



National  
Qualifications  
2016

**X740/76/02**

**Human Biology  
Section 1 — Questions**

MONDAY, 9 MAY

1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *Page 02* of your question and answer booklet X740/76/01.

Record your answers on the answer grid on *Page 03* of your question and answer booklet.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



\* X 7 4 0 7 6 0 2 \*

**SECTION 1 — 20 marks**

**Attempt ALL questions**

1. In a developing embryo, tissues such as muscle and nerve are produced by
- A somatic cells dividing by meiosis
  - B germline cells dividing by meiosis
  - C somatic cells dividing by mitosis
  - D germline cells dividing by mitosis.
2. A genetic disorder of the nervous system results from a mutation in which a nucleotide is inserted into a gene.

Which of the following types of mutation causes this genetic disorder?

- A nonsense
  - B missense
  - C translocation
  - D frame-shift
3. The following steps occur during the Polymerase Chain Reaction (PCR).
- 1. Binding of primer
  - 2. Replication of DNA
  - 3. Heating of sample DNA
  - 4. Separation of DNA strands

In which sequence do these steps occur?

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

4. The diagrams below represent the shapes of an enzyme molecule and its substrate.

*Enzyme molecule*



*Substrate molecule*



Which row in the table below shows the possible shapes of two types of molecule that could inhibit the enzyme above?

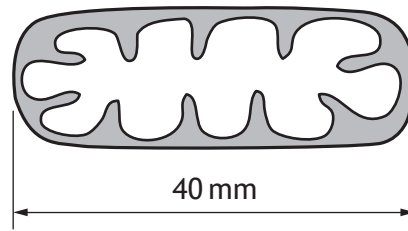
	<i>Competitive Inhibitor</i>	<i>Non-competitive Inhibitor</i>
A		
B		
C		
D		

5. During glycolysis, dehydrogenase enzymes catalyse the

- A removal of hydrogen ions from  $\text{NADH}_2$
- B removal of hydrogen ions from citrate
- C transfer of hydrogen ions to glucose
- D transfer of hydrogen ions to NAD.

[Turn over

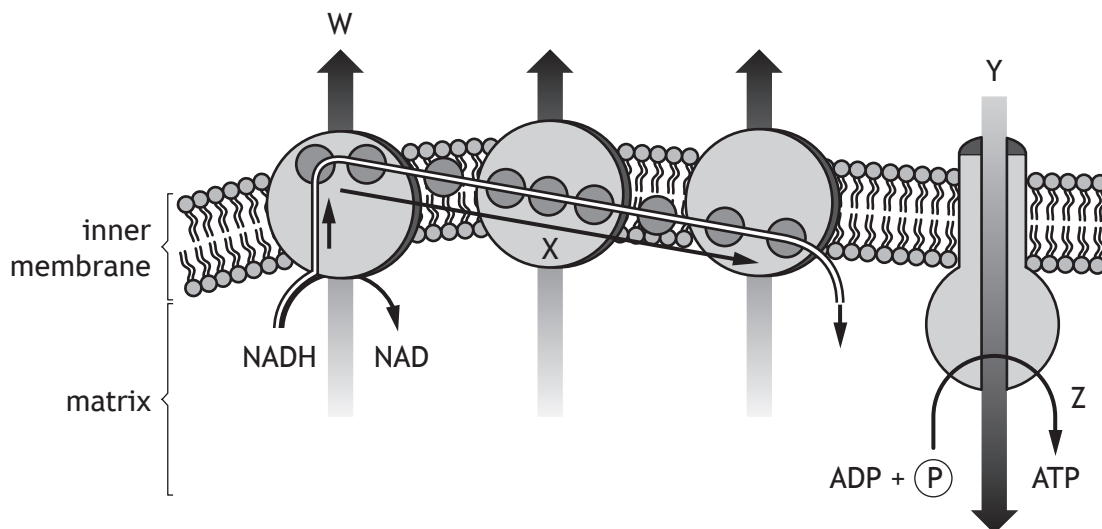
6. The diagram below represents a mitochondrion which has been magnified 10 000 times.



What is the actual length of this mitochondrion?

(1 mm = 1000 micrometres)

- A 0.04 micrometres
  - B 0.4 micrometres
  - C 4 micrometres
  - D 40 micrometres
7. The diagram below represents some of the processes which occur at the inner membrane of a mitochondrion.

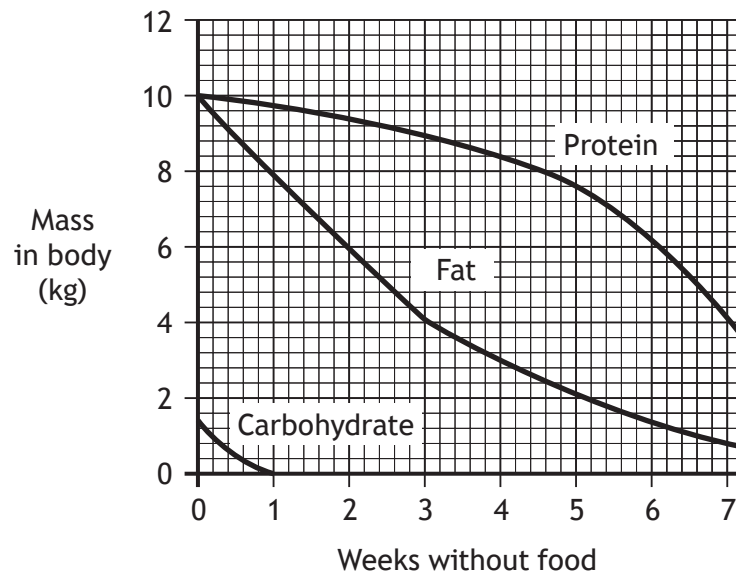


Which letter represents the transfer of high energy electrons?

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

8. During cellular respiration, the activity of phosphofructokinase can be inhibited by
- A ATP and citrate
  - B ADP and citrate
  - C ATP and lactic acid
  - D ADP and lactic acid.

