

Exercise walk-through

Non-Mendelian Genetics ■ 5.4

eXercise

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

Method — 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.

Method — 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.

Method — 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 .

Method — 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.

Practice 2.1 ■ 1 mark

In incomplete dominance, what is the heterozygote's phenotype?

Solution 2.1

Method: Incomplete dominance

Worked steps

A blend of the two (e.g. pink) **B1**.

Practice 2.2 ■ 2 marks

What blood type is genotype $I^A I^B$, and why?

Solution 2.2

Method: Codominance

Worked steps

Type AB — both the I^A and I^B alleles are fully expressed (codominance) **M1** **A1**.

Practice 2.3 ■ 1 mark

Why are males more often affected by X-linked recessive traits?

Solution 2.3

Method: Sex-linked traits

Worked steps

Males have only one X chromosome, so a single recessive allele is expressed (no second X to mask it) **B1**.

Exam-style 3.1 ■ 1 mark

When both alleles are fully expressed in the heterozygote, the pattern is

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

Solution 3.1

Method: Codominance

A complete dominance

B incomplete dominance

C codominance



D recessive

Worked steps

C — codominance.

Exam-style 3.2 ■ 3 marks

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

- (a) Cross two pink flowers ($RW \times RW$) and give the phenotype ratio.
- (b) State how this differs from a normal Mendelian 3 : 1 ratio.

Solution 3.2

Method: Incomplete dominance

Worked steps

- (a) $RW \times RW$ gives $1 RR : 2 RW : 1 WW = 1 \text{ red} : 2 \text{ pink} : 1 \text{ white}$ **M1 M1 A1**.
- (b) The heterozygote (pink) is a distinct phenotype, so there are three phenotypes (1 : 2 : 1) instead of two (3 : 1) **B1**.

Exam-style 3.3 ■ 2 marks

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

Solution 3.3

Method: Sex-linked traits

Worked steps

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 **M1** **A1**.