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 : **35 minutes**

Score : **/ 29**

Percentage : **/100**

Grade Boundaries:

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

1 DNA is said to replicate in a semi-conservative way.

Results of Meselson and Stahl's experiments gave overwhelming support to this theory. They used *E. coli* which has a generation time of 50 minutes.

Here are the stages occuring in their experiment but they are in the wrong order. ^{14}N DNA contains the 'light' isotope of nitrogen. ^{15}N DNA contains the 'heavy' isotope.

P All bacteria contain ^{15}N DNA.

Q All bacteria contain hybrid DNA (^{15}N DNA and ^{14}N DNA).

R Bacteria contain either all ^{14}N DNA or hybrid DNA.

S Bacteria grown in a ^{15}N medium for many generations.

T Bacteria transferred to a ^{14}N medium and sampled every 50 minutes.

Which sequence of letters shows the correct order of the stages in the experiment?

A P → S → T → R → Q

B P → T → S → Q → R

C S → P → T → Q → R

D S → T → P → R → Q

2 A short piece of DNA 19 base pairs long was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown below.

	number of nucleotide bases			
	A	C	G	T
strand 1				4
strand 2		7		

How many nucleotides containing C were present in strand 1?

A 2 **B** 3 **C** 5 **D** 7

3 Which statements about complementary base pairing are correct?

1 Cytosine forms two hydrogen bonds with guanine.

2 Purines and pyrimidines are different sizes.

3 Adenine forms the same number of hydrogen bonds with thymine and uracil.

4 The base pairs are of equal length.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

4 What does the enzyme DNA polymerase synthesise in a cell?

A a polypeptide using DNA as a template

B a strand of DNA using a polypeptide as a template

C a strand of DNA using DNA as a template

D a strand of mRNA using DNA as a template

5 The following statements describe events that take place during DNA replication and transcription.

Which row is **not** correct?

		DNA replication	transcription
A	adenine pairs with thymine	yes	no
B	both DNA polynucleotide chains act as templates	yes	no
C	the original DNA molecule is changed after the process	no	yes
D	uracil pairs with adenine	no	yes

6 Which statements about complementary base pairing are correct?

1 Purines and pyrimidines are different sizes.

2 It occurs during translation.

3 The base pairs are of different length.

4 Uracil forms two hydrogen bonds with adenine.

A 1, 2 and 3 only **B** 1, 2 and 4 only **C** 1, 3 and 4 only **D** 2, 3 and 4 only

7 What is the minimum number of base substitutions required to change the nucleotide sequence of the HbA (normal) allele to the HbS (sickle cell) allele?

A 1 **B** 2 **C** 3 **D** 4

8 What is the minimum number of hydrogen bonds in a length of DNA containing 700 base pairs?

A 350 **B** 700 **C** 1400 **D** 2100

9 Which statements about complementary base pairing are correct?

1 It occurs during translation.

2 Purines and pyrimidines are the same size.

3 The base pairs are of equal length.

4 Uracil forms three hydrogen bonds with adenine.

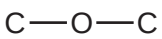
A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 3 and 4 only

10 Which features of DNA enable it to meet these requirements as a molecule of inheritance?

	requirement of DNA molecule			
	ability to remain stable	ability to contain information	ability to transfer information	ability to replicate
A	complementary base pairing	formation of mRNA for translation	sequence of nucleotides	sugar-phosphate backbone
B	formation of mRNA for translation	complementary base pairing	sugar-phosphate backbone	sequence of nucleotides
C	sequence of nucleotides	sugar-phosphate backbone	complementary base pairing	formation of mRNA for translation
D	sugar-phosphate backbone	sequence of nucleotides	formation of mRNA for translation	complementary base pairing

11 Which diagram shows the bond linking the individual units of a nucleic acid?

A



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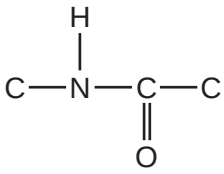
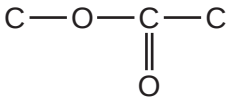


C

D



12 In a genetic engineering experiment a piece of double-stranded DNA containing 6000 nucleotides coding for a specific polypeptide is transcribed and translated.

