H

National Qualifications SPECIMEN ONLY

Mark

SQ25/H/01

Human Biology
Section 1 — Answer Grid and Section 2

Date — Not applicable

Duration — 2 hours and 30 minute

SQ25H01

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
D D	M M	Y Y

Scottish candidate number

Total marks — 100

SECTION 1 — 20 marks

Attempt ALL questions.

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

SECTION 2 — 80 marks

Attempt ALL questions.

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

SECTION 1— 20 marks

The questions for Section 1 are contained in the question paper SQ25/H/02.
Read these and record your answers on the answer grid on *Page three* opposite.
Do NOT use gel pens.

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
○	●	○	○

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
○	⊗	○	●

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		A	B	C	D
○	⊗✓	○	⊗	or	○	⊗✓	○	○

You must record your answers to Section 1 questions on the answer grid on **Page 3** of your **answer booklet**
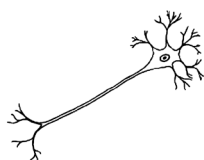
SECTION 2 — 80 marks

Attempt ALL questions
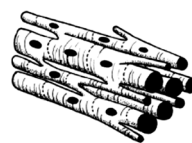
Note that question 14 contains a choice.

1. The human body contains many specialised cells, all of which have developed from stem cells in the early embryo.

Nerve cells   Liver cells   Cardiac muscle cells

(a) Name the process by which a stem cell develops into a specialised body cell and explain how this process occurs. **2**

Process _____

Explanation _____

_____

(b) Both germline and somatic cells retain the ability to divide.

 (i) State the type of cell division that only occurs in germline cells. **1**

_____

  (ii) Explain why mutations in germline cells are potentially more serious than mutations in somatic cells. **1**

_____

_____

(c) A company has developed a drug that could be used to treat the symptoms of an inherited disease. Before proceeding to clinical trials using volunteers, the company decides to carry out additional tests in the laboratory using stem cells.

Describe one ethical consideration that might have influenced this decision to use stem cells. **1**

_____

_____

2. The diagram below shows stages in the synthesis of a polypeptide.
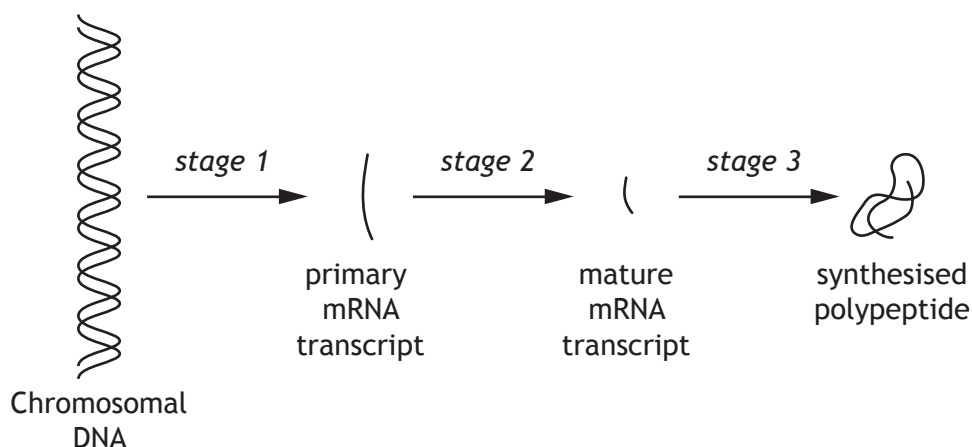
Chromosomal
DNA

(a) Name the enzyme that catalyses stage 1 of this process. **1**

_____

(b) Name stage 3 and state the exact location where it occurs within a cell. **1**

Name _____

Location _____

(c) (i) Explain why the primary mRNA transcript is so much shorter than chromosomal DNA. **1**

_____

_____

(ii) Explain why the mature mRNA transcript is shorter than the primary mRNA transcript. **1**

_____

_____

3. An experiment was carried out to investigate the effect of substrate concentration on the production of an end-product in an enzyme controlled reaction.

