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BIOLOGY

THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	GENETICS
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	6
TOTAL MARKS	32

Genetic - 2

1.

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)**

2.

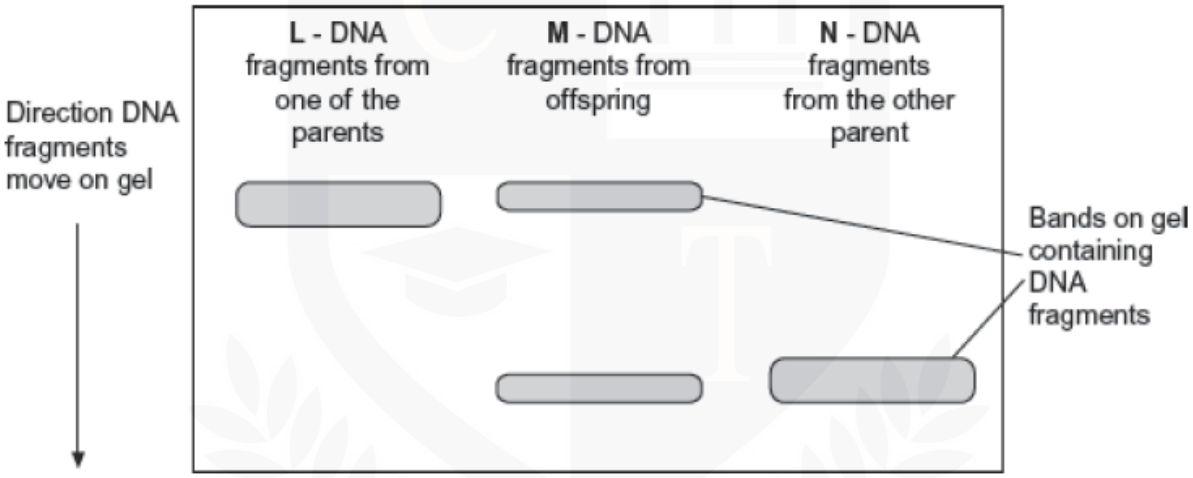
Each sample of DNA fragments was treated with two distinct primers by the scientists in preparation for the polymerase chain reaction (PCR).

• 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)**

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

(c) 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)**

3.

Another team of researchers believed that elevated P450 monooxygenase (PM) activity was connected to pesticide resistance in some flies. Insecticides are broken down by this enzyme.

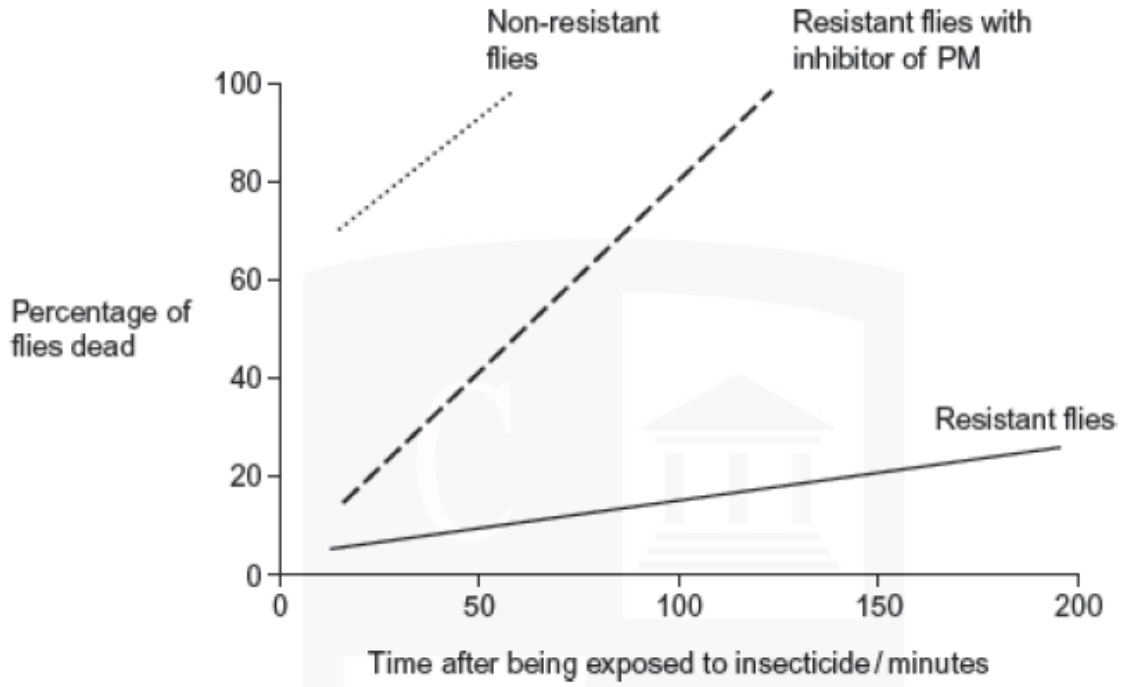
Both resistant and non-resistant flies were collected in great quantities by the investigators. After that, they organized the subsequent tests.

