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BIOLOGY

THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	RECOMBINANT DNA
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	6
TOTAL MARKS	27

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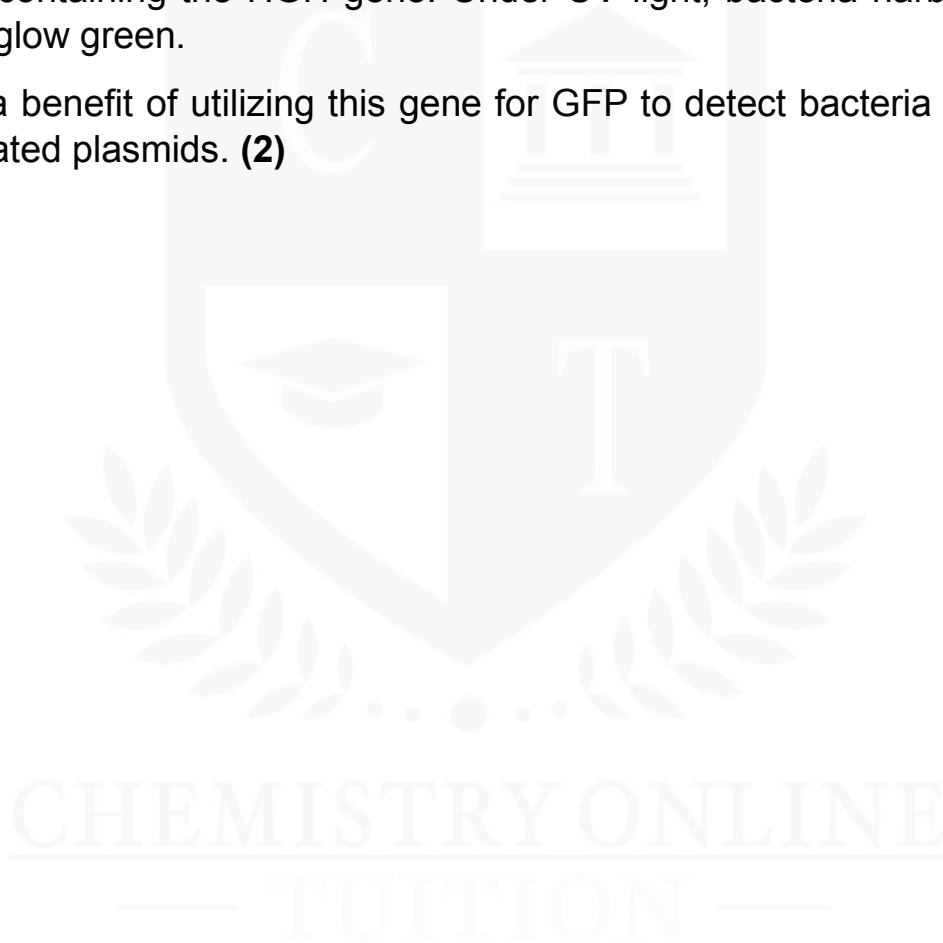
Recombinant DNA - 2

1.

