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BIOLOGY

GENETICS, POPULATIONS, EVOLUTION & ECOSYSTEMS

Level & Board	AQA (A-LEVEL)
TOPIC:	POPULATIONS
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	6
TOTAL MARKS	25

Population - 2

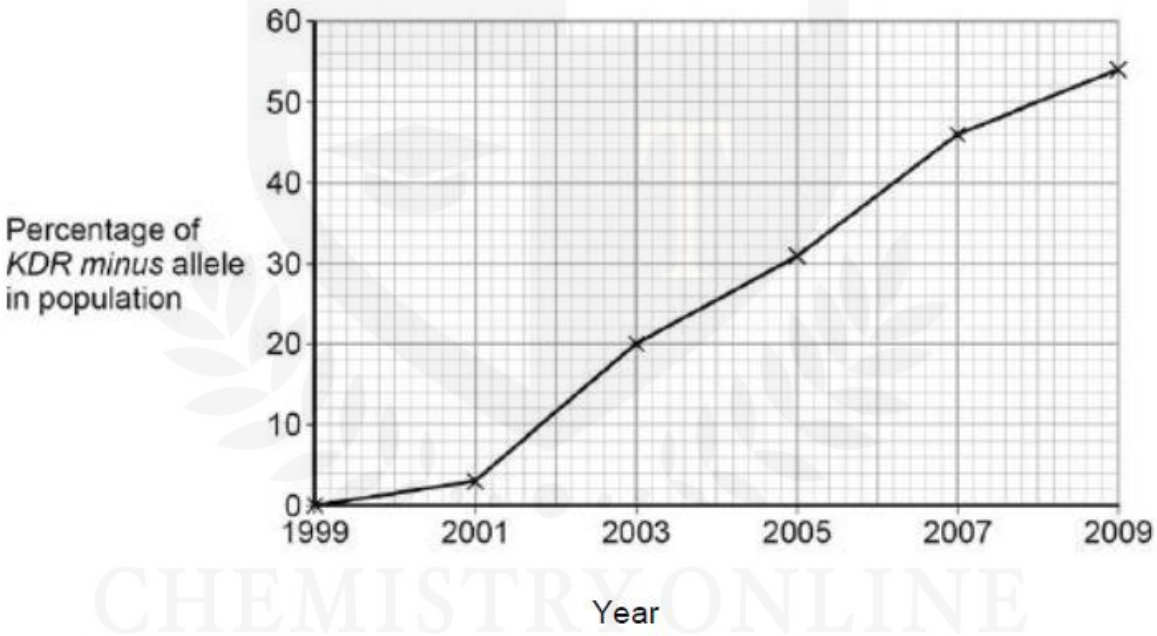
1.

Mosquitoes are the insects that carry the malaria virus. DDT is a chemical that is used in Africa to try and stop the spread of malaria by killing mosquitoes.

There is a gene in mosquitoes called KDR. A KDR minus allele of this gene is present in some mosquitoes today, providing them with resistance to DDT. KDR +, the other allele, does not produce resistance.

Over a ten-year period, researchers looked into the prevalence of the KDR minus allele in a population of mosquitoes in an African nation.

The scientists' findings are depicted in the image below.



Neuronal sodium ion channels are encoded by the KDR + allele.

(a) A sodium ion channel that has been bound by DDT stays open all the time. Make suggestions about how DDT kills insects based on this information. **(2)**

I am Sorry !!!!!

(b) Suggest how the KDR minus allele gives resistance to DDT. **(2)**

2.

In birds, XX denotes males while XY denotes females.

(a) Explain to the audience why female birds are more likely than male birds to exhibit recessive, sex-linked traits. **(2)**

3.

A gene located on the X chromosome regulates the rate at which feathers are produced in hens. The allele for producing feathers slowly, F, is dominant over the allele for producing feathers quickly, f. The outcomes of a farmer's crosses are depicted in the following figure.