9. The graph below shows changes which occur in the masses of protein, fat and carbohydrate in a person's body during seven weeks without food.



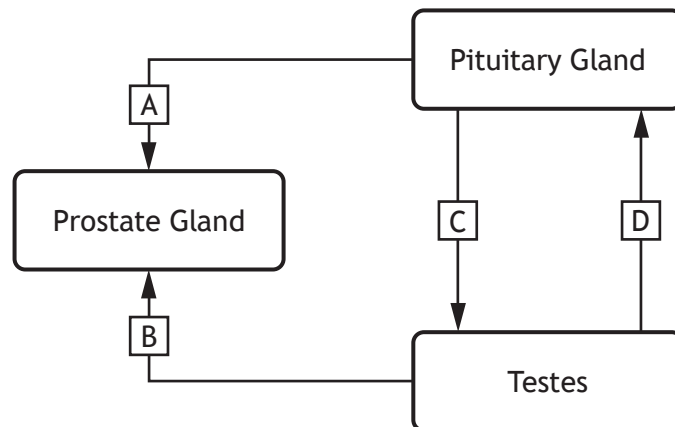
The person's starting mass was 60 kg.

Predict their mass after two weeks without food.

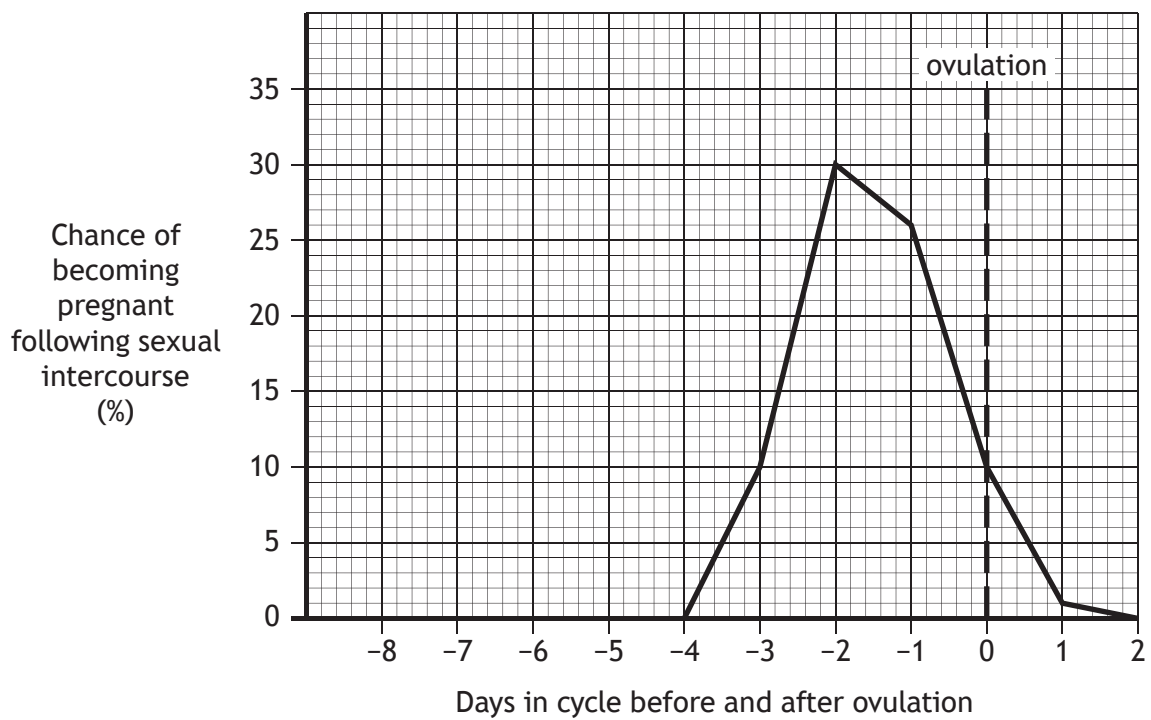
- A 57 kg
- B 54 kg
- C 50 kg
- D 43 kg

[Turn over

10. The diagram below represents connections between parts of the male reproductive system. Which arrow in the diagram does **not** represent a male reproductive hormone?



11. The graph below shows the chance of a woman becoming pregnant, following sexual intercourse, on the days before and after ovulation.



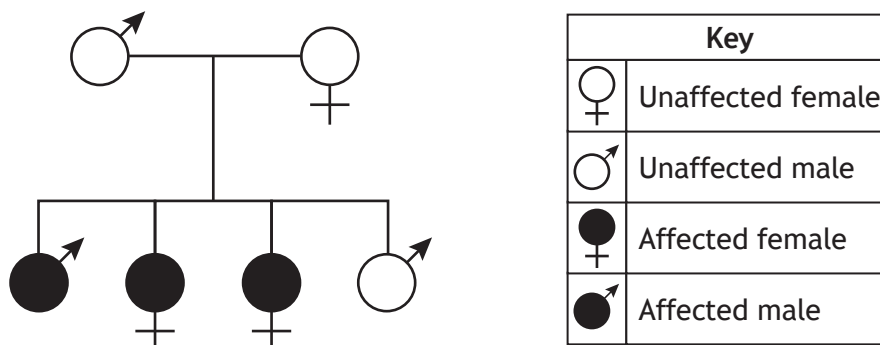
This woman has a 28 day menstrual cycle and ovulates on the 3rd of May.

On which day in May would having sexual intercourse give her the best chance of becoming pregnant?