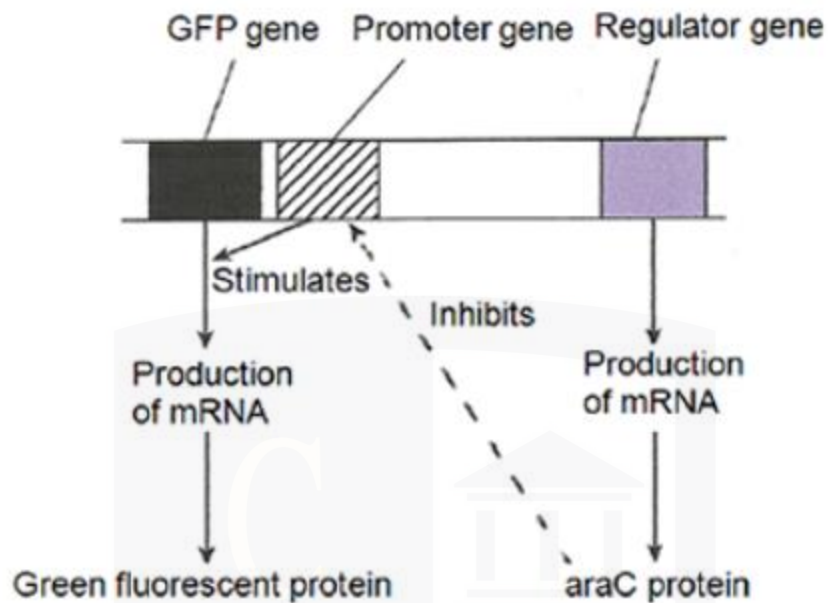
(a) The geneticist intends to attempt to convert E. coli cells using the plasmids carrying the HGH gene. She is aware that not all E. coli will ingest the plasmid.

Green fluorescent protein (GFP) is coded for in the plasmids she plans to employ, which will allow her to detect which bacteria have taken up the plasmid containing the HGH gene. Under UV light, bacteria harboring this plasmid glow green.

Identify a benefit of utilizing this gene for GFP to detect bacteria that have incorporated plasmids. (2)



A portion of the plasmid harboring the gene for GFP is depicted in the diagram below. The functions of two genes that regulate the GFP gene are also displayed.



(b) The sugar arabinose has the ability to bind to the araC protein.

Explain why the geneticist needs to add arabinose to the agar that she plans to use to cultivate *E. coli* carrying the transgenic plasmids using the information in the diagram. **(2)**

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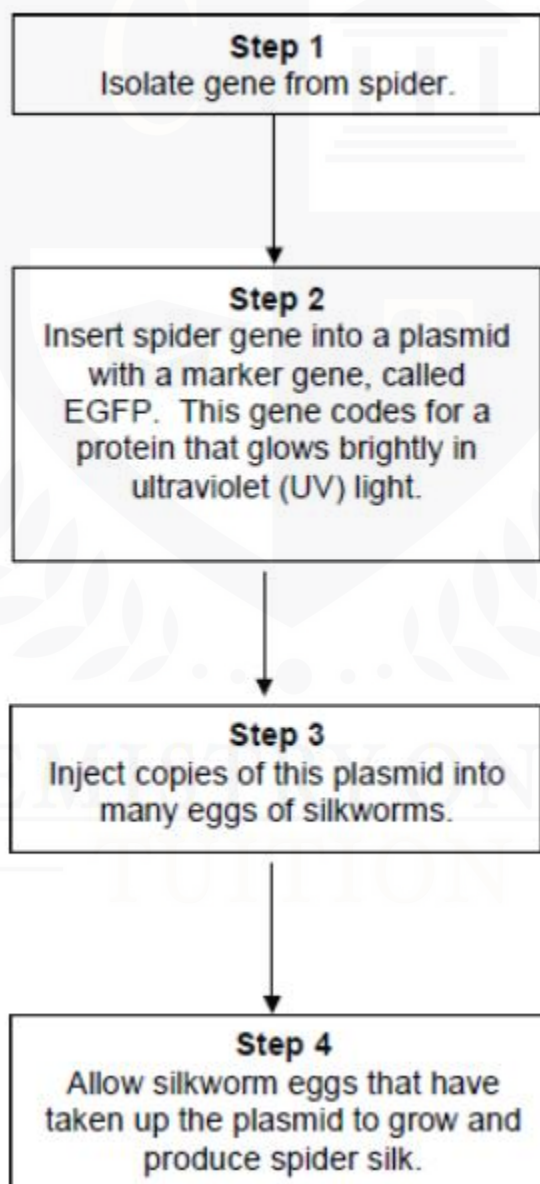
2.

The silk fibers secreted by silkworms are collected and utilized to make silk fabrics.

