OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

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INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 4 Control

Monday 11 June 2018 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided

0 1 A scientist used microelectrodes to measure the maximum membrane potential of a Pacinian corpuscle and a sensory neurone when different pressures were applied to a fingertip.

Figure 1 shows the Pacinian corpuscle, sensory neurone and positions of two microelectrodes, **P** and **S**. Microelectrode **S** is at the base of the finger.

Figure 1

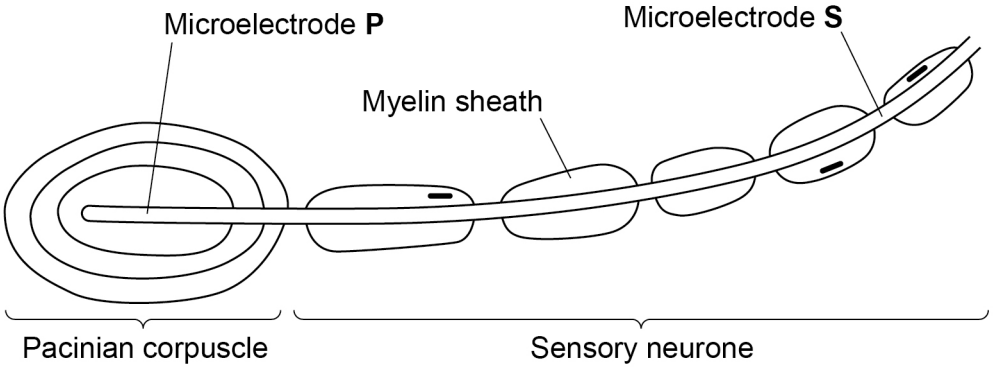


Table 1 shows the scientist's results.

Table 1

Relative amount of pressure applied to fingertip	Membrane potential recorded by microelectrode **P** / millivolts (mV)	Membrane potential recorded by microelectrode **S** / millivolts (mV)
None	–74	–74
Light	–52	–74
Medium	–46	+37
Heavy	–40	+37

0 1 . 1 Explain how the resting potential of –74 mV is **maintained** in the sensory neurone when no pressure is applied.

[2 marks]

Do not write outside the box

0 1 . 2 Explain how applying pressure to the Pacinian corpuscle produces the changes in membrane potential recorded by microelectrode **P** in **Table 1**.

[3 marks]

0 1 . 3 The membrane potential recorded by microelectrode **S** in **Table 1** is the same whether medium or heavy pressure is applied to the fingertip.

Explain why.

