FOR OFFICIAL USE

National Qualifications 2016

Mark

X707/76/01

Biology
Section 1 — Answer Grid and Section 2

MONDAY, 9 MAY

9:00 AM – 11:30 AM

X707760 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

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.

Questions 7 and 14 contain 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 ©

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SECTION 1 — 20 marks

The questions for Section 1 are contained in the question paper X707/76/02.

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 thigh bone is called the

A humerus

B femur

C tibia

D fibula.

The correct answer is **B** — femur. 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
○	~~●~~ ✓	○	~~●~~

or

A	B	C	D
○	~~●~~ ✓	○	○

SECTION 1 — Answer Grid

0BJ20AD1

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

X707760103

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X707760104

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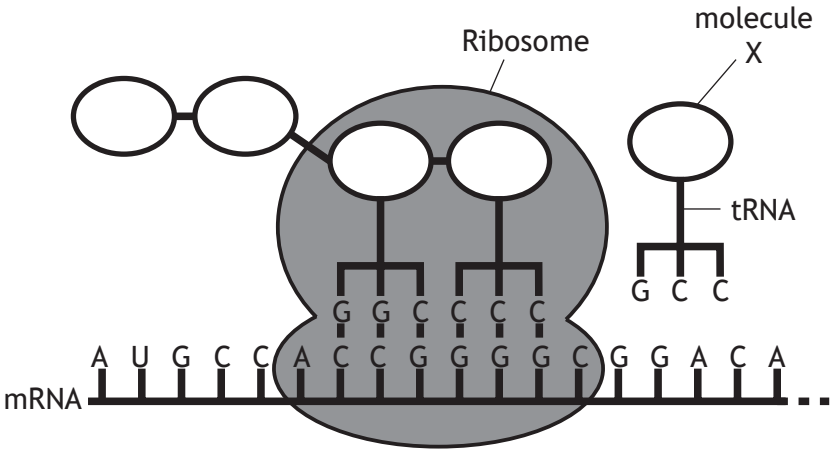
MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 2 — 80 marks

Attempt ALL questions

Questions 7 and 14 each contain a choice.

1. The diagram below shows a process involved in the production of a polypeptide in a cell.



(a) Name molecule X. **1**

_____

(b) State **one** substance, other than ribosomal RNA (rRNA), that makes up the ribosome. **1**

_____

(c) Many polypeptides are modified in order to produce functional proteins.

Describe **one** way in which a polypeptide could be modified. **1**

_____

_____

(d) In some eukaryotic cells, different mRNA molecules, and therefore different proteins, can be expressed from a single gene.

Name and describe the process which results in different mRNA molecules being expressed. **2**

Name _____

Description _____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

2. DNA holds the genetic information in both prokaryotic and eukaryotic cells.

(a) (i) Describe **one** organisational difference between prokaryotic and eukaryotic chromosomal DNA. **1**

_____

_____

(ii) Name the substance with which DNA is packaged in eukaryotes. **1**

_____

(b) State **one** location, other than the nucleus, where DNA is found in eukaryotic cells. **1**

_____

(c) During DNA replication two new daughter strands are synthesised using the original strands as templates.

(i) State why the antiparallel nature of the DNA molecule results in one of the strands being synthesised in short fragments. **1**

_____

_____

(ii) Template DNA, enzymes and ATP are necessary for DNA replication.