Researchers have created genetically modified (GM) silkworms with a spider gene.

The spider web protein, or "spider silk," secreted by the genetically modified silkworms is stronger than the protein found in regular silk fibers.

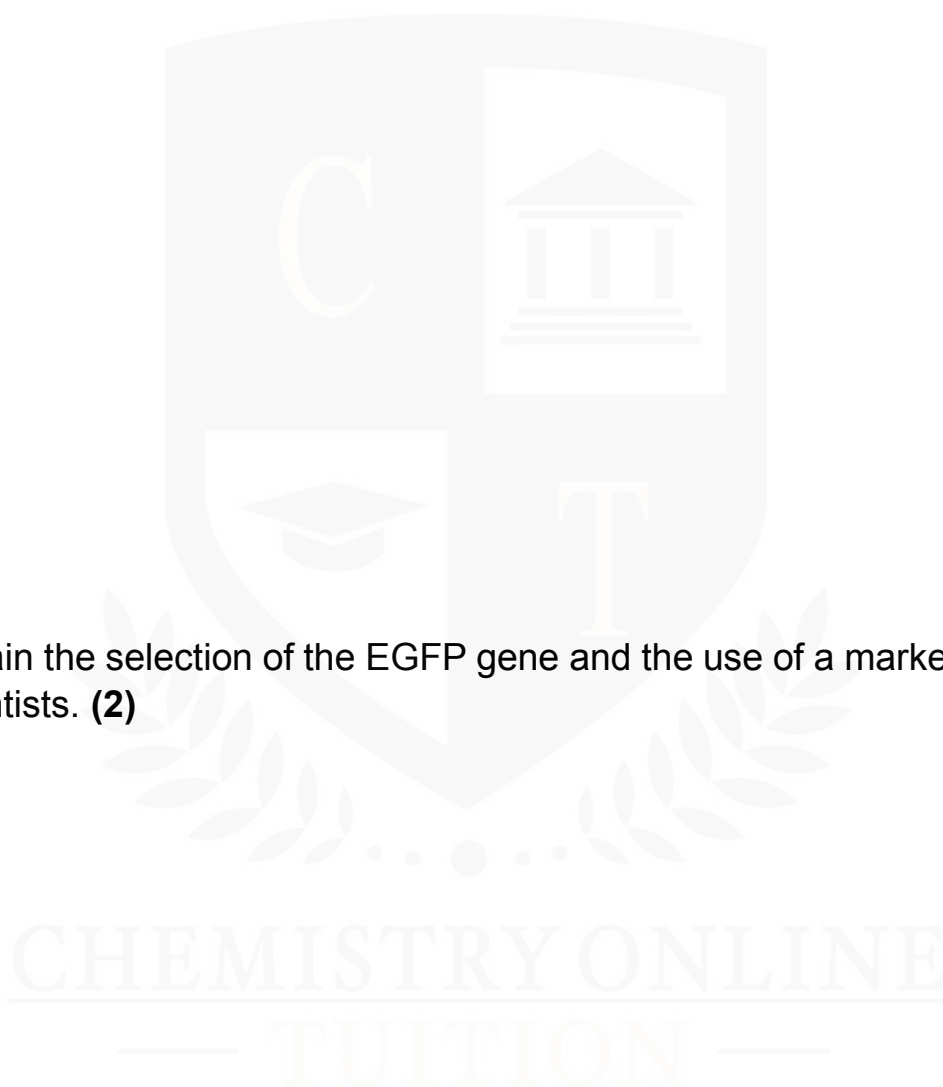
The graphic below depicts the technique the scientists employed.



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(a) Explain the rationale behind injecting the plasmids into the silkworm eggs as opposed to the silkworms themselves. **(2)**

(b) Explain the selection of the EGFP gene and the use of a marker gene by the scientists. **(2)**



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The scientists ensured the spider gene was expressed only in cells within the silk glands.