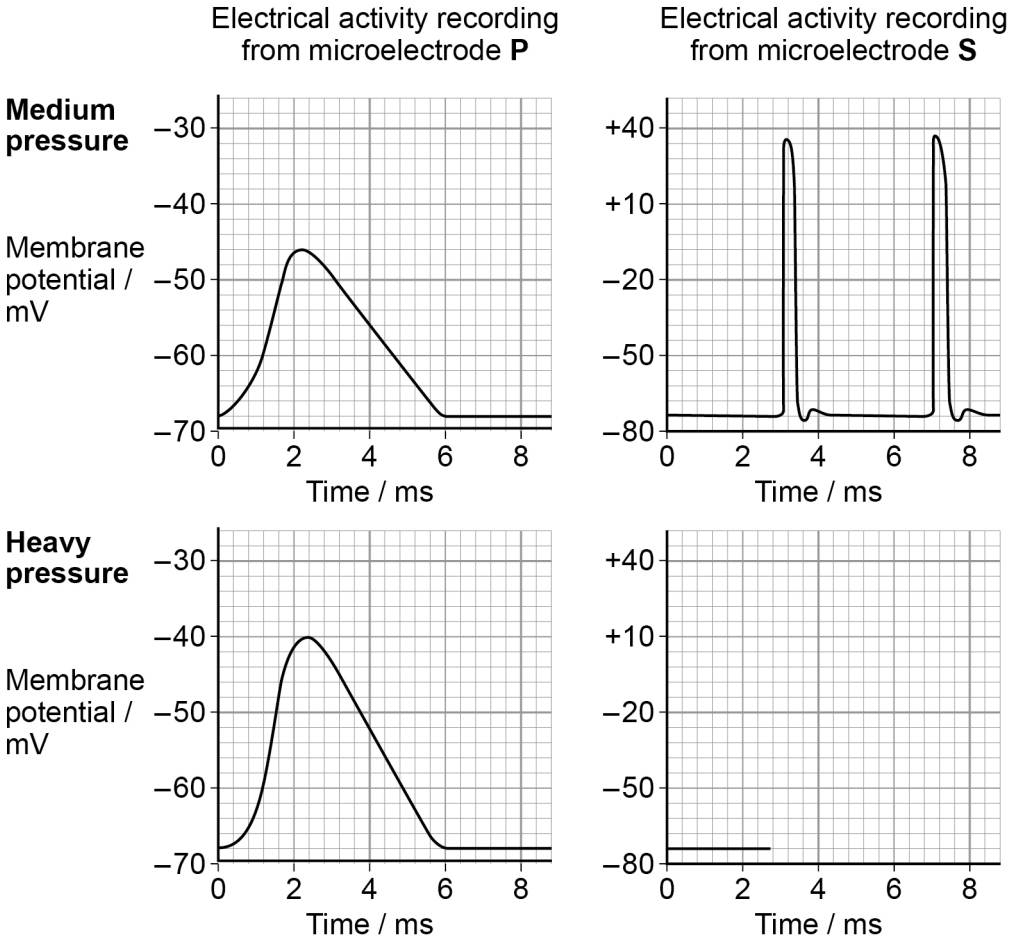
[2 marks]

Question 1 continues on the next page

Do not write outside the box

Figure 2 shows the electrical activity simultaneously recorded from the Pacinian corpuscle and sensory neurone when medium and heavy pressure is applied to the fingertip. The time was measured in milliseconds (ms).

Figure 2



0 1 . 4 Complete **Figure 2** to show the electrical activity recorded by microelectrode **S** when **heavy pressure** is applied to the fingertip.

[2 marks]

Do not write outside the box

0 1 . 5 Medium pressure is applied to the fingertip.

Using information from **Figure 2**, calculate the delay between the maximum depolarisation recorded by microelectrode **P** and the first depolarisation recorded by microelectrode **S**.

Give your answer to one significant figure.

[1 mark]

Delay = _____ ms

0 1 . 6 The distance between microelectrodes **P** and **S** in **Figure 1** was 10.3 cm.

Use this value **and** your answer to **01.5** to calculate the speed of the electrical impulse along the sensory neurone when medium pressure is applied.

Give your answer in metres per second (ms^{-1}) to 1 decimal place.

[2 marks]

Speed of impulse = _____ ms^{-1}

Question 1 continues on the next page

Do not write outside the box

0 1 . 7 Most of the sensory neurone in **Figure 1** is covered by a myelin sheath. Neuromyelitis optica is a disease in which parts of a myelin sheath surrounding a neurone in the optic nerve of the eye become destroyed.

Explain how this can cause slower responses to stimuli.

[2 marks]

0 1 . 8 The rate of ATP consumption in a non-myelinated neurone is greater than that of a myelinated neurone when conducting electrical impulses at the same frequency.

Explain why.

[2 marks]

16

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0 2 A student investigates tropisms in the roots of tomato plants.

0 2 . 1 What is a tropism?