- A 3rd May
- B 17th May
- C 29th May
- D 31st May

12. In the treatment of infertility, ovulation can be stimulated by drugs that prevent the negative feedback effect of
- A oestrogen on LH secretion
  - B oestrogen on FSH secretion
  - C progesterone on LH secretion
  - D progesterone on FSH secretion.
13. During antenatal care, which **two** techniques can be used to obtain cells for production of a karyotype?
- A Chorionic villus sampling (CVS) and amniocentesis
  - B Ultrasound imaging and chorionic villus sampling (CVS)
  - C Amniocentesis and pre-implantation genetic diagnosis (PGD)
  - D Pre-implantation genetic diagnosis (PGD) and ultrasound imaging

14. The inheritance of an allele for deafness is shown in the family tree below.



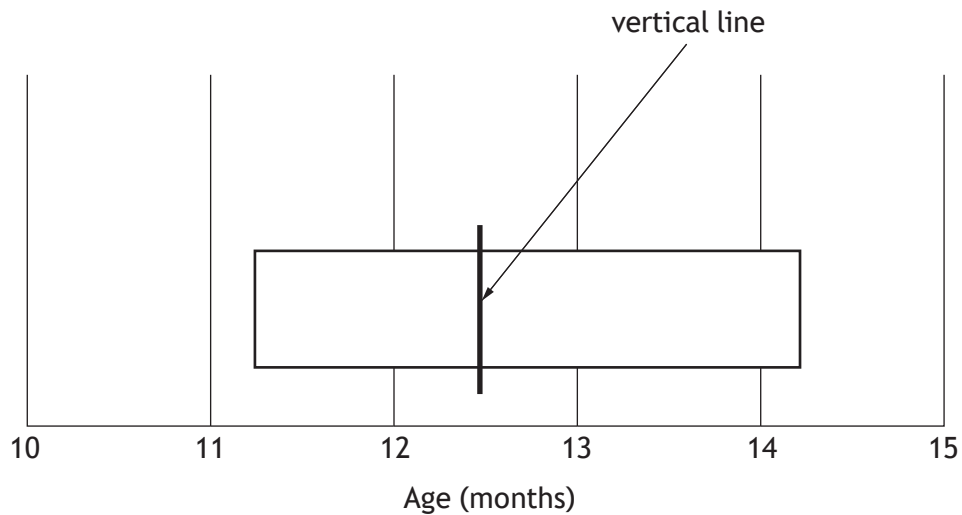
This condition is controlled by an allele which is

- A dominant and sex-linked
- B recessive and sex-linked
- C dominant and not sex-linked
- D recessive and not sex-linked.

[Turn over

15. Which of the following memories would be stored in the limbic system only?
- A The tune to your favourite song.
  - B How to keep three balls in the air when juggling.
  - C The route to your bed across your bedroom in the dark.
  - D The taste of your favourite food.
16. Playing cards normally have hearts and diamonds in red, and spades and clubs in black. An investigation showed that the speed and accuracy in recognising the cards decreased when the colours were reversed, for example when hearts appeared black. This result was most likely to have been caused by the effect of
- A a perceptual set
  - B a binocular disparity
  - C a segregation into figure and ground
  - D an organisation into coherent patterns.

17. The diagram below shows the ages at which infants are able to walk unaided. The left end of the bar shows the age at which 25% of infants can walk unaided. The right end of the bar shows the age at which 90% of infants can walk unaided. The vertical line on the bar shows the age at which 50% of infants can walk unaided.



If 24 infants, aged 12 months, were tested, how many would be expected to walk unaided?

- A 6  
 B 10  
 C 14  
 D 18
18. The table below contains information about two groups of students who were asked to construct a paper model from a set of instructions.

<i>Group</i>	<i>Arrangement of students</i>	<i>Average time to complete model (s)</i>
1	all students together in one room	105
2	each student in a separate room	140

The improved performance of the students in group 1 is likely to be due to

- A shaping  
 B discrimination  
 C deindividuation  
 D social facilitation.

19. When tissue is damaged, mast cells release histamine which **immediately** results in
- A an accumulation of phagocytes
  - B increased delivery of antimicrobial proteins and clotting elements
  - C increased localised blood vessel dilation and capillary permeability
  - D stimulation of a specific immune response by activating lymphocytes.
20. In Scotland cases of influenza are always present but occasionally they rise to unusually high levels. In this case, the disease is said to have changed from being
- A epidemic to endemic
  - B endemic to epidemic
  - C sporadic to epidemic
  - D endemic to sporadic.

**[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2  
OF YOUR QUESTION AND ANSWER BOOKLET.]**

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**X740/76/01**

**Human Biology  
Section 1 — Answer Grid  
and Section 2**

MONDAY, 9 MAY  
1:00 PM – 3:30 PM



Fill in these boxes and read what is printed below.

Full name of centre

--

Town

--

Forename(s)

--

Surname

--

Number of seat

--

Date of birth

Day

--	--

Month

--	--

Year

--	--

Scottish candidate number

--	--	--	--	--	--	--	--	--	--

**Total marks — 100**

**SECTION 1 — 20 marks**

Attempt ALL questions.

Instructions for the completion of Section 1 are given on *Page 02*.

**SECTION 2 — 80 marks**

Attempt ALL questions.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



The questions for Section 1 are contained in the question paper X740/76/02.

Read these and record your answers on the answer grid on *Page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).
2. There is **only one correct** answer to each question.
3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

### Sample Question

The digestive enzyme pepsin is most active in the

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

The correct answer is **B** — stomach. The answer **B** bubble has been clearly filled in (see below).

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	or	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>		<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>



SECTION 1 — Answer Grid



	A	B	C	D
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



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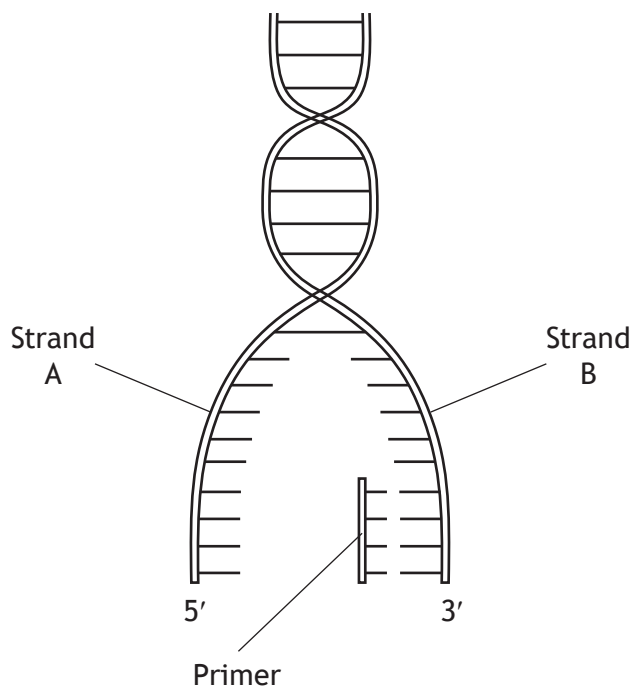
\* X 7 4 0 7 6 0 1 0 4 \*

SECTION 2 — 80 marks

Attempt ALL questions

Note that Question 13 contains a choice.

