



National
Qualifications
2017

X740/76/02

**Human Biology
Section 1 — Questions**

TUESDAY, 23 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 *

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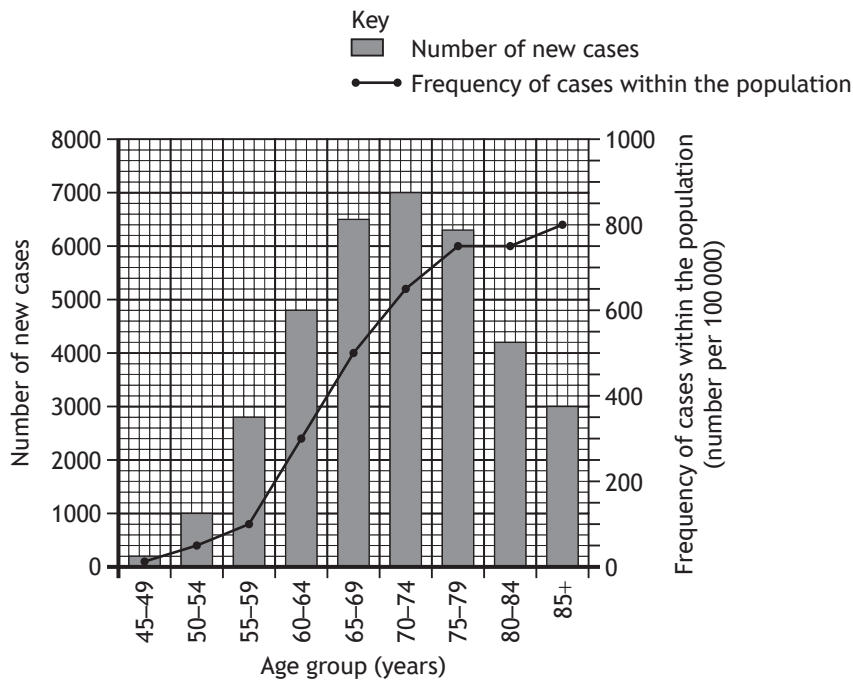
SECTION 1 — 20 marks

Attempt ALL questions

1. Which row in the table shows the type of stem cell that has the potential to form the greatest variety of specialised cells?

	Type of stem cell	State of differentiation
A	embryonic	differentiated
B	tissue	differentiated
C	embryonic	undifferentiated
D	tissue	undifferentiated

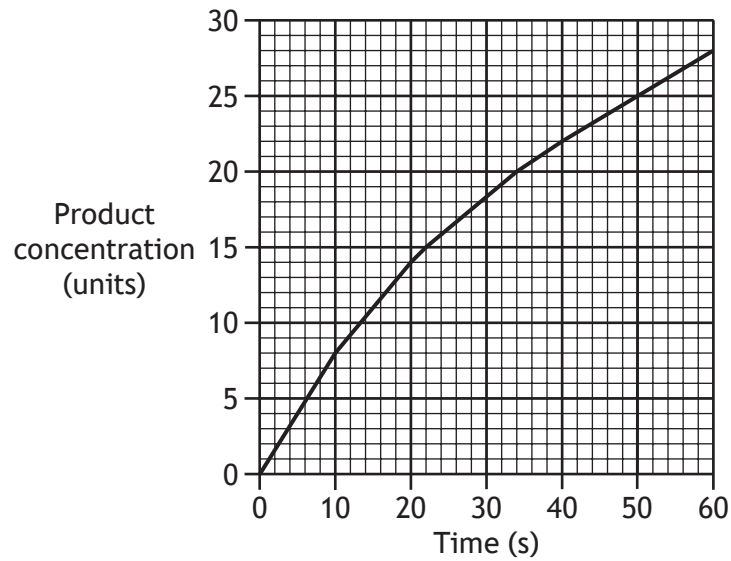
2. The graph contains information about prostate cancer in the UK in 2006.



Which of the following conclusions can be drawn from the graph?

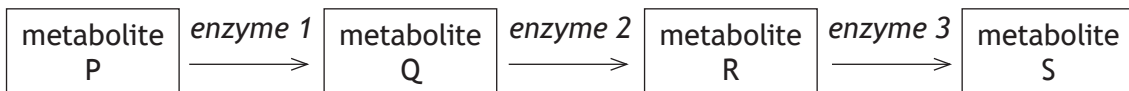
- A The highest frequency of cases within the population was in the 70–74 year old age group.
- B As the age group increases, the frequency of cases within the population always increases.
- C When there were 4800 new cases, the frequency of cases within the population was 600 per 100 000.
- D The greatest increase in the number of new cases, between consecutive age groups, occurred between 55–59 and 60–64.

3. The graph shows how the concentration of product changes during an enzyme-controlled reaction.



How long does it take the product concentration to reach 50% of its final concentration?

- A 20 s
 - B 22 s
 - C 25 s
 - D 28 s
4. A metabolic pathway is shown.



In end-product inhibition

- A enzyme 3 binds to enzyme 1
- B enzyme 3 binds to metabolite P
- C metabolite S binds to enzyme 1
- D metabolite S binds to metabolite P.

[Turn over

5. Mature red blood cells have no nucleus and no mitochondria.

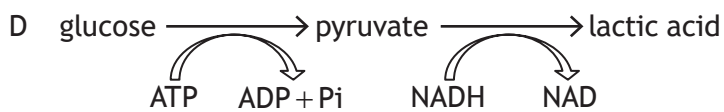
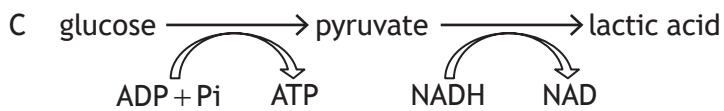
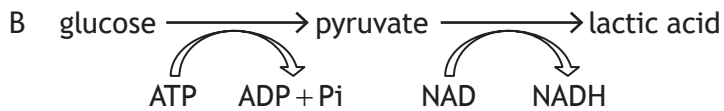
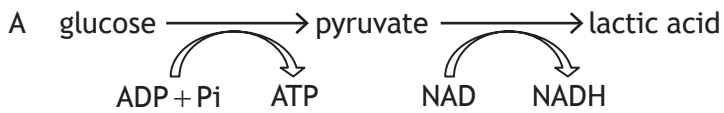
Which of the following processes can be carried out by a mature red blood cell?