State **one** other substance required. **1**

_____

(d) Explain why cells need to carry out DNA replication. **1**

_____

_____

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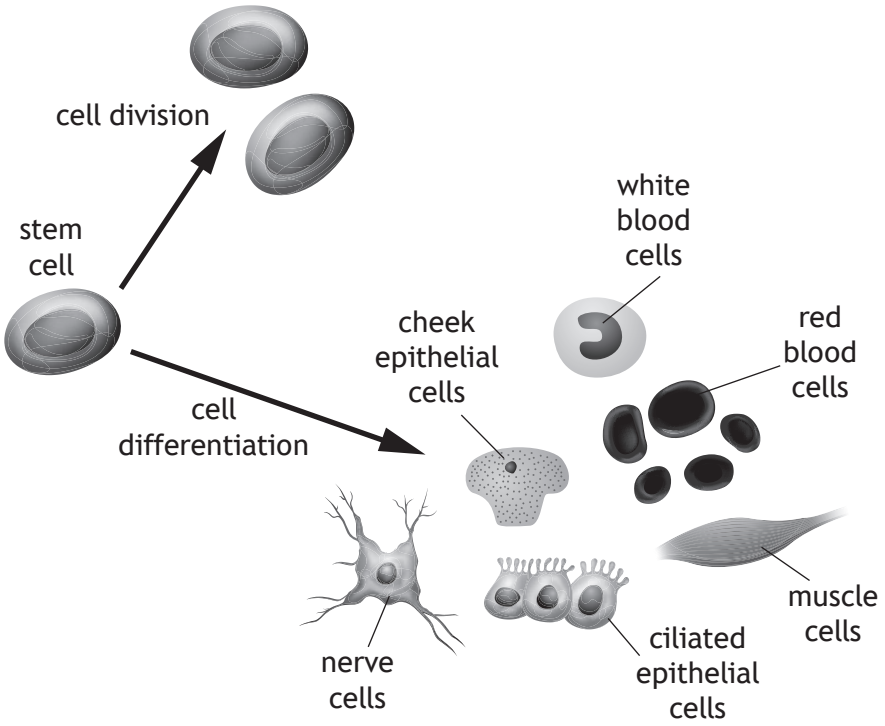
MARKS | DO NOT WRITE IN THIS MARGIN

3. Stem cells are unspecialised cells which can be found in embryonic and adult tissue.



(a) Explain how the diagram above indicates that the stem cell shown is an embryonic and not a tissue (adult) stem cell. **1**

(b) After a stem cell differentiates, only certain genes are expressed.
Explain how this results in different cell types. **1**

(c) Give **one** therapeutic use of stem cells. **1**

(d) State **one** ethical issue relating to the use of embryonic stem cells. **1**

X 7 0 7 7 6 0 1 0 8

[Turn over for next question

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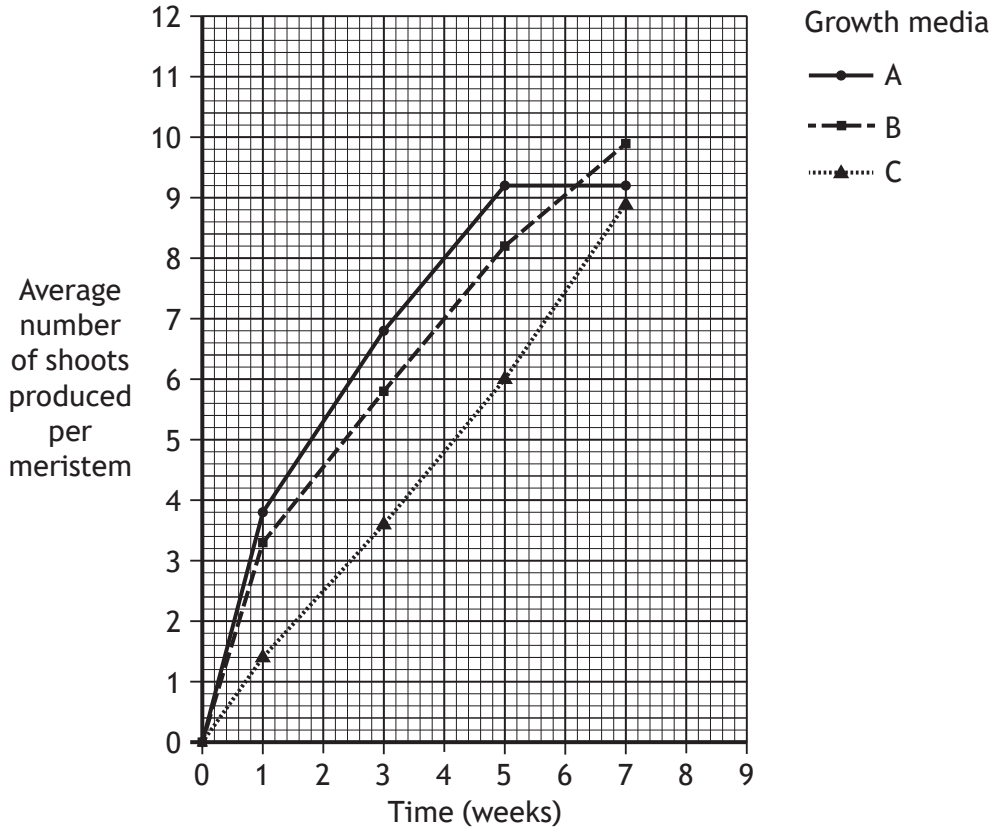
X707760109