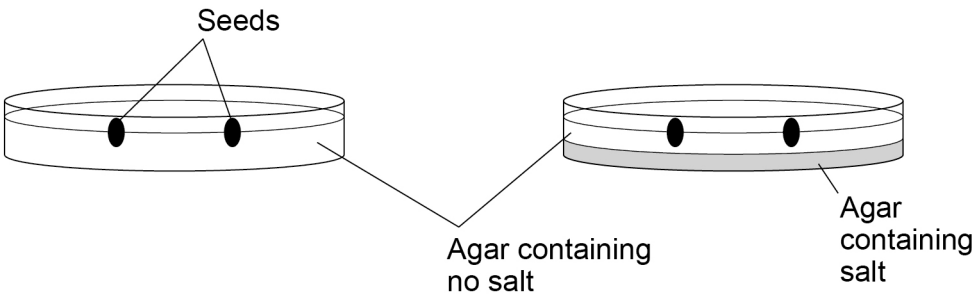
[2 marks]

The student:

1. places four tomato plant seeds of the same variety in a solution of dilute bleach for five minutes
2. rinses the seeds in sterile distilled water
3. uses sterile forceps to gently press two seeds onto a sterilised agar plate that contains **no salt**
4. uses sterile forceps to gently press the other two seeds onto a different, sterilised agar plate that contains **no salt in the top half of the agar but salt in the bottom half**
5. places the agar plates in a 45º position in a well-lit area for 48 hours
6. observes the tropism of the roots.

Figure 3 shows the two agar plates at steps **3** and **4**.

Figure 3



0 2 . 2 Why are sterile conditions important in this investigation?

[2 marks]

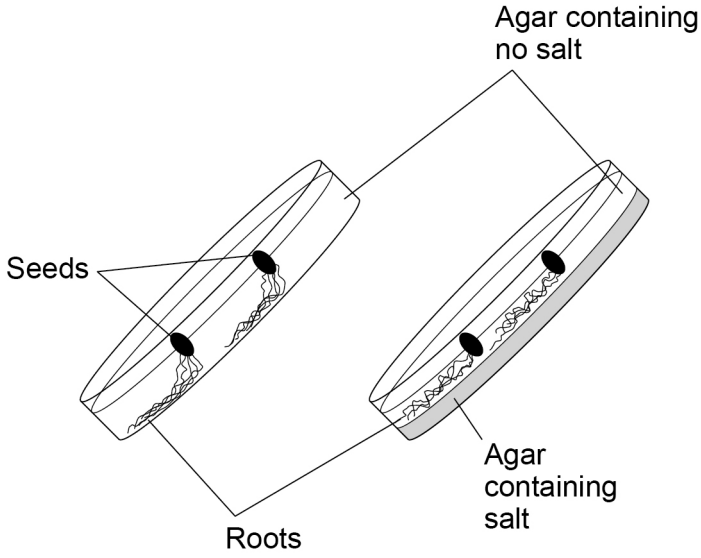
Do not write outside the box

0 2 . 3 Suggest why the seeds are gently pressed onto the agar but are **not** completely covered with the agar.

[2 marks]

Figure 4 shows the observed tropisms of the tomato plant roots after being placed in in a 45º position (steps **5** and **6** in the method).

Figure 4



0 2 . 4 What do these results suggest about the tropisms of the roots of tomato plants?

[3 marks]

Do not write outside the box

0 2 . 5 Give **two** reasons why the results may not be valid.

[2 marks]

1 _____

_____

2 _____

_____

11

Turn over for the next question

Do not write outside the box

0 3 Read the following passage.

The discovery of stem cells in the 1950s prompted suggestions that they could be used clinically in medical treatments. Stem cells are described as being potent and immortal.

Human stem cells are found in both embryos and in adult tissues. Tissue grown from stem cells can be transplanted into patients to replace damaged tissue. 5

In vitro fertilisation (IVF), a technique used for helping infertile couples reproduce, often results in several embryos being produced that are no longer needed for reproduction. Such 'spare' embryos can be used to obtain embryonic stem cells. 10

'Spare' embryos, however, are not an ideal source of embryonic stem cells for medical treatments on patients.

In 2006, a technique was developed by one scientist to genetically reprogramme specialised adult cells to become undifferentiated, induced pluripotent stem cells (iPSCs). This new technique *may* make the use of embryo stem cells unnecessary. 15

Use information from the passage and your own knowledge to answer the questions.

