AP BIOLOGY • EXERCISE SHEET

7.4 Population Genetics

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

KEY WORDS allele frequencies 等位基因频率 • genetic drift 遗传漂变 • gene flow 基因流 • population genetics 群体遗传学 • evolution 进化

Objective

Build the skills to answer exam questions on **population genetics** — allele and genotype frequencies.

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

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.

■ 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**.

■ 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 $a = 0.4$.

■ 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.

■ 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**.

2 Practice

Now apply the methods above.

2.1 How many alleles for a gene does each individual carry? [1]

2.2 In a population, allele A has frequency 0.7. What is the frequency of a? [1]

2.3 Name two causes of allele-frequency change. [2]

3 Exam-style questions

3.1 Evolution at the population level is defined as a change in [1]

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

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

(a) Find the total number of alleles. [1]

(b) Calculate the frequency of the B allele. [3]

3.3 Explain why genetic drift changes allele frequencies more in a small population than a large one. [2]

Solutions

2.1 Two.

2.2 $1 - 0.7 = 0.3$.

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

3.1 **B** — allele frequencies over generations.

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

3.3 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.