4. Meristems can be cultured in growth medium to produce new plants.

An experiment was carried out to investigate the effects of three different growth media (A, B and C) on the production of shoots by meristems of African violet plants.

Five meristems were removed and cultured in each medium for a period of seven weeks. The average number of shoots produced per meristem was recorded at specific times during the investigation.

The results are shown in the graph below.



(a) (i) **Use values from the graph** to describe the average number of shoots produced per meristem over the seven week period in medium A. **2**

_____

_____

_____

(ii) Calculate the percentage increase in the average number of shoots produced per meristem between week 1 and week 7 in medium B. **1**

Space for calculation

_____ %

4. (a) (continued) MARKS DO NOT WRITE IN THIS MARGIN

(iii) Table 1 below shows the number of shoots produced per meristem at three weeks in one of the media.

Table 1

Meristem	*Number of shoots produced per meristem*
1	4
2	5
3	7
4	7
5	6

Using information from **Table 1 and the graph**, state the medium in which these meristems were cultured. **1**

Space for calculation

Medium _____

(b) Predict which medium would produce plants with the greatest number of shoots after nine weeks growth. Give a reason for your answer. **2**

Medium _____

Reason _____

_____

(c) In a further experiment, the average number of roots and average root length at 7 weeks were recorded in each of the media.

The results are shown in Table 2 below.

Table 2

Medium	*Average number of roots produced per meristem*	*Average root length* (mm)
A	12	12
B	11	19
C	12	17

After analysing the results, medium B was used for the commercial production of plants.

Use the information in Table 2 to explain why plants cultured in medium B would grow best. **2**

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

5. In the North Pacific Ocean there are two different populations of killer whales *Orcinus orca*. One population feeds mainly on fish while the other feeds mainly on sea mammals.

This behavioural barrier has led to considerable genetic variation between these populations.

(a) (i) Name the type of speciation which could occur as a result of this barrier. **1**

_____

(ii) State the importance of isolation barriers in speciation. **1**

_____

_____

(iii) Scientists believe that these two populations are still the same species.

Suggest how they could confirm this. **1**

_____

_____

(b) Polyploidy can lead to speciation.

(i) State what is meant by the term polyploidy. **1**

_____

_____

(ii) Describe **one** example of the importance of polyploidy in evolution. **1**

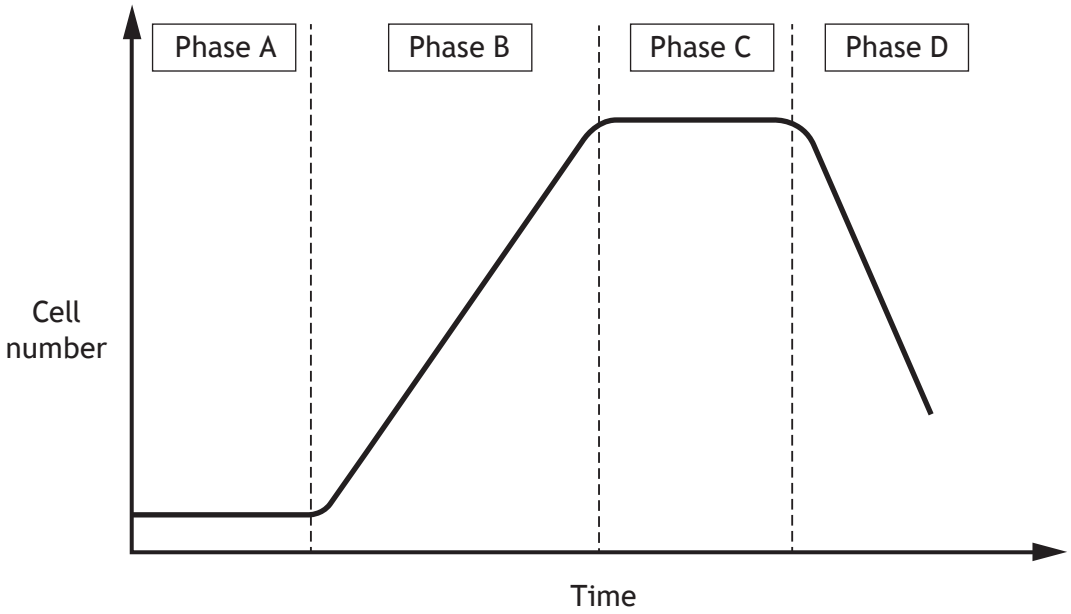
_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