0 3 . 1 Explain why stem cells are described as being:

[2 marks]

potent (line 3) _____

_____

_____

immortal (line 3) _____

_____

_____

Do not write outside the box

0 3 . 2 Human stem cells are found in both embryos and adult tissues (line 4).

Which of the following stem cell types are **only** found in embryos?

[1 mark]

Tick (✓) **one** box.

Multipotent and unipotent ☐

Pluripotent and multipotent ☐

Totipotent and multipotent ☐

Totipotent and pluripotent ☐

0 3 . 3 Suggest why 'spare' embryos are not an ideal source of embryonic stem cells for medical treatments on patients (lines 11–12).

[4 marks]

Do not write outside the box

0 3 . 4 The creation of iPSCs *may* make the use of embryonic stem cells unnecessary (lines 15–16).

Suggest why we cannot be certain that the creation of iPSCs will make the use of embryonic stem cells unnecessary.

[1 mark]

_____

_____

_____

8

Do not write outside the box

0 4 Tissue within the heart is able to control the regular contraction of the atria and ventricles.

0 4 . 1 Describe how tissue within the heart coordinates the cardiac cycle.

[5 marks]

0 4 . 2 The rate of respiration increases during exercise.

Explain how this causes the heart rate to increase.

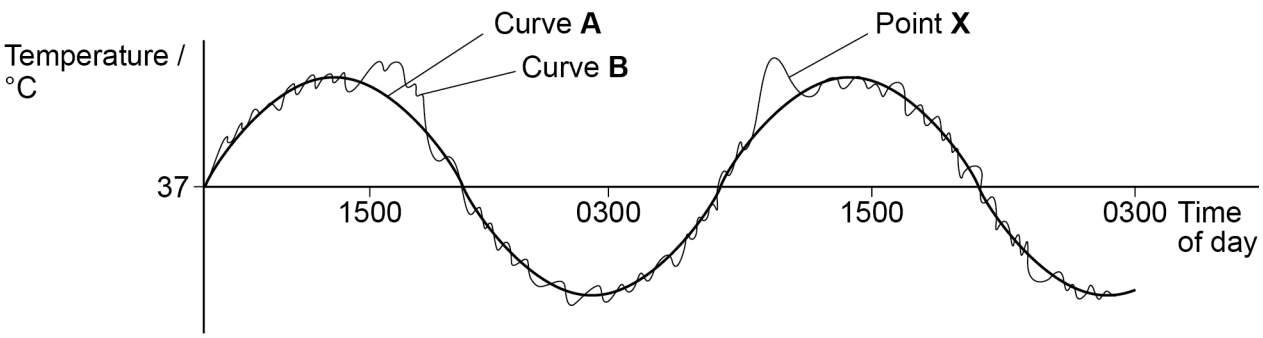
[5 marks]

10

Do not write outside the box

0 5 **Figure 5** shows the daily fluctuations in body temperature in one student. **Curve A** shows the mean core body temperature. **Curve B** shows variations from the mean.

Figure 5



0 5 . 1 Why is it important to maintain a stable core body temperature?

[1 mark]

0 5 . 2 A student states that **Curve A** is evidence of positive feedback.
Use information from **Figure 5** to explain why the student is **not** correct.

[2 marks]

Do not write outside the box

0 5 . 3 With reference to **Curve B** in **Figure 5**, suggest **two** physiological changes that could be occurring at **Point X**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 5 . 4 Suggest an explanation for the daily fluctuations in body temperature shown in **Curve A** in **Figure 5**.

[2 marks]

_____

_____

_____

_____

7

Turn over for the next question

Do not write outside the box

0 6 Diabetes is a condition caused by a failure of glucose homeostasis. There are two forms of the condition, Type 1 and Type 2.

People with Type 2 diabetes have cells with low sensitivity to insulin. About 80% of people with Type 2 diabetes are overweight or obese. Some people who are obese have gastric bypass surgery (GBS) to help them to lose weight.

Doctors investigated whether GBS affected sensitivity to insulin. They measured patients' sensitivity to insulin before and after GBS. About half of the patients had Type 2 diabetes. The other half did not have diabetes but were considered at high risk of developing the condition.