- A Glycolysis
- B Cell division
- C Protein synthesis
- D Electron transport chain

6. During respiration most ATP is produced when

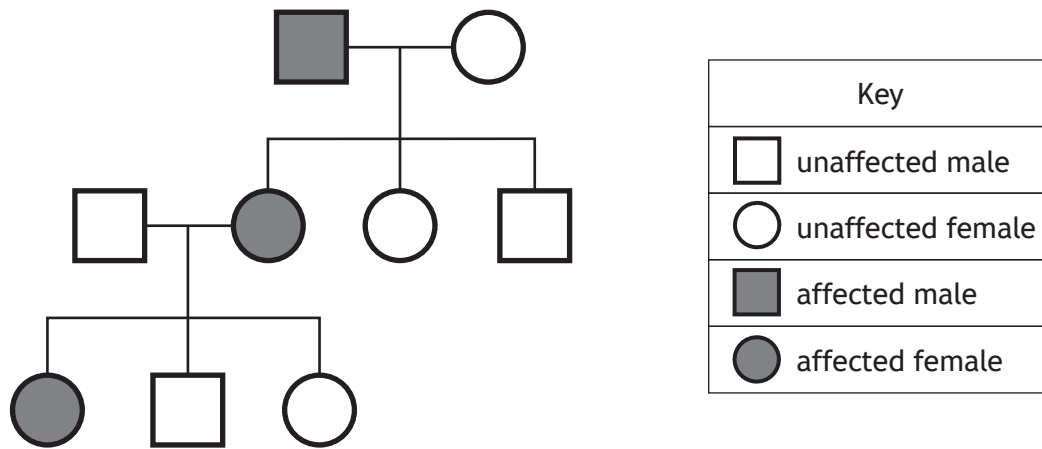
- A electrons are passed through the membrane protein ATP synthase
- B hydrogen ions are passed through the membrane protein ATP synthase
- C electrons are pumped through the outer membrane of the mitochondrion
- D hydrogen ions are moved along carriers in the inner membrane of the mitochondrion.

7. Which of the following equations summarises the conversion of glucose to lactic acid?



8. The diagram shows the inheritance of familial hypercholesterolaemia (FH) in three generations of a family.

FH is caused by an autosomal dominant allele.



How many individuals in this family are homozygous dominant for this condition?

- A 0
 B 1
 C 2
 D 3
9. Red-green colour vision deficiency is a sex-linked recessive condition. Females heterozygous for the condition are described as being 'carriers'. A colour vision deficient woman and an unaffected man have children. Which of the following show the expected phenotypic ratio of the children?

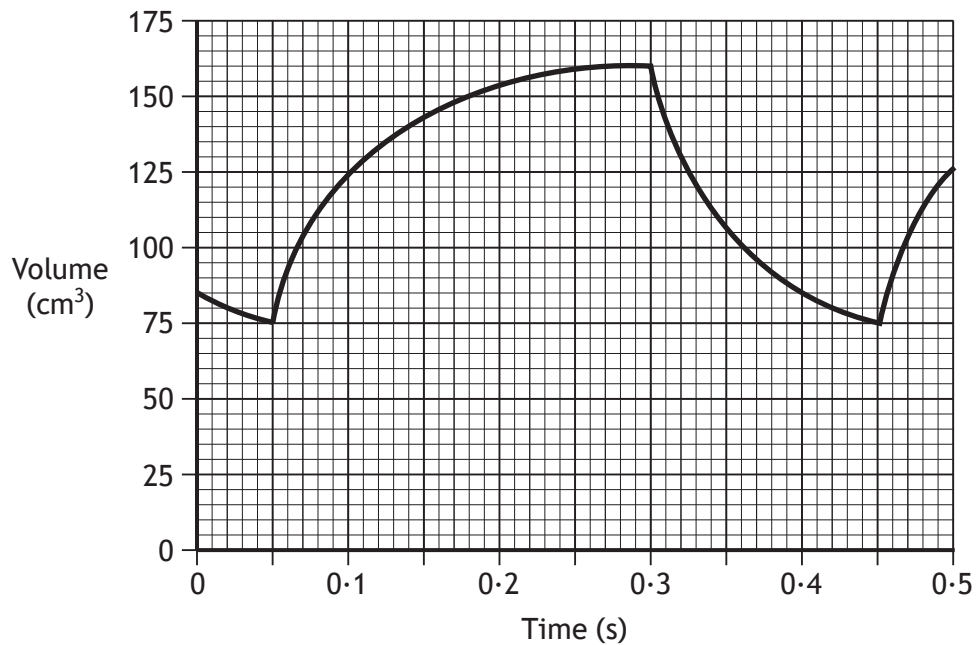
- A 1 carrier daughter : 1 colour vision deficient son
- B 1 unaffected daughter : 1 colour vision deficient son
- C 1 unaffected daughter : 1 colour vision deficient son : 1 unaffected son : 1 carrier daughter
- D 1 carrier daughter : 1 colour vision deficient son : 1 unaffected son : 1 colour vision deficient daughter

[Turn over

10. Which row in the table shows how the autonomic nervous system controls an increase in heart rate?

	<i>Branch of autonomic nervous system</i>	<i>Neurotransmitter</i>
A	sympathetic	acetylcholine
B	parasympathetic	noradrenaline
C	sympathetic	noradrenaline
D	parasympathetic	acetylcholine

11. The graph shows changes in the volume of blood in the left ventricle of an individual's heart while running.



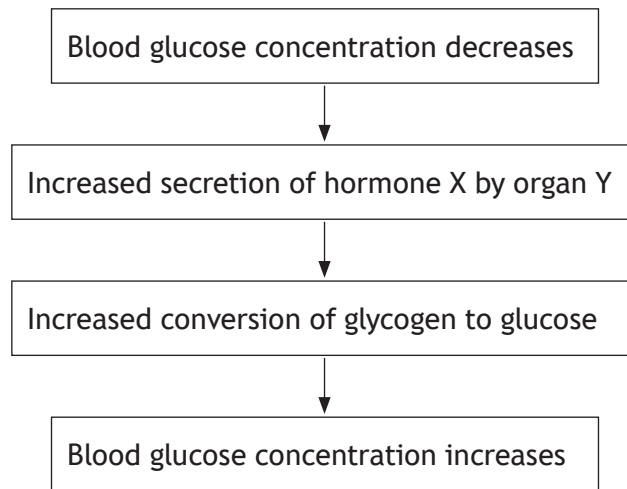
The cardiac output of this individual is

- A 5 100 cm³/min
- B 10 200 cm³/min
- C 12 750 cm³/min
- D 24 000 cm³/min.

