Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Q1.

(a) Describe and explain how the polymerase chain reaction (PCR) is used to amplify a DNA fragment.

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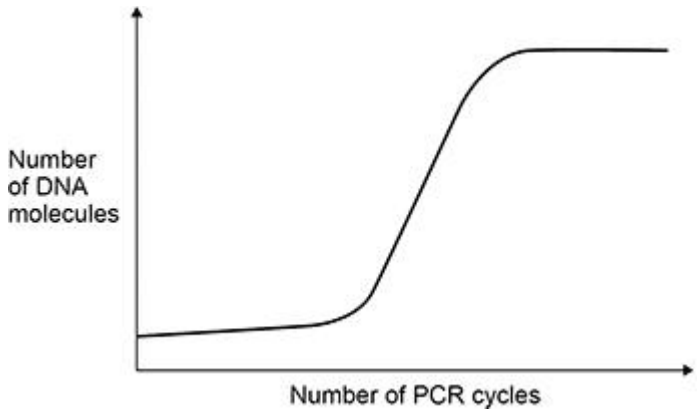
(4)

The figure below shows the number of DNA molecules produced using a PCR.



(b) Explain the shape of the curve in the figure above.

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(2)
(Total 6 marks)

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Q2.

Plants transport sucrose from leaves to other tissues for growth and storage. SUT1 is a sucrose co-transporter protein.

Scientists investigated whether the cells of tobacco plant leaves used SUT1 to transport sucrose to other tissues.

(a) The scientists used a radioactively labelled DNA probe to show that the cells of tobacco plant leaves contained the *SUT1* gene.

Describe how they would do this.

Do **not** include PCR in your answer.

_____

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(4)

(b) To study the role of SUT1 in tobacco plants, scientists reduced the expression of the *SUT1* gene.

When the *SUT1* gene is transcribed, the SUT1 mRNA produced is called 'sense' SUT1 mRNA. The scientists genetically modified plants by inserting an **extra** gene so that this **also** allowed the production of 'antisense' SUT1 mRNA.

The scientists had two types of tobacco plants:

- type **A** – plants that were genetically modified
- type **B** – plants that were **not** genetically modified.

Suggest how the production of 'antisense' SUT1 mRNA in type **A** plants would reduce the expression of the *SUT1* gene.

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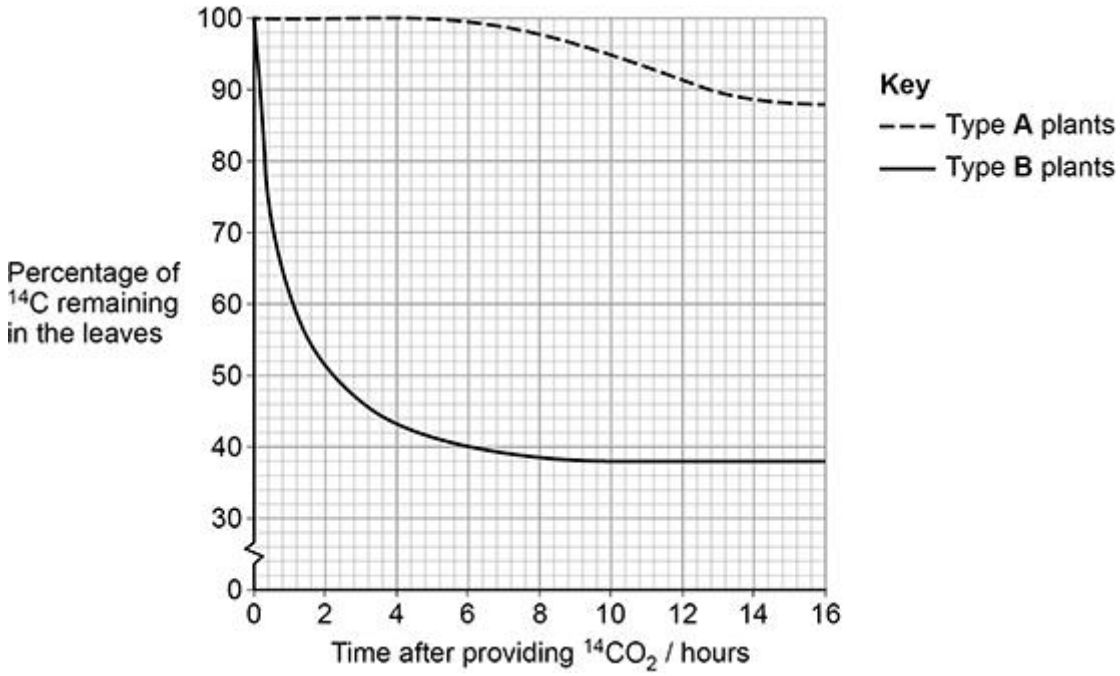
(4)

(c) The scientists hypothesised that lower rates of sucrose transport from leaves would cause reduced growth.

To test this hypothesis, the scientists provided leaves of type **A** and type **B** plants with labelled carbon dioxide ($^{14}CO_2$). To estimate sucrose transport out of leaves, they measured the percentage of ^{14}C remaining in the leaves for 16 hours.

The figure below shows their results.



Calculate the ratio of percentage of ^{14}C remaining in leaves of type **B** to type **A** plants 16 hours after providing $^{14}CO_2$

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Answer _____

(1)

(d) In type **B** plants, the percentage of ^{14}C remaining in the leaves does not reach zero per cent, as shown in the figure above.

Suggest **two** reasons why.

1 _____

_____

2 _____

_____

(2)

The scientists measured physiological differences between type **A** plants and type **B** plants.

The table below shows the scientists' results as they presented them.

Physiological factor	**Type of tobacco plant**	
	Type A	**Type B**
Rate of sucrose transport from leaf cells / µmol m^{-2} s^{-1}	0.1	3.7
Leaf sucrose concentration / mmol m^{-2}	22	4
Ratio of shoot:root dry mass	6:1	2:1
Rate of photosynthesis / µmol glucose m^{-2} s^{-1}	4	14

Sucrose is able to inhibit the production and activity of rubisco in leaves of a plant. Type **A** plants have decreased dry mass compared with type **B** plants.

(e) Use all the information to suggest **and** explain how the physiological factors in the table above would contribute to the decreased dry mass observed in type **A** plants.

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(4)

(Total 15 marks)

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