    The enzyme urease was used which breaks down urea into ammonia.

$$\text{urea} \xrightarrow{\text{urease}} \text{amonia}$$
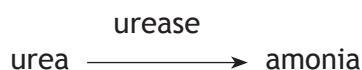
Urease and urea solutions were mixed together and added to test tubes containing agar jelly as shown in the diagram below.
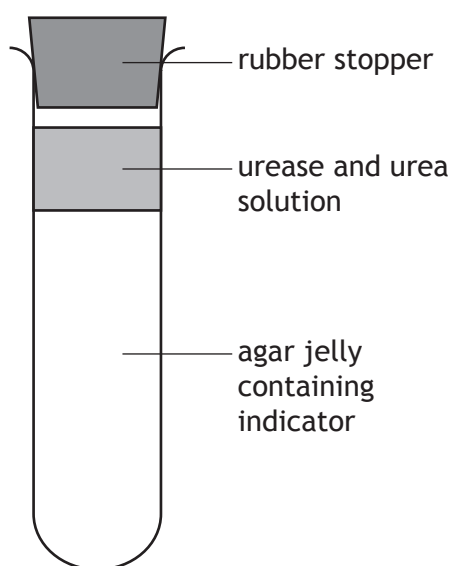
Five different concentrations of urea solution were added.

During the reaction the ammonia produced diffused through the agar jelly changing the indicator from yellow to blue.

The length of the agar jelly stained blue was measured after the experiment had been allowed to run for 48 hours.

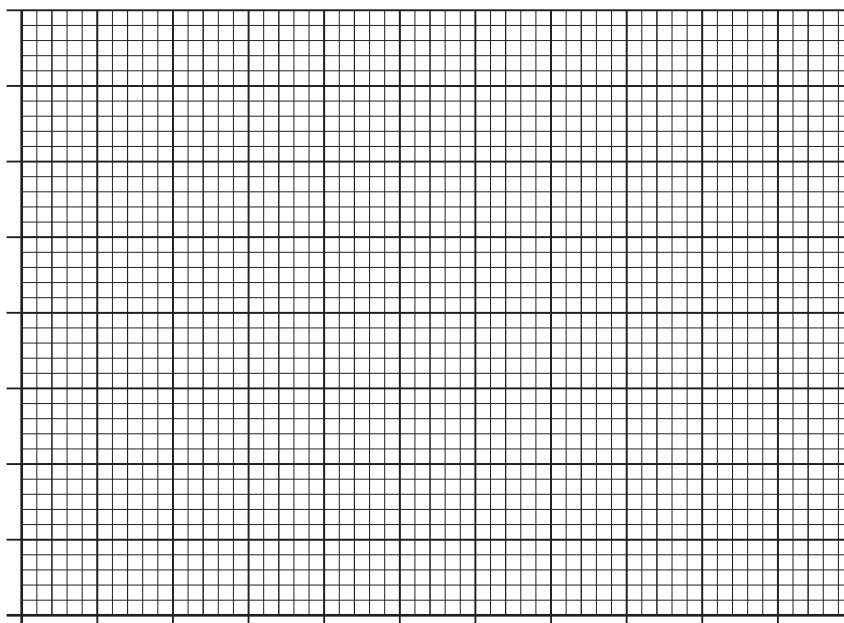The results of the experiment are shown in the table below.

Urea concentration added (molar)	Average length of agar jelly stained blue (mm)
0·03	2
0·06	4
0·13	8
0·25	16
0·50	32

3. (continued)

(a) Plot a line graph to illustrate the results of the experiment.

(Additional graph paper, if required, can be found on *Page twenty-six*) **2**

(b) (i) Name **one** variable that should be controlled when setting up this experiment. **1**

_____

(ii) Name **one** variable that should be kept constant during the 48 hours of this experiment. **1**

_____

(c) Give the feature of this experiment that makes the results reliable. **1**

_____

_____

(d) Explain why the test tubes were left for 48 hours before the results were obtained. **1**

_____

_____

3. **(continued)**

(e) State **one** conclusion that can be drawn from the results of this experiment.

1

_____

_____

(f) Using the **information in the table**, predict the length of agar jelly that would have been stained blue if a 0·75 molar urea solution had been used in the experiment.

1

Space for calculation

_____ **mm**

(g) Thiourea is a competitive inhibitor of urease.

In another experiment, a test tube of agar jelly was set up containing the urease solution, 0·5 molar urea solution and thiourea.

After 48 hours only 7mm of agar jelly had turned blue.

(i) Explain why less agar jelly turned blue in this experiment than in the first experiment, which also used a 0·5 molar urea solution.
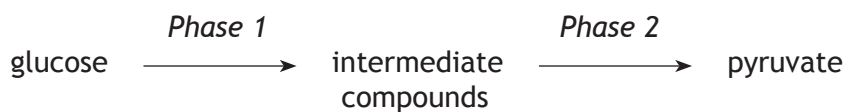
1

_____

_____

(ii) Suggest why 7mm of agar jelly turned blue in this experiment.