(c) What would the scientists have inserted into the plasmid along with the spider gene to ensure that the spider gene was only expressed in the silk glands of the silkworms? **(2)**

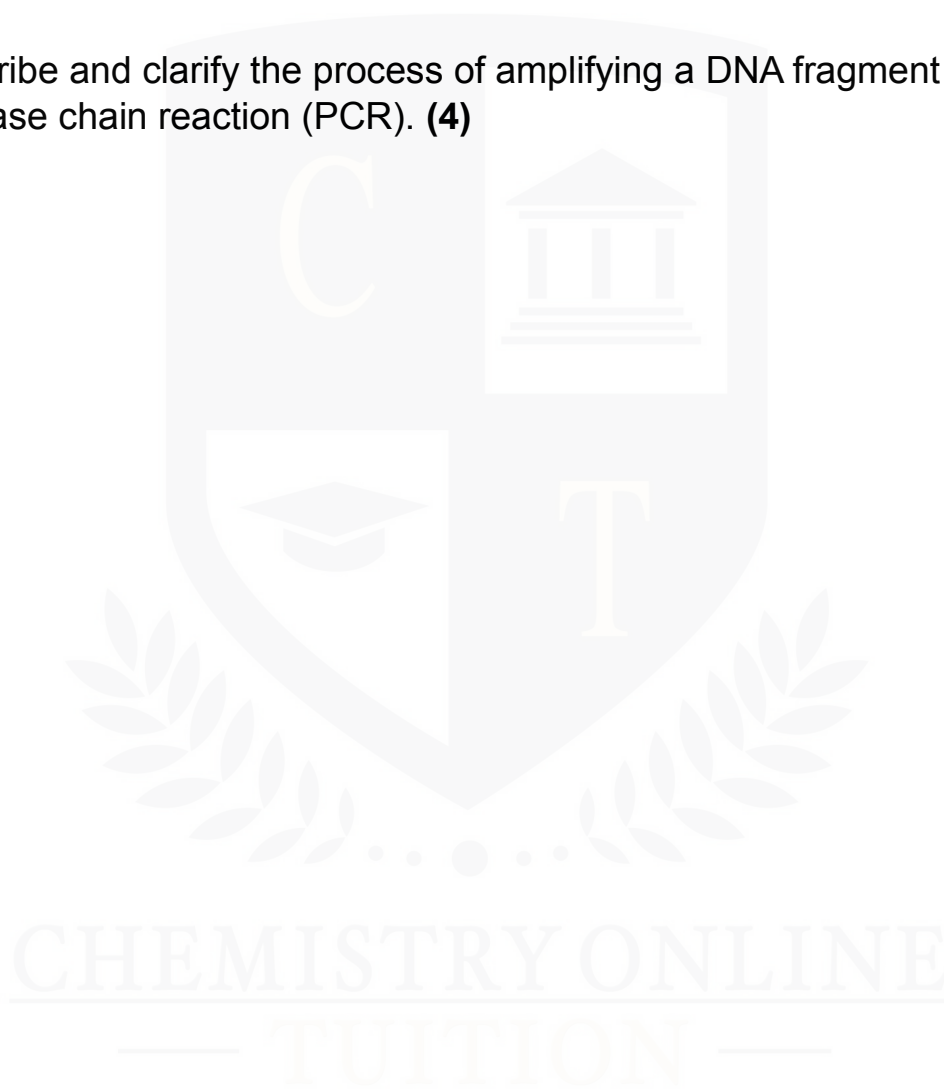


(d) Provide two arguments for the significance of the spider gene's exclusive expression in the silkworms' silk glands. **(2)**

