

30.1 Inheritance, variation and probability

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS allele • genotype

Objective

Inheritance, variation and probability. Supported SL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

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.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ 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.

Constructed $Aa \times aa$ cross

	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.
- 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**

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- 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.

Example:

In $Aa \times aa$, what percentage of offspring are predicted to be aa? Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ **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.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A dominant allele must be the most common allele in a population. This claim is false: 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.

Key:

Inheritance, variation and probability: 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.

2 Practice

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]

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

[1]

3 Exam-style questions

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]

Solutions

2.1 B 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.

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

2.3 False. 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.

2.4 allele. allele means A variant of a gene.

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.