1

_____

_____

4. The diagram below represents the glycolysis stage of respiration in a muscle cell.

$$\text{glucose} \xrightarrow{\textit{Phase 1}} \text{intermediate compounds} \xrightarrow{\textit{Phase 2}} \text{pyruvate}$$

(a) Phase 1 is the energy investment stage of glycolysis while phase 2 is the energy pay-off stage of glycolysis.

Describe what happens during the energy investment and energy pay-off phases of glycolysis.

2

Energy investment phase _____

_____

Energy pay-off phase _____

_____

(b) Once pyruvate has been formed it can be converted into two different compounds, depending on the conditions.

Name one of these compounds and state under what conditions it would be produced.

2

_____

_____

(c) Many athletes take creatine supplements to improve their sporting performance.

State whether sprinters or marathon runners would gain the greatest benefit from taking creatine and give a reason for your choice.

1

Athlete _____

Reason _____

_____

5. Sickle cell disease is an autosomal blood disorder in which a faulty form of haemoglobin, called haemoglobin S, is produced. This protein is an inefficient carrier of oxygen.

The allele for normal haemoglobin (H) is incompletely dominant to the allele for haemoglobin S (S).

Heterozygous individuals (HS) suffer from a milder condition called sickle cell trait.

The pedigree chart below shows the incidence of these conditions in three generations of a family.
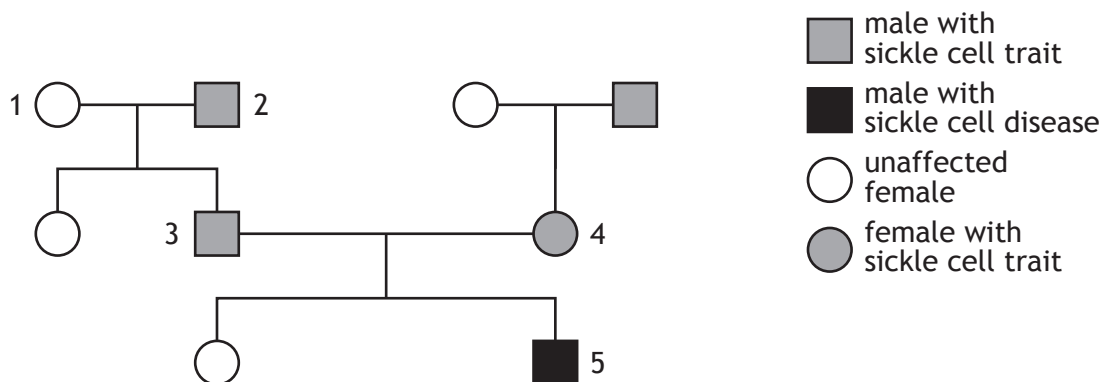
(a) State the genotype of individual 5. **1**

_____

(b) Individuals 3 and 4 go on to have a 3rd child.

State the percentage chance that this child will have the same genotype as the parents. **1**

Space for calculation

_____%

(c) Sickle cell disease is caused by a substitution mutation in the gene that codes for haemoglobin.

(i) Describe how this form of mutation affects the structure of the gene. **1**

_____

_____

(ii) Explain how this might change the structure of a protein such as haemoglobin. **1**

_____

_____

5. (continued)

(d) During IVF treatment, it is possible to detect single gene disorders in fertilised eggs before they are implanted into the mother.

Give the term that describes this procedure. **1**

_____

(e) It has been discovered that the gene that codes for fetal haemoglobin is unaffected by the substitution mutation that causes sickle cell disease.
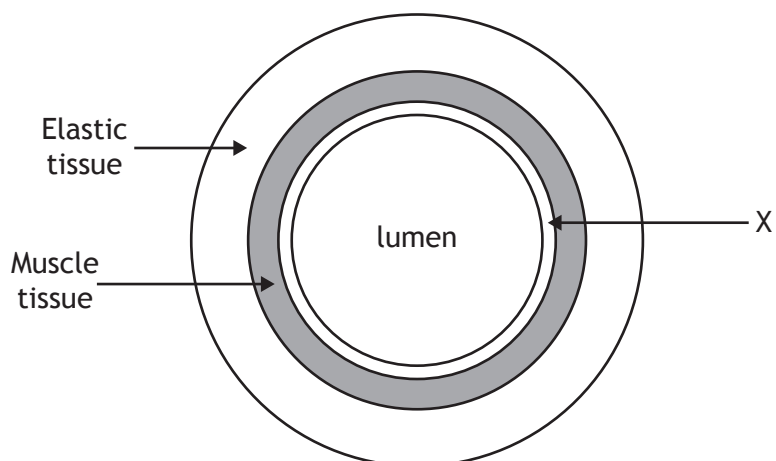
This gene is "switched off" at birth.

