

# Nucleic acids and protein synthesis

## Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Nucleic acids and Protein synthesis
Sub Topic	
Booklet	Multiple Choice
Paper Type	Question Paper 2

Time Allowed : 42 minutes

Score : / 35

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 In a genetic engineering experiment a piece of double-stranded DNA containing 6000 nucleotides is transcribed and translated.

What is the total number of amino acids used?

- A** 500                      **B** 1000                      **C** 2000                      **D** 3000

- 2 DNA from a chromosome is analysed and 20% of its bases are found to be cytosine.

Which percentage of uracil molecules will be found in mRNA transcribed from this DNA?

- A** 20                      **B** 30                      **C** 40                      **D** 60

- 3 One of the codons for the amino acid phenylalanine is UUC.

Which diagram shows how the tRNA carrying phenylalanine pairs with the corresponding section of mRNA?

- A** tRNA                      AAG  
mRNA                      UUC
- B** tRNA                      TTG  
mRNA                      UUC
- C** tRNA                      UUC  
mRNA                      AAG
- D** tRNA                      UUC  
mRNA                      TTG

- 4 A polypeptide molecule contains the amino acid sequence, glycine – leucine – lysine – valine.

The table shows the DNA codes for these amino acids.

glycine	leucine	lysine	valine
CCC	GAA	TTT	CAA

Transfer RNA molecules with which anticodons are needed for the synthesis of this polypeptide?

- A** CCC GAA TTT CAA  
**B** CCC GAA UUU CAA  
**C** GGG CUU AAA GUU  
**D** GGG CUU UUU GUU

5 A protein contains all the common amino acids.

What would be the hypothetical minimum number of types of tRNA molecules needed for the synthesis of this protein?

- A** 3                      **B** 4                      **C** 20                      **D** 64

6 A peptide consists of ten amino acids of four different kinds.

What is the theoretical minimum number of tRNA molecules required to translate the mRNA for this peptide?

- A** 4  
**B** 10  
**C** 12  
**D** 30

7 Which type of molecule is the end product of translation?

- A** amino acid  
**B** DNA  
**C** mRNA  
**D** polypeptide

8 Some antibiotics work by binding to ribosomes and preventing protein synthesis.

Which statement explains why these antibiotics kill bacterial cells but not human cells?

- A In bacterial cells mRNA is formed in the cytoplasm from naked DNA.
- B Ribosomes in human cells have a different structure from those in bacterial cells.
- C The antibiotics cannot pass through human cell surface membranes.
- D The tRNA molecules in bacterial cells are different from those in human cells.

9 Which statements about tRNA are correct?

- 1 contains base pairing
- 2 contains hydrogen bonds
- 3 is single stranded

- A 1, 2 and 3      B 1 and 2 only      C 1 and 3 only      D 2 and 3 only

10 Which molecules are involved in transcription and which molecules are involved in translation?

	transcription	translation
A	DNA and mRNA	mRNA and tRNA
B	DNA and tRNA	mRNA and amino acids
C	mRNA and amino acids	DNA and mRNA
D	tRNA and mRNA	amino acids and DNA

11 Which term best describes the length of DNA that codes for the synthesis of a polypeptide?

- A anticodon
- B codon
- C gene
- D nucleotide

12 What does the process of translation require?

- A DNA, free nucleotide bases and mRNA
- B DNA, mRNA and RNA polymerase
- C mRNA, ribosomes and RNA polymerase
- D mRNA, ribosomes and tRNA

13 Which is **not** a description of a gene?

- A a length of DNA which carries coded information as a sequence of nucleotides that can result in the formation of a polypeptide chain
- B any section of a molecule that has two strands, each with a sequence of nucleotides that are complementary to each other and are held together by hydrogen bonding
- C a sequence of nucleotides which can be copied by complementary base pairing and then be translated at a ribosome
- D a sequence of nucleotides that can be transcribed using a polymerase enzyme and free activated nucleotides and which results in the formation of a messenger RNA molecule

14 Which row in the table correctly shows situations in which **both** DNA and RNA are both involved?

	replication	transcription	translation
<b>A</b>	✓	✓	x
<b>B</b>	✓	x	✓
<b>C</b>	x	✓	x
<b>D</b>	x	x	✓

key  
 ✓ involved  
 x not involved

- 15 The diagram shows the stages in the production of a polypeptide.

DNA nucleotide sequence	
template strand	T A C G A C A A T C G C
mRNA sequence	A U G C U G U U A G C G
amino acid sequence	met leu leu ala

Which feature of the triplet code is illustrated by the information given?