6. The antibiotic bacitracin is produced by the bacterial species *B.subtilis*.

The graph below shows the growth curve of a population of *B.subtilis* cultured to produce the antibiotic.



(a) Name Phase A and explain why cells do not divide during this phase. **2**

Name _____

Explanation _____

_____

(b) (i) Name the phase in which the bacteria produce the secondary metabolite bacitracin. **1**

_____

(ii) Explain why this secondary metabolite gives an ecological advantage to *B.subtilis*. **1**

_____

_____

(c) This growth curve shows viable cell numbers of *B.subtilis*.

Give evidence from the graph to justify this statement. **1**

_____

_____

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MARKS | DO NOT WRITE IN THIS MARGIN

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

A Describe and compare anabolic and catabolic reactions. **4**

OR

B Describe and compare metabolism in conformers and regulators. **4**

[Turn over for next question

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X707760115

MARKS | DO NOT WRITE IN THIS MARGIN

8. An investigation was set up to monitor growth of bacteria in compost. The compost was added to a fermenter and the temperature of the compost was recorded over a 20 day period. Samples of the compost were cultured and the numbers of three bacterial species present were recorded.

The compost temperatures and the populations of the three species of bacteria are shown in the table below.

Time (days)	*Compost Temperature* (°C)	*Population* (millions per gram of compost)		
		Species A	*Species B*	*Species C*
0	21	396·0	0·4	123·0
2	40	4·2	10·2	14·6
4	72	0·1	195·0	0·1
6	53	0	8·5	0
20	32	0	0	0

(a) Calculate how many times greater the population of Species A was compared to Species B at the start of the investigation. **1**

Space for calculation

(b) Describe the relationship between temperature of the compost and population of Species C over the first four days. **1**

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

MARKS | DO NOT WRITE IN THIS MARGIN

8. (continued)

(c) (i) **Using information in the table**, state which species of bacteria is thermophilic and justify your answer. **2**

Species _____

Justification _____

_____

(ii) Describe how thermophilic bacteria are adapted to survive in their environment. **1**

_____

_____

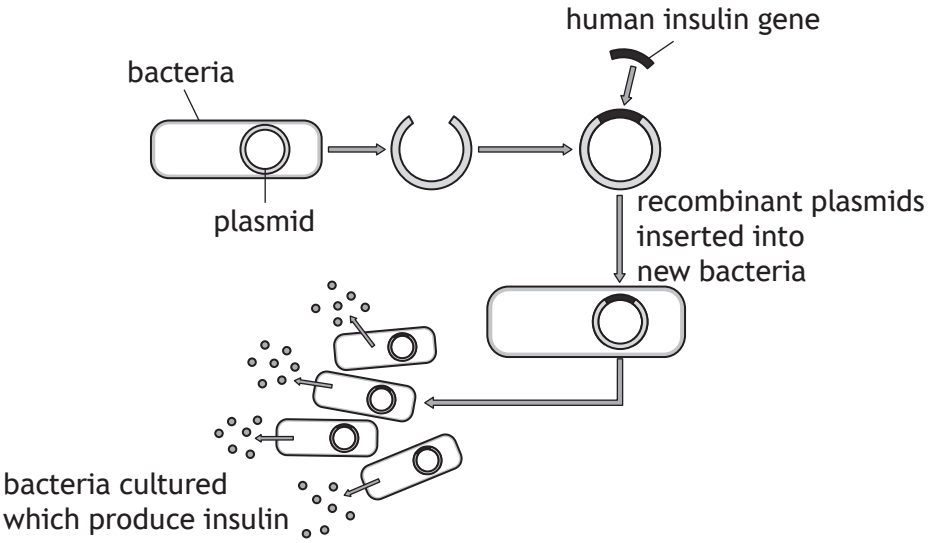
(iii) Give an example, other than in compost, of an environment where thermophilic bacteria are adapted to grow successfully. **1**

