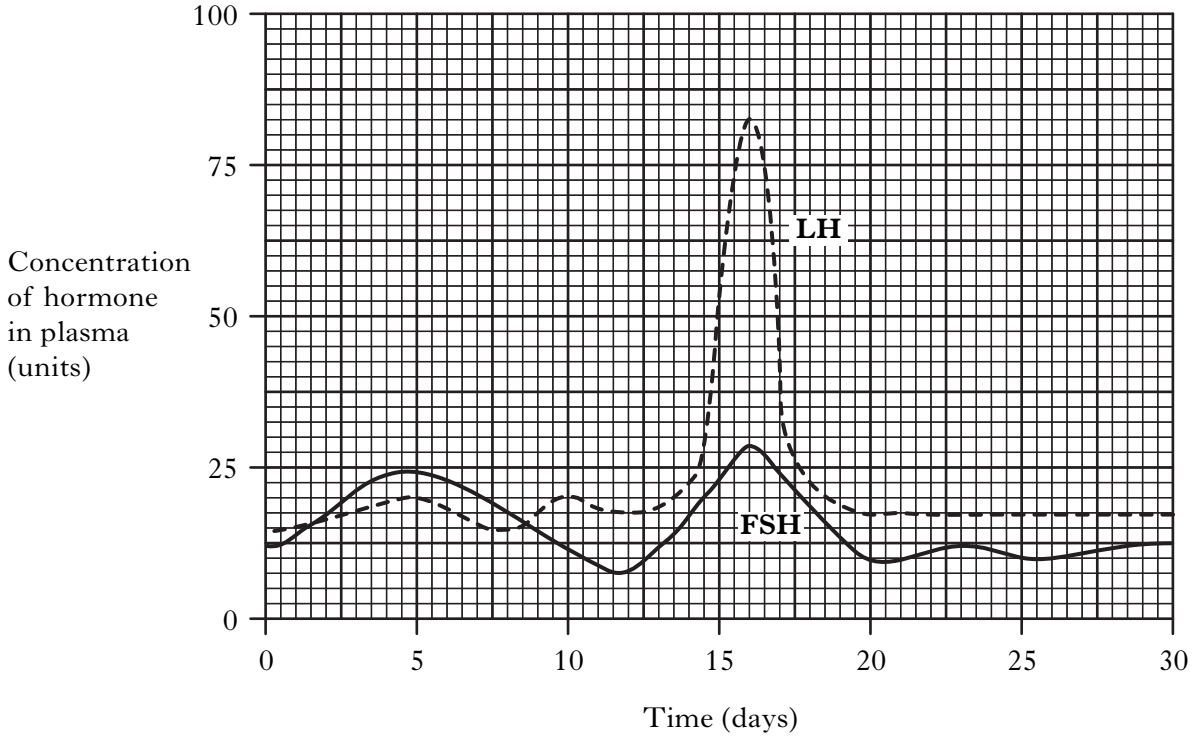
[Turn over

4. The graphs below show the plasma concentrations of certain hormones throughout a woman's menstrual cycle.

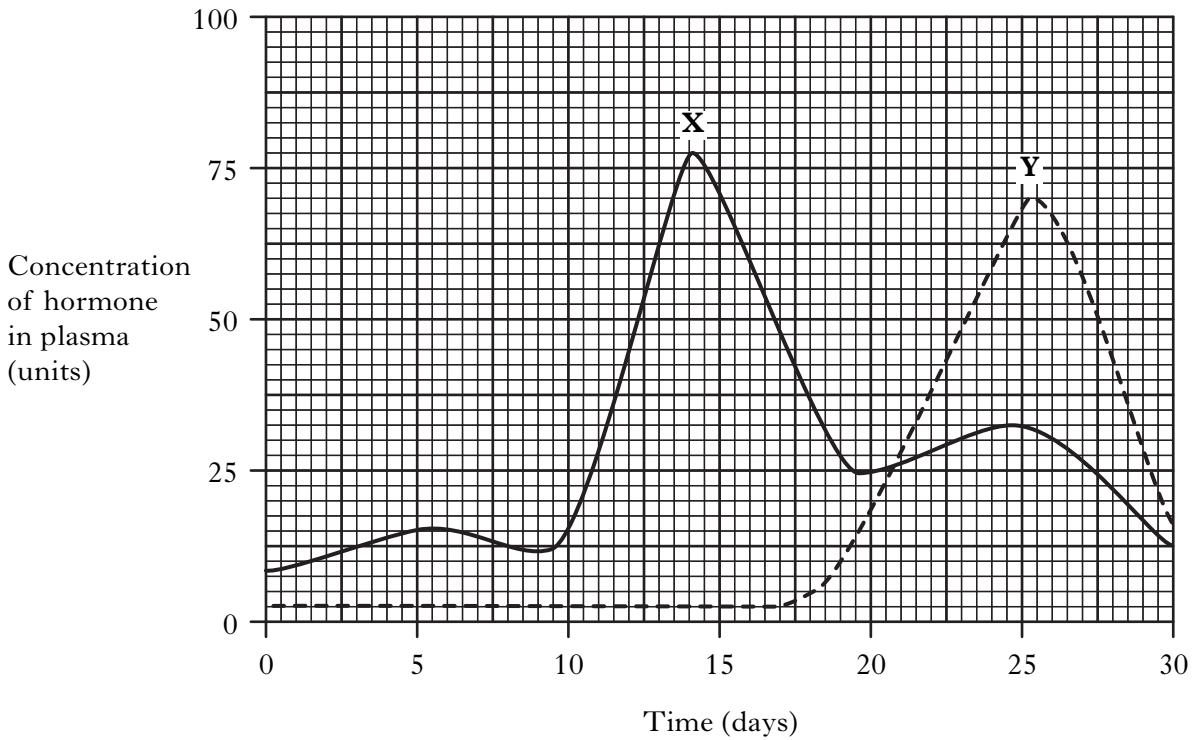
Graph 1 shows the concentrations of FSH and LH.

Graph 2 shows the concentration of two other hormones, X and Y.

Graph 1



Graph 2



4. (continued)

Marks

(a) Where in the body are FSH and LH produced?

1

(b) Name hormones X and Y.

X _____

Y _____

1

(c) What is the maximum concentration of hormone Y?

_____ units

1

(d) On which day did ovulation occur? Give a reason for your answer.

Day _____

1

Reason _____

1

(e) During her next cycle, the woman became pregnant.

Describe any differences which would occur in the concentrations of FSH and hormone Y after day 25.

FSH _____

1

Hormone Y _____

1

[Turn over

5. (a) The table shows average quantities of substances filtered and excreted by the kidney per day.

Marks

<i>Substance</i>	<i>Quantity filtered per day</i>	<i>Quantity excreted per day</i>	<i>Quantity reabsorbed per day</i>
Water	180 dm ³	1.5 dm ³	
Glucose	175 g	0 g	
Urea	48 g	31 g	
Protein	0 g	0 g	0 g

(i) Complete the table by calculating the quantities reabsorbed per day for water, glucose and urea.

1

(ii) What percentage of water filtered by the kidney is reabsorbed?

Space for calculation

_____ %

1

(iii) In which part of the kidney tubule is glucose reabsorbed?

1

(b) Nephrosis is a kidney condition in which glomeruli are damaged.

As a result of nephrosis, the quantity of soluble proteins in the blood decreases and there is a build up of tissue fluid in the body.

(i) Explain why damage to the glomeruli results in a decrease of soluble protein in the blood.