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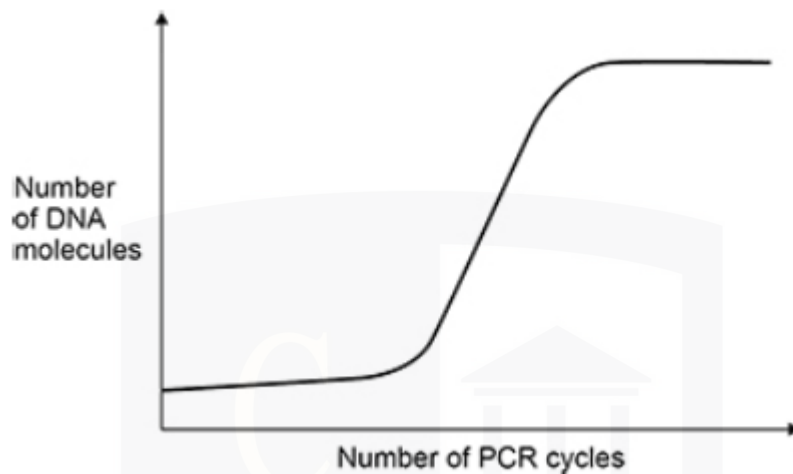
3.

(a) Describe and clarify the process of amplifying a DNA fragment using the polymerase chain reaction (PCR). **(4)**