12. During clot formation, thrombin

- A forms prothrombin
- B causes formation of fibrin threads
- C causes the release of clotting factors
- D forms a meshwork that clots the blood.

13. The flow diagram shows how the concentration of glucose in the blood is controlled during exercise.



Which row in the table identifies hormone X and organ Y?

	<i>Hormone X</i>	<i>Organ Y</i>
A	insulin	liver
B	glucagon	liver
C	insulin	pancreas
D	glucagon	pancreas

14. A person is 170 cm tall and weighs 70 kg.

They have a body mass index (BMI) of

- A 2.4
- B 24.2
- C 28.8
- D 41.2.

[Turn over

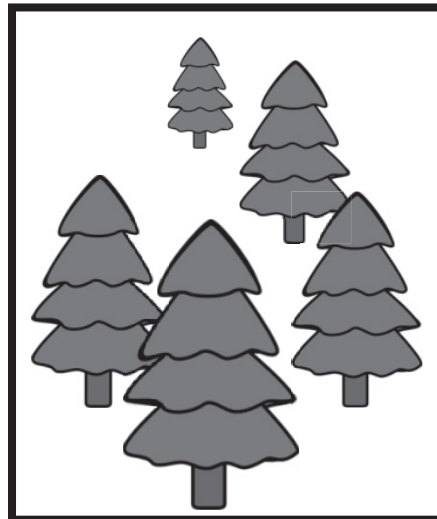
15. The following list shows three areas of the brain.

- 1 Cortex
- 2 Limbic system
- 3 Corpus callosum

Which of these areas are involved in storing spatial memories?

- A 1 only
- B 2 only
- C 1 and 2 only
- D 1, 2 and 3

16. The picture shows a scene with trees.



What visual cues are used in the perception of depth in this picture?

- 1 Relative size
 - 2 Relative height
 - 3 Superimposition
 - 4 Perceptual constancy
- A 1 only
 - B 1 and 2 only
 - C 1, 2 and 3 only
 - D 1, 2, 3 and 4

17. Some individuals who suffer head injuries forget the events that happened a few seconds before the injury occurred.

This memory loss is most likely to be due to the injury affecting

- A retrieval
- B displacement
- C long-term memory
- D short-term memory.

18. Three groups of students were asked to make paper aeroplanes.
Each student had to make five aeroplanes.

The table shows the conditions under which each group worked.

<i>Group</i>	<i>Written set of instructions supplied</i>	<i>Demonstration given on how to fold the paper</i>	<i>Prize awarded to the first student finished</i>
1	yes	no	no
2	no	yes	no
3	no	no	yes

What behavioural term is used to describe the method of learning used by group 2 only?

- A Shaping
- B Imitation
- C Trial and error
- D Reinforcement

[Turn over for next question

19. The table shows the numbers of different types of white blood cells found in blood samples taken from a healthy person and from three different patients.

<i>Type of white blood cell</i>	<i>White blood cells found in blood sample (cells/mm³)</i>			
	<i>Healthy person</i>	<i>Patient X</i>	<i>Patient Y</i>	<i>Patient Z</i>
Phagocyte	7000	7000	8000	7000
Lymphocyte	3000	2000	3000	3500
Mast cell	1000	1000	1000	1500

Use the information above to match each condition to the correct patient.

	<i>Condition</i>		
	<i>Allergic response</i>	<i>HIV</i>	<i>Infected wound</i>
A	Y	X	Z
B	X	Z	Y
C	Z	Y	X
D	Z	X	Y

20. Which term would be used to describe a global outbreak of an infectious disease?
- A Endemic
 - B Sporadic
 - C Epidemic
 - D Pandemic

[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**

TUESDAY, 23 MAY

1:00 PM – 3:30 PM



* X 7 4 0 7 6 0 1 *

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

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Year

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Scottish candidate number

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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.

Question 12 contains a choice.

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.



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

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).

A	B	C	D
<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**.

A	B	C	D
<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:

A	B	C	D	or	A	B	C	D
<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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[Turn over for next question

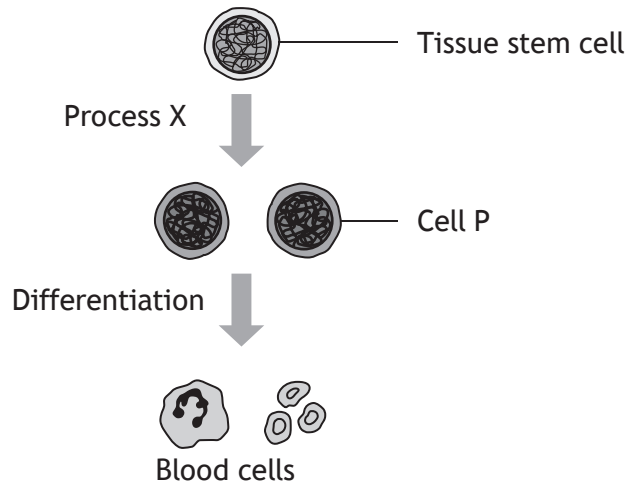
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* X 7 4 0 7 6 0 1 0 5 *

SECTION 2 — 80 marks
 Attempt ALL questions
 Question 12 contains a choice

1. The diagram shows some stages in the development of blood cells.



(a) Name process X. 1

(b) Name the tissue type to which blood cells belong. 1

(c) Explain why red blood cells contain haemoglobin after differentiation but white blood cells do not. 1

