FOR OFFICIAL USE

National Qualifications 2017

Mark

X740/76/01

Human Biology
Section 1 — Answer Grid and Section 2

TUESDAY, 23 MAY
1:00 PM – 3:30 PM

X7407601

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.

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.

SQA ©

X7407601 01

SECTION 1 — 20 marks

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

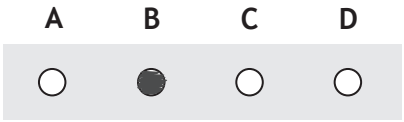
A mouth

B stomach

C duodenum

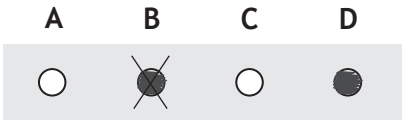
D pancreas.

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

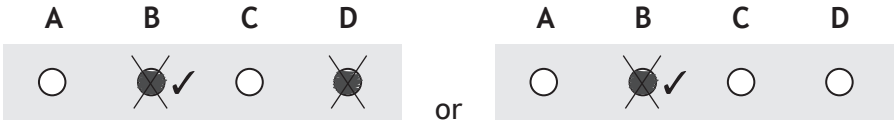


Changing an answer

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**.



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:



SECTION 1 — Answer Grid

OBJ20AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

X7407601 03

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DO NOT WRITE ON THIS PAGE

X7407601 04

[Turn over for next question

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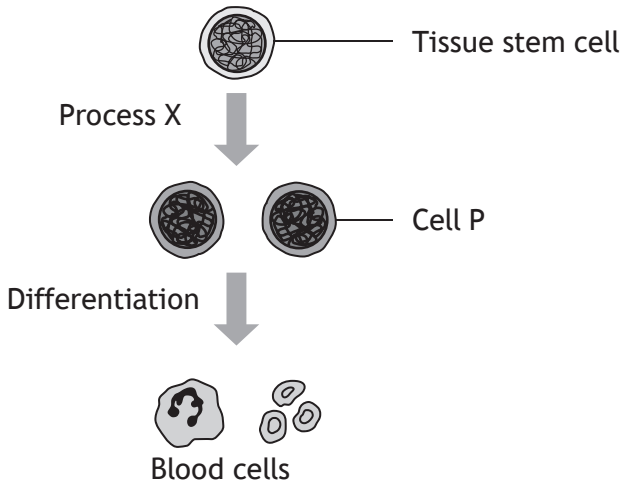
X7407601 05