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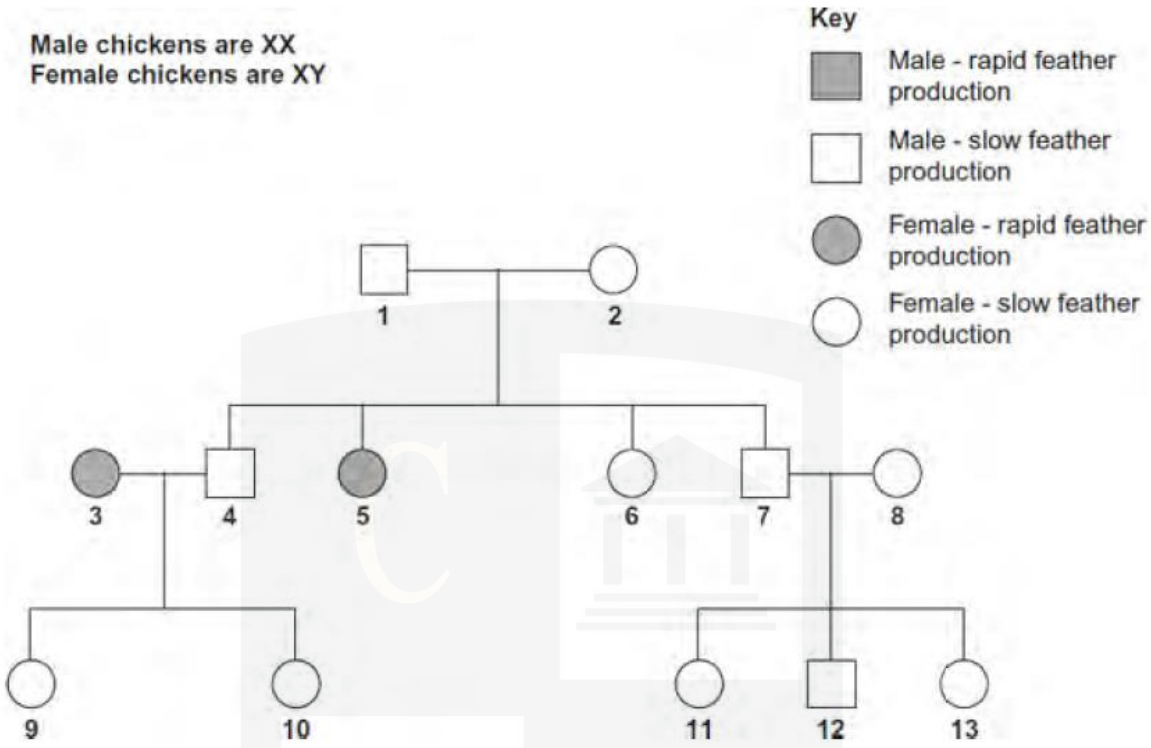

(a) Describe one example from the image that demonstrates the recessive nature of the allele responsible for producing feathers quickly. **(2)**

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(b) List every potential genotype combination for the chickens in the following figure. **(2)**

Chicken 5:

Chicken 7:

(c) A cross between two chickens produced four offspring. Two of these were males with rapid feather production and two were females with slow feather production. Give the genotypes of the parents. **(2)**

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4.

(a) In one species of chicken, two codominant alleles that are not sex-linked determine the color of the feathers. For black feathers, the allele CB codes,

whereas for white feathers, the allele C^W codes. Chickens that are heterozygous have blue feathers.

Four percent of the chickens on a farm had black feathers. Determine the proportion of this population that you would anticipate to be blue-feathered using the Hardy-Weinberg equation. Display your work. **(3)**

5.

Red blood cells are destroyed by malaria. Researchers looked at the possibility of a link between specific red blood cell morphologies and the development of severe or mild malaria. The study conducted a comparison between the red blood cell morphologies of hospitalized individuals with severe malaria and those with mild malaria. The table displays the outcomes.

Red blood cell phenotype	Ratio of patients with severe malaria : patients with mild malaria
Sickle cell trait	0.48 : 1
Blood group A	2.45 : 1
Blood group O	0.96 : 1

(a) Describe the benefit of showing the data as a ratio. **(2)**

(b) What does this data indicate regarding the relationship between red blood cell morphologies and the likelihood of contracting severe malaria as opposed to mild malaria? **(2)**

(c) HbA is the allele responsible for normal hemoglobin in red blood cells. The population of the allele HbC is highly frequent in particular regions of Africa where malaria is prevalent. People who carry the HbC gene are less likely to get severe malaria. In Africa, severe malaria is a major cause of death for many people.

Justify the high prevalence of the HbC allele in malaria-endemic regions. **(3)**

6.

The Hardy-Weinberg formula is as follows:

$p^2 + 2pq + q^2 = 1$.

The frequency of a recessive allele in a population can be calculated using the Hardy-Weinberg equation. A recessive allele is the cause of hemochromatosis. One person out of every 400 was found to have hemochromatosis in one nation.

(a) Explain how you would apply the Hardy-Weinberg equation to determine the frequency of individuals who possess the hemochromatosis allele but are otherwise healthy (heterozygotes). **(3)**

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