(d) Describe how a tumour might develop from cell P. 1

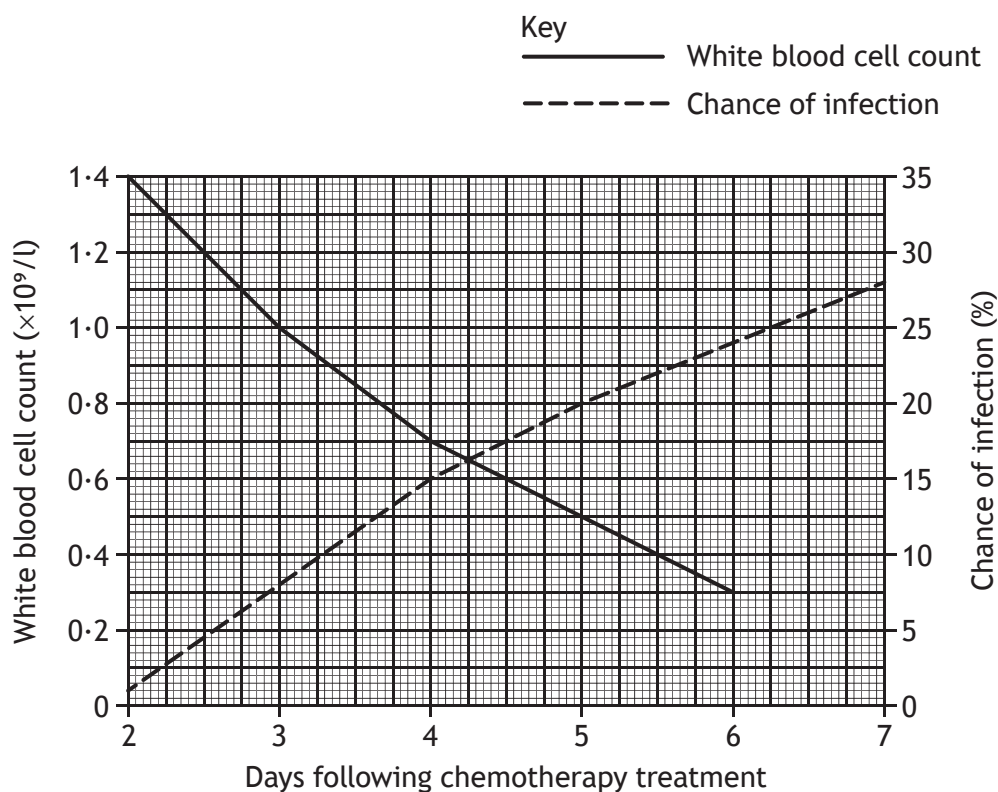


1. (continued)

(e) Cancer patients can be treated using chemotherapy.

This treatment destroys tumour cells but also reduces the number of white blood cells. As a result, patients have a higher chance of infection.

The graph shows the white blood cell count of a cancer patient and their chance of infection in the days following chemotherapy treatment.



(i) State the chance of infection after treatment when the white blood cell count was $0.7 \times 10^9/l$. 1

_____ %

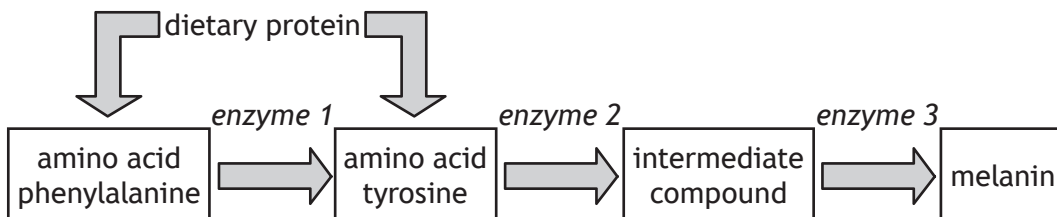
(ii) Predict the white blood cell count seven days following chemotherapy treatment. 1

_____ $\times 10^9/l$

[Turn over



2. Phenylketonuria (PKU) is an example of a genetic disorder which affects the following metabolic pathway.



(a) In PKU enzyme 1 is faulty.

(i) Describe how a substitution mutation would alter the gene coding for enzyme 1. 1

(ii) Explain how a substitution mutation may cause the synthesis of a faulty enzyme. 1

(b) Use the metabolic pathway above to suggest

(i) why PKU results in a build-up of phenylalanine; 1

(ii) why individuals with PKU can still produce melanin. 1

2. (continued)

(c) Babies born with PKU can develop brain damage from the build-up of phenylalanine and its harmful metabolites.

(i) All babies are tested for PKU immediately after birth.

State the term used to describe this type of diagnostic testing.

1

(ii) Describe how brain damage can be prevented in babies diagnosed with PKU.

1

(d) PKU is caused by an autosomal recessive allele.

A couple, who are both unaffected, have a child who has PKU.

Calculate the percentage chance of their next child having this disorder.

1

Space for calculation

_____ %

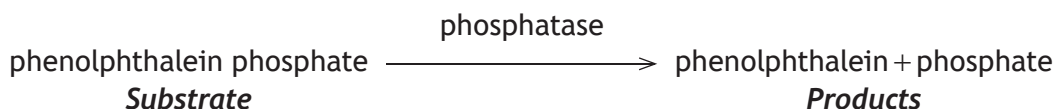
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* X 7 4 0 7 6 0 1 0 9 *

3. An investigation was carried out into the effect of a competitive inhibitor on the activity of phosphatase at different substrate concentrations.

Phosphatase is an enzyme which catalyses the reaction shown.



Six test tubes each containing a different concentration of substrate were set up. The inhibitor and then the enzyme were added to each tube.

Figure 1 shows the contents of each tube.

After 30 minutes, 1 cm³ of alkali was added to each tube.

Phenolphthalein turns pink in the presence of alkali. The more phenolphthalein produced, the more intense the pink colour and the higher the absorbance reading measured by a colorimeter.

Table 1 shows the results of the investigation.

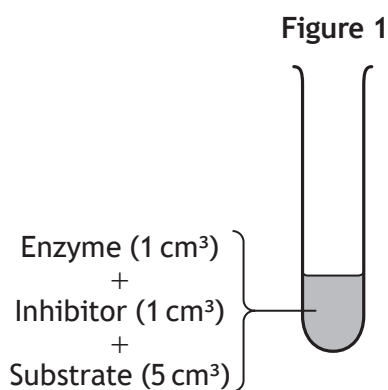


Table 1

Concentration of substrate (M)	Absorbance (units)
0.05	0.20
0.10	0.30
0.20	0.48
0.40	0.64
0.60	0.78
0.80	0.90

- (a) Suggest why alkali was **not** added to each tube at the start of the investigation.

1

- (b) State **two** variables, other than those shown above, which should be kept constant to make this investigation valid.

