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BIOLOGY

THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	DNA PROBE & GEL ELECTROPHORESIS
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	6
TOTAL MARKS	33

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DNA probe and Gel Electrophoresis - 1

1.

For development and storage, plants move sucrose from their leaves to other tissues.

Protein SUT1 is a co-transporter of sucrose.

Researchers looked into whether tobacco plant leaf cells transported sucrose to other tissues via SUT1.

(a) The SUT1 gene was found in the cells of tobacco plant leaves by the scientists using a radioactively tagged DNA probe.

Explain their plan of action.

Don't mention PCR in your response**. (4)**

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(b) Scientists lowered the expression of the SUT1 gene in order to investigate the function of SUT1 in tobacco plants.

The SUT1 mRNA generated during transcription of the SUT1 gene is referred to as "sense" SUT1 mRNA. Through the insertion of an additional gene, the scientists genetically altered plants to enable the synthesis of "antisense" SUT1 mRNA.

Two varieties of tobacco plants were available to the scientists:

type A: Genetically modified plants

type B: Non-genetically modified plants.

Explain how the expression of the SUT1 gene would be decreased in type A plants if 'antisense' SUT1 mRNA were produced**. (4)**

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2.

(a) What is a probe of DNA? **(2)**

(b) To make the DNA probe, the geneticist had to find the base sequence of the normal gene. Once he had copies of the gene, what methods would he use to find the base sequence of the gene? **(2)**

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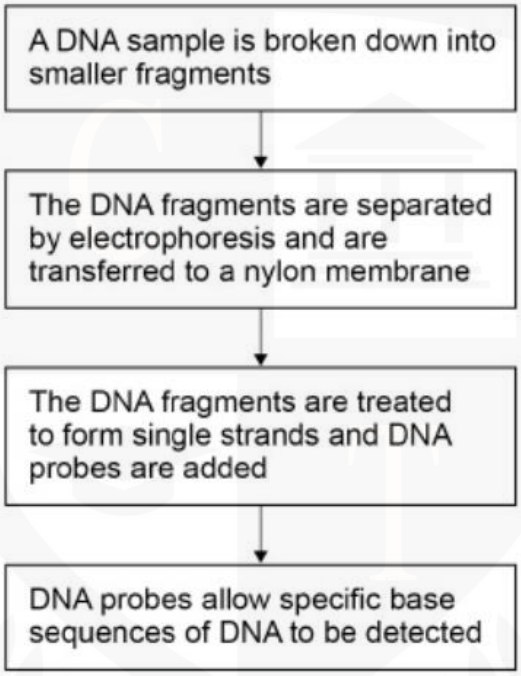
3.

DNA probes are used to identify particular DNA base sequences.

The steps are displayed in Figure 1.

Figure 1



(a) Explain the process by which DNA fragments into smaller pieces**. (2)**

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(b) Single strands of DNA are formed by treating the DNA on the nylon membrane. Describe your reasoning. **(2)**

4.

A scientist screened four volunteers for five distinct viral DNA fragments using electrophoresis and DNA probes.

The findings the scientist came to are displayed in Figure 2. The four volunteers are represented by the lanes numbered 2 through 5.

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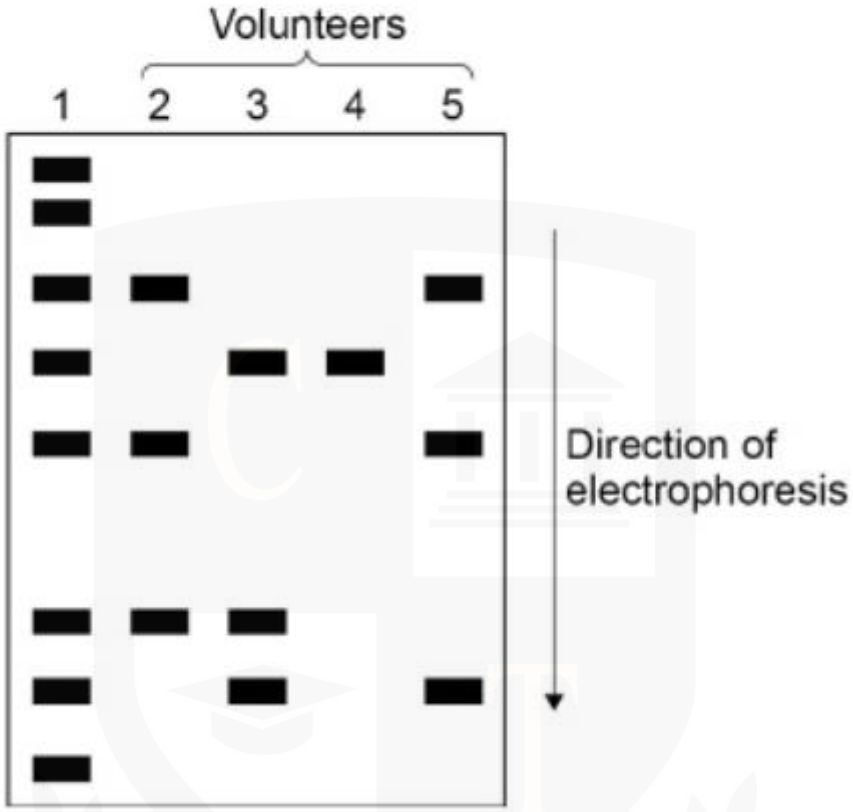
Figure 2



