Q1.

(a) In fruit flies, a gene for body colour has a dominant allele for grey body, **G**, and a recessive allele for black body, **g**.

Explain how you would determine if the genotype of a grey fly is homozygous or heterozygous for body colour.

(2)

(b) In fruit flies, males are **XY** and females are **XX**.

A cross between a grey-bodied male fly and a black-bodied female fly produced some black-bodied females. Explain how this shows that the gene for body colour is **not** sex-linked.

(1)

(c) A population of fruit flies contained 19% grey-bodied flies.

Use the Hardy–Weinberg equation to calculate the percentage of flies heterozygous for gene **G**.

Show your working.

Answer ____________________ %

(2)

(d) In fruit flies, a gene for wing shape has a dominant allele for curly wings, **R**, and a recessive allele for normal wings, **r**. The alleles for this gene are on a different pair of chromosomes from the gene for body colour.

Fruit flies that are homozygous dominant for curly wings do not survive beyond the embryo stage.

A curly-winged fly, homozygous for grey body colour was crossed with a curly-winged, black-bodied fly.

Complete the genetic diagram to show all the possible genotypes and the ratio of phenotypes expected to develop into adults from this cross.

Phenotypes of parents Curly-winged, grey-bodied, × Curly-winged, black-bodied

Genotypes of parents ________________ × ________________

Genotypes of offspring ____

____

Phenotypes of offspring ____

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Ratio of offspring ____

(3)

(Total 8 marks)

Q2.

In cats, males are XY and females are XX. A gene on the X chromosome controls fur colour in cats. The allele **G** codes for ginger fur and the allele **B** codes for black fur.
These alleles are codominant. Heterozygous females have ginger and black patches of fur and their phenotype is described as tortoiseshell female.

The two alleles, **F** and **f** of a different gene, which is **not** sex-linked, interact with the gene controlling fur colour. The allele **F** is dominant and stops the formation of pigment in the fur, resulting in white fur. The allele **f** is recessive and has no effect on fur colour.

(a) Name the type of interaction between the two genes affecting fur colour.

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(1)

(b) What phenotype would a cat with the following genotype have?

X^GX^Bff ____

(1)

(c) Complete the genetic diagram to show all the possible genotypes and the ratio of phenotypes expected in the offspring of this cross.

Phenotypes of parents **X^GX^GFf** x **X^BYff**

Genotypes of offspring ______________________________________

Phenotypes of offspring ______________________________________

Ratio of offspring phenotypes _________________________________

(3)

(d) In a population, 36% of cats had the **F** allele and had white fur.

Use the Hardy–Weinberg equation to calculate the frequency of the **f** allele in this population.

Show your working.

Answer ____________________

(2)

(Total 7 marks)

Q3.

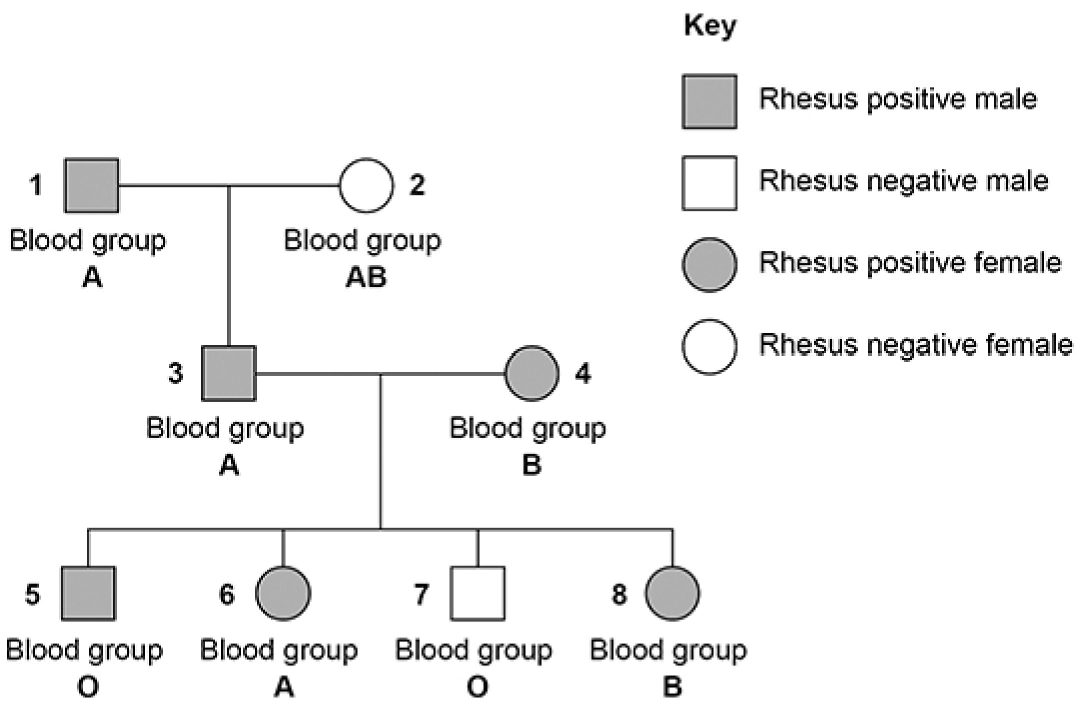
In humans, the ABO blood groups and Rhesus blood groups are under genetic control. The inheritance of the ABO blood groups is controlled by three alleles of a single gene, I^A, I^B and I^O. The alleles I^A and I^B are codominant, and the allele I^O is recessive to I^A and recessive to I^B.

There are four ABO phenotypes, **A**, **B**, **AB** and **O**.

The gene for the Rhesus blood groups has two alleles. The allele for Rhesus positive, **R**, is dominant to the allele for Rhesus negative, **r**.

The genes for the ABO and Rhesus blood groups are **not** sex-linked and are **not** on the same chromosome.

The diagram below shows the phenotypes in a family tree for the ABO and Rhesus blood groups.



(a) Give the genotypes of the ABO blood groups for individuals **1** and **2**.

Do **not** include the genotypes for the Rhesus blood groups in your answer.

1 ________________________________

2 ________________________________

(1)

(b) Explain **one** piece of evidence from the figure above that the allele for Rhesus positive is dominant.

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___

___

(2)

(c) Calculate the probability of individuals **1** and **2** producing a Rhesus positive son with blood group **A** (individual **3**). You can assume that individual **1** is heterozygous for the Rhesus blood group.

Show your working.

Probability ________________

(2)

Scientists determined the frequencies of the ABO alleles and ABO phenotypes in a large population. They then used a statistical test to determine if the frequencies of the four phenotypes differed significantly from the frequencies expected according to the Hardy–Weinberg equation.

(d) The frequencies of the $\mathbf{I^A}$ and $\mathbf{I^O}$ alleles were 0.15 and 0.65. What is the frequency of the $\mathbf{I^B}$ allele?

Frequency of $\mathbf{I^B}$ allele ________________

(1)

(e) Name the statistical test you should use to determine if the observed frequencies of the four phenotypes differed significantly from the frequencies expected according to the Hardy–Weinberg equation.

State how many degrees of freedom should apply.

Statistical test ______________________________________

Number of degrees of freedom ____________________________

(2)

(f) The scientists concluded that the observed frequencies of the four phenotypes differed significantly from the expected frequencies. Use your knowledge of the Hardy–Weinberg principle to suggest **two** reasons why.

1 ____

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2 ____

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(2)

(Total 10 marks)