2

1 _____

2 _____

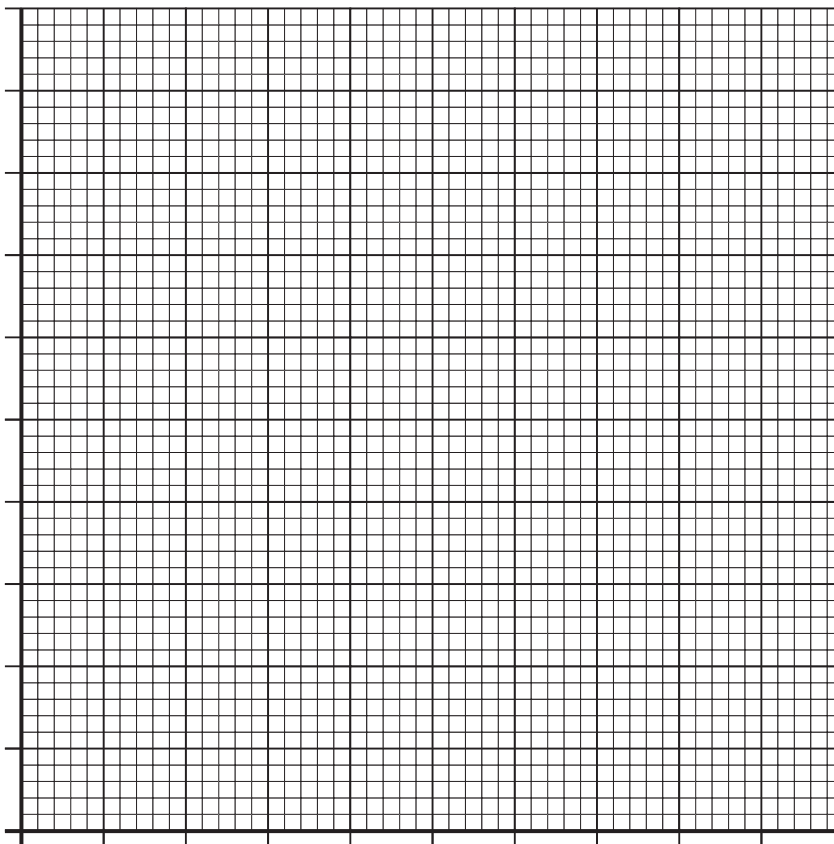


3. (continued)

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- (c) Construct a line graph to show the data in **Table 1**.
(Additional graph paper, if required, can be found on *Page 28*)

2



- (d) It was concluded that increasing substrate concentration reduces the effect of the competitive inhibitor.

Explain how the results of this investigation support this conclusion.

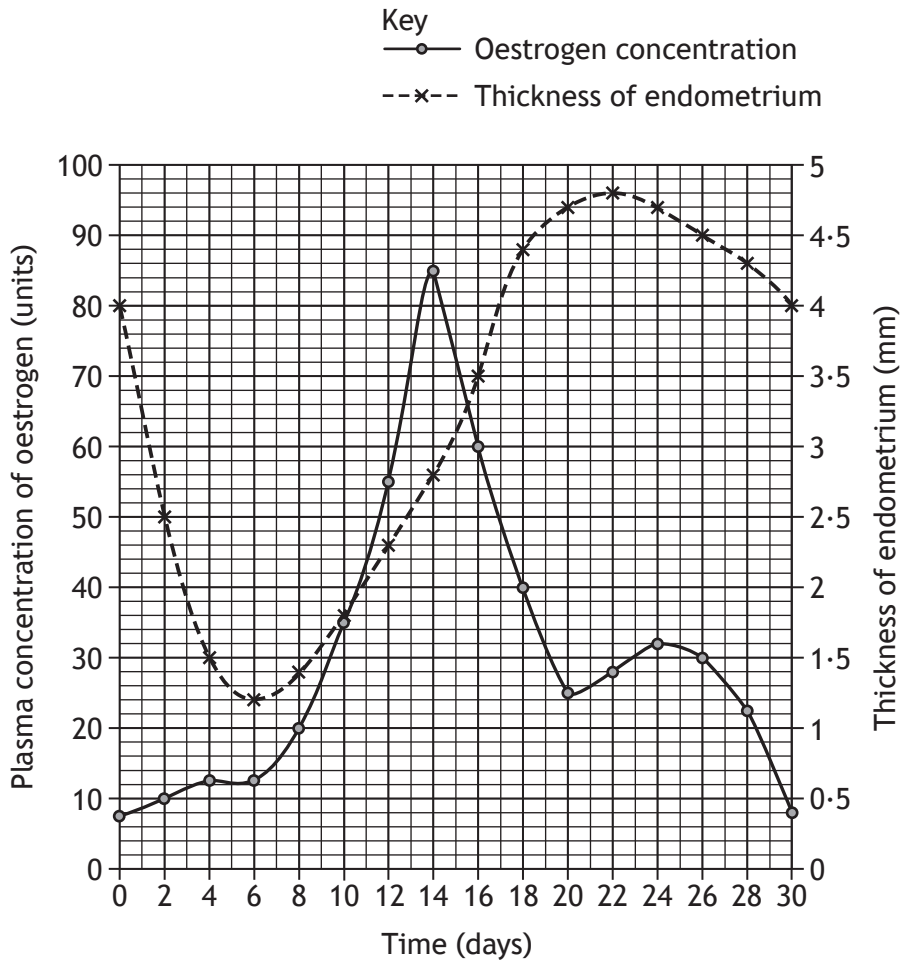
2

- (e) Suggest how the results of this investigation would be different if a non-competitive inhibitor had been used.

1



4. The graph shows how the plasma concentration of oestrogen and the thickness of the endometrium vary during a woman's menstrual cycle.



(a) Ovulation occurs on day 15 of this cycle.

(i) Describe the role of oestrogen in triggering this event.

1

(ii) State the thickness of the endometrium on day 15.

1

_____ mm



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

4. (continued)

- (b) (i) Express, as a simple whole number ratio, the thickness of the endometrium on day 6 compared to day 22.

1

Space for calculation

_____ : _____
Day 6 Day 22

- (ii) Oestrogen stimulates thickening of the endometrium.

Describe evidence from the graph which indicates that another factor also stimulates thickening of the endometrium.

1

- (c) Suggest **one** way in which the graph for the next menstrual cycle would differ from this one if the woman became pregnant during that cycle.