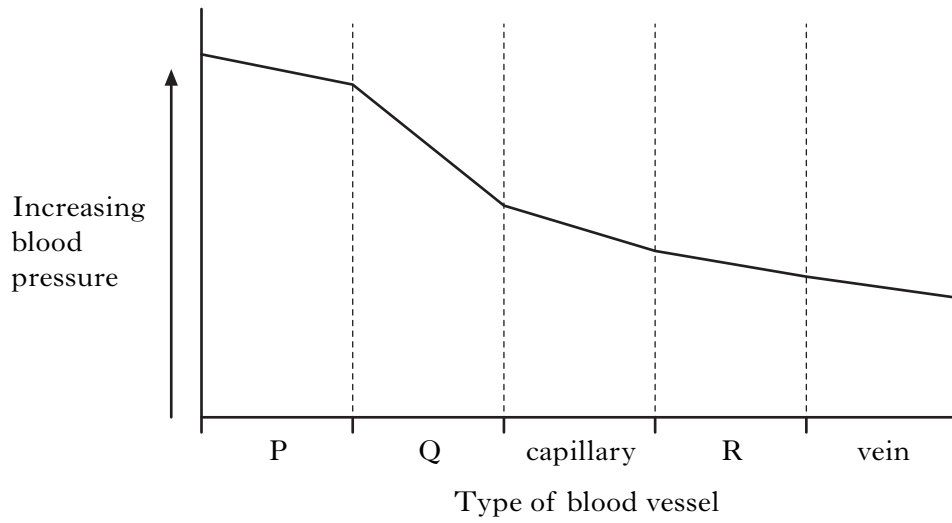
1

(ii) Suggest a reason for the build-up of tissue fluid in the body.

1

6. The graph shows average blood pressure in different types of blood vessels.

Marks



(a) Name the types of blood vessel represented by P, Q and R.

P _____

Q _____

R _____

2

(b) Blood pressure values fluctuate in vessel type P.

Explain the reason for this.

1

(c) Explain why there is a large drop in blood pressure in vessel type Q.

1

(d) In the vena cava, blood pressure falls below atmospheric air pressure yet blood is still able to return to the heart.

Explain how the blood flow is maintained.