- A** An amino acid can be coded for by more than one triplet.
- B** The triplet code is non-overlapping and is only read in one direction.
- C** The triplet code is universal for the DNA of all organisms.
- D** There are some triplets that code for 'start' and 'stop'.
- 16 The sequence of nucleotides in DNA in a gene that controls the synthesis of a protein is arranged in triplets, each coding for specific amino acids. The table shows three examples of these triplets.

	triplet code	example
1	DNA code	TAC
2	mRNA code	AUG
3	tRNA code	UAC

Which are the correct codon and anticodon?

	codon	anticodon
<b>A</b>	1	3
<b>B</b>	2	3
<b>C</b>	3	1
<b>D</b>	3	2

17 Enzymes are .....1..... proteins, made up of polypeptides.

A gene is a sequence of .....2....., which are parts of a .....3..... molecule coding for a polypeptide.

Which words correctly complete gaps 1, 2 and 3 in the sentences?

	1	2	3
<b>A</b>	fibrous	amino acids	tRNA
<b>B</b>	fibrous	bases	DNA
<b>C</b>	globular	nucleotides	DNA
<b>D</b>	globular	triplets	mRNA

18 Which process does **not** occur during the formation of messenger RNA?

- A** condensation
- B** polymerisation
- C** replication
- D** transcription

19 A gene codes for the production of a protein, p53, that binds to damaged DNA during interphase and prevents its replication. A carcinogen in cigarette smoke mutates this gene.

Which statement explains why this mutation may cause cancer?

- A** Lack of p53 allows cells to undergo mitosis.
- B** Lack of p53 allows cells with damaged DNA to replicate.
- C** The carcinogen in cigarette smoke increases the rate of cell division.
- D** The p53 causes uncontrolled cell division.

20 What makes the exact copying of DNA molecules possible?

- A base pairing
- B hydrogen bonding between nucleotides
- C sugar-phosphate backbone
- D the double helix shape

21 The table shows the role of four different proteins involved in DNA replication.

protein	helicase	topoisomerase	single-strand binding protein	DNA polymerase
role	unwinds the parental DNA double helix	breaks and rejoins the DNA strands	binds to separated DNA strands to stabilise them	synthesises strand of DNA

Which shows the function of these proteins?

	helicase	topoisomerase	single-strand binding protein	DNA polymerase
<b>A</b>	adds DNA nucleotides to the 3' end of a growing polynucleotide strand	prevents original strands reforming complementary base pairs	enables tension caused by unwinding to be released	makes strands available as templates
<b>B</b>	enables tension caused by unwinding to be released	prevents original strands reforming complementary base pairs	makes strands available as templates	adds DNA nucleotides to the 3' end of a growing polynucleotide strand
<b>C</b>	enables tension caused by unwinding to be released	makes strands available as templates	adds DNA nucleotides to the 3' end of a growing polynucleotide strand	prevents original strands reforming complementary base pairs
<b>D</b>	makes strands available as templates	enables tension caused by unwinding to be released	prevents original strands reforming complementary base pairs	adds DNA nucleotides to the 3' end of a growing polynucleotide strand

22 Which row shows the correct combination?

	triplet code	codon	anticodon
<b>A</b>	DNA	mRNA	tRNA
<b>B</b>	DNA	tRNA	mRNA
<b>C</b>	mRNA	DNA	tRNA
<b>D</b>	tRNA	mRNA	DNA

23 A peptide consists of ten amino acids of four different kinds.

What is the theoretical minimum number of tRNA molecules required to translate the mRNA for this peptide?

- A** 4                      **B** 10                      **C** 12                      **D** 30

24 The table gives the tRNA anticodons for four amino acids.

amino acid	anticodon (tRNA)
asparagine	UUA
glutamic acid	CUU
proline	GGA
threonine	UGG

A cell makes a polypeptide with the amino acid sequence:

glutamic acid – asparagine – threonine – proline

What was the sequence of bases on the strand of the DNA which was complimentary to the mRNA from which this polypeptide was formed?

- A** CTTTTATGGGGA  
**B** CUUUUAUGGGGA  
**C** GAAAATACCCCT  
**D** GAAAUAACCCCU

25 Which type of molecule is the end product of translation?

- A amino acid
- B DNA
- C mRNA
- D polypeptide

26 An unidentified single-stranded molecule was described as having the following features.

- complementary base pairing along some of its length
- an area that can attach to a ribosome
- a site to which a specific amino acid attaches

What is the unidentified molecule?