Table 2 below shows the doctors' results. The higher the number, the greater is the sensitivity to insulin.

Table 2

Patients	Mean sensitivity to insulin / arbitrary units (± SD)	
	Before gastric bypass surgery	1 month after gastric bypass surgery
Did not have diabetes	0.55 (± 0.32)	1.30 (± 0.88)
Had Type 2 diabetes	0.40 (± 0.24)	1.10 (± 0.87)

0 6 . 1 The doctors concluded that many of the patients who did not have Type 2 diabetes were at high risk of developing the condition.

Use the data in **Table 2** to suggest why they reached this conclusion.

[2 marks]

Do not write outside the box

0 6 . 2 A journalist reported that GBS cured many patients' diabetes.

Do the data in **Table 2** support this conclusion?

Give reasons for your answer.

[4 marks]

0 6 . 3 Many people who suffer from Type 2 diabetes often have high blood pressure.

Explain why.

[3 marks]

Question 6 continues on the next page

Do not write outside the box

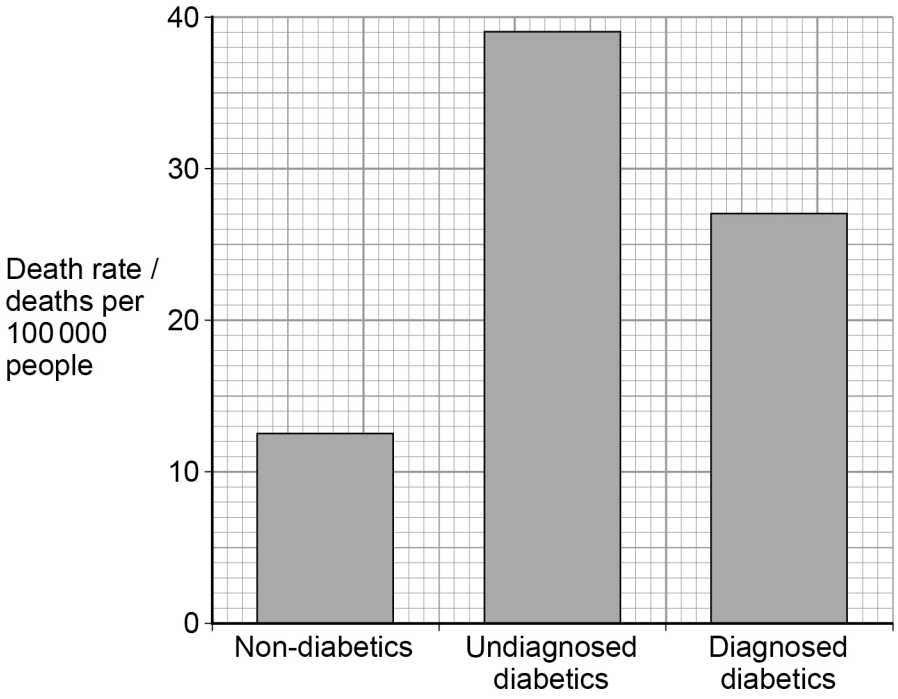
Other doctors studied a large group of different people in one country. They recorded the death rates for:

- non-diabetic people
- people that had not been diagnosed with diabetes, but were later found to have the condition – undiagnosed diabetics
- people that had been diagnosed with diabetes – diagnosed diabetics.

They gave the death rates as deaths per 100 000 people.

Figure 6 shows the death rates.

Figure 6



0 6 . 4 Suggest why the death rate was given **per 100 000 people**.

[1 mark]

Do not write outside the box

0 6 . 5 Using information from **Figure 6**, calculate the ratio of the death rate of diagnosed diabetics **to** undiagnosed diabetics.

Give the ratio in its simplest form.

[2 marks]

Ratio = _____

12

Turn over for the next question

Do not write outside the box

0 7 Recombinant DNA technology involves using a vector to transfer a fragment of DNA from one organism to another.