Use this information to suggest how a drug designed to treat sickle cell disease in young children could function. **1**

_____

_____

_____

6. The diagram below represents a section through an artery.

Elastic tissue

Muscle tissue

lumen

X

(a) Describe how the presence of muscle tissue in the artery wall helps to control the flow of blood around the body. **1**
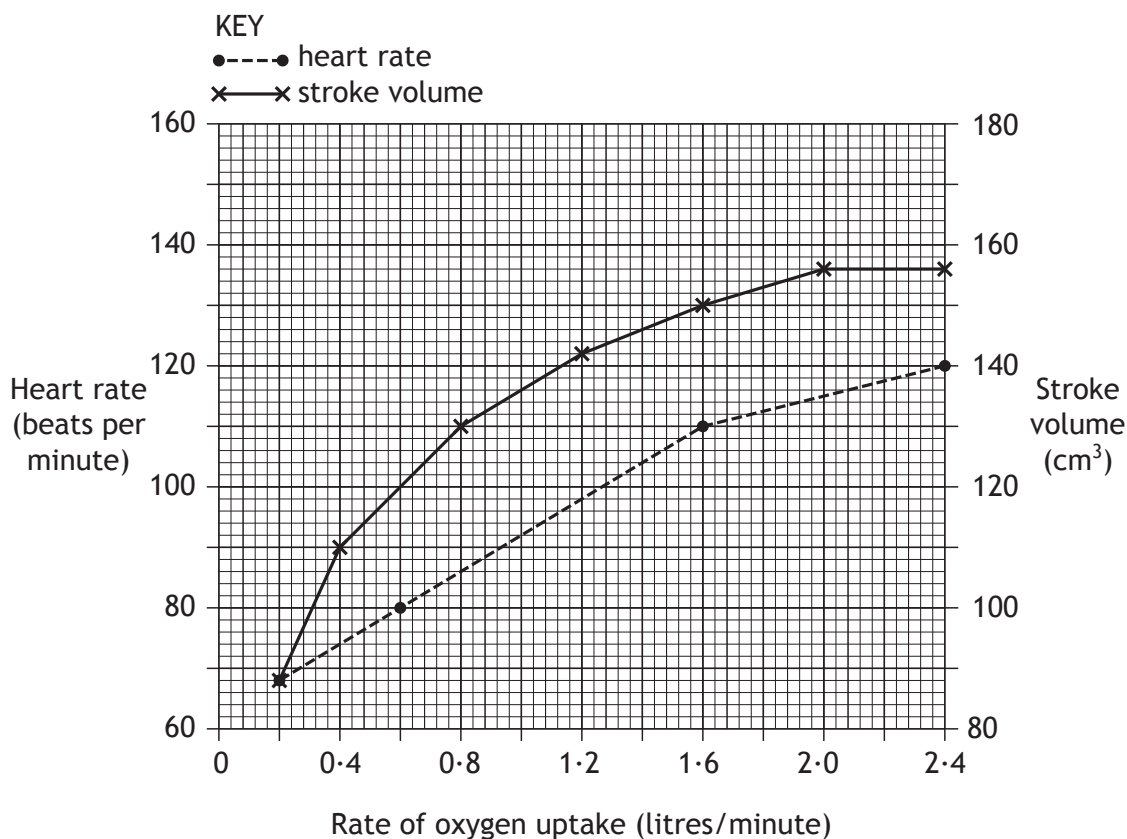
_____

_____

(b) Describe how an atheroma forming under layer X may lead to the formation of a blood clot and state the possible effects of this. **5**

Space for answer

7. The graph below shows how an individual's heart rate and stroke volume changed as their oxygen uptake increased during exercise.

KEY
●----● heart rate
✕——✕ stroke volume

Rate of oxygen uptake (litres/minute)

(a)　(i)　State the individual's heart rate when the rate of oxygen uptake was 1·2 litres/minute.

1

_____

(ii)　Using data from the graph, describe how the stroke volume changed as oxygen uptake increased.

1

_____

_____

(iii)　State the stroke volume when the heart rate was 110 beats per minute.

1

_____ cm³

7. (continued)

(b) Calculate the cardiac output when the rate of oxygen uptake was 2·4 litres per minute.

Space for calculation

_____ litres/min

1

(c) (i) When the individual's blood pressure was measured an hour after exercise, a reading of 140/90 mm/Hg was recorded.

Explain why two figures are given for a blood pressure reading.

1

_____

_____

(ii) The individual was diagnosed as having high blood pressure.

