

6.2 Protein synthesis

Name: _____ Class: _____ Date: _____

Total: 17 marks

KEY WORDS gene 基因 • triplet 三联体 • mutation 突变 • intron 内含子 • translation 翻译

Objective

Build the skills to answer exam questions on **protein synthesis** — the **genetic code** 遗传密码, **transcription** 转录 and **translation** 翻译, splicing, and **gene mutations** 基因突变.

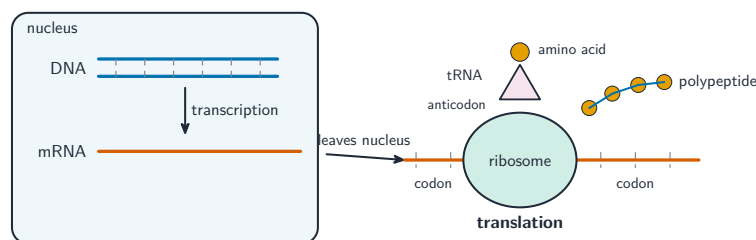
You must be able to:

- describe the universal triplet code and the roles of RNA polymerase, mRNA, codons, tRNA, anticodons and ribosomes
- work out an mRNA sequence and amino acids from a DNA template
- explain splicing (introns/exons) and the effects of substitution, deletion and insertion mutations

1 Worked examples

■ The genetic code and protein synthesis

A **gene** 基因 is a DNA sequence coding for one **polypeptide** 多肽. The code is read in **triplets** 三联体 (three bases): each codes one amino acid or a start/stop signal. It is **universal**.



Transcription (nucleus) → mRNA → translation (ribosome) → polypeptide

- transcription** — RNA polymerase copies the DNA **template strand** 模板链 into mRNA (uracil pairs with adenine).
- translation** — at the **ribosome** 核糖体, mRNA is read in **codons** 密码子;

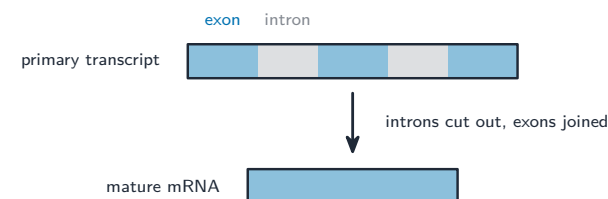
tRNA 转运 RNA brings amino acids whose **anticodon** 反密码子 pairs with the codon; amino acids join by peptide bonds.

■ Reading the code from a DNA template

To find the amino acids, copy the template into mRNA (A→U, T→A, C→G, G→C), then read the mRNA codons. Example: DNA template TAC → mRNA codon AUG (the start codon, methionine); the tRNA anticodon is UAC.

■ Splicing

In eukaryotes the **primary transcript** 初级转录本 has coding **exons** 外显子 and non-coding **introns** 内含子. The introns are removed and exons joined to make the finished mRNA.



Splicing removes introns and joins exons

■ Mutations

original	A	T	G	C	A	T	T	A	C
substitution	A	A	G	C	A	T	T	A	C
deletion	A	T	G	A	T	T	A	C	
insertion	A	T	G	G	C	A	T	T	A

red = changed base; shaded = shifted by a frameshift (deletion or insertion)

A substitution changes one triplet; a deletion or insertion shifts every later triplet (a frameshift)

- substitution** 替换 — one base swapped; changes at most one amino acid (sometimes none).
- deletion** 缺失 / **insertion** 插入 — shifts how every later triplet is read (a **frameshift**), usually changing many amino acids.

2 Practice

2.1 Name the molecule that (a) carries the code from the nucleus to the ribosome, and (b) brings amino acids to the ribosome. [2]

2.2 Complete the table for this DNA template strand. [3]

DNA template	mRNA codon	tRNA anticodon
T A C		
C G A		

3 Exam-style questions

3.1 What is a codon? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** a triplet of DNA bases on the template strand
B a triplet of mRNA bases coding for one amino acid
C a tRNA molecule
D an enzyme that builds mRNA

3.2 Which type of mutation is most likely to change **every** amino acid after the point of mutation? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** a substitution
B a deletion of one base
C no mutation changes later amino acids
D a substitution at the start codon

3.3 (a) Describe what happens during transcription. [3]

(b) Explain the roles of tRNA and the ribosome during translation. [3]

3.4 (a) Explain why a substitution mutation sometimes has no effect on the polypeptide. [2]

(b) Explain why removing introns is necessary before translation. [2]