What is the total number of amino acids in this polypeptide?

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

13 Bacteria were grown in a medium containing ^{15}N. After several generations, all of the DNA contained ^{15}N. Some of these bacteria were transferred to a medium containing the common isotope of nitrogen, ^{14}N. The bacteria were allowed to divide once. The DNA of some of these bacteria was extracted and analysed. This DNA was all hybrid DNA containing equal amounts of ^{14}N and ^{15}N.

The remaining bacteria were left in the medium with ^{14}N and allowed to divide one more time. The DNA of some of these bacteria was extracted and analysed.

What is the composition of this DNA?

A 25 % hybrid DNA

B 50 % hybrid DNA

C 75 % hybrid DNA

D 100 % hybrid DNA

14 DNA was extracted from the salivary glands of a fruit fly and a human cheek cell.

In which way did the DNA molecules differ?

A in the ratio of adenine to thymine

B in the sequence of the nucleotides

C in the type of pentose sugar

D in the types of nucleotide

15 Which statement describes the semi-conservative replication of DNA?

A Parental DNA is broken down into nucleotides and reassembled with new nucleotides.

B Parental DNA is split into triplets and new triplets are added.

C Parental DNA is split into two strands, each of which is replicated.

D Parental DNA remains intact and a new daughter DNA copy is built from new nucleotides.

16 The table shows the percentages of nitrogenous bases in four samples of nucleic acids.

Which base is adenine?

sample	percentage of nitrogenous bases				
	A	**B**	**C**	**D**	uracil
1	19	31	30	19	nil
2	27	23	24	26	nil
3	25	25	nil	25	25
4	17	32	33	18	nil

17 The table shows the percentages of bases in DNA from various types of cell.

source of DNA	percentage of bases in DNA			
	adenine	guanine	thymine	cytosine
calf thymus	28.2	21.5		
bull spleen	27.9	22.7		
bull sperm	28.6	22.2		
rat bone marrow	28.7	21.4	28.4	21.5
yeast	31.3	18.7		

What is a valid deduction from these data?

A All cells from the same species have approximately the same content of DNA.

B Small differences in DNA from different cells have large effects.

C The four bases show complementary base pairing.

D The structure of DNA is different in yeast and animal cells.

18 A culture of bacteria had all its DNA labelled with the heavy isotope of nitrogen (^{15}N). A sample was taken and spun in a centrifuge.

The diagram shows the position of the DNA band at Z in the centrifuge tube.

The culture was then allowed to reproduce using nucleotides containing the normal isotope of nitrogen (^{14}N). Samples were taken and spun in a centrifuge after one generation and again after two generations.

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

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

19 The following statements describe events that take place during DNA replication and transcription.

Which statement is **not** correct?

		DNA replication	transcription
A	adenine pairs with thymine	yes	no
B	both DNA polynucleotide chains act as templates	yes	no
C	the original DNA molecule is changed after the process	no	yes
D	uracil pairs with adenine	no	yes

20 What does the enzyme DNA polymerase synthesise in a cell?

A a polypeptide using DNA as a template

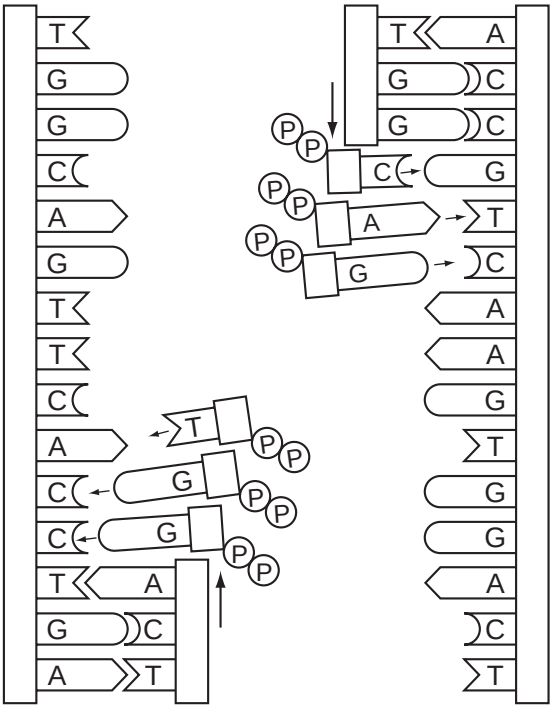
B a strand of DNA using a polypeptide as a template

