



## GENETICS PROBLEMS



### Checklist

Make sure you:

- Solve monohybrid genetics problems
- Determine proportion and ratio of genotypes and phenotypes
- Use examples to distinguish amongst the following:  
**Complete dominance** – one allele is dominant over the other; the other is recessive  
**Incomplete dominance** – none of the two alleles of a gene are dominant over each other  
**Co-dominance** – both alleles of a gene are equally dominant
- Solve genetics problems involving the inheritance of characteristics involving each of the three types of dominance
- Differentiate between sex chromosomes (gonosomes) and autosomes in the karyotype of human males and females
- Represent a genetic cross to show the inheritance of sex
- State what is meant by multiple alleles
- Using the alleles  $I^A$ ,  $I^B$  and  $i$ , show how the 4 blood groups arise
- Solve genetics problems involving the inheritance of blood type
- Differentiate between sex chromosomes (gonosomes) and autosomes
- State what is meant by 'sex-linked characteristics'
- Solve genetics problems involving the following sex-linked characteristics:  
 Haemophilia  
 Colour blindness
- State what is meant by a genetic pedigree
- Interpret pedigree diagrams showing the inheritance of characteristics over many generations
- State Mendel's principle of independent assortment
- Solve dihybrid genetics problems
- Determine proportion/ratio of genotypes and phenotypes



### Exam Questions

#### Question 1

- 1.1 Justify the following statement: "Sex chromosomes are largely responsible for the fact that in human populations there are approximately as many men as there are women." Use a Punnett diagram to justify the statement above.

<b>Gametes</b>		

- 1.2 In dogs, there is an hereditary deafness caused by a recessive gene, "d." A kennel owner has a male dog that she wants to use for breeding purposes if possible. The dog can hear, so the owner knows his genotype is either DD or Dd. If the dog's genotype is Dd, the owner does not wish to use him for breeding so that the deafness gene will not be passed on. This can be tested by breeding the dog to a deaf female (dd). Use a genetic diagram to illustrate this cross. (6)