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

9. The diagram below shows how a human gene can be inserted into bacteria to produce human insulin using recombinant DNA technology.



(a) Name **one** enzyme used in this process and state its function. **2**

Name _____

Function _____

(b) (i) The recombinant plasmid also contains a gene for resistance to the antibiotic, ampicillin.

Describe a procedure which would allow only cells containing the recombinant plasmid to be selected. **2**

_____

_____

_____

(ii) Plasmids with these antibiotic resistance genes have been passed to other bacterial species by horizontal transfer.

Describe the process of horizontal transfer. **1**

_____

_____

(c) When culturing the bacteria which produce insulin, sterile conditions are maintained.

Explain why this is important. **1**

_____

_____

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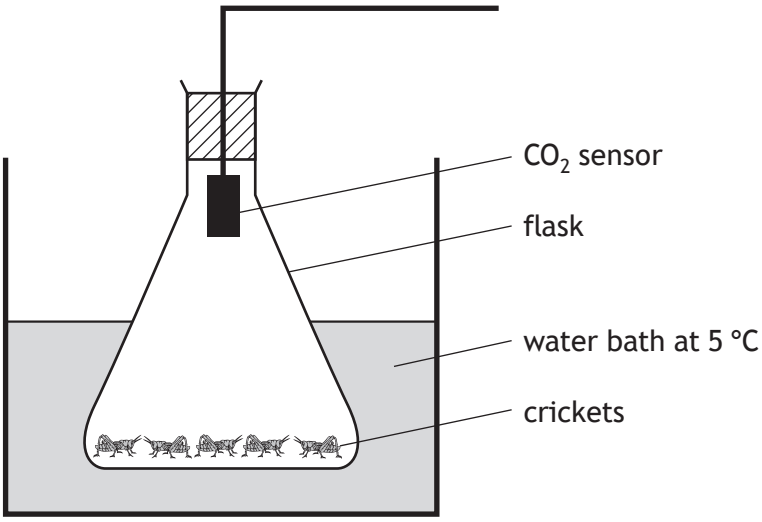
10. An investigation was carried out to compare the rate of metabolism in a species of cricket, *Gryllus assimilis*, at different temperatures.

Five crickets were placed in a sealed flask which was fitted with a carbon dioxide (CO_2) sensor as shown in the diagram below.



The flask was placed in a water bath at 5 °C and left for 10 minutes.

The CO_2 produced per minute was then measured. This procedure was repeated at 10, 15, 20 and 30 °C.

The results are shown in the table below.

Temperature (°C)	*Rate of CO_2 production* (units per minute)
5	300
10	500
15	800
20	1200
30	1600

(a) (i) Give a reason why the flask was left for 10 minutes at each temperature **before** each reading was taken. **1**

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

10. (a) (continued)

(ii) A control flask should be included in this investigation.
Describe the control and explain its purpose in the investigation. **2**

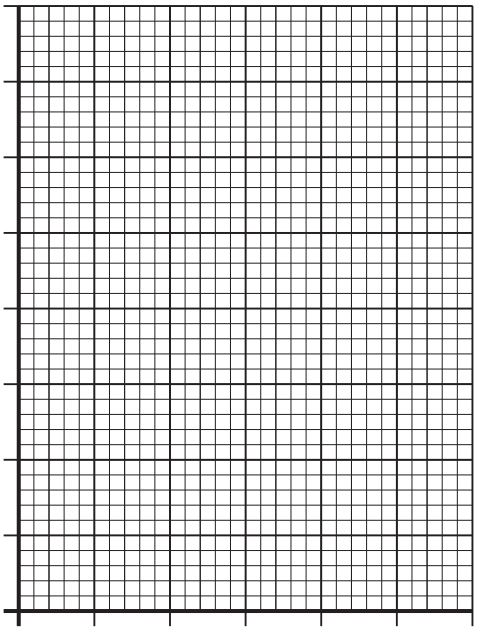
Description _____

_____

Explanation _____

_____

(b) Plot a line graph to show the results of the investigation. **2**
(Additional graph paper, if required can be found on *Page 31*).