C a strand of DNA using DNA as a template

D a strand of mRNA using DNA as a template

21 Which diagram shows the semi-conservative replication of a section of a molecule of DNA?

A



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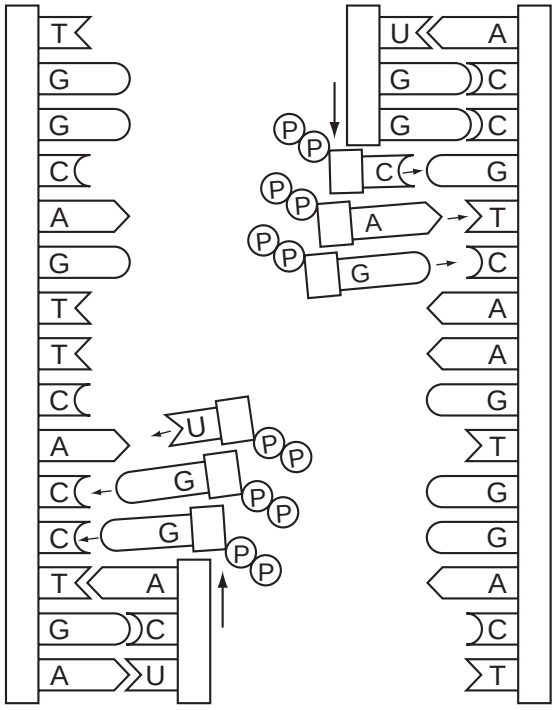

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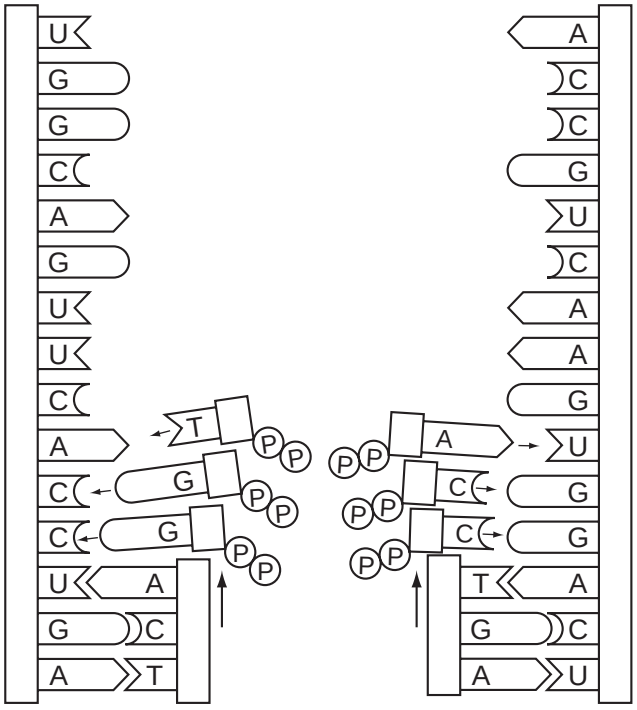
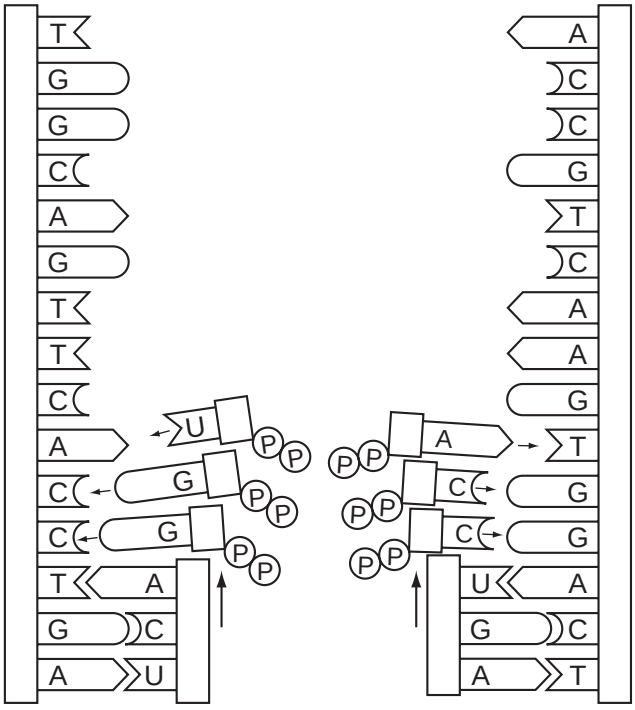