A scientist uses a vector called the R plasmid to attempt to transform some bacterial cells with fragments of human DNA.

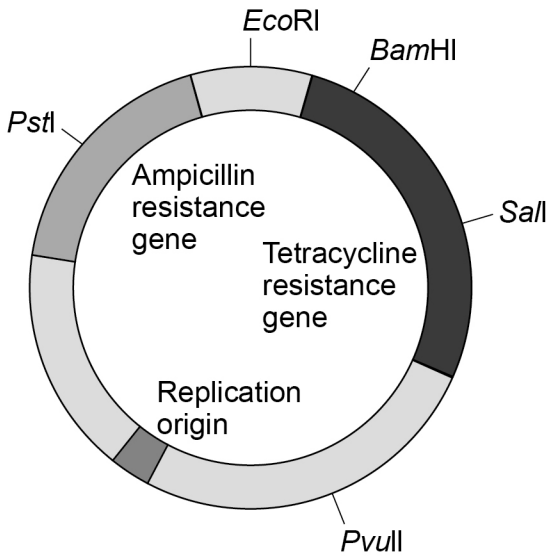
The scientist:

- cuts a fragment of donor human DNA using a restriction endonuclease enzyme
- copies the fragment of DNA many times using the polymerase chain reaction (PCR)
- cuts R plasmids using the same restriction enzyme
- mixes the copied fragments of human DNA with the cut R plasmids
- then mixes the R plasmids with bacterial cells.

Figure 7 shows the structure of the R plasmid that the scientist uses.

Figure 7

The R plasmid



0 7 . 1 *Eco*RI, *Bam*HI, *Sal*I, *Pvu*II and *Pst*I are sites where different restriction enzymes cut the DNA.

Give the reason why the *Eco*RI and *Bam*HI restriction enzymes cut the DNA at different sites.

[1 mark]

_____

_____

Do not write outside the box

0 7 . 2 The scientist uses the polymerase chain reaction (PCR) to amplify **one** fragment of human DNA twenty times.

How many **polynucleotide strands** will be produced?

[2 marks]

Number of polynucleotide strands = _____

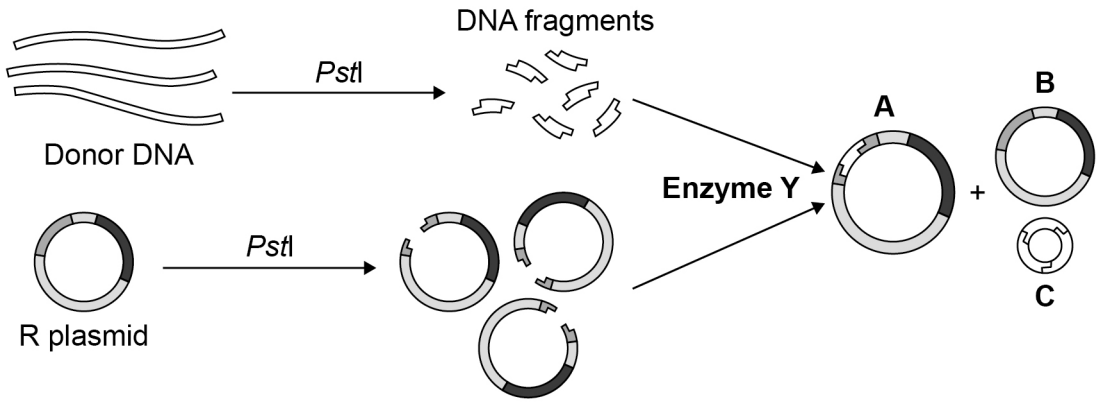
Question 7 continues on the next page

Do not write outside the box

The scientist uses the restriction enzyme *Pst*I to cut the sample of human DNA and to cut the R plasmid. When the scientist mixes the copied human DNA fragments with the cut R plasmids several products are formed.

Figure 8 shows the method as well as the products **A**, **B** and **C**.

Figure 8



0 7 . 3 Name **enzyme Y** shown in **Figure 8**.