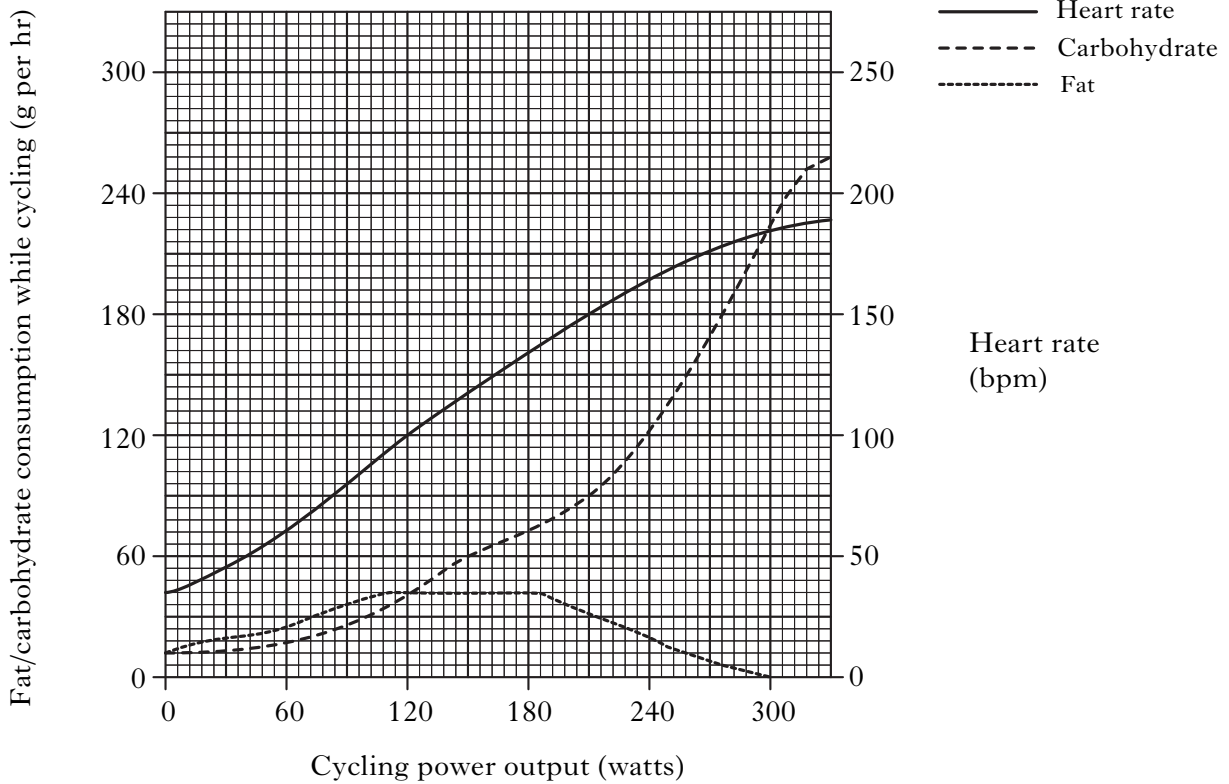
2

7. An investigation was carried out to find out how a cyclist's metabolism changed while he pedalled at increasing speed.

Marks

The cyclist's heart rate, fat and carbohydrate consumption were measured at different power outputs.

The graph below shows the results of the investigation.



(a) What is the heart rate of the cyclist when his power output is 90 watts?

_____ bpm

1

(b) What evidence is there from the graph that the cyclist is very fit?

1

(c) Compare the consumption of fat and carbohydrate as cycling power increases. Quote data from the graph in your answer.

3

Marks

7. (continued)

- (d) (i) Cyclists often use heart-rate monitors in training. A cyclist wishes to maintain his fat consumption at its maximum and, at the same time, limit his carbohydrate consumption.

At what heart rate should he cycle?

_____ bpm

1

- (ii) Suggest why it is good practice in a long distance cycling race to maximise fat consumption and minimise carbohydrate consumption.

1

- (e) The cyclist raced for 4 hours at a power output of 210 watts. During that time he consumed 100 g of carbohydrate in a liquid drink. Assuming he started with a carbohydrate store of 500 g, how much carbohydrate would he be left with at the end of the race?

Space for calculation

_____ g

1

- (f) (i) Glycogen is a major source of carbohydrate. Where is glycogen stored in the body?

1

- (ii) Name a hormone which promotes the conversion of glycogen to glucose.

1

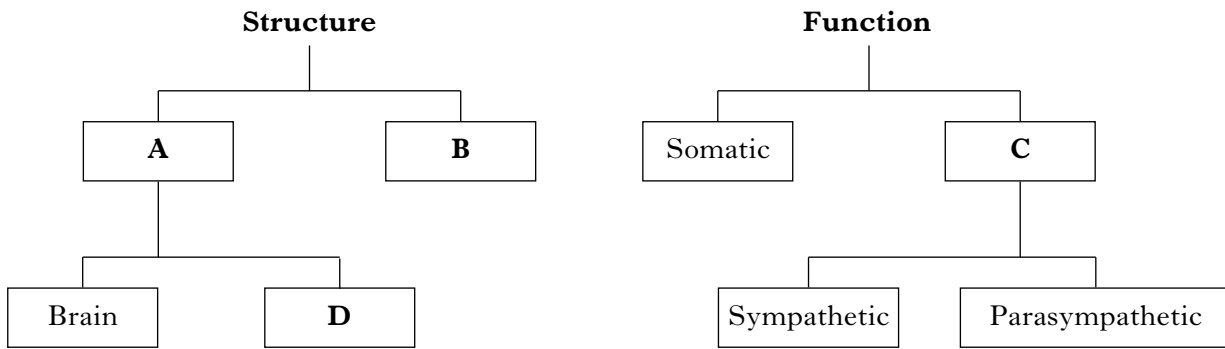
- (iii) What substance is used as a source of energy after glycogen and fat stores have been used up?

1

[Turn over

Marks

8. The diagrams below show two possible ways of classifying the nervous system.



(a) (i) Identify A to D.

