Q1.

In one species of squirrel, *Sciurus carolinensis*, fur colour is controlled by one gene, with two codominant alleles. **C^G** represents the allele for grey fur colour, and **C^B**

represents the allele for black fur colour.

The table below shows the three possible phenotypes.

Genotype	Phenotype
C^{G}C^G	Grey fur
C^{G}C^B	Brown-black fur
C^{B}C^B	Black fur

(a)   In a population of 34 *S. carolinensis*, 2 had black fur.

Use the Hardy–Weinberg equation to estimate how many squirrels in this population had brown-black fur. Show your working.

Answer _____

(2)

(b)   The actual number of squirrels in this population that had brown-black fur was 16.

Use all of the information to calculate the **actual** frequency of the **C^G** allele.

Do **not** use the Hardy–Weinberg equation in your calculation.

Give your answer to 2 decimal places.

Answer _____

(1)

Q2.

Read the following passage.

Complete achromatopsia is a form of complete colour blindness. It is caused by having only rods and no functional cone cells. People with complete achromatopsia have difficulty in seeing detail. Complete achromatopsia is caused by an autosomal recessive allele and is usually very rare in populations with only one in 40 000 being affected. However on the Pacific   5 island of Pingelap ten percent of the population are affected.

One form of red-green colour blindness is caused by a sex-linked recessive allele which affects more men than women. People with this red-green colour blindness are unable to distinguish between red and green, and also between other colours. They have green-sensitive cones but the   10 photoreceptive pigment they contain does not function.

Scientists investigated the use of gene therapy to correct red-green colour blindness in monkeys. They injected viruses containing the gene for the green-sensitive pigment directly into the eyes of the monkeys. Although the monkeys maintained two years of colour vision, there is debate on whether   15 this form of gene therapy is worthwhile. No clinical trials of this procedure have been carried out on humans. Current research into the treatment of red-green colour blindness involves the use of induced pluripotent stem cells (iPS cells). The use of iPS cells could have advantages over the use of gene therapy.   20

Use the information in the passage and your own knowledge to answer the following questions.

(a)   People with complete achromatopsia have difficulty in seeing detail (lines 2–3).

Explain why.

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(3)

(b)   Ten percent of the population on the Pacific island of Pingelap are affected by complete achromatopsia (lines 3–6).

Use the Hardy-Weinberg equation to calculate the percentage of this population who are heterozygous for this disorder.
Show your working.

Answer = _____ %

(2)

Q3.

(a)   What is a gene pool?

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_____

(1)

Q4.

Malaria is a disease that is spread by insects called mosquitoes. In Africa, DDT is a pesticide used to kill mosquitoes, to try to control the spread of malaria.

Mosquitoes have a gene called *KDR*. Today, some mosquitoes have an allele of this gene, *KDR minus*, that gives them resistance to DDT. The other allele, *KDR plus*, does not give resistance.

Scientists investigated the frequency of the *KDR minus* allele in a population of mosquitoes in an African country over a period of 10 years.

The figure below shows the scientists' results.

Year
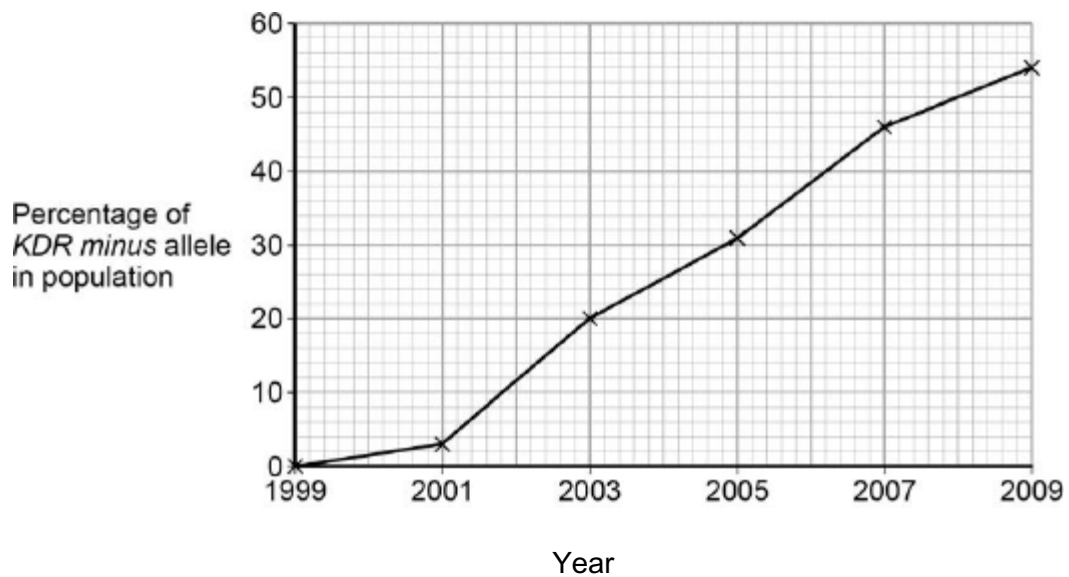
(a)   Use the Hardy–Weinberg equation to calculate the frequency of mosquitoes heterozygous for the *KDR* gene in this population in 2003.

Show your working.

Frequency of heterozygotes in population in 2003 _____

(2)

(b) Suggest an explanation for the results in the figure above.

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(4)