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**

_____

_____

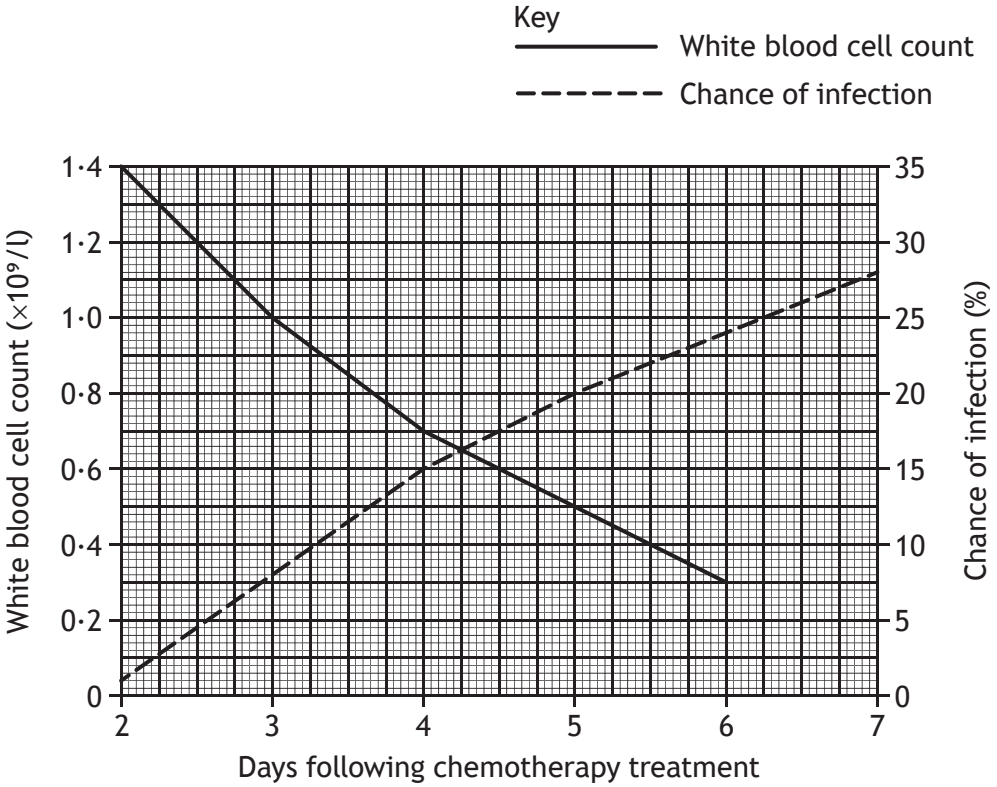
_____

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 $0{\cdot}7 \times 10^9$/l. **1**

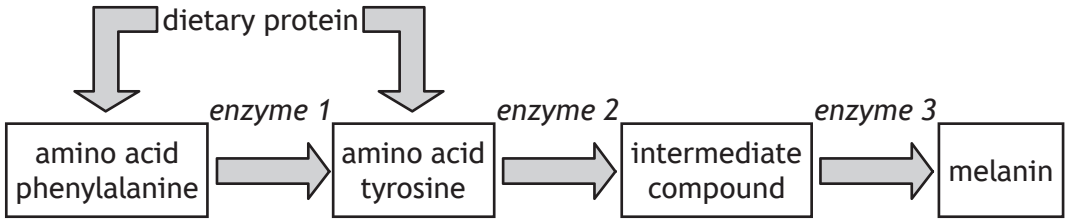
_____%

(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

_____%

[Turn over

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.

$$\underset{\textit{Substrate}}{\text{phenolphthalein phosphate}} \xrightarrow{\text{phosphatase}} \underset{\textit{Products}}{\text{phenolphthalein} + \text{phosphate}}$$

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 cm^3 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.

Figure 1

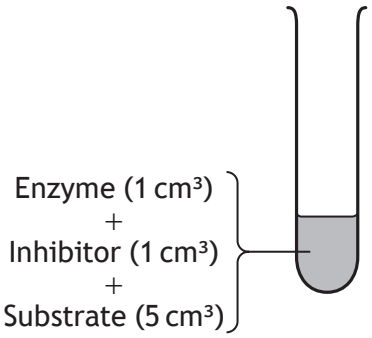


Table 1

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**

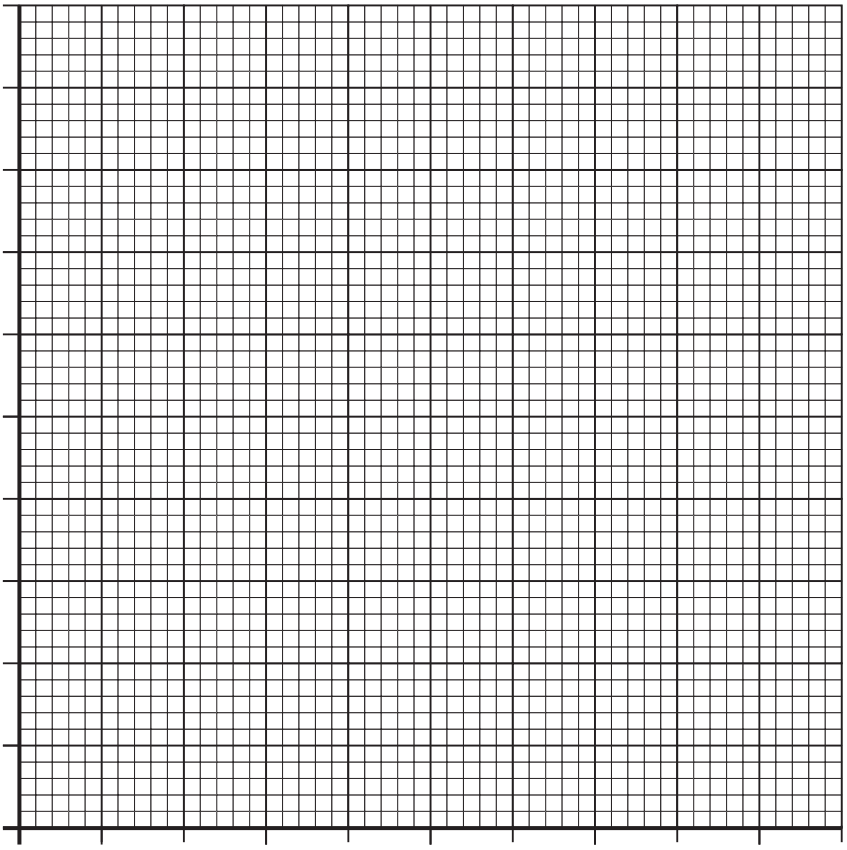
1 _____

2 _____

MARKS | DO NOT WRITE IN THIS MARGIN

(c) Construct a line graph to show the data in **Table 1**. **2**

(Additional graph paper, if required, can be found on *Page 28*)

