

5.4 Non-Mendelian Genetics

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS incomplete dominance 不完全显性 • codominance 共显性 • sex-linked 伴性
• phenotype 表型 • genotype 基因型

Objective

Build the skills to answer exam questions on **non-Mendelian genetics**.

You must be able to:

- describe **incomplete dominance** 不完全显性 and **codominance** 共显性
- describe **multiple alleles** (e.g. ABO blood groups) and **sex-linked** 伴性 traits
- predict offspring for these patterns

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Incomplete dominance

Neither allele fully dominates, so the heterozygote is a **blend**. Red (RR) $\times$ white (WW) flowers give **pink** (RW) — a 1 : 2 : 1 phenotype ratio in the F₂.

■ Codominance

Both alleles are fully expressed together (not blended). In ABO blood, $I^A I^B$ gives type **AB** — both A and B markers appear.

■ Multiple alleles

A gene can have **more than two** alleles in the population (though each individual has only two). ABO blood group has three: I^A , I^B , i .

■ Sex-linked traits

Genes on the **X chromosome** (like color blindness) are **sex-linked**: males (XY) show a recessive X trait with just one copy, so they are affected more often.

2 Practice

Now apply the methods above.

2.1 In incomplete dominance, what is the heterozygote's phenotype? [1]

2.2 What blood type is genotype $I^A I^B$, and why? [2]

2.3 Why are males more often affected by X-linked recessive traits? [1]

3 Exam-style questions

3.1 When both alleles are fully expressed in the heterozygote, the pattern is [1]

- **A** complete dominance
- **B** incomplete dominance
- **C** codominance
- **D** recessive

3.2 Red (RR) and white (WW) flowers show incomplete dominance (pink RW).

(a) Cross two pink flowers ($RW \times RW$) and give the phenotype ratio. [3]

(b) State how this differs from a normal Mendelian 3 : 1 ratio. [1]

3.3 A color-blind allele is X-linked recessive. Explain why a son can inherit color blindness from a carrier mother. [2]

Solutions

2.1 A blend of the two (e.g. pink).

2.2 Type AB — both the I^A and I^B alleles are fully expressed (codominance).

2.3 Males have only one X chromosome, so a single recessive allele is expressed (no second X to mask it).

3.1 C — codominance.

3.2 (a) $RW \times RW$ gives $1RR : 2RW : 1WW = 1 \text{ red} : 2 \text{ pink} : 1 \text{ white}$. (b) The heterozygote (pink) is a distinct phenotype, so there are three phenotypes ($1 : 2 : 1$) instead of two ($3 : 1$).

3.3 The mother carries one color-blind X allele; she can pass that X to her son, and since he has only one X (from her), he will be color-blind.