A _____

B _____

C _____

D _____

2

(ii) Describe **one** function of the somatic nervous system.

1

(b) The brain contains two cerebral hemispheres.

(i) Name the structure which links these two hemispheres.

1

(ii) The surfaces of the hemispheres are heavily folded to provide a large surface area.

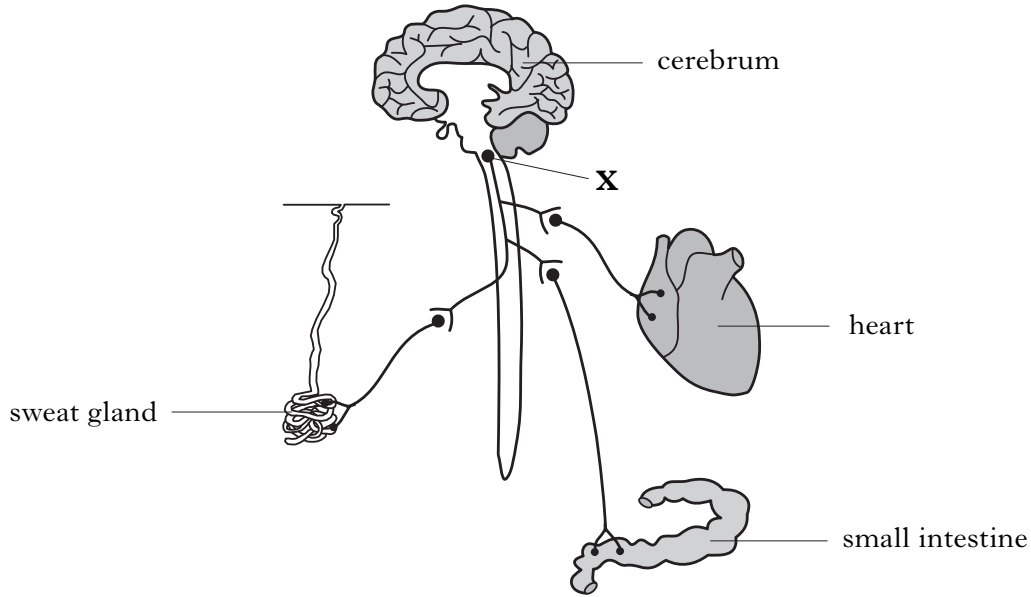
Explain the significance of this feature.

1

Marks

8. (continued)

(c) The diagram below shows some of the nerve connections between the brain and three parts of the body.



(i) Identify the part of the brain labelled **X**.

1

(ii) The sympathetic and parasympathetic systems are often described as antagonistic to one another.

Explain the meaning of *antagonistic*.

1

(iii) Complete the table to show the effect of sympathetic stimulation on the heart, sweat glands and small intestine.