• Flies that are not resistant to insecticides; • Flies that are resistant to insecticides; and • Flies that are resistant to pesticides after being treated with a PM inhibitor.

The proportion of dead flies at various intervals following insecticide exposure was then calculated.

Their findings are displayed in Figure 2.

Figure 2



(a) Justify the scientists' choice to use non-resistant flies in the control experiment. **(2)**

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(b) The scientists came to the conclusion that while increased PM activity plays a role in the flies' resistance to the insecticide, other factors also play a role.

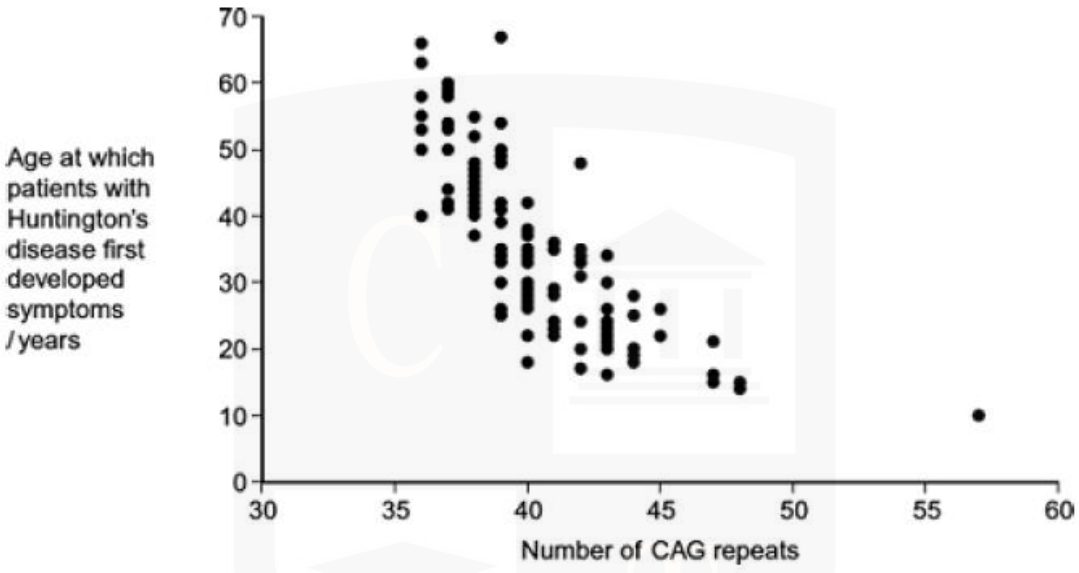
Describe how this conclusion is supported by the evidence. **(2)**

4.

A genetic disorder called Huntington's disease causes brain function to be lost. A region of DNA in the implicated gene has many repeats of the nucleotide sequence CAG. Whether an allele of this gene will result in Huntington's disease depends on the quantity of these repeats.

Huntington's disease can be caused by an allele with 40 or more CAG repeats, but it can also be caused by an allele with 36 to 39 CAG repeats. Huntington's disease cannot be caused by an allele with fewer than 36 CAG repeats.

The graph displays the number of CAG repeats in the allele that causes Huntington's disease in each patient as well as the age at which a sample of individuals with the disease first experienced symptoms.



(a) Tests can be performed on individuals to determine if they carry an allele of this gene that has more than 36 CAG repeats. Certain medical professionals propose that the outcomes could be utilized to forecast the onset age of Huntington's disease.

Utilize the data in the graph to assess this recommendation. **(3)**

(b) The disease Huntington's is invariably lethal. The allele is nevertheless inherited by human populations. Make suggestions about why using the data in the graph**. (2)**

5.

(a) How do you make a genetic fingerprint? **(2)**

(b) What is the difference between DNA fingerprinting and fingerprinting? **(2)**

(c) What are the applications of genetic fingerprinting? **(2)**

6.

(a) What is meant by genetic fingerprint? **(2)**

(b) When was genetic fingerprinting first used? **(2)**

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(c) How is electrophoresis used in genetic fingerprinting? **(2)**

(d) What is the principle of DNA fingerprinting? **(2)**

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