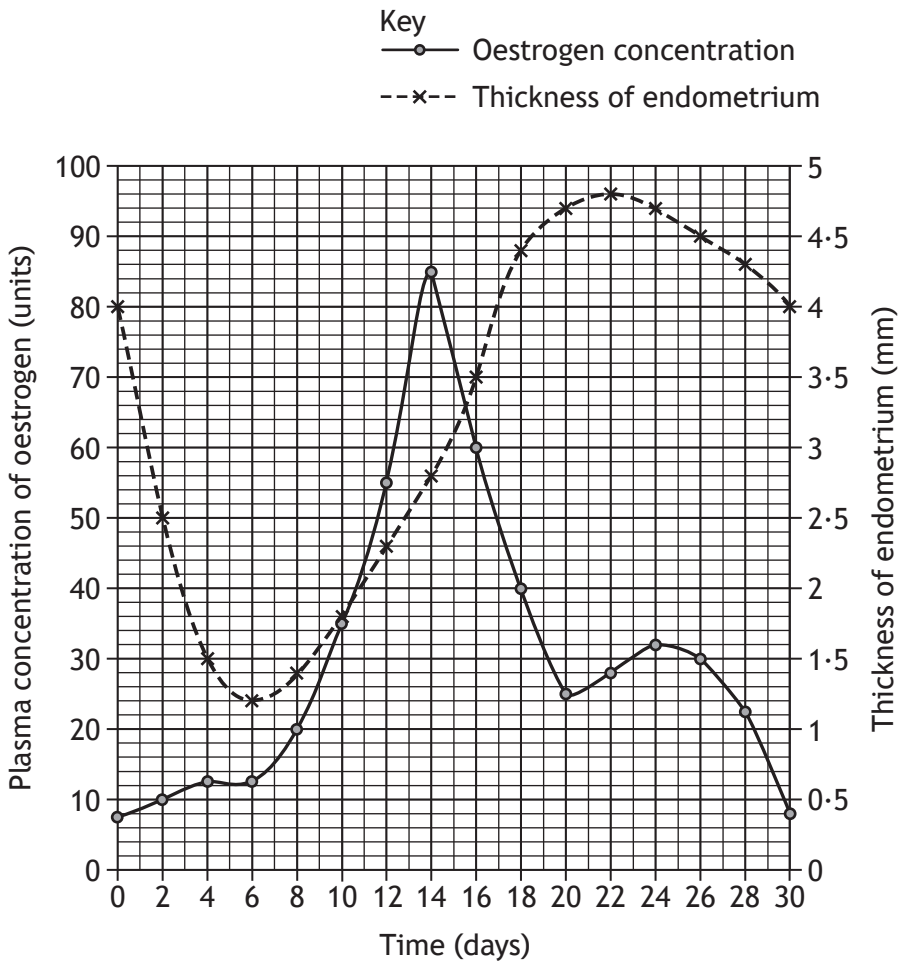


(d) It was concluded that increasing substrate concentration reduces the effect of the competitive inhibitor.

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

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**

_____

_____

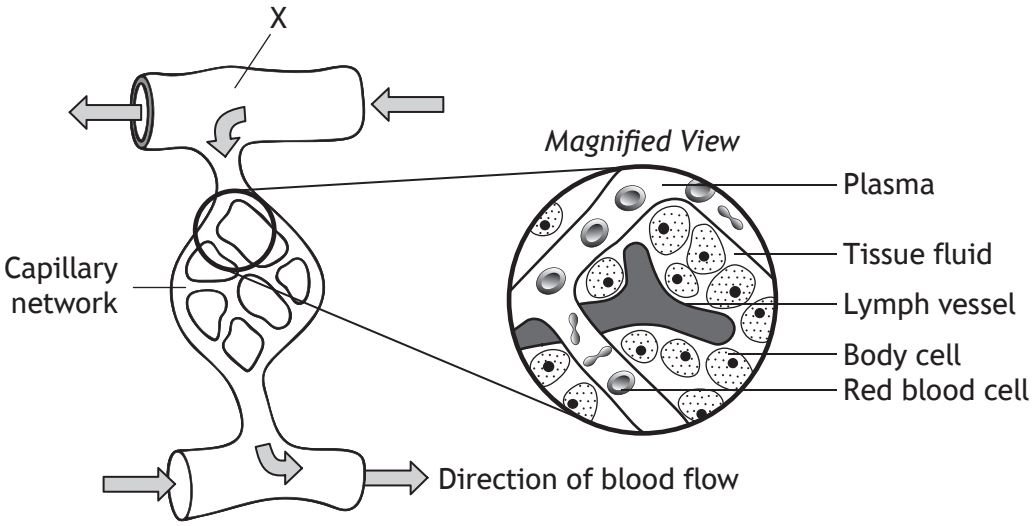
(d) State how fertility drugs stimulate ovulation. **1**