(c) Draw a conclusion from these results. **1**

_____

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

11. Colchicine is a chemical used in plant breeding programmes to induce mutations and produce cultivars with improved characteristics.

Sesame is an important crop plant grown for its edible seeds and leaves.

An investigation was carried out to determine the effects of colchicine concentration on sesame. Sesame seeds were soaked in different concentrations of colchicine solution for 24 hours. Seeds from each concentration were germinated and 50 plants were grown from each concentration. Ninety days later the total leaf area, number of seeds and mass of seeds per plant were recorded.

The average results are shown in the table below.

Colchicine concentration (m mol l^{-1})	*Average total leaf area per plant* (cm^2)	*Average number of seeds per plant*	*Average total mass of seeds per plant* (g)
0	1500	548	2·8
0·1	2315	532	3·5
0·5	2786	550	4·4
1·0	3500	512	4·7

(a) (i) Identify the independent variable in this investigation. **1**

_____

(ii) State an aspect of the investigation which helped to ensure that reliable results were obtained. **1**

_____

(b) (i) An important characteristic of food crops is the *1000 seed mass* which is the total mass of a sample of 1000 seeds.

Calculate the *1000 seed mass* for the plants grown from seeds soaked in a colchicine concentration of 0·5 m mol l^{-1}. **1**

Space for calculation

_____ g

MARKS | DO NOT WRITE IN THIS MARGIN

11. (b) (continued)

(ii) Express, as the simplest whole number ratio, the average total leaf area per plant from seeds soaked in a colchicine concentration of 0 to that at 1·0 m mol l^{-1}. **1**

Space for calculation

_____ : _____

0 m mol l^{-1} 1·0 m mol l^{-1}

(c) Explain the relationship between the total leaf area and total mass of seeds. **2**

_____

_____

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

12. Malaria is a disease in humans caused by a parasite which is transmitted from human to human by mosquitoes. The stages of infection in humans are shown in the flow diagram below.

A female mosquito carrying parasites in its saliva bites a human to feed on blood which it needs for production of her eggs.

↓

Parasites pass into human blood and travel to the liver where they multiply and destroy liver cells.

↓

Parasites are released from liver cells into the blood where they enter red blood cells and destroy them.

(a) (i) Identify the vector in this parasitic relationship. **1**

_____

(ii) Give a reason why only female mosquitoes transmit the malaria parasite. **1**

_____

_____

(b) Explain the effect of a parasitic relationship on the host. **1**

_____

_____

(c) Two methods used to control the spread of malaria are described below.

Method 1 – mosquito repellent applied to the skin.
Method 2 – anti-malarial drugs that kill the parasite.

Choose **one** of these methods and explain how it can reduce the number of cases of malaria. **1**

Method _____

Explanation _____

_____

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[Turn over for next question