1. The diagram below represents a stage in the process of DNA replication.



(a) (i) Name the type of bond which links the primer to strand B. 1

\_\_\_\_\_

(ii) Name the chemical group found at the 5' end of a DNA strand. 1

\_\_\_\_\_

(b) Strand B is replicated continuously while strand A can only be replicated in fragments. Explain why the strands are replicated in different ways. 1

\_\_\_\_\_  
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 \_\_\_\_\_



MARKS

DO NOT  
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MARGIN

1. (continued)

(c) Describe the role of the following enzymes in DNA replication.

2

DNA polymerase \_\_\_\_\_

\_\_\_\_\_

Ligase \_\_\_\_\_

\_\_\_\_\_



\* X 7 4 0 7 6 0 1 0 6 \*

2. At the start of polypeptide synthesis in a cell, DNA transcription occurs in the nucleus to form mRNA.

The sequence of bases from a section of a DNA strand is shown below.

..... C A C G A T C G A T A G G A T .....

- (a) (i) State the sequence of bases in the primary mRNA transcript formed from this strand of DNA. 1

\_\_\_\_\_

- (ii) State the term used to describe the coding regions of a primary mRNA transcript. 1

\_\_\_\_\_

- (iii) Name the process by which the coding regions of a primary mRNA transcript are joined together to produce a mature mRNA transcript. 1

\_\_\_\_\_

- (iv) The sequence of bases in the mature mRNA transcript, formed from the section of the DNA strand, is shown below.

..... G U G C U A U C C U A .....

Using this mature mRNA transcript, state the order of bases in the intron present in the primary mRNA transcript. 1

\_\_\_\_\_

- (b) State the location for the translation of a mature mRNA transcript into a polypeptide. 1

\_\_\_\_\_

- (c) Describe **one** form of post-translational modification of a polypeptide. 1

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[Turn over

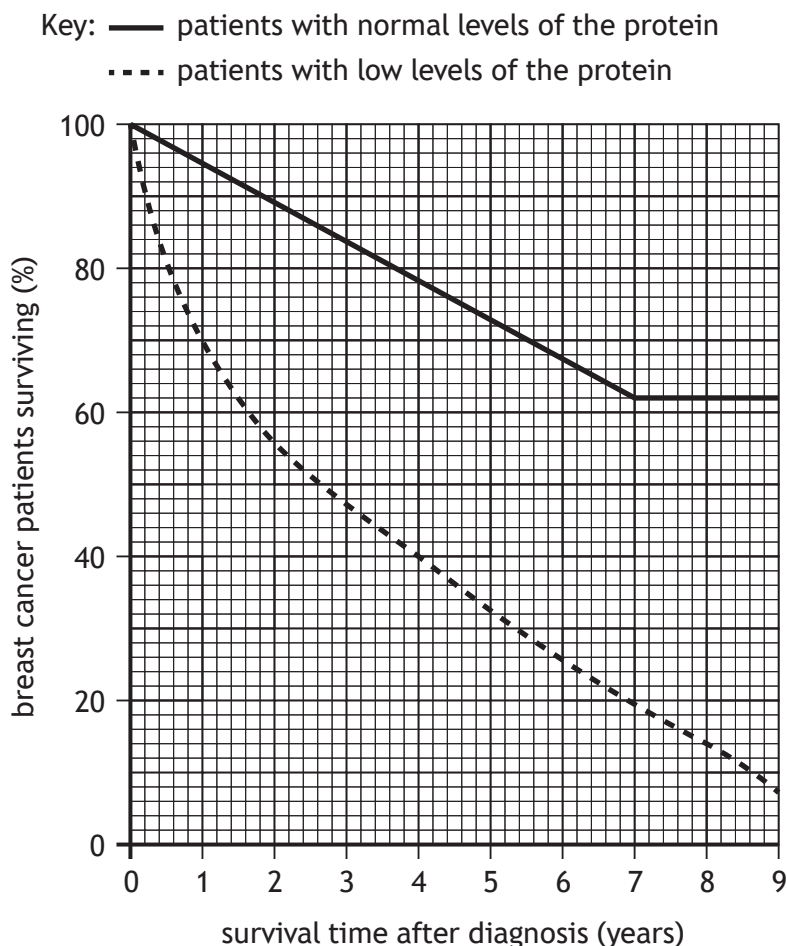


\* X 7 4 0 7 6 0 1 0 7 \*

3. A naturally occurring cell protein (nm23) has been shown to inhibit the activity of cancer cells.

Individuals produce varying levels of this protein depending on their genetic make-up.

The graph below shows the results of a 9 year study of women diagnosed with breast cancer. The women were divided into two groups according to their production of the protein.



- (a) (i) In a city, 1000 women were diagnosed with breast cancer. Of these women, 900 had normal levels of the protein while 100 had low levels.

Using the results from the study, calculate how many of the 1000 women would be expected to survive for 4 years after diagnosis.

1

*Space for calculation*



## 3. (a) (continued)

- (ii) Use data from the graph to describe the changes in the percentage of surviving breast cancer patients with normal levels of the protein during the study.

2

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- (b) Describe how cancer can develop and spread through the body.