1

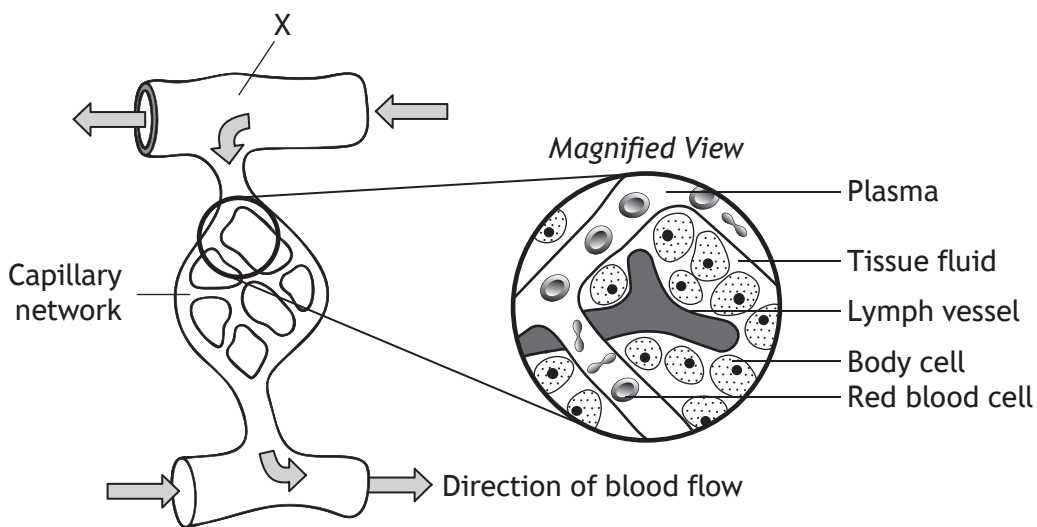
- (d) State how fertility drugs stimulate ovulation.

1

[Turn over



5. The diagram represents a capillary network, associated vessels and cells.



(a) (i) Name the type of blood vessel labelled X. 1

(ii) State how blood vessel X can reduce blood flow to the capillary network. 1

(b) (i) Name the layer of cells which forms the wall of a capillary. 1

(ii) Describe how substances pass from plasma to tissue fluid. 1

(iii) Name a type of molecule which is present in plasma but absent in tissue fluid. 1

(c) Describe **one** role of the lymph vessel in the diagram. 1



6. The picture shows a man having his blood pressure measured.



(a) A blood pressure reading consists of a high systolic value and a lower diastolic value.

Explain the difference between these two values.

1

(b) Suggest a reason why the pulse in the man's left wrist stops when the cuff is inflated.

1

(c) The man's blood pressure was measured as 160/100.

(i) Explain how atherosclerosis could have caused this high blood pressure.

2

(ii) The man's blood HDL to LDL ratio was lower than normal. Describe how this may have contributed to atherosclerosis.

1



7. Hormone replacement therapy (HRT) is used by women to relieve symptoms of the menopause, which usually occurs from around the age of 50.

A study was carried out into the effects of HRT on the health of 12 000 women. The women were separated into three equal groups according to their age. Half of each group took a daily HRT tablet while the other half received a placebo. Over the next five years the number of women in each group who developed either a pulmonary embolism or coronary heart disease was recorded.

The results are shown in the table.

Age group (years)	Conditions developed by women in the study			
	Pulmonary Embolism		Coronary Heart Disease	
	Number of cases in women given HRT	Number of cases in women given a placebo	Number of cases in women given HRT	Number of cases in women given a placebo
50–59	10	5	20	18
60–69	20	12	35	33
70–79	30	15	80	76

- (a) Describe **two** trends shown by the results for pulmonary embolism. 2

1 _____

2 _____

- (b) It was concluded that taking HRT has no effect on the risk of coronary heart disease. 1
 Explain why the results of the study support this conclusion.

- (c) Suggest a factor, other than HRT, which could have influenced the results of this study. 1



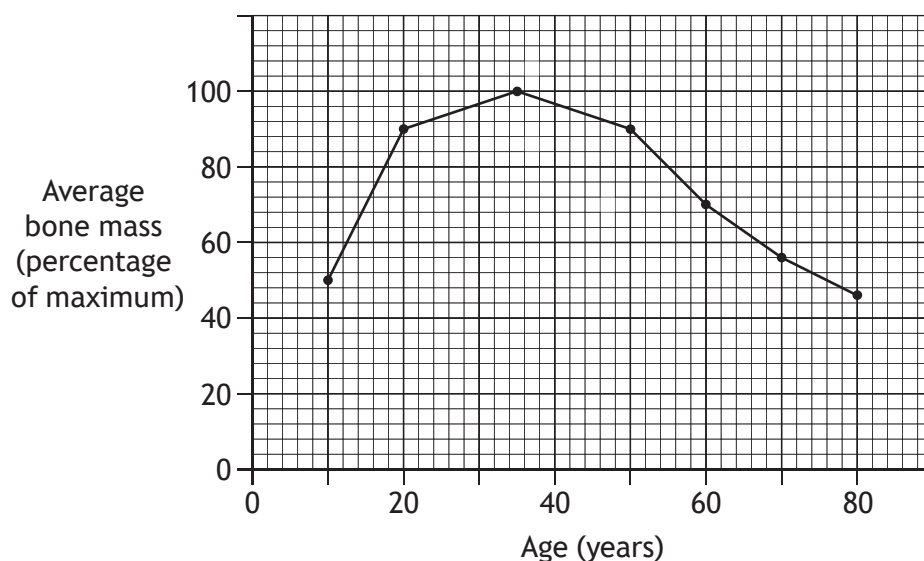
7. (continued)

- (d) Describe how the researchers attempted to make sure that the results of this study were reliable.

1

- (e) HRT can be prescribed to treat osteoporosis, a condition which increases the risk of bones thinning and breaking.

The graph shows how the average bone mass of women changes with age.



- (i) Use data from the graph to describe the changes that occur in the average bone mass between the ages of 10 and 80.

2

- (ii) State the number of years the average bone mass of women is at least 80% of the maximum.

