

Exercise walk-through

Population Genetics ■ 7.4

eXercise

You must be able to

- calculate **allele frequencies** 等位基因频率 from genotype counts
- describe how frequencies change with evolution
- name the causes of allele-frequency change

Method — Allele frequency

An **allele frequency** is the fraction of all copies of a gene that are a given allele.
Count alleles: each individual has **two**.

Method — A worked frequency

In 100 individuals: 36 AA , 48 Aa , 16 aa (200 alleles total). A count
 $= 2(36) + 48 = 120$; frequency of $A = 120/200 = 0.6$. So $a = 0.4$.

Method — Evolution = change in frequencies

Evolution at the population level is a **change in allele frequencies** over generations.
If frequencies stay constant, the population is not evolving.

Method — Causes of change

Allele frequencies change due to **natural selection**, **mutation**, **gene flow** (migration), **genetic drift** (chance, strong in small populations), and **non-random mating**.

Practice 2.1 ■ 1 mark

How many alleles for a gene does each individual carry?

Solution 2.1

Method: Allele frequency

Worked steps

Two **B1**.

Practice 2.2 ■ 1 mark

In a population, allele A has frequency 0.7. What is the frequency of a ?

Solution 2.2

Worked steps

$$1 - 0.7 = 0.3 \text{ (B1).}$$

Practice 2.3 ■ 2 marks

Name two causes of allele-frequency change.

Solution 2.3

Method: Causes of change

Worked steps

Any two: natural selection, mutation, gene flow, genetic drift, non-random mating

B1 **B1**.

Exam-style 3.1 ■ 1 mark

Evolution at the population level is defined as a change in

- A** an individual's genes
- B** allele frequencies over generations
- C** the environment
- D** the number of species

Solution 3.1

Method: Evolution = change in frequencies

- A an individual's genes
- B allele frequencies over generations
- C the environment
- D the number of species



Worked steps

B — allele frequencies over generations.

Exam-style 3.2 ■ 1 mark

A population of 50 has 18 BB , 24 Bb , and 8 bb .

- (a) Find the total number of alleles.
- (b) Calculate the frequency of the B allele.

Solution 3.2

Worked steps

(a) $50 \times 2 = 100$ alleles **B1**. (b) B count = $2(18) + 24 = 60$; frequency = $60/100 = 0.6$ **M1** **M1** **A1**.

Exam-style 3.3 ■ 2 marks

Explain why genetic drift changes allele frequencies more in a small population than a large one.

Solution 3.3

Method: Causes of change

Worked steps

In a small population, chance events (which few individuals happen to reproduce) have a large effect on frequencies; in a large population these random effects average out **M1** **A1**.