_____

_____

[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**

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

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.

	Conditions developed by women in the study			
	Pulmonary Embolism		*Coronary Heart Disease*	
Age group (years)	*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.

Explain why the results of the study support this conclusion. **1**

_____

_____

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

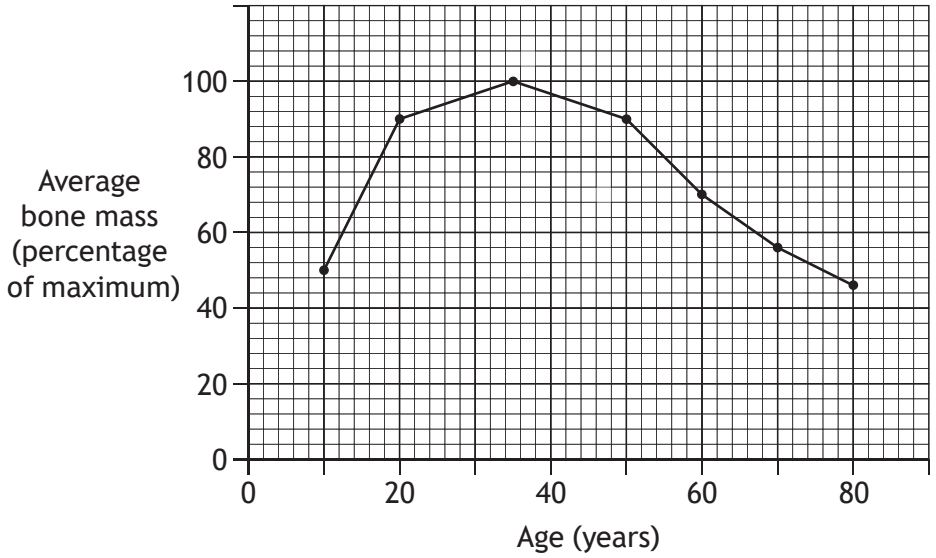
_____

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.



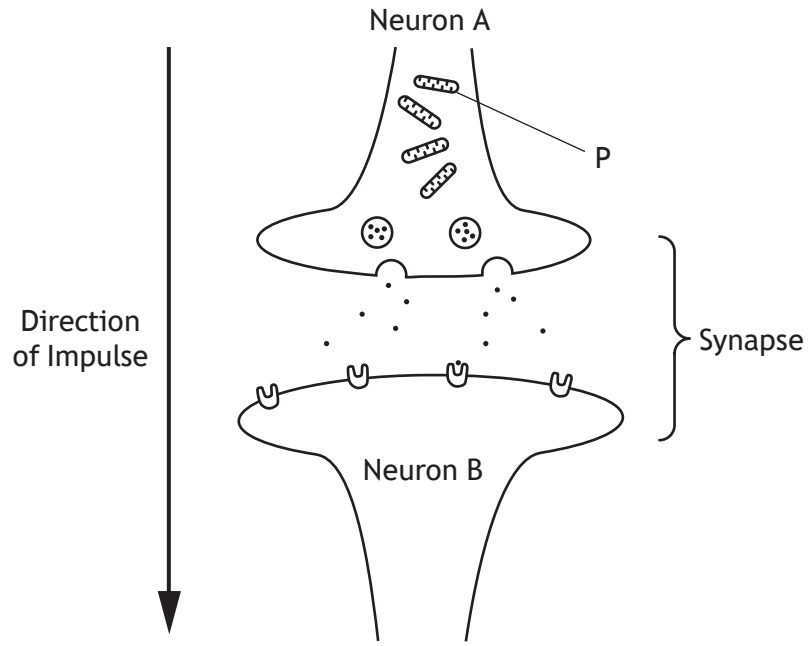
(i) **Use data from the graph** to describe the changes that occur in the average bone mass between the ages of 10 and 80. **2**

(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

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.