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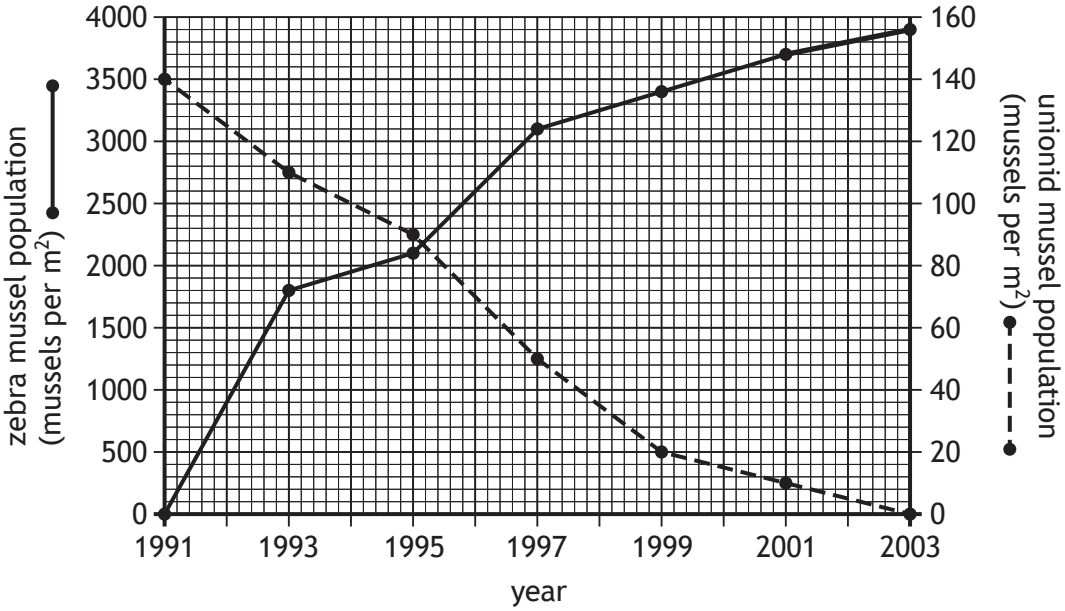
X707760125

MARKS | DO NOT WRITE IN THIS MARGIN

13. Freshwater mussels are small animals which live on the beds of lakes and rivers. Zebra mussels are a species of freshwater mussel native to lakes in Russia. They were accidentally introduced by humans into a river in North America in 1991. The populations of zebra mussels and the native unionid mussels were measured over a 12 year period.

The results are shown in the graph below.



(a) (i) State the unionid mussel population in 1993. **1**

_____ mussels per m^2

(ii) State the zebra mussel population when the unionid mussel population was 50 mussels per m^2. **1**

_____ mussels per m^2

(iii) Calculate the average increase per year in the zebra mussel population between 1991 and 2003. **1**

Space for calculation

_____ mussels per m^2 per year

(b) Explain how the graph confirms that zebra mussels are more successful competitors than unionid mussels. **1**

_____

_____

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

MARKS | DO NOT WRITE IN THIS MARGIN

13. (continued)

(c) **Using evidence from the graph**, explain why zebra mussels are an invasive species. **1**

(d) Suggest a reason why the population of zebra mussels may have increased faster in the North American river than in its native habitat. **1**

(e) Invasive species have a negative impact on genetic diversity of an ecosystem.

State what is meant by genetic diversity. **1**

[Turn over for next question

MARKS | DO NOT WRITE IN THIS MARGIN

14. Answer **either A or B** in the space below and on *Pages 29* and *30*.

A Write notes on crop protection under the following headings:

(i) weeds, pests and diseases; **4**

(ii) methods of control. **4**

OR

B Write notes on social behaviour in animals under the following headings:

(i) social hierarchy and cooperative hunting; **4**

(ii) social insects. **4**

SPACE FOR ANSWERS

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SPACE FOR ANSWERS

[END OF QUESTION PAPER]

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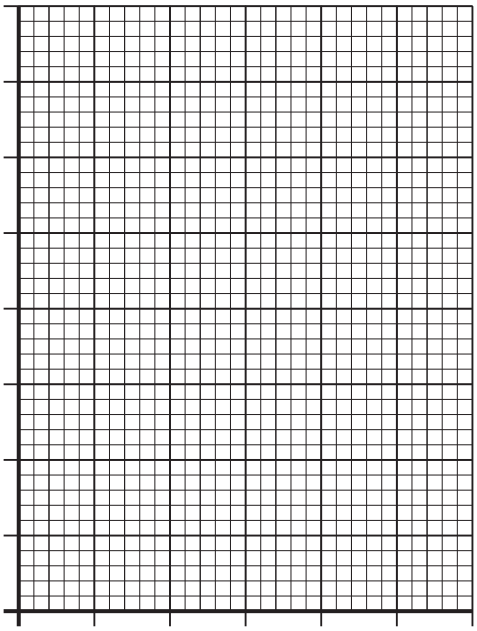
MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL GRAPH PAPER FOR QUESTION 10 (b)



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MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ACKNOWLEDGEMENT

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