# 1.9 Monohybrid Inheritance and Genetic Diagrams: 30-minute Pack

EDEXCEL 4BI1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** Define what is meant by homozygous for a particular gene in human genetics.

**(Total for Question 1 is 1 mark)**

**2** State what is meant by a dominant allele when discussing a single gene trait in humans.

**(Total for Question 2 is 1 mark)**

**3** In a crop plant, allele R for red fruit is dominant to r for yellow fruit. A plant with genotype Rr is crossed with rr. State the probability that an offspring has yellow fruit.

**(Total for Question 3 is 1 mark)**

**4** Give one similarity and one difference between the inheritance of cystic fibrosis and thalassaemia as recessive human disorders.

**(Total for Question 4 is 2 marks)**

**5** In a plant, allele T for tall stems is dominant to t for short stems. A short plant is crossed with a tall plant, and some offspring are short. Deduce the tall parent genotype.

**(Total for Question 5 is 2 marks)**


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**6** In a small mammal, allele B for black fur is dominant to b for brown fur. Two black-furred parents have a brown-furred offspring. State the genotype of each parent and the probability of a brown offspring in another mating between them.

**(Total for Question 6 is 2 marks)**

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**7** In a seedling species, allele A for broad leaves is dominant to a for narrow leaves. A heterozygous broad-leaved plant is crossed with a narrow-leaved plant. Show the parental gametes and offspring genotypes, then state the probability of broad-leaved offspring.

**(Total for Question 7 is 3 marks)**

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**8** Construct a genetic diagram to show the result of a cross between a carrier parent for cystic fibrosis (genotype Cc, where c is the recessive cystic fibrosis allele) and an affected parent with cystic fibrosis (genotype cc). Label the gametes, the Punnett square, and give the genotypes of the offspring.

**(Total for Question 8 is 3 marks)**

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**9** Predict the percentage of children expected to have cystic fibrosis when two carrier parents (both genotype Cc) have a child. Show your working and give the answer as a percentage.

**(Total for Question 9 is 2 marks)**


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**10** In a fruit fly species, allele W for normal wings is dominant to w for short wings. A normal-winged fly with genotype Ww is crossed with a short-winged fly ww. For 120 offspring, calculate the expected number with normal wings and with short wings, and state the ratio.

**(Total for Question 10 is 3 marks)**

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**11** Explain, using a labelled Punnett square and genotypes, how two unaffected carrier parents can have an affected child with a recessive disorder such as cystic fibrosis. In your answer, include the terms carrier, homozygous recessive and probability, and explain the difference between genotype and phenotype.

**(Total for Question 11 is 6 marks)**


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# Mark scheme · 1.9 Monohybrid Inheritance and Genetic Diagrams: 30-minute Pack

## Question 1

having two identical alleles for a particular gene (e.g. AA or aa) **B1**

**Answer: Having two identical alleles for a gene, e.g. AA or aa**

## Question 2

an allele that is expressed in the phenotype when at least one copy is present **B1**

**Answer: An allele expressed in the phenotype when at least one copy is present**

## Question 3

1/2 or 50% **B1**

**Answer: The Rr parent produces R and r gametes; the rr parent produces r only. Half the outcomes are rr, so the probability is 1/2 (50%).**

## Question 4

valid similarity: both are inherited as recessive alleles, so affected individuals are homozygous recessive **B1**

valid difference: they affect different systems or have different symptoms, e.g. cystic fibrosis affects lungs and digestion, thalassaemia affects haemoglobin and causes anaemia **B1**

**Answer: Similarity: both recessive so affected are homozygous recessive. Difference: CF affects lungs and digestion, thalassaemia affects haemoglobin causing anaemia**

## Question 5

short offspring must be tt and receive t from each parent **M1**

tall parent is Tt **A1**

**Answer: The short parent is tt. A short offspring is tt and must receive t from the tall parent, so the tall parent is Tt.**

## Question 6

both parents are Bb because each passed b to the brown bb offspring **M1**

Bb x Bb gives 1/4 or 25% bb **A1**

**Answer: The brown offspring is bb, so each black parent supplied b and must be Bb. In Bb x Bb, one of four equally likely outcomes is bb, giving 1/4 (25%).**

## Question 7

Aa parent produces A and a gametes; aa parent produces a gametes **M1**

offspring genotypes Aa and aa in equal numbers **M1**

broad phenotype occurs in Aa, so probability is 1/2 or 50% **A1**

**Answer: Parents Aa x aa. Gametes: A or a, and a. Offspring: Aa, Aa, aa, aa. Since A is dominant, the two Aa outcomes are broad-leaved: probability 2/4 = 1/2 = 50%.**

## Question 8

correct gametes shown: C and c for the carrier parent, c and c for the affected parent **M1**

Punnett square completed with four boxes showing genotypes: Cc, Cc, cc, cc or equivalent placement **M1**

final statement of offspring genotypes: 2 Cc and 2 cc, or 50% Cc and 50% cc cao **A1**

**Answer: Gametes: C and c, and c and c. Punnett square yields 2 Cc and 2 cc, so 50% carriers and 50% affected**

## Question 9

uses genotype ratio from Punnett square, e.g. 1 CC : 2 Cc : 1 cc and identifies 1 out of 4 are cc **M1**

gives 25% cao **A1**

**Answer: 25%**

## Question 10

Ww x ww gives equal probabilities of Ww and ww **M1**

expected numbers are 120 x 1/2 = 60 normal and 60 short **M1**

ratio normal:short is 1:1 **A1**

**Answer: Gametes W or w and w give Ww, Ww, ww, ww. Each phenotype has probability 1/2. Expected numbers: 120 x 1/2 = 60 normal-winged and 60 short-winged. Ratio = 60:60 = 1:1.**

## Question 11

**Level 1** Basic description of carriers or a simple statement about how two carriers might produce an affected child with minimal reference to genotypes or probabilities. **1-2**

**Level 2** Clear explanation including a correct Punnett square for Cc x Cc, statement of genotype ratio and probability, and a brief mention of why carriers are unaffected. **3-4**

**Level 3** Detailed explanation that includes a labelled Punnett square, correct genotypic and phenotypic ratios, calculation of probability as a percentage, clear definitions of carrier, homozygous recessive, genotype and phenotype, and an explicit link showing how genotype determines phenotype for the disorder. **5-6**

**Indicative content:**

- Draws and labels gametes C and c for both parents and completes Punnett square showing CC, Cc, Cc, cc
- States genotypic ratio 1 CC : 2 Cc : 1 cc and phenotypic ratio 3 unaffected : 1 affected
- Calculates probability of affected child as 1 in 4 or 25%
- Defines carrier as a heterozygote (Cc) who has the recessive allele but shows the dominant phenotype
- Defines homozygous recessive (cc) as having two recessive alleles and showing the disorder
- Explains difference between genotype (the alleles present) and phenotype (the observable trait or disorder) and links cc genotype to affected phenotype


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