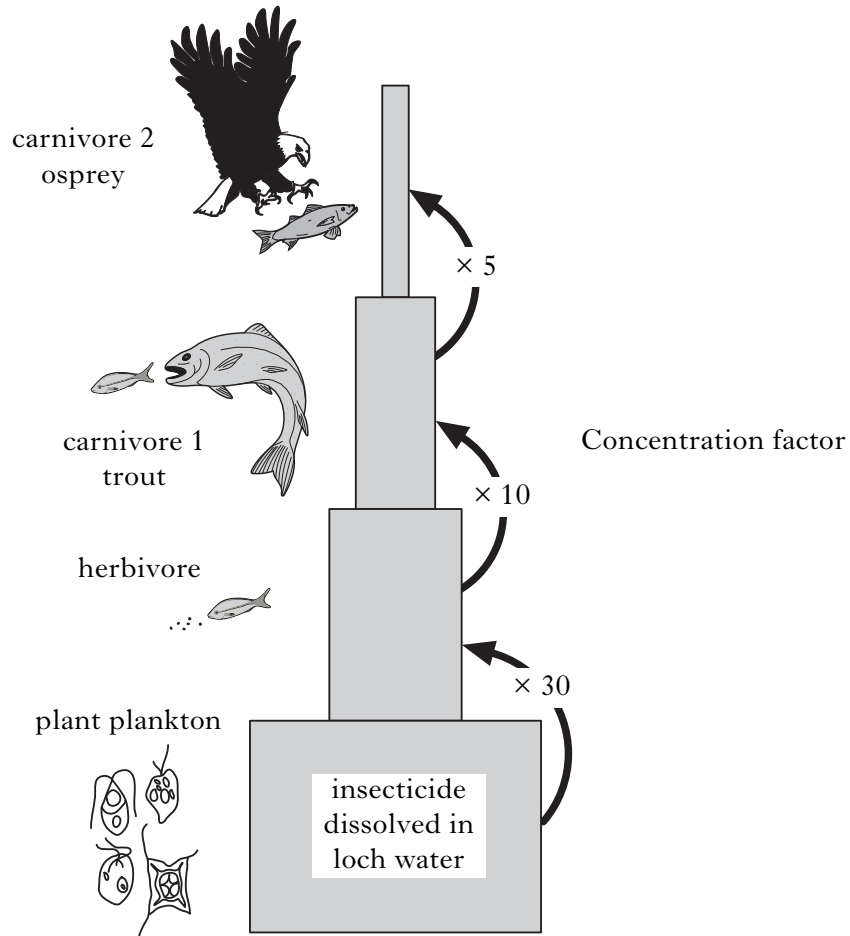
<i>Part of body</i>	<i>Sympathetic effect</i>
Heart	
Sweat glands	
Small intestine	

2

[Turn over

Marks

9. The diagram shows how a non-biodegradable insecticide passes through a food chain in a Scottish fresh-water loch.



- (a) Describe **one** way in which the insecticide could get into the loch water.

1

- (b) (i) The diagram shows the number of times the insecticide becomes concentrated at each stage of the food chain.

If the concentration of insecticide in the plant plankton is 0.025 ppm what would be the expected concentration in the osprey?

Space for calculation

_____ ppm 1

Marks

9. (b) (continued)

(ii) Explain why insecticide becomes more concentrated in carnivores at the top of the food chain.

2

(c) DDT is an insecticide which breaks down slowly at a rate of 50% every fifteen years. Calculate how long it would take for 100 kg of DDT to break down to less than 1 kg.

Space for calculation

_____ years

1

(d) Insecticides are chemicals used extensively in agriculture.

Name **two** other types of chemical used to treat crops and explain why they are used.

Chemical 1 _____

Use _____

1

Chemical 2 _____

Use _____

1

(e) Some insecticides work by disrupting enzyme-catalysed pathways.

What term is used to describe their action on enzymes?