D



22 What is the function of the enzyme RNA polymerase?

A to form a polypeptide using mRNA as a template

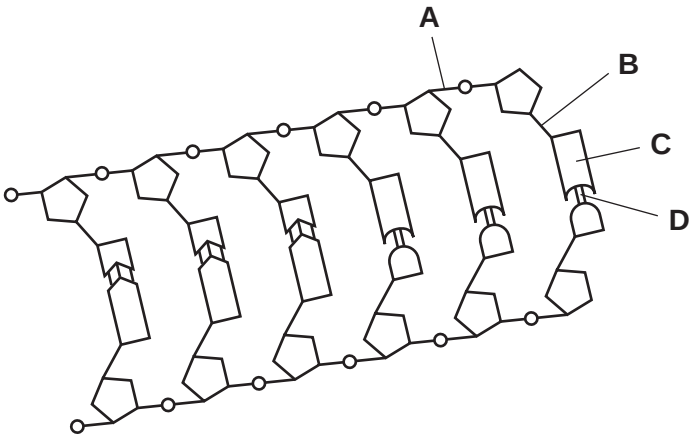
B to form a strand of DNA using mRNA as a template

C to form a strand of mRNA using DNA as a template

D to form a strand of mRNA using tRNA as a template

23 The diagram shows part of a DNA molecule.

Where are hydrogen bonds found?



24 What is the function of the enzyme DNA polymerase in a cell?

A to synthesise a polypeptide using DNA as a template

B to synthesise a strand of DNA using a polypeptide as a template

C to synthesise a strand of DNA using DNA as a template

D to synthesise a strand of mRNA using DNA as a template

25 In transcription, what is transcribed and what is the product?

	transcribed	product
A	DNA	mRNA
B	DNA	polypeptide
C	mRNA	DNA
D	mRNA	polypeptide

26 Analysis of DNA produced the following ratios of nitrogenous bases.

source of DNA	ratio of purines to pyrimidines
bean seeds	0.99
cow heart	1.01
human liver	1.02
rat bone marrow	1.00

Which statement explains the difference in the ratios?

A Animal DNA contains more purines than pyrimidines.

B Different parts of organisms contain different proportions of purines and pyrimidines.

C DNA contains thymine instead of uracil.

D There are variations in the accuracy of analytical techniques.

27 Which structural feature of the DNA molecule varies?

A the arrangement of the sugar-phosphate groups

B the double helical arrangement

C the order of bases on a single nucleotide chain

D the pairing of purines with pyrimidines

28 What is the function of the enzyme DNA polymerase?

A to synthesise a polypeptide using mRNA as a template

B to synthesise a strand of DNA using a polypeptide as a template

C to synthesise a strand of DNA using DNA as a template

D to synthesise a strand of mRNA using DNA as a template

29 The following events occur in the replication of DNA.

1. bonds between complementary bases break
2. bonds between complementary bases form
3. opposite strands separate
4. sugar-phosphate bonds form
5. free nucleotides pair with complementary nucleotides on each strand

In which order do these events take place?

	first → last				
A	1	3	5	2	4
B	1	5	3	2	4
C	3	1	5	4	2
D	5	1	3	4	2