(a) Figure 2 Lane 1 made it possible to calculate the sizes of the various viral pieces.

Propose and describe how. **(2)**

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The viral DNA fragments measured the following lengths: 600 base pairs, 250 base pairs, 535 base pairs, 300 base pairs, and 500 base pairs.

(b) Which volunteers possessed at least one 250- or 535-base pair viral DNA fragment? **(2)**

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5.

Tuberculosis is caused by Mycobacterium tuberculosis. There is a direct repeat (DR) region in the DNA of Mycobacterium TB. Spacers are 43 distinct non-coding base sequences that make up the DR region. Every spacer in the DR area is located in a particular location.

There are strains of M. tuberculosis that have lost some of these spacers.

(a) The base sequences in the DR region are non-coding.

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What does the term "non-coding base sequence" mean? **(2)**

(b) Identify the mechanism through which a spacer's base sequence is removed from a DR region. **(2)**

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(c) The DNA probe the geneticist used was for an exon in the DNA, not an intron. Explain why. **(2)**

6.

Researchers looked into the DR regions of various M. tuberculosis strains.

A DNA probe was created for every one of the forty-three spacer sequences. Every probe was: • labeled with a fluorescent marker that illuminated when the probe was positioned in relation to its matching spacer.

• affixed to a certain slide square.

From every strain, they collected samples of the DR region. These were divided into tiny pieces of single-stranded DNA. Each strain's pieces were put on a slide along with the DNA probes. Their findings using 20 of the probes for a single strain of M. tuberculosis are displayed in the diagram below.

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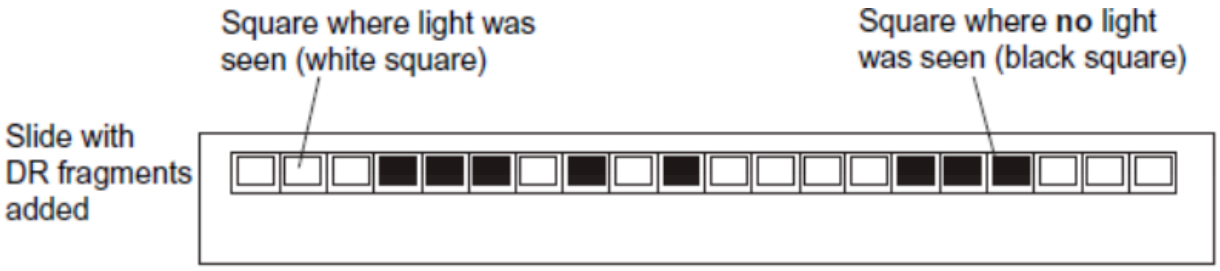

(a) Before looking for spacers, the scientists cloned the DNA of the DR region in vitro.

Name the technique that was employed to clone the DNA in vitro. **(2)**

(b) Describe how the outcomes shown in the diagram were obtained by using DNA probes. **(3)**

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(c) Doctors can use the method with DNA probes to identify the specific strain of M. tuberculosis infecting a patient. This is very important when there is an outbreak of a number of cases of tuberculosis in a city.

Suggest and explain why it is important to be able to identify the specific strain of M. tuberculosis infecting a patient. **(2)**

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