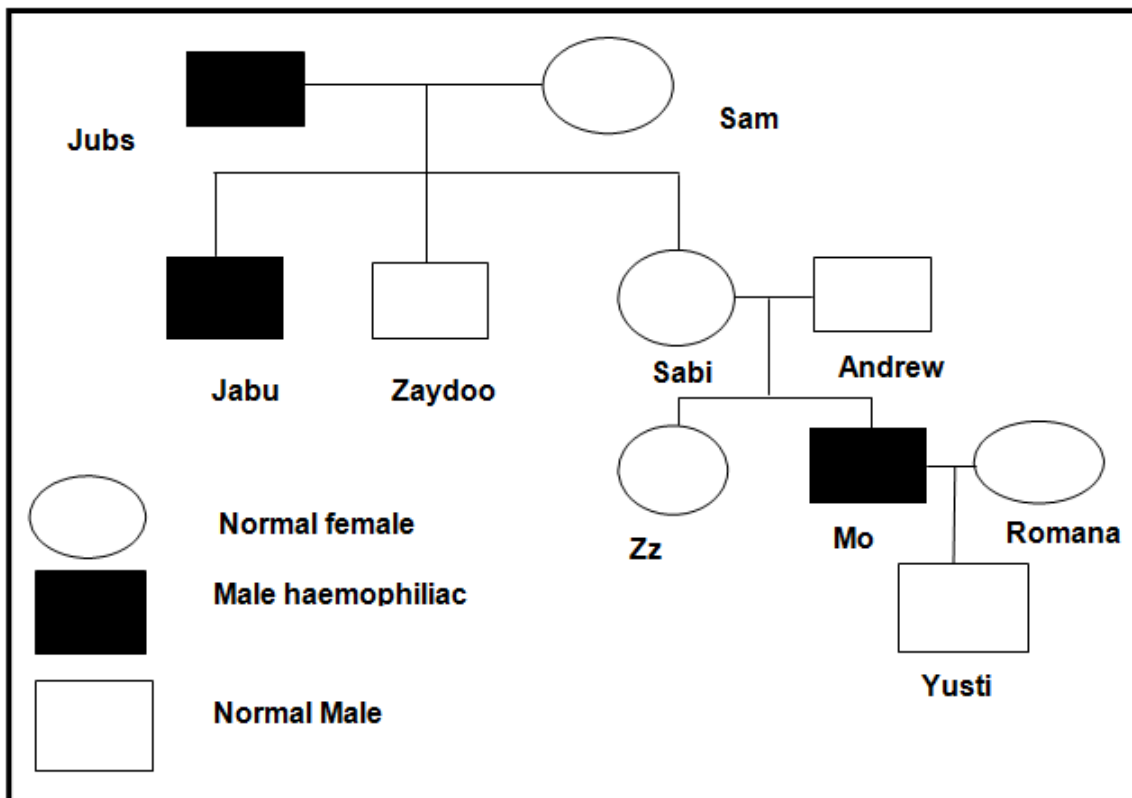
### Question 2

- 2.1 A homozygous snapdragon plant with red flowers (**R**) was cross-pollinated with a homozygous snapdragon plant with white (**W**) flowers. All the plants that grew from the cross had pink flowers. Represent a genetic cross to determine the genotype of the F<sub>1</sub> generation of plants.
- 2.2 Ms. Johnston, Ms. Johnson, and Ms. Johnstone all entered the same hospital and gave birth to baby girls on the same day, and all three babies were taken to the nursery to receive care, there. Someone later claimed that the hospital mixed up the babies. As a hospital administrator, it is your job to make sure that each pair of parents has the correct baby, so you order blood typing to be done on all the parents and all the babies. The results are as follows:
- Ms. Johnston A
  - Mr. Johnston B
  - Ms. Johnson B
  - Mr. Johnson O
  - Ms. Johnstone A
  - Mr. Johnstone A
  - Baby 1 O
  - Baby 2 AB
  - Baby 3 B

Represent a genetic cross to show which baby belongs to which parents.

### Question 3

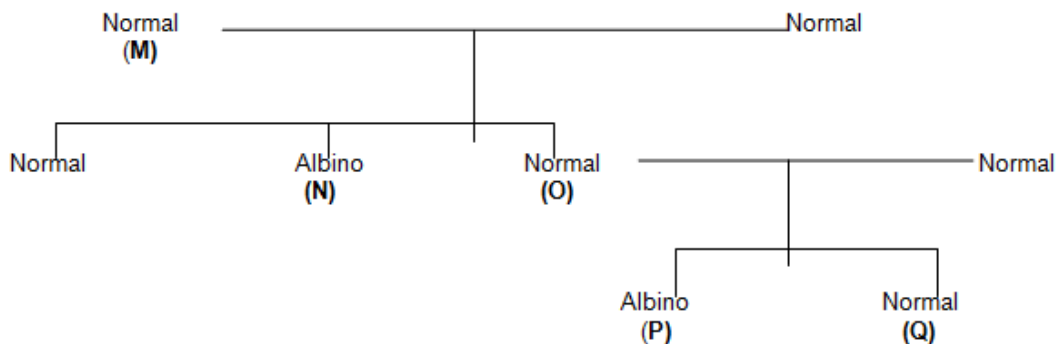
- 3.1 Study the pedigree diagram of a family where some individuals have haemophilia. Haemophilia is a sex-linked disorder. Use **H** for normal blood clotting and **h** for the haemophiliac trait.





- 3.1.1 Write down all the possible genotypes of the following individuals (2)
- a.) Jubs (2)
- b.) Sabi (2)
- c.) Yusti (2)
- 3.1.2 From the pedigree diagram above, state the relationship between gender and haemophilia. (2)
- 3.1.3 Illustrate the cross between Mo and Romana if Romana is a carrier for Haemophilia. (6)

3.2 The diagram below shows a pedigree diagram for albino inheritance. The albino condition is caused by a recessive allele (**a**) while the normal pigment is controlled by the dominant allele (**A**)



- 3.2.1 What are the possible genotypes of individuals M, N and O? (3)
- 3.2.2 If individual Q is heterozygous what are the chances of individuals P and Q having a normal child? Illustrate your answer with a genetic diagram. (7)

#### Question 4

A rooster with white feathers and a yellow beak mated with a hen with black feathers and a red beak. The F1 generation consists of 12 chickens; all with white feathers but 9 had yellow beaks and 3 had red beaks.

Use the symbols **F** and **f** for feather colour and **B** and **b** for beak colour.