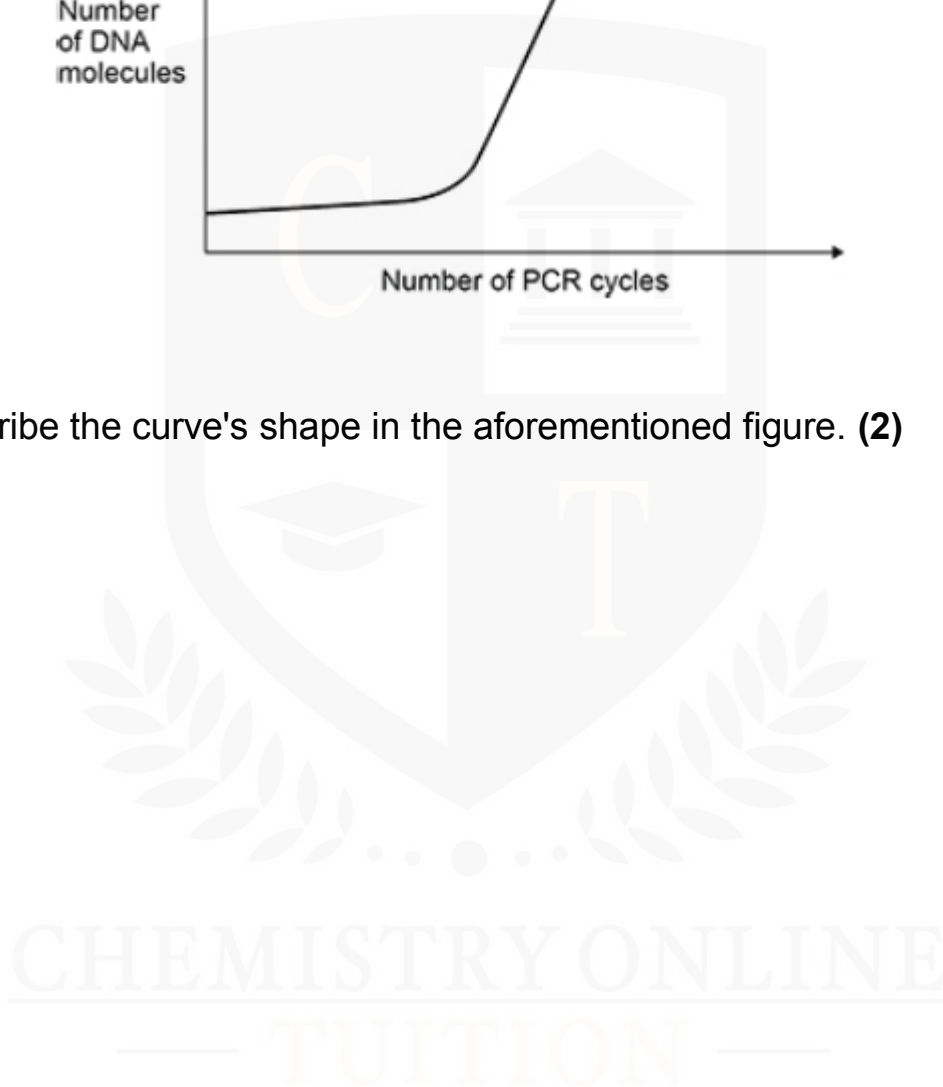


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A PCR produces a certain amount of DNA molecules, as seen in the image below.



(b) Describe the curve's shape in the aforementioned figure. **(2)**



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4.

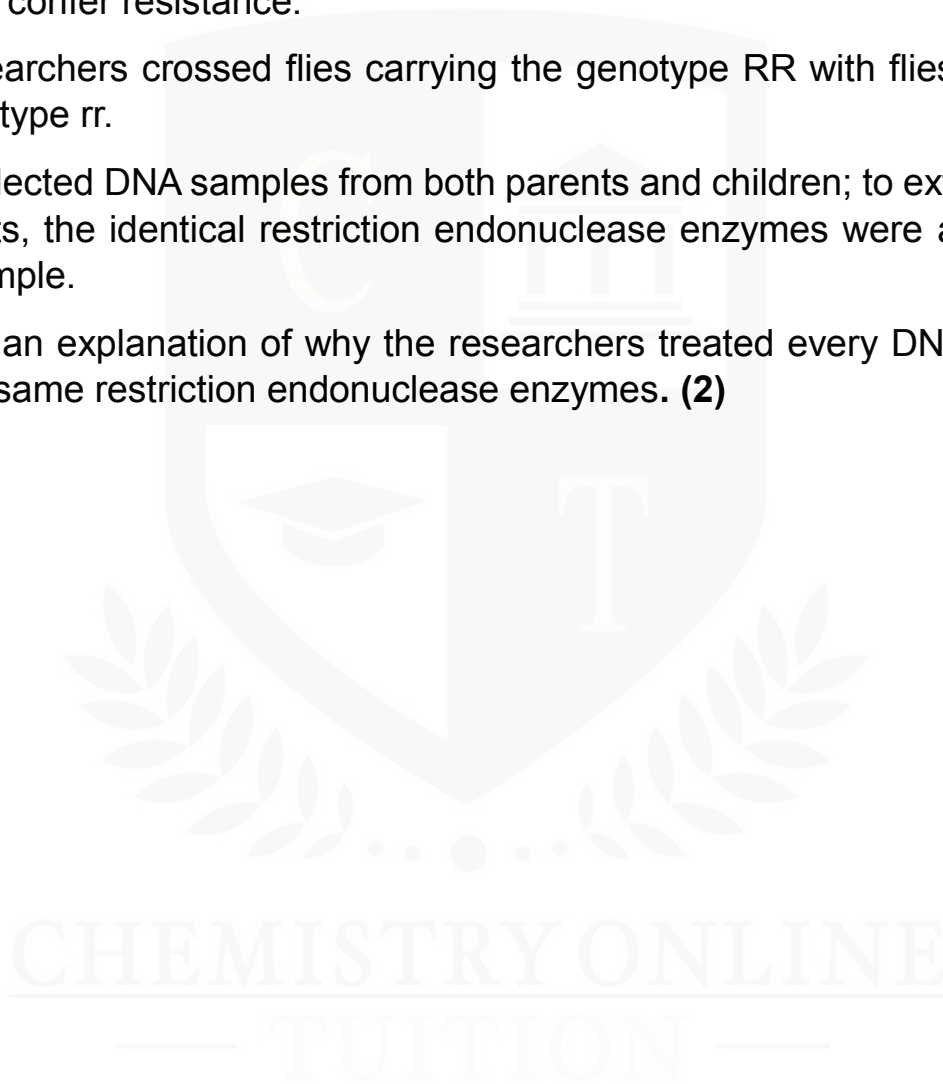
Fly populations are evolving resistance to insecticides meant to eradicate them.