- A DNA polymerase
  - B messenger RNA
  - C RNA polymerase
  - D transfer RNA
- 27 A culture of bacteria had all its DNA labelled with the heavy isotope of nitrogen,  $^{15}\text{N}$ . The culture was then allowed to reproduce using nucleotides containing normal  $^{14}\text{N}$ . The DNA was examined using a centrifuge after one generation and again after two generations.

The diagram shows the position of the DNA band at **Z** in the centrifuge tube when the DNA was first labelled.



In which pattern would the DNA be found after the first and after the second cell generations?

	after first generation	after second generation
<b>A</b>	half at <b>X</b> and half at <b>Y</b>	quarter at <b>X</b> , quarter at <b>Z</b> and half at <b>Y</b>
<b>B</b>	half at <b>X</b> and half at <b>Z</b>	quarter at <b>X</b> , quarter at <b>Z</b> and half at <b>Y</b>
<b>C</b>	all at <b>Y</b>	half at <b>X</b> and half at <b>Y</b>
<b>D</b>	all at <b>Z</b>	half at <b>Y</b> and half at <b>Z</b>

- 28 What terminates the formation of a polypeptide chain during protein synthesis in cells?
- A when a 'stop' codon is reached on the mRNA molecule
  - B when a 'stop' codon is reached on the tRNA molecule
  - C when the ribosome reaches the end of the mRNA molecule
  - D when the ribosome reaches the end of the tRNA molecule

- 29 When **not** involved in protein synthesis, ribosomes exist as separate subunits.

What do these subunits consist of?

- A mRNA and lipid
  - B mRNA and tRNA
  - C rRNA and lipid
  - D rRNA and protein
- 30 In the DNA sequence for sickle cell anaemia, adenine replaces thymine in a CTT triplet, forming the triplet CAT. During synthesis of the sickle cell haemoglobin molecule, the amino acid valine is incorporated instead of glutamic acid.

What is the anticodon in the transfer RNA molecule carrying this valine?

- A CAT                      B CAU                      C GTA                      D GUA

- 31 The table shows mRNA triplets and their corresponding amino acids.

mRNA triplet	GCA	GCG	GAA	GAG	AAA	AAG
amino acid	ala	ala	glu	glu	lys	lys

A tripeptide is glu-lys-ala.

Which sequence of bases in DNA could code for this tripeptide?

- A CTCCGTTTT
- B CTTTTCCGT
- C TTCCGTCTT
- D TTTCTCCGC

32 Three polypeptides were made using synthetic mRNA molecules as shown.

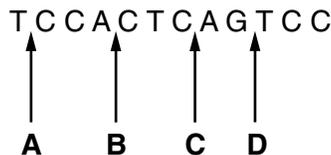
synthetic mRNA used	polypeptide produced
UUUUUUUUUUUUU	phenylalanine-phenylalanine-phenylalanine-phenylalanine
AAAAAAAAAAAAA	lysine-lysine-lysine-lysine
UUUAAAUUUAAA	phenylalanine-lysine-phenylalanine-lysine

What are the DNA codes for the amino acids phenylalanine and lysine?

	phenylalanine	lysine
<b>A</b>	AAA	TTT
<b>B</b>	AAA	UUU
<b>C</b>	TTT	GGG
<b>D</b>	UUU	AAA

33 The RNA triplet UAG acts as a stop codon, terminating the synthesis of a polypeptide. The diagram shows a strand of DNA which codes for four amino acids.

Where would a mutation, introducing a thymine nucleotide, result in the termination of transcription?



34 The sequence of bases on part of a molecule of DNA is shown.

TACAAATGACCA                    sense strand  
 ATGTTTACTGGT                    antisense strand

What is the sequence of bases in mRNA transcribed from this sequence?

- A** ATGTTTACTGGT
- B** AUGUUUACUGGU
- C** TACAAATGACCA
- D** UACAAAUGACCA

**35** The table gives the tRNA anticodons for four amino acids.

amino acid	anticodon (tRNA)
asparagine	UUA
glutamic acid	CUU
proline	GGA
threonine	UGG

A cell makes a polypeptide with the amino acid sequence:

glutamic acid – asparagine – threonine – proline

What was the sequence of bases on the mRNA from which this was formed?

- A** GAAAATACCCCT
- B** AGGGGUGUUUUC
- C** TCCCCGCAAAG
- D** GAAAAUACCCCU