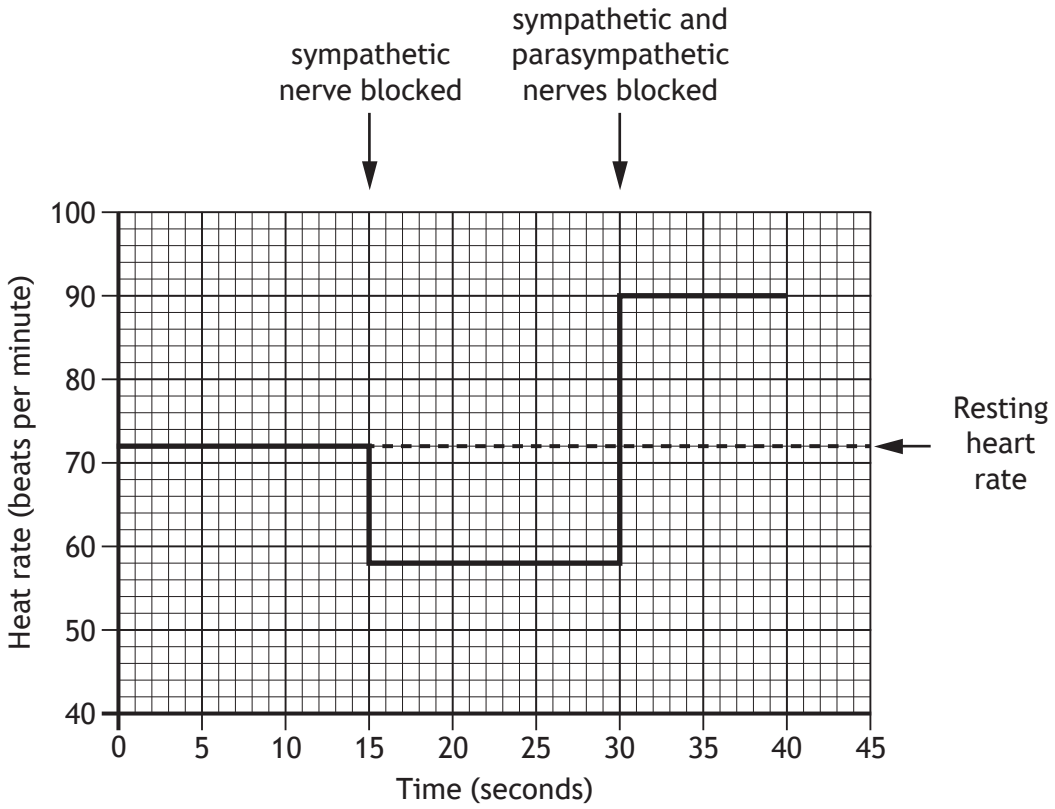
Explain what this statement means. **1**