1

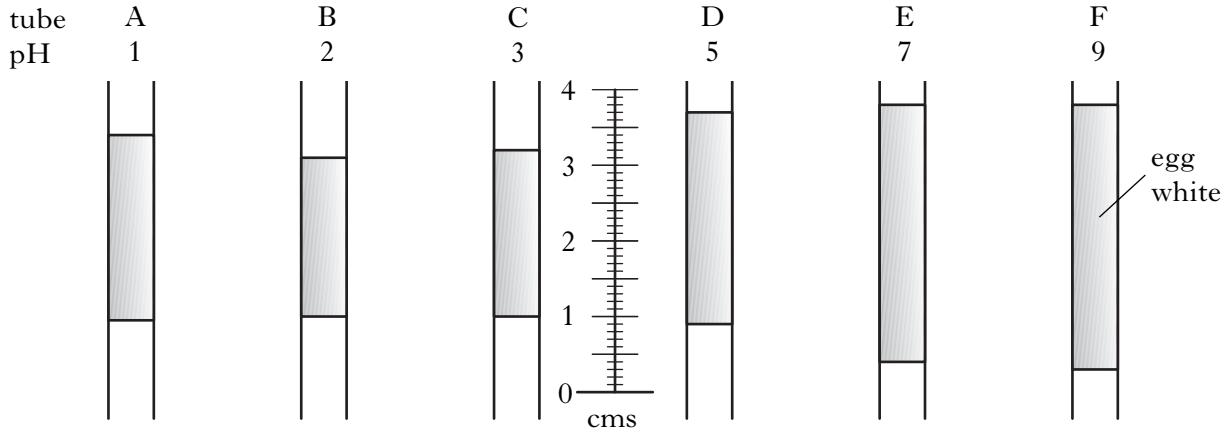
[Turn over

10. An experiment was carried out to investigate the effect of pH on the activity of the enzyme pepsin.

Six beakers were filled with pepsin solution and the pH adjusted in each beaker to give a range from pH 1 to pH 9. Six glass tubes were filled with egg albumen and boiled in water to set the egg white. The starting lengths of the egg white were measured and recorded in the table below.

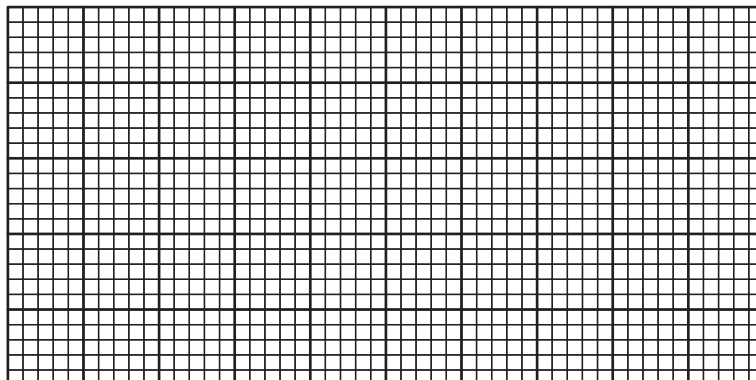
Marks

The glass tubes were placed in the pepsin solution for a number of hours to allow digestion of the egg white. The lengths of egg white left in each tube at the end of the investigation are shown in the diagram below.



Tube	pH of pepsin solution	Length of egg white at start (mm)	Length of egg white at finish (mm)	Percentage decrease in length (%)
A	1	36	24	33
B	2	35	20	43
C	3	36		
D	5	34		
E	7	36	34	6
F	9	35	35	0

- (a) (i) Complete the table above by measuring and recording the final lengths of egg white in tubes C and D. 1
- (ii) Calculate the percentage decrease in length of egg white in tubes C and D and complete the table. 1
- (b) Draw a line graph to show the relationship between pH and percentage decrease in length of egg white.



(Additional graph paper, if required, can be found on page 28.)

2

10. (continued)

Marks

(c) (i) What conclusion can be drawn from the results of this experiment?

1

(ii) Predict the percentage decrease in length of egg white in a pepsin solution of pH 12.

1

(iii) Why was it necessary to calculate a *percentage* decrease?

1

(iv) Describe a suitable control for tube **A** in this investigation.

1

(v) State **three** variables which would have to be kept constant throughout this investigation.

1 _____

2 _____

3 _____

2

(vi) Describe **one** way in which the results could be made more reliable.

1

(d) Pepsin is produced in an inactive form by cells lining the stomach.

Why is it important that pepsin is inactive when it is produced?

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 temperature regulation in cold conditions under the following headings:

- | | |
|-----------------------------|-------------|
| (i) voluntary responses; | 3 |
| (ii) involuntary responses; | 5 |
| (iii) hypothermia. | 2 |
| | (10) |

OR

B. Give an account of the development of boys at puberty under the following headings:

- | | |
|------------------------|-------------|
| (i) physical changes; | 3 |
| (ii) hormonal changes. | 7 |
| | (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 how the impact of disease on the human population can be reduced. **(10)**

OR

B. Describe the factors which influence the development of behaviour. **(10)**

[END OF QUESTION PAPER]

SPACE FOR ANSWERS

SPACE FOR ANSWERS

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SPACE FOR ANSWERS

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 10(b)