One of the effects of this was that their ankles regularly swelled up due to a build-up of tissue fluid.

Explain the link between high blood pressure and the build-up of tissue fluid.

2

_____

_____

_____

_____

8. The graph below shows changes in blood glucose concentration in a diabetic and a non-diabetic individual after each had consumed a glucose drink.
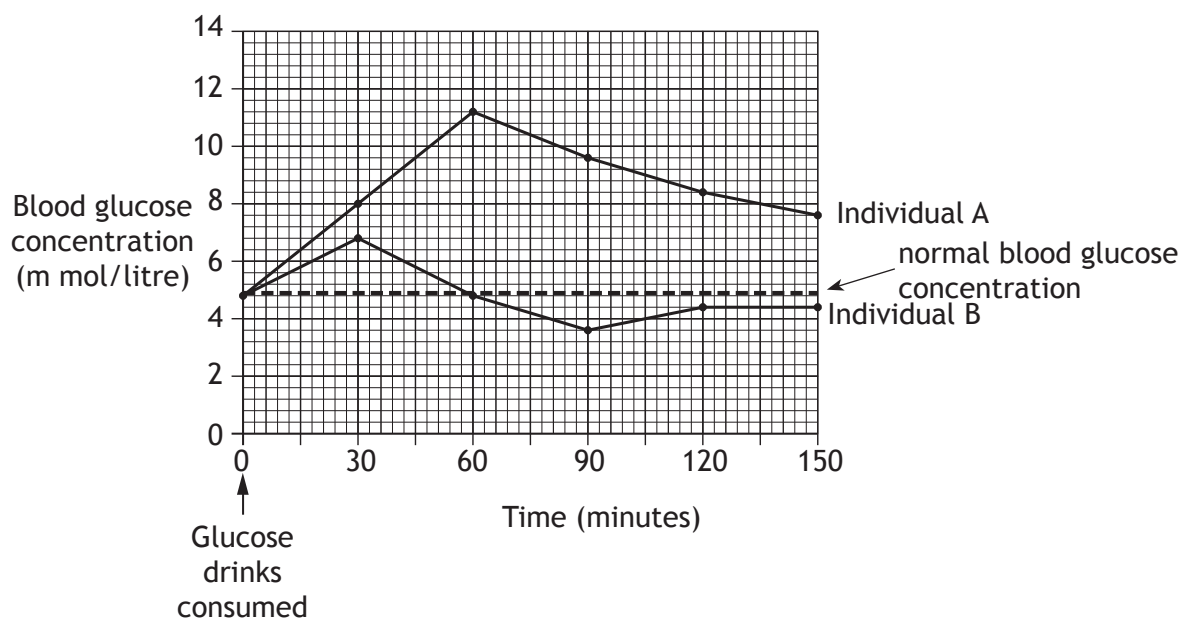
(a) (i) Choose **one** individual, A or B and indicate whether the individual is diabetic or non-diabetic.

Individual _____

Diabetic ☐   Non-diabetic ☐

Using evidence from the graph, justify your choice.   **1**

_____

_____

(ii) Using data from the graph, describe the changes that occurred in the blood glucose concentration of individual A after consuming the glucose drink.   **2**

_____

_____

_____

_____

8. (continued)

(b) Describe the role of insulin in the development of type 1 and type 2 diabetes.