_____

_____

(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

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**

_____

_____

_____

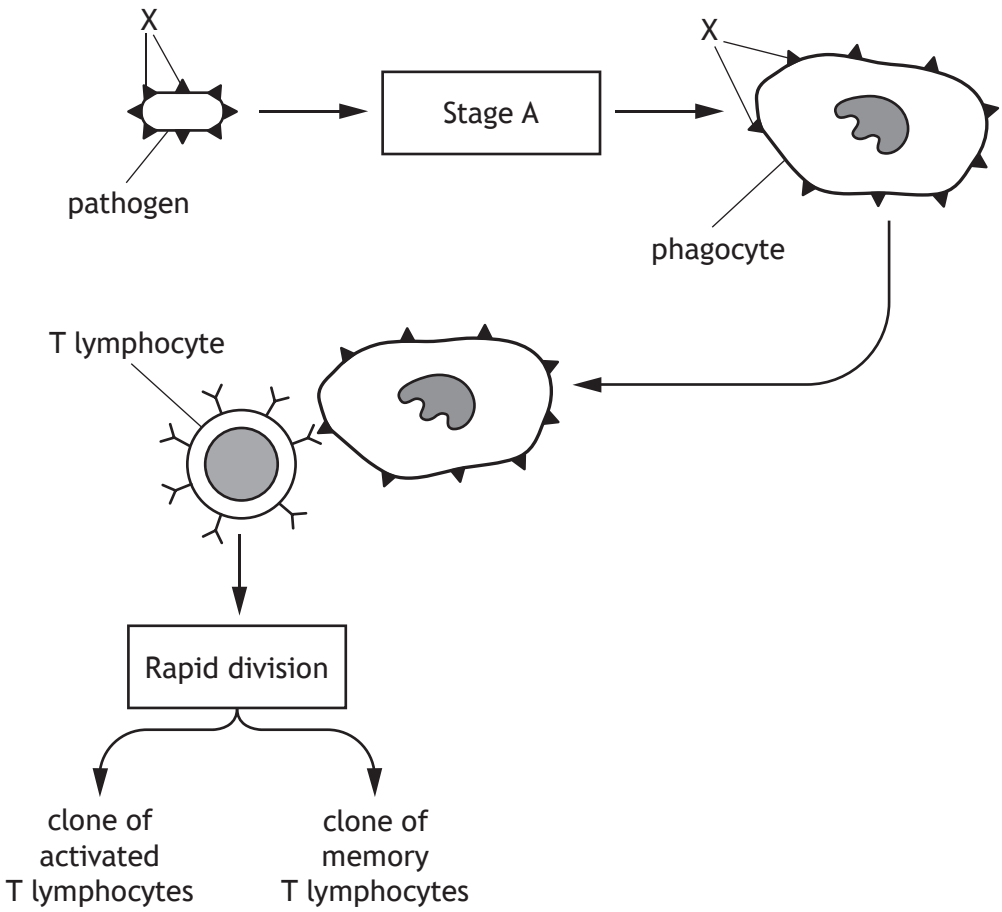
(f) State **one** other effect the sympathetic nervous system has on the body. **1**

_____

_____

[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

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

	Average life expectancy of child (years)		
Year	*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

	Average Life Span (years)		
Year	*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**

_____

_____

[Turn over

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**

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWER to Question 12

[END OF QUESTION PAPER]

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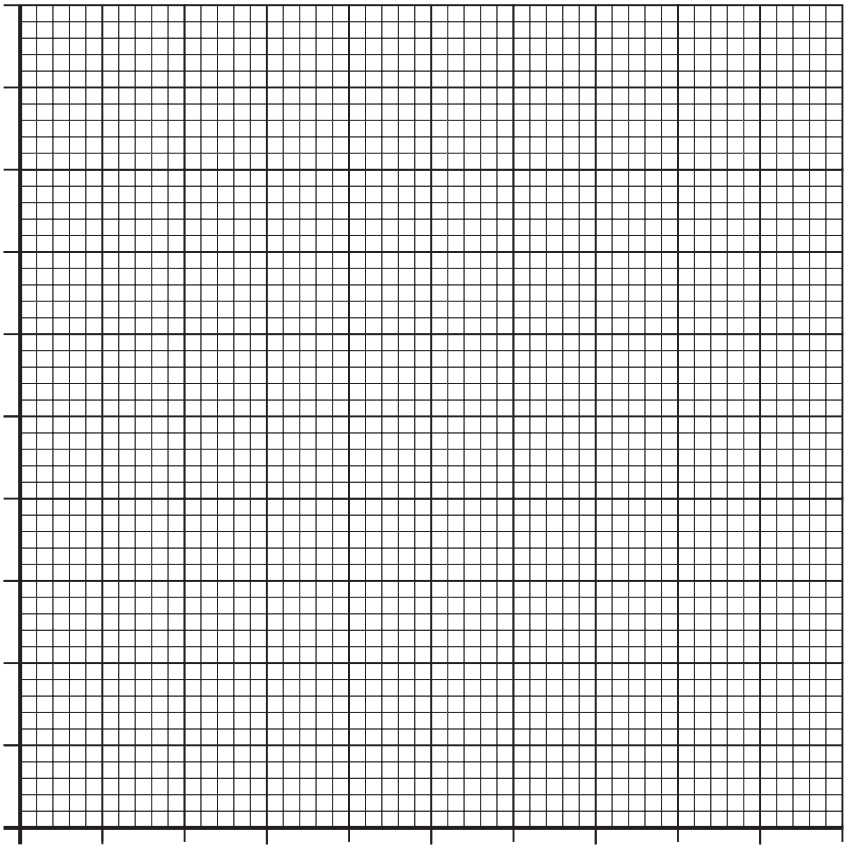
ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph paper for Question 3 (c)



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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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