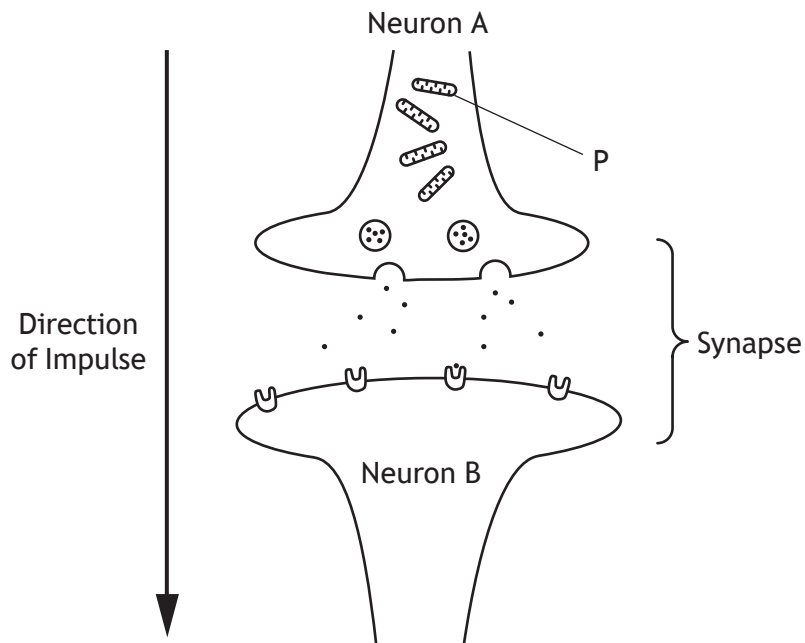
1

_____ years

[Turn over



8. The diagram represents two neurons and the synapse between them.



(a) Name the structure labelled P which generates ATP.

1

(b) Describe how an impulse is transmitted from Neuron A to Neuron B.

3

8. (continued)

- (c) Many drugs which affect synapses may cause sensitisation over a period of time.

Describe the effect that sensitisation has on the synapse and the consequences for the individual.

2

Effect _____

Consequences _____

[Turn over



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9. Sympathetic and parasympathetic nerves regulate heart rate.

(a) Name the part of the brain that regulates the heart rate.

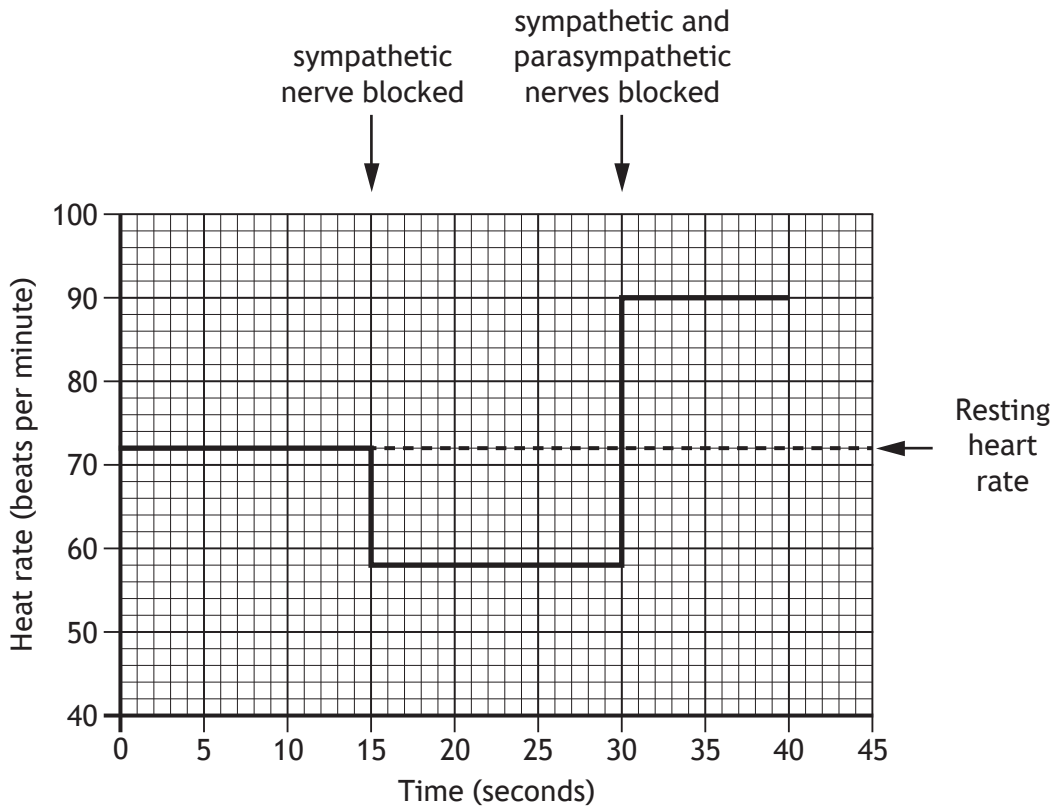
1

(b) The sympathetic and parasympathetic nerves work antagonistically. Explain what this statement means.

1

(c) An investigation was carried out to determine the effects these nerves have on heart rate by firstly blocking the sympathetic nerve and then blocking both nerves.

The graph shows the results of the investigation.



(i) State the heart rate when only the sympathetic nerve is blocked.

1

_____ beats per minute



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

9. (c) (continued)

- (ii) Calculate the increase in the heart rate which then occurs when the parasympathetic nerve is also blocked.

1

_____ beats per minute

- (d) Explain why the heart continues to contract when both nerves are blocked.

1

- (e) The parasympathetic nerve has a greater effect on the resting heart rate than the sympathetic nerve.

Use information from the graph to justify this statement.