2

Type 1 _____

_____
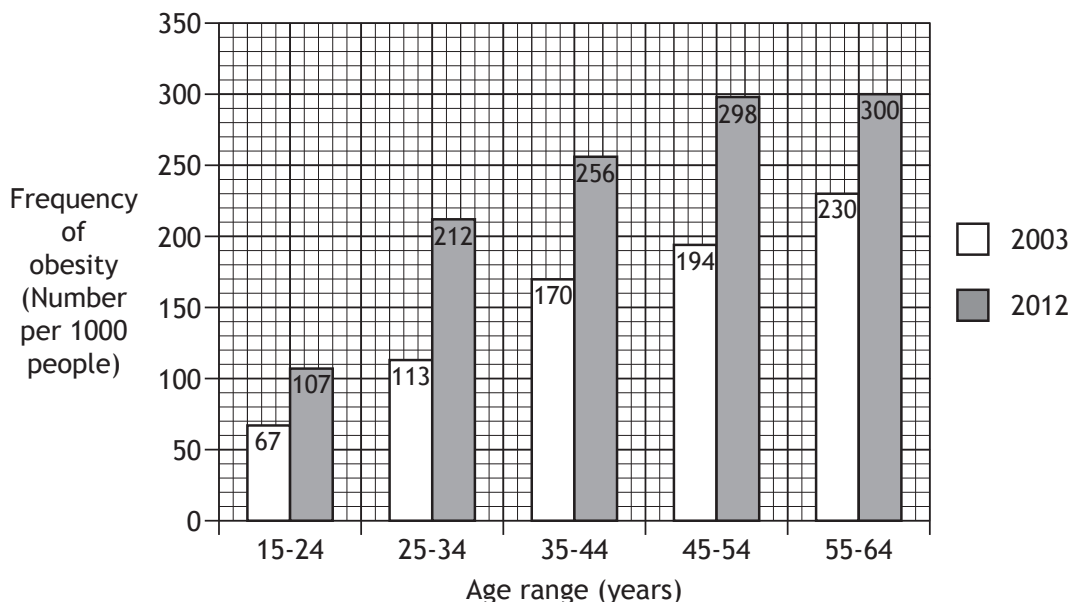
Type 2 _____

_____

MARKS

9. The graph below shows obesity data for a European country in 2003 and 2012.

Individuals are described as obese if they have a body mass index (BMI) of 30 or greater.

(a) (i) Describe **two** general trends shown in the graph. **2**

1 _____

_____

2 _____

_____

(ii) In 2012 the number of people in this country aged 35 to 44 was 6 million.

Calculate how many people aged 35 to 44 were obese. **1**

Space for calculation

Number of people _____

(b) State one piece of advice that an obese individual would be given to adapt their diet or lifestyle in order to avoid long-term health problems. **1**

_____

10. A student carried out an investigation into the effect of age on learning ability.

Eight children from three different age groups were each given five attempts to complete a twenty-piece jigsaw puzzle.

The fastest times that they achieved are shown in the table below.

	Fastest time achieved (seconds)		
	8-year-olds	*12-year-olds*	*16-year-olds*
	123	97	99
	98	68	74
	111	75	62
	138	112	67
	87	93	84
	136	83	101
	79	75	58
	120	81	55
average	**111·5**		**75·0**

(a) Calculate the average fastest time achieved by the 12 year-old children and write your answer in the table above. **1**

Space for calculation

(b) Describe **two** additional variables that would have to be kept constant to ensure a valid comparison could be made between the three groups of children. **2**

Variable 1 _____

_____

Variable 2 _____

_____

10. **(continued)**

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

1

_____

_____

(d) (i) Explain why the first attempt to complete the puzzle was always slower than the fifth attempt, no matter the age of the child.

1

_____

_____

(ii) Suggest why some children did not produce their fastest time on their fifth attempt.
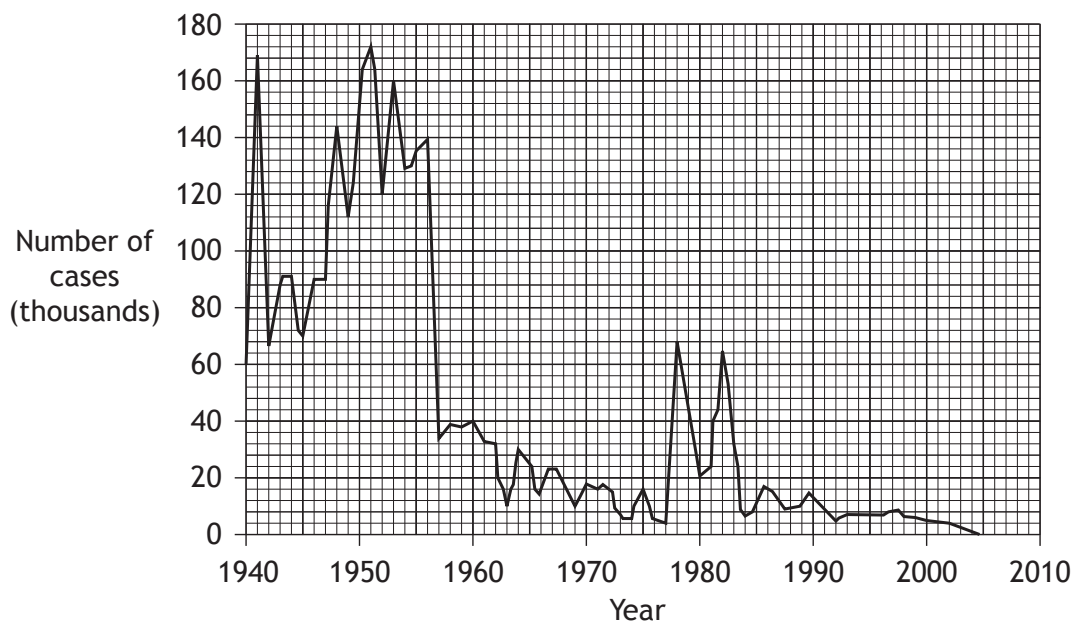
1

_____

_____

(e) Suggest how the student could adapt the investigation to demonstrate social facilitation.

