AP BIOLOGY • EXERCISE SHEET

# 5.4 Non-Mendelian Genetics

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

## 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 ($RR$) × 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]

## 4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **5.4 Non-Mendelian Genetics** lesson on the **Learn** page;

- read the **Non-Mendelian Genetics** section of the AP Biology handout on the **Know** page.

## 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 $1\,RR : 2\,RW : 1\,WW$ = 1 red : 2 pink : 1 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.