

5.2 Meiosis and Genetic Diversity

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

KEY WORDS crossing over 交叉互换 • independent assortment 自由组合 • meiosis 减数分裂
• homologous chromosomes 同源染色体 • gametes 配子

Objective

Build the skills to answer exam questions on **meiosis and genetic diversity**.

You must be able to:

- explain **crossing over** 交叉互换 and **independent assortment** 自由组合
- explain how **random fertilization** adds variation
- link these to the diversity of offspring

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.

■ Three sources of variation

Meiosis and reproduction create genetic diversity by:

1. **Crossing over** — homologous chromosomes swap segments, making new gene combinations.
2. **Independent assortment** — homologous pairs line up randomly, so chromosomes are sorted into gametes in many combinations.
3. **Random fertilization** — any sperm can fertilize any egg.

■ Crossing over

During meiosis I, homologous chromosomes exchange pieces, so a chromosome ends up with a **new mix** of alleles from both parents.

■ Independent assortment

Each homologous pair lines up independently, so with n pairs there are 2^n possible gamete combinations from assortment alone.

■ A worked count

Humans have 23 pairs, giving 2^{23} (over 8 million) combinations from independent assortment — before crossing over and random fertilization add even more.

2 Practice

Now apply the methods above.

2.1 Name the process where homologous chromosomes swap segments. [1]

2.2 What does independent assortment describe? [1]

2.3 For an organism with 3 chromosome pairs, how many gamete combinations arise from independent assortment? [2]

3 Exam-style questions

3.1 Crossing over increases variation by [1]

- | | |
|---|---|
| A | B |
| C | D |
- A copying DNA exactly
B exchanging segments between homologous chromosomes
C removing chromosomes
D joining two gametes

3.2 A student lists sources of genetic variation.

(a) Name three sources from meiosis and reproduction. [3]

(b) Explain how independent assortment creates variation. [2]

3.3 Explain why sexual reproduction produces more genetic variation than asexual reproduction. [2]