1

_____

_____

11. The graph below shows the number of whooping cough cases over a 65 year period in a country.

(a) (i) Using information from the graph, state the year in which a vaccine for whooping cough was introduced. **1**

Year _____

(ii) Suggest a reason for the unexpected increase in the number of cases of whooping cough in 1977. **1**

_____

_____

(b) The number of cases of whooping cough decreases to a very low level after 2000 because of herd immunity.

Explain what is meant by the term "herd immunity". **2**

_____

_____

_____

_____

12. The diagrams below contain information about the causes of death and survival rates in two countries in 2010.

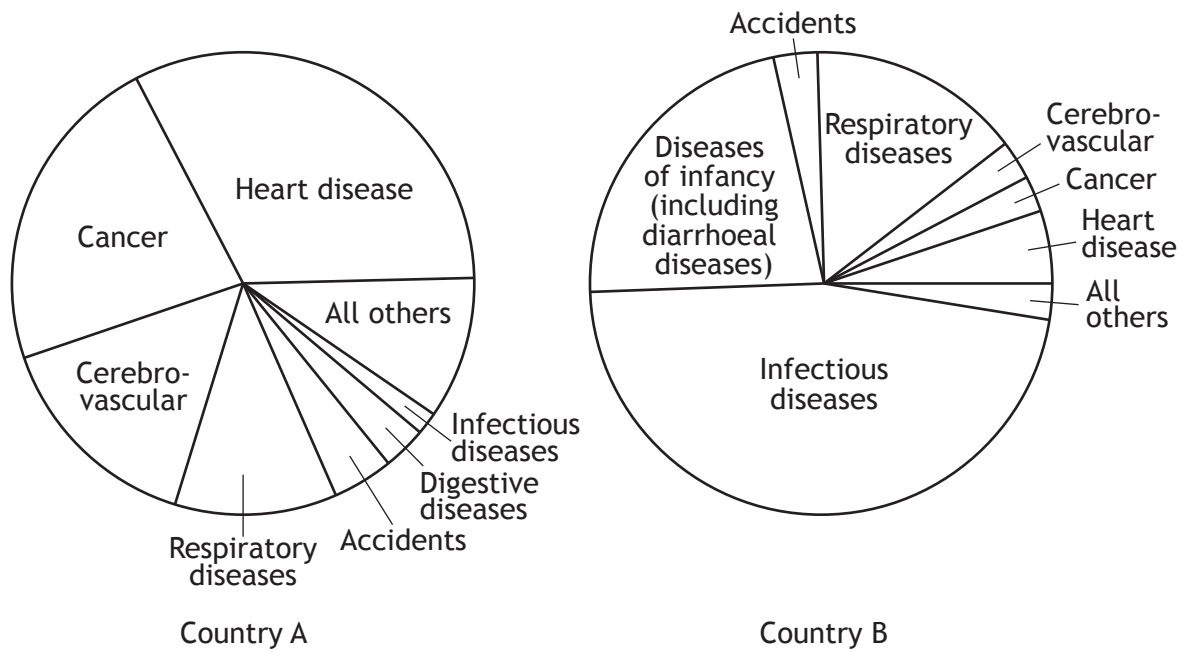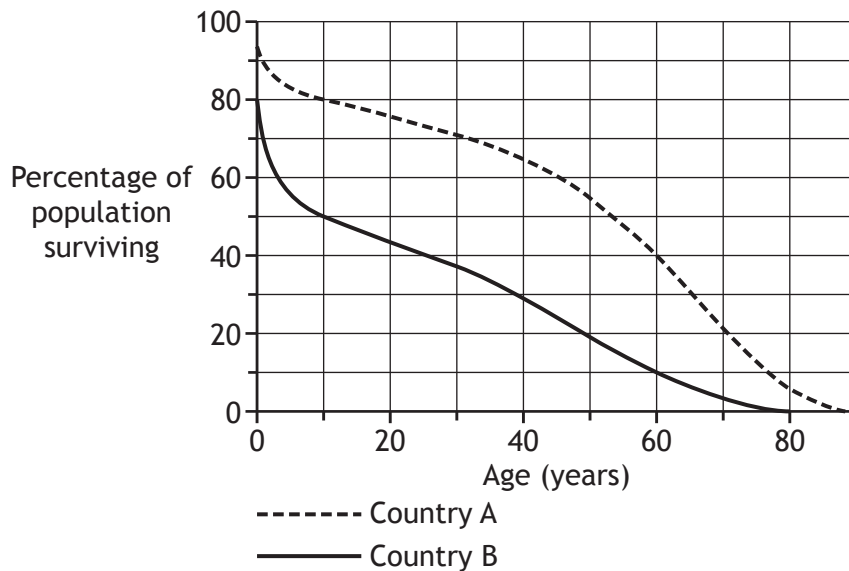**Figure 1** - Causes of death in countries A and B during 2010