- 4.1 Name the recessive characteristics from the cross given above. (1)
- 4.2 Give the genotype of the rooster and the hen. (2)
- 4.3 Give the possible gametes produced by the rooster. (2)
- 4.4 Write down all the possible genotypes of the F1 generation. (2)
- 4.5 Illustrate the original cross with a punnet square. (6)
- 4.6 State Mendel's principle of independent assortment.



## Answers

### Exam Questions

#### Question 1

1.1 2:2::XX:XY✓/ 50% women and 50% men

1.2

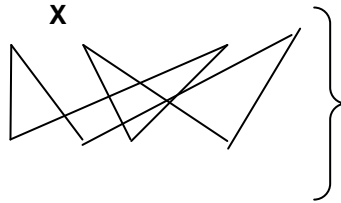
**P<sub>1</sub> Phenotype**  
**Genotype**

**X** **X**  
**X**

**Meiosis**  
**Gametes/G**

**Fertilisation**

**F<sub>1</sub> Genotype**



**Phenotype**

<b>Gametes</b>		

1 mark for correct gametes  
1 mark for correct genotypes

1 mark for stating P<sub>1</sub> and F<sub>1</sub>  
1 mark for stating meiosis and fertilisation

#### Question 2

2.1

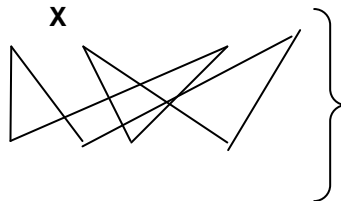
**P<sub>1</sub> Phenotype**  
**Genotype**

**X** **X**  
**X**

**Meiosis**  
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**F<sub>1</sub> Genotype**



**Phenotype**

<b>Gametes</b>		

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1 mark for stating P<sub>1</sub> and F<sub>1</sub>  
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2.2

P<sub>1</sub> Phenotype X  
Genotype X

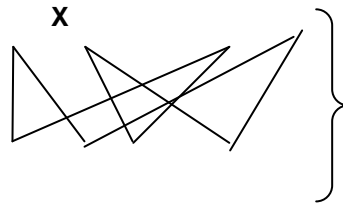
Meiosis

Gametes/G

Fertilisation

F<sub>1</sub> Genotype

Phenotype



Gametes		

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Genotype X

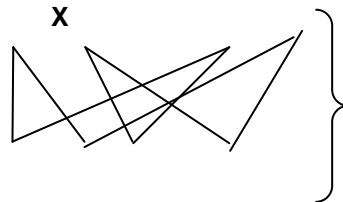
Meiosis

Gametes/G

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F<sub>1</sub> Genotype

Phenotype



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Genotype X

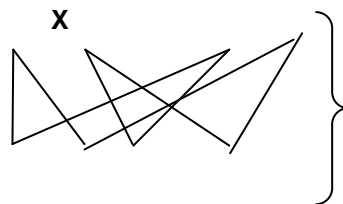
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F<sub>1</sub> Genotype

Phenotype



Gametes		

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### Question 3

- 3.1.1 a.) X<sup>H</sup>Y  
b.) X<sup>H</sup>X<sup>h</sup>  
c.) X<sup>H</sup>Y/ X<sup>h</sup>Y depending on Romana
- 3.1.2 Haemophilia occurs in males only



3.1.3

P<sub>1</sub> Phenotype  
Genotype

X  
X

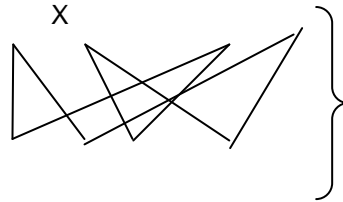
Meiosis

Gametes/G

Fertilisation

F<sub>1</sub> Genotype

Phenotype



Gametes		

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1 mark for stating P<sub>1</sub> and F<sub>1</sub>  
1 mark for stating meiosis and fertilisation

3.2.1

3.2.2

P<sub>1</sub> Phenotype  
Genotype

X  
X

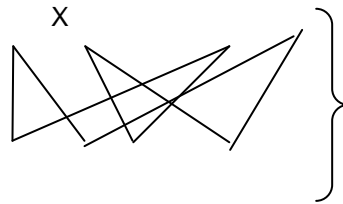
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1 mark for stating meiosis and fertilisation

### Question 4

4.1 black feathers, red beaks

4.2 rooster - FFBb

hen - ffbb

4.3 FB

Fb

4.4 FfBb ; **Ffbb**

4.5






4.6 Allele pairs separate independently during the formation of gametes.