1

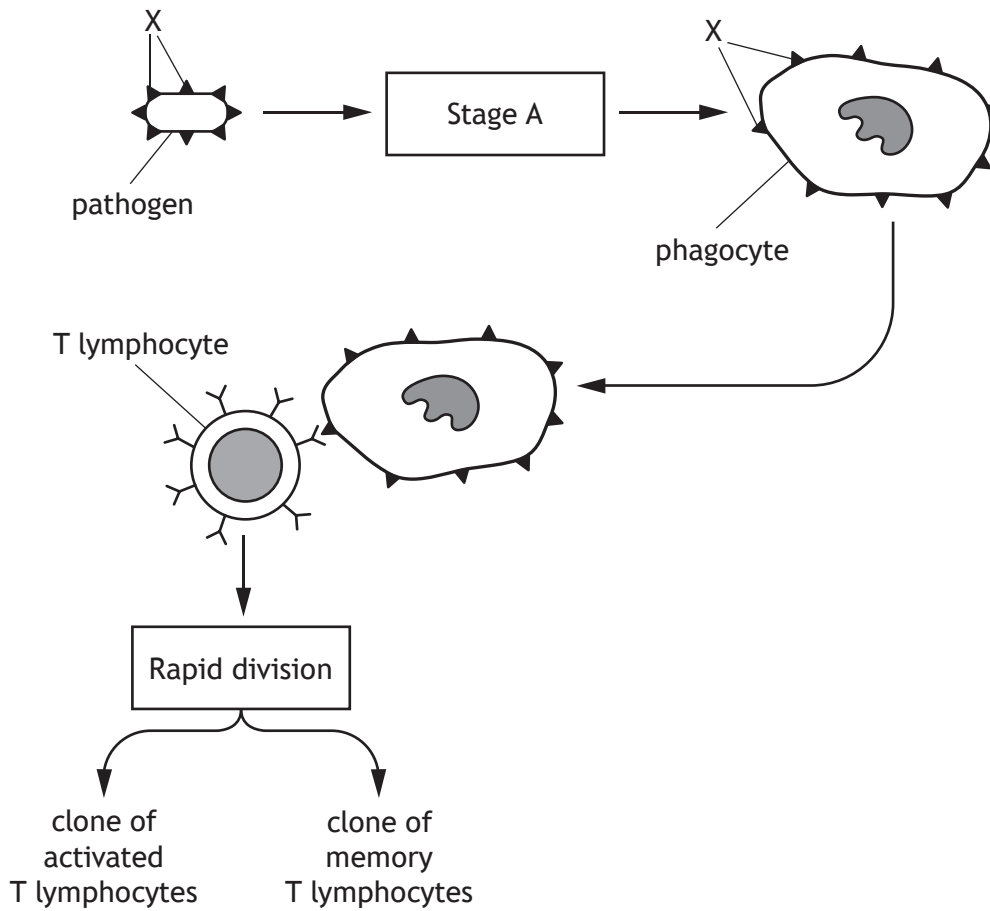
- (f) State **one** other effect the sympathetic nervous system has on the body.

1

[Turn over



10. The diagram shows some of the stages leading to the production of a clone of T lymphocytes by the immune system in response to infection by a pathogen.



(a) Name the structures labelled X.

1

(b) Describe what happens during Stage A.

2

(c) Name the chemicals which aid the movement of T lymphocytes to the site of infection.

1



10. (continued)

- (d) The diagram shows how a clone of memory T lymphocytes is produced.
Describe an advantage of having memory cells.

1

- (e) State how a tuberculosis (TB) pathogen avoids immune detection.

1

[Turn over



* X 7 4 0 7 6 0 1 2 3 *

11. Table 1 contains information about the life expectancy of Scottish children between 1861 and 2011.

Life expectancy is the additional number of years a person is expected to survive from a given age.

Table 1

Year	Average life expectancy of child (years)		
	from birth	from age 1	from age 15
1861	42	47	43
1891	46	52	46
1921	55	59	50
1951	66	68	55
1981	72	72	59
2011	78	77	63

- (a) (i) Calculate the percentage increase in life expectancy for children born in 2011 compared to children born in 1861. 1

Space for calculation

_____ %

- (ii) Give the 30 year period during which the greatest increase in life expectancy from birth occurred. 1

From _____ to _____

- (iii) Suggest **two** reasons for an increase in life expectancy over the 150 year period. 2

1 _____

2 _____



11. (continued)

- (b) Table 2 contains information about the life span of Scottish children.
Life span is the number of years a person lives for.

Table 2

Year	Average Life Span (years)		
	from birth	from age 1	from age 15
1861	42	48	58
2011			

- (i) Use the information in Table 1 to complete Table 2 to indicate the expected average life span of children in 2011. 1
- (ii) Suggest why the figures for 1861 increase from 42 to 58 years. 1

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MARKS

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12. Answer **either A or B** in the space below.

Labelled diagrams may be used where appropriate.

A Describe the structure of DNA and the process of DNA replication.

9

OR

B Describe the structure of RNA and the process of transcription.

9



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ADDITIONAL SPACE FOR ANSWER to Question 12

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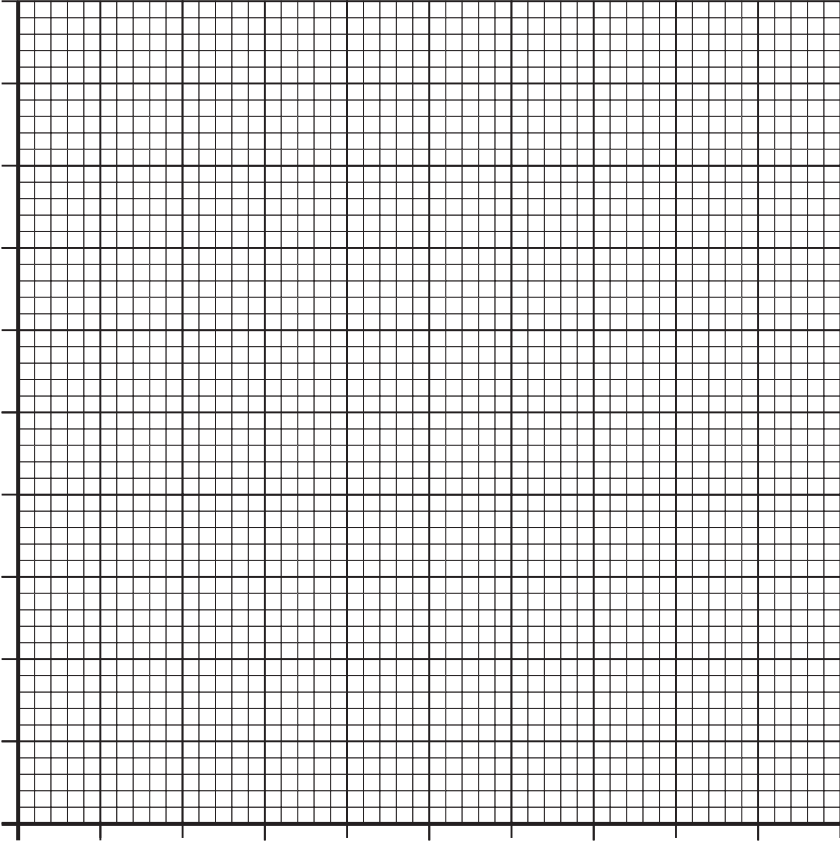
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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph paper for Question 3 (c)



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