Researchers created a technique to determine if a fly had the recessive allele, r , which confers pesticide resistance. This gene's dominant allele, R , does not confer resistance.

The researchers crossed flies carrying the genotype RR with flies carrying the genotype rr .

They collected DNA samples from both parents and children; to extract DNA fragments, the identical restriction endonuclease enzymes were applied to each sample.

(a) Give an explanation of why the researchers treated every DNA sample with the same restriction endonuclease enzymes. **(2)**



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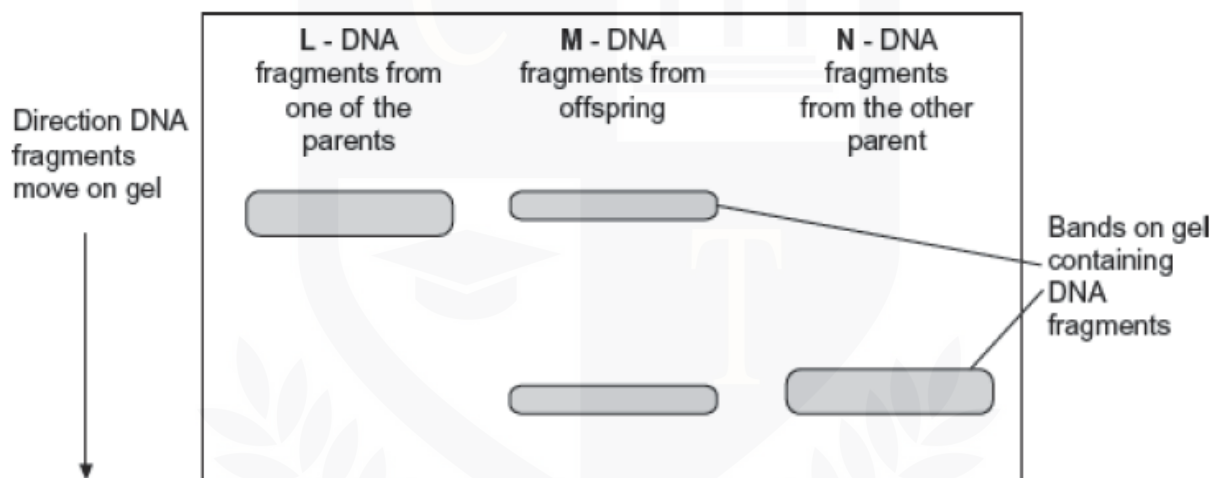
5.

Each sample of DNA fragments was treated with two distinct primers by the scientists in preparation for the polymerase chain reaction (PCR).

- Only a 195 base-pair fragment from allele r is bound by primer A3.
- Only a 135 base-pair fragment from allele R can be bound by primer A4.

On a gel, where shorter pieces travel farther in a predetermined amount of time, the scientists separated the DNA fragments generated by the PCR.

Figure 1 displays their findings.



(a) Justify the limited binding of primers A3 and A4 to particular DNA segments. **(2)**

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(b) Explain the findings in Figure 1 using all the available information. **(3)**



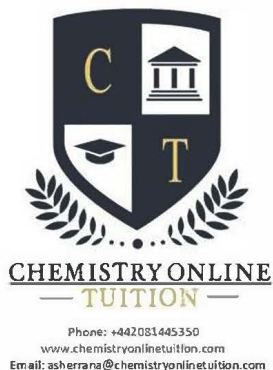
6.

(a) The question that the scientists had was which chromosome the gene containing alleles R and r was on. They extracted mitotic cells from the flies with genotype RR and introduced a labeled DNA probe specific for allele R. After that, they used an optical microscope to examine the cells.

Describe the rationale behind the employment of mitotic cells. **(2)**



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