3

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[Turn over



\* X 7 4 0 7 6 0 1 0 9 \*

4. A student carried out an investigation into the effect of physical activity on respiration rate.

The rate of respiration of six individuals was measured after carrying out three different activities for five minutes.

Immediately after completing the activity, each individual breathed into a bottle containing a pH indicator solution. This indicator changes colour from blue to yellow in the presence of a high concentration of carbon dioxide.

Figure 1 – Apparatus used

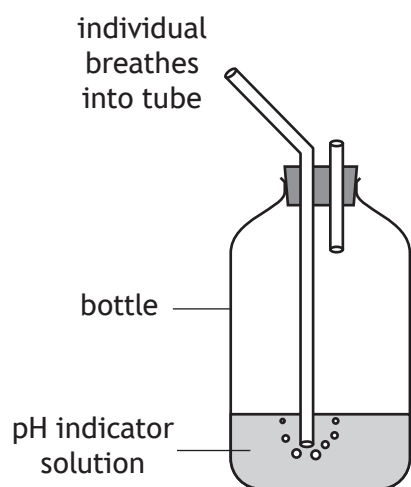


Table 1 – Results of Investigation

Individual	Time taken for pH indicator to turn yellow (s)		
	Activity 1 resting	Activity 2 walking	Activity 3 running
1	33	28	22
2	29	14	11
3	22	16	12
4	30	26	20
5	44	35	22
6		31	21
Average time taken (s)	33	25	18

- (a) State **two** variables which would have to be kept constant when setting up the apparatus shown in Figure 1.

2

- 1 \_\_\_\_\_  
 2 \_\_\_\_\_

- (b) Calculate the time taken for the indicator to turn yellow after individual 6 had completed Activity 1.

1

Space for calculation

\_\_\_\_\_ s



4. (continued)

(c) Describe how the student increased the reliability of the results.

1

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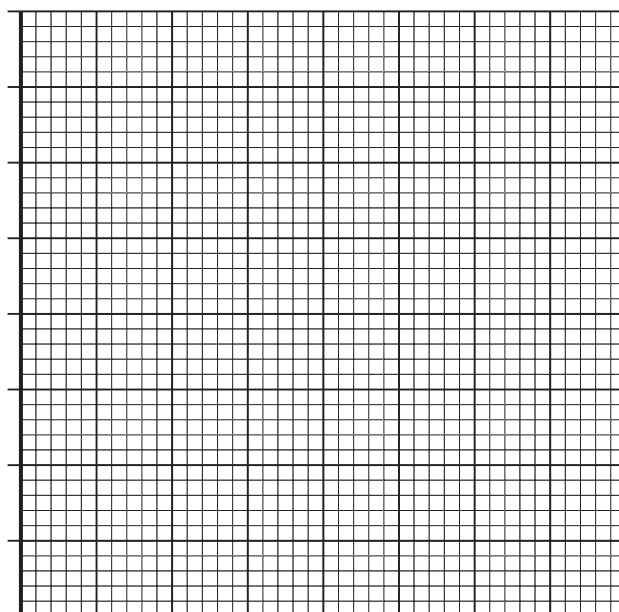


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(d) Construct a bar graph to show the average results obtained in this investigation.

2

(Additional graph paper, if required, can be found on *Page 31*)



(e) State a conclusion that can be drawn from the results of this investigation.

1

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(f) Suggest an explanation for the results obtained in this investigation.

1

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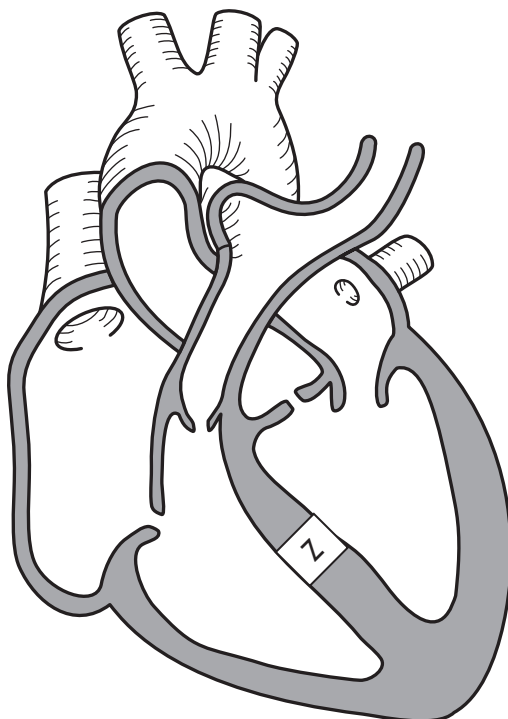
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5. The diagram below represents the structure of the heart and its associated blood vessels.



- (a) On the diagram, **label** the pulmonary artery with the letter P. 1
- (b) Sometimes babies can be born with a ventricular septal defect (VSD) in which a "hole" occurs at point Z in the heart.
- Explain how the presence of this hole would affect the oxygen concentration of the blood leaving the heart through the aorta. 2

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5. (continued)

(c) Babies with a VSD sometimes have irregular heart rhythms. This can be detected by recording the electrical activity from the heart.

(i) Name the chamber of the heart in which this electrical activity originates.

1

\_\_\_\_\_

(ii) Name the type of graph that displays such patterns of electrical activity.

1

\_\_\_\_\_

(d) Babies with a VSD often have a lower stroke volume than babies who have a normal heart structure.

Despite this, both groups of babies often have similar cardiac outputs.

Suggest how babies with a VSD are able to achieve a similar cardiac output to babies with a normal heart structure.

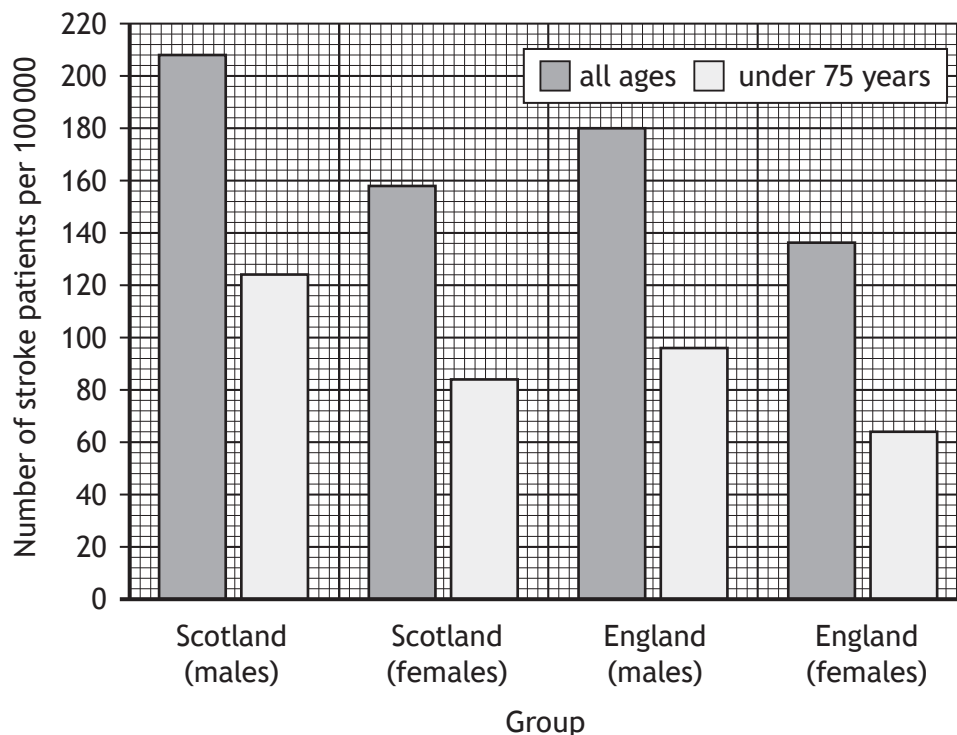
1

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[Turn over



6. The graph below shows the number of stroke patients in different groups from Scotland and England in 2007.



- (a) (i) Calculate the difference in the number of male stroke patients of all ages in Scotland and England in 2007. 1

*Space for calculation*

\_\_\_\_\_ per 100 000

- (ii) Explain the importance of presenting the data as the number of stroke patients **per 100 000**. 1

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6. (a) (continued)

(iii) Scotland's population was 5.1 million in 2007.

Calculate the number of female stroke patients in Scotland under 75 years of age in this year.

1

*Space for calculation*

\_\_\_\_\_

(iv) Express, as a simple whole number ratio, the number of male stroke patients under 75 years of age compared to female stroke patients under 75 years of age in England in 2007.

1

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_  
 male patients      female patients

(b) Describe what causes a stroke.

1

\_\_\_\_\_  
 \_\_\_\_\_

(c) Paralysis occurs when voluntary muscle is unable to contract.

Explain how a stroke could lead to muscle paralysis on the left side of the body.

2

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



7. The table below contains information about five obese patients who attended a weight loss clinic for 12 weeks.

Patient	Height (m)	Starting weight (kg)	Starting BMI	Final Weight (kg)	Final BMI
P	1.74	92	30.5	82	27.2
Q	1.68	98	34.8	90	32.1
R	1.81	104	31.8	97	29.7
S	1.89	121	33.9	113	31.4
T	1.90	100	32.3	94	

(a) (i) Calculate the final BMI of patient T. 1  
*Space for calculation*

Final BMI = \_\_\_\_\_

(ii) State why patient Q was still classed as obese after 12 weeks. 1

\_\_\_\_\_

\_\_\_\_\_

(b) Explain why all the patients were advised to exercise regularly to increase their weight loss. 1

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\_\_\_\_\_



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7. (continued)

(c) Rugby players may have a BMI which indicates that they are obese.

Suggest why a BMI reading may not be a reliable indicator of obesity in rugby players.

1

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[Turn over



\* X 7 4 0 7 6 0 1 1 7 \*

8. Statins are drugs which reduce the production of cholesterol in the liver. A year-long trial was carried out to investigate the effects of taking a newly-developed statin on blood cholesterol levels.

Sixty individuals with raised blood cholesterol levels were selected and divided into two groups of thirty.

Individuals in Group 1 were prescribed a capsule, containing 20 mg of the statin, to take each day. Individuals in Group 2 were the control group. At two-monthly intervals, blood samples were taken from all individuals and their blood cholesterol levels measured.

The results are shown in the table below.

<i>Month of trial</i>	<i>Average blood cholesterol level (mmol/l)</i>	
	Group 1	Group 2
0	6.3	6.3
2	6.3	6.3
4	6.3	6.1
6	6.3	6.3
8	5.6	6.1
10	5.3	6.2
12	5.1	6.1

- (a) Using the results in the table, give one reason why this drug might be 2

recommended \_\_\_\_\_

\_\_\_\_\_

not recommended \_\_\_\_\_

\_\_\_\_\_

- (b) Suggest what was prescribed to the individuals in Group 2 during this trial. 1

\_\_\_\_\_

\_\_\_\_\_



8. (continued)

- (c) Describe the design features which would have been used to ensure that this was both a randomised and a double-blind trial. 2

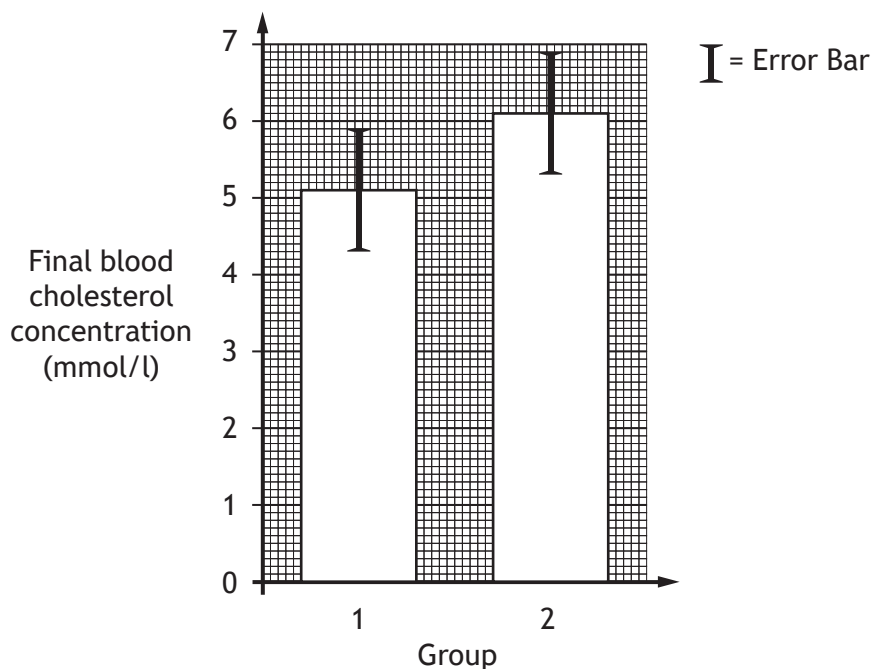
randomised \_\_\_\_\_

\_\_\_\_\_

double-blind \_\_\_\_\_

\_\_\_\_\_

- (d) The bar graph below summarises the data collected in the final month of this trial.



- Using evidence from the bar graph, suggest why it was decided that this statin was not worth further development. 1

\_\_\_\_\_

\_\_\_\_\_



- (e) Describe **one** function of cholesterol in the human body. 1

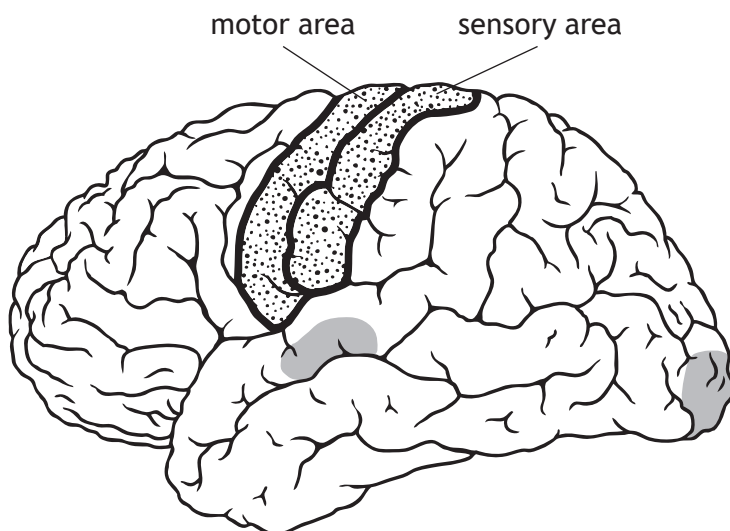
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9. The diagram below represents areas of high activity in a part of the brain of an individual as a task is described to them which they then complete.

-  areas of high activity during the description of the task
-  areas of high activity during the completion of the task



(a) Name the part of the brain shown in the diagram. 1

\_\_\_\_\_

(b) Explain how the diagram supports the suggestion that there is localisation of function in the brain. 1

\_\_\_\_\_  
\_\_\_\_\_

(c) Explain the high level of brain activity during the description of the task. 1

\_\_\_\_\_  
\_\_\_\_\_



## 9. (continued)

(d) The task was to fold a piece of paper.

Explain why the diagram shows high levels of activity in the sensory and motor areas.

2

Sensory area \_\_\_\_\_

\_\_\_\_\_

Motor area \_\_\_\_\_

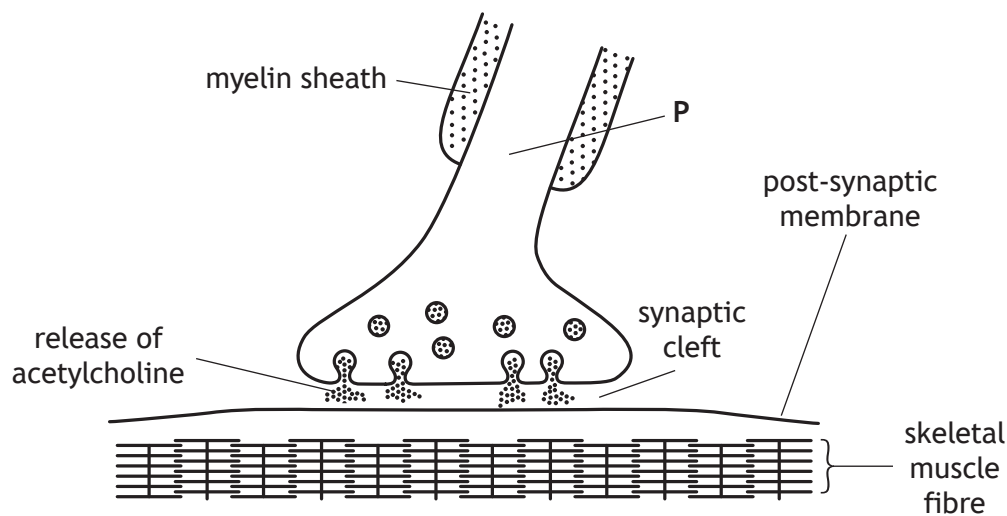
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\* X 7 4 0 7 6 0 1 2 1 \*

10. The diagram below shows a synapse in skeletal muscle of a weightlifter.



(a) Name the part of the motor neuron labelled P. 1

\_\_\_\_\_

(b) Describe what acetylcholine does when it reaches the post-synaptic membrane. 1

\_\_\_\_\_  
\_\_\_\_\_

(c) Name the type of skeletal muscle fibres which will be the most common in the arm muscles of a champion weightlifter. 1

\_\_\_\_\_



## 10. (continued)

(d) Nicotine is a drug that is an agonist of acetylcholine.

(i) Explain how an agonist works.

1

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(ii) Suggest how nicotine induces feelings of pleasure and so reinforces smoking behaviour.