Country A

Country B

Figure 2 - Percentage survival rates in countries A and B in 2010

------- Country A
——— Country B

(a) (i) Use information from **Figure 2** to explain the lower incidence of heart disease in Country B.

1

_____

_____

12. (a) (continued)

(ii) Give an example of how diseases of infancy can be reduced in Country B through community responsibility, other than by vaccination programmes.

1

_____

_____

(b) (i) Calculate the percentage of the population of Country A that die before the age of 10.

1

Space for calculation

_____ %

(ii) In 1950 three million babies were born in Country B.

Calculate how many of these individuals were still alive in 2010, assuming no migration occurred.

1

Space for calculation

_____

13. Pulmonary tuberculosis (TB) is an infectious disease of the lungs caused by a bacterium.

This bacterium can also damage other organs in the body. When this happens it is called non-pulmonary TB.

The table below shows the number of reported cases of pulmonary and non-pulmonary TB in Scotland between 1981 and 2006.

Year	Number of cases of pulmonary TB	Number of cases of non-pulmonary TB
1981	659	140
1986	500	178
1991	452	97
1996	408	102
2001	275	125
2006	255	153

(a) Suggest how pulmonary TB is transmitted between individuals. **1**

_____

_____

(b)   (i) In which 5 year period was the greatest decrease in the total number of cases of TB? **1**

Space for calculation

_____

(ii) Suggest a reason for this decrease. **1**

_____

_____

(iii) Compare the trend in the number of cases of pulmonary TB with that of non-pulmonary TB between 1991 and 2006. **1**

_____

_____

13. (b) (continued)

    (iv) Calculate, as a simple whole number ratio, the number of cases of pulmonary TB compared to non-pulmonary TB in 2001. **1**

        Space for calculation

<div align="center">

_____ : _____

pulmonary TB   non-pulmonary TB

</div>

(c) Non-pulmonary TB is often associated with HIV infection.

    Suggest a reason for this association. **1**

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

A   Describe the structure and function of the autonomic nervous system.   **7**

OR

B   Describe the function and mechanism of neurotransmitter action at the synapse.   **7**
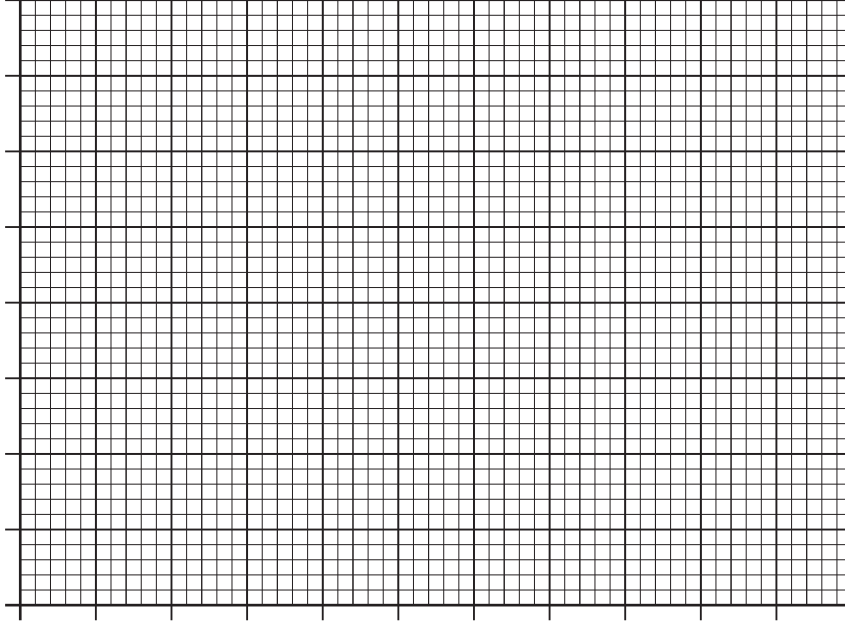
[END OF SPECIMEN QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional Graph for Question 3 (a)

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK