

Exercise walk-through

36.1

Inheritance, variation and probability

International Baccalaureate · IB Diploma · Biology · HL

36.1 Inheritance, variation and probability

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS allele • genotype

Objective

Inheritance, variation and probability. Original classroom practice for IB HL; not an official IB paper.

1 Key knowledge and worked examples

■ What would explain this observation?

- Two parents can carry a recessive **allele** without expressing the associated phenotype. Their children do not have to match the parents phenotypically.

■ Build the model

- An allele is a variant of a gene.
- A **genotype** lists alleles; a phenotype is the expressed characteristic, influenced by genotype and sometimes environment.
- Dominant and recessive describe the relationship between alleles, not how common they are.
- allele: A variant of a gene.

- genotype: The alleles an organism carries.

	A	a	
a	Aa	aa	One allele from each parent
a	Aa	aa	
	Equal-probability model combinations		

Boxes show possible outcomes, not a fixed sequence of births.

■ Choose evidence that can test it

- In a simple monohybrid cross $Aa \times Aa$, gametes carry A or a.
- Combining independent gametes gives AA, Aa, Aa and aa.
- The predicted probabilities describe many possible fertilizations, not a fixed order of children.

In the lab: Write parental genotypes and gametes before making the grid. State the inheritance model and phenotype key. Use a pedigree to check consistency with a model; do not infer certainty from a small family alone.

■ Work from known quantities

- Known: $Aa \times Aa$ with complete dominance.
- Probability of aa = $1/4 = 25\%$.
- Probability of the dominant phenotype = $3/4 = 75\%$.
- If four children are born, there is no guarantee that exactly one has the recessive phenotype.

Your turn: In $Aa \times aa$, what percentage of offspring are predicted to be aa?

■ Check the conclusion and its limits

- A dominant allele can be rare.
- Mutation is a source of new variation; selection changes the relative success of existing variants rather than directing mutations toward a goal.

Not true: A dominant allele must be the most common allele in a population. Dominant describes how an allele is expressed in a heterozygote, not how common it is. A dominant allele can be rare in a population and a recessive allele can be common; frequency depends on inheritance and selection, not dominance.

Key:

- An allele is a variant of a gene.
- In a simple monohybrid cross $Aa \times Aa$, gametes carry A or a.
- Watch for: A dominant allele can be rare.

■ Write from an expected 5 offspring

- Aa crosses with Aa. There are 20 offspring. Complete dominance applies.
- Find the expected number of aa offspring. The count is not a guarantee.

Exercises 2.1·2.3

2.1 What does a 25% probability in $Aa \times Aa$ mean? Choose one answer.

- **A** Exactly one of every four siblings must be aa
- **B** Each fertilization has probability one quarter of aa under this model
- **C** The fourth child must be aa

[1]

2.2 In $Aa \times aa$, what percentage of offspring are predicted to be aa? Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A dominant allele must be the most common allele in a population.

[2]

Exercises 2.1-2.3

2.1 What does a 25% probability in $Aa \times Aa$ mean? Choose one answer.

- **A** Exactly one of every four siblings must be aa
- **B** Each fertilization has probability one quarter of aa under this model
- **C** The fourth child must be aa

[1]

2.1 B The 25% is a probability for each fertilization under the model: each child of $Aa \times Aa$ parents has a one-quarter chance of aa. Chance has no memory, so no fixed number of aa children is guaranteed in any family of four.

2.2 In $Aa \times aa$, what percentage of offspring are predicted to be aa? Show the relation, substitution and units.

[2]

2.2 Aa gives A or a with equal probability; aa gives only a. $P(aa)=1/2=50\%$.

2.3 Decide whether this claim is true and justify: A dominant allele must be the most common allele in a population.

[2]

2.3 False. Dominant describes how an allele is expressed in a heterozygote, not how common it is. A dominant allele can be rare in a population and a recessive allele can be common; frequency depends on inheritance and selection, not dominance.

Exercises 2.4·3.1

2.4 A variant of a gene: write the technical term.

[1]

3.1 For $Aa \times aa$ under complete dominance, find the probability that two independently conceived offspring both have the recessive phenotype. Does a family of two have to match the ratio?

[4]

Exercises 2.4·3.1

2.4 A variant of a gene: write the technical term. [1]

2.4 allele. allele means A variant of a gene.

3.1 For $Aa \times aa$ under complete dominance, find the probability that two independently conceived offspring both have the recessive phenotype. Does a family of two have to match the ratio? [4]

3.1 $(1/2)^2 = 1/4$. Mendelian probabilities describe repeated independent outcomes; a family need not contain one child of each phenotype. State complete dominance and independence.