1

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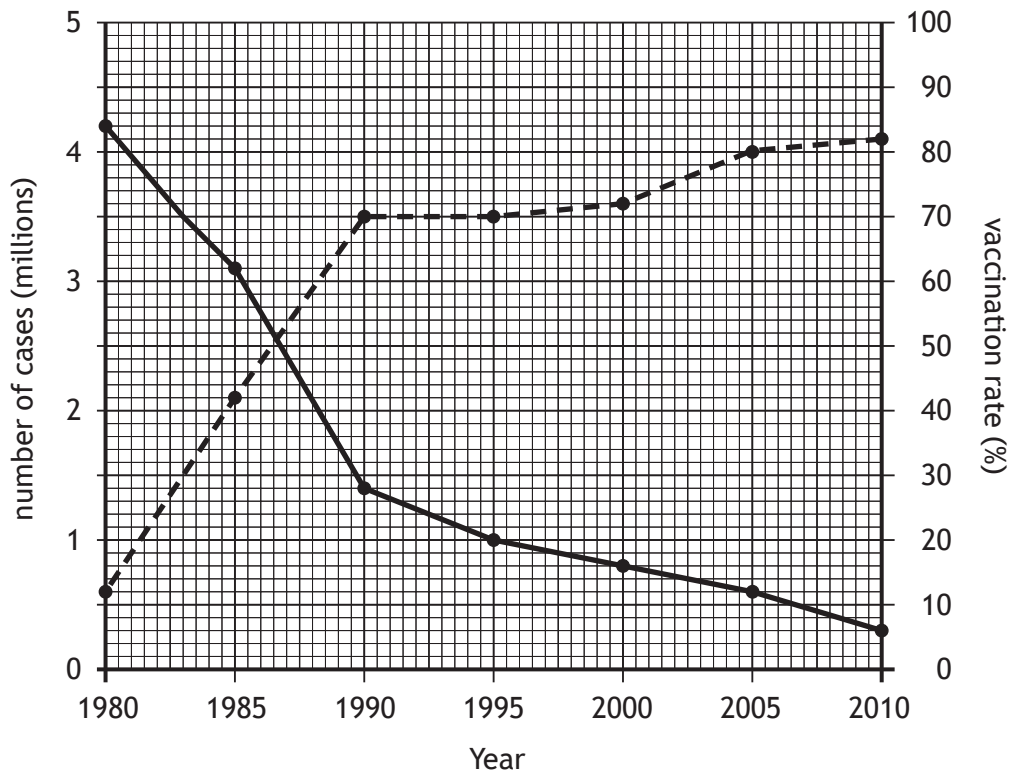
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11. The graph below shows the number of cases of measles that occurred in the world between 1980 and 2010. It also shows the global vaccination rate against measles over the same period.

Key: ●——● number of cases    ●- - - -● vaccination rate



- (a) State how many cases of measles there were in 1985. 1
- \_\_\_\_\_
- (b) State the vaccination rate when there were 3.5 million cases of measles in the world. 1
- \_\_\_\_\_ %
- (c) Calculate the percentage decrease in the number of cases of measles between 1995 and 2010. 1
- Space for calculation*
- \_\_\_\_\_



11. (continued)

(d) In many countries herd immunity has been established against measles.

(i) Explain why people in these countries who have not been vaccinated are still protected against measles.

1

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(ii) Suggest **one** reason why widespread vaccination programmes against measles are not possible in all countries of the world.

1

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(e) In 2010 the population of the world was 6900 million.

Using the information from the graph, calculate how many people in the world had not been vaccinated against measles in 2010.

1

*Space for calculation*

\_\_\_\_\_ million

(f) The World Health Organisation (WHO) has set a goal of eliminating measles worldwide by 2020.

Explain how the information in the graph indicates that this goal can be achieved.

1

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12. Specific cellular defences are part of the body's immune system and give protection against individual types of pathogen.

(a) (i) Explain how a clonal population of lymphocytes would be formed when a pathogen invades the body.

2

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(ii) Describe the role of phagocytes in the specific immune response.

2

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(b) Failure of the immune system can lead to conditions such as allergy and autoimmune disease.

Choose **one** of these conditions and complete the table below with information about it.

2

Condition \_\_\_\_\_

<i>Type of white blood cell involved</i>	<i>Description of immune system failure</i>



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13. Answer either A or B in the space below.

Labelled diagrams may be used where appropriate.

A Discuss the causes, development and associated health problems of atherosclerosis.

8

OR

B Discuss the diagnosis, treatment and role of insulin in Type 1 and Type 2 diabetes.

8



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ADDITIONAL SPACE FOR ANSWER to Question 13

[END OF QUESTION PAPER]



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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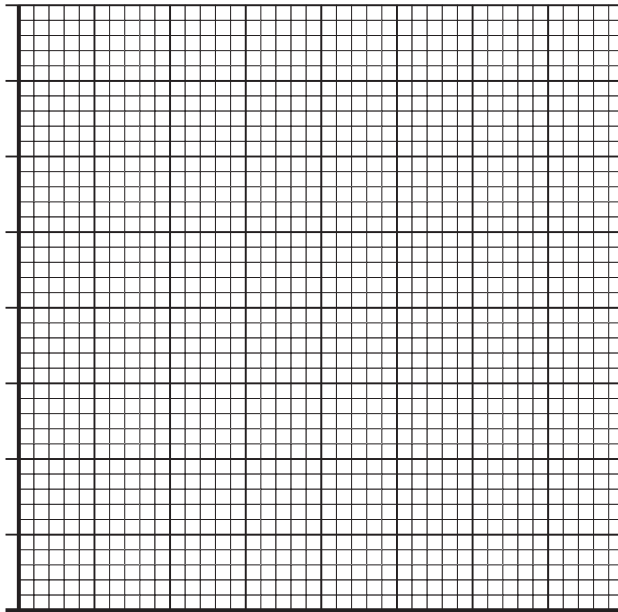
ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph paper for Question 4 (d)



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