[1 mark]

_____

0 7 . 4 Describe exactly what each of products **A**, **B** and **C** is composed of.

[3 marks]

A is _____

_____

B is _____

_____

C is _____

_____

Do not write outside the box

The scientist attempts to insert the copied human DNA fragments into the R plasmids by cutting each plasmid at the site of the ampicillin resistance gene shown in **Figure 7**. The tetracycline resistance gene is not cut.

0 7 . 5 The scientist mixes bacterial cells with the products, **A**, **B** and **C**, shown in **Figure 8**.

The bacterial cells are then grown on a master plate containing the antibiotic tetracycline.

Explain why.

[2 marks]

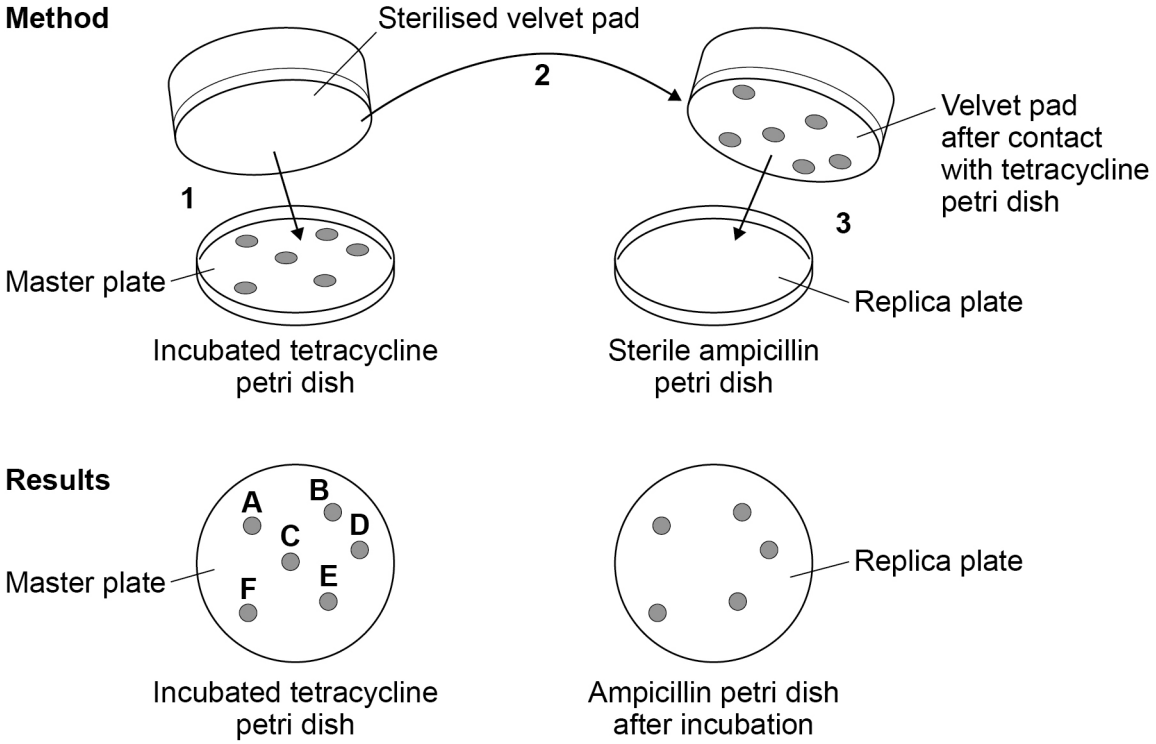
Question 7 continues on the next page

Do not write outside the box

0 7 . 6 The bacterial cells grew to form colonies on the master plate.

The scientist set up a replica plate containing the antibiotic ampicillin as shown in **Figure 9**.

Figure 9



Give the letter of **one** bacterial colony that contained a plasmid with the human DNA fragment.

Explain your answer.

[2 marks]

Colony containing plasmid _____

Explanation _____

_____

_____

11

END OF QUESTIONS

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