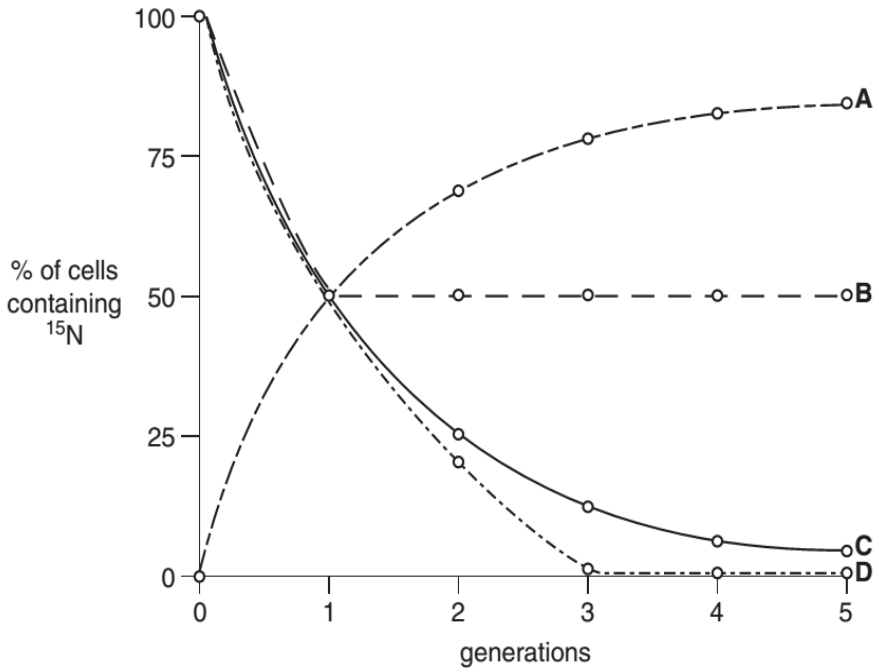
Genetic Control

1	**18** 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 9700/1/M/J03
2	**19** Bacteria were cultured in a medium containing heavy nitrogen (^{15}N) until all the DNA was labelled. These bacteria were then grown in a medium containing only normal nitrogen (^{14}N) for five generations. The percentage of cells containing ^{15}N in each generation was estimated. Which curve provides evidence that DNA replication is semi-conservative?  9700/1/M/J03

3

20 RNA is extracted from β cells in the pancreas. It is used to make DNA coding for human insulin.

Which enzyme is used to make the DNA?

A DNA ligase

B restriction enzyme

C reverse transcriptase

D RNA polymerase

9700/1/M/J03

4

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

A amino acid

B DNA

C mRNA

D polypeptide

9700/1/M/J03

5

22 Which statement about the strands of a newly replicated DNA molecule is correct?

A Both strands are made up of newly assembled nucleotides.

B Both strands contain some nucleotides from the original molecule.

C One strand is new and the other is part of the original molecule.

D The sugar-phosphate chains are conserved and new bases are inserted between them.

9700/01/M/J/04

6

23 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

9700/01/M/J/04

7

24 A protein contains all the common amino acids.

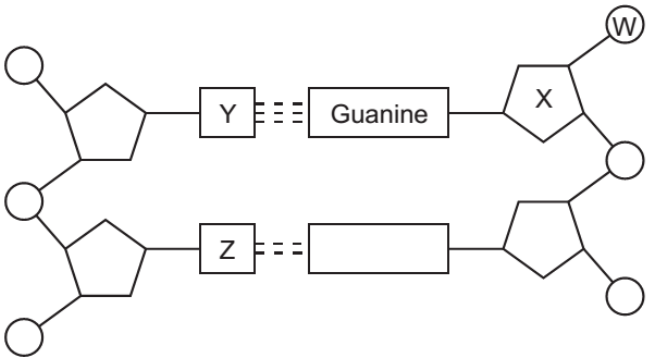
What would be the hypothetical minimum number of types of tRNA molecules needed for the synthesis of this protein?

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

9700/01/M/J/04

8

25 The diagram shows part of a DNA molecule.



Which letters indicate cytosine, deoxyribose, phosphate and thymine?

	cytosine	deoxyribose	phosphate	thymine
A	W	X	Y	Z
B	Y	X	W	Z
C	Z	W	X	Y
D	Y	Z	X	W

9700/01/M/J/04

9

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

source of DNA	adenine	guanine	thymine	cytosine
calf thymus	28.2	21.5	27.8	22.5
bull spleen	27.9	22.7	27.3	22.1
bull sperm	28.7	22.2	27.2	22.0
rat bone marrow	28.6	21.4	28.4	21.5
yeast	31.3	18.7	32.9	17.1

What is a valid deduction from these data?

A DNA occurs in about the same amounts in all cells from the same species.

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

C The four bases show complementary base pairing.

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

9700/01/M/J/05

10

23 Which statement correctly describes the transcription of DNA?

A It is a semi-conservative process.

B It occurs at the surface of the ribosome.

C It produces messenger RNA.

D It produces polypeptides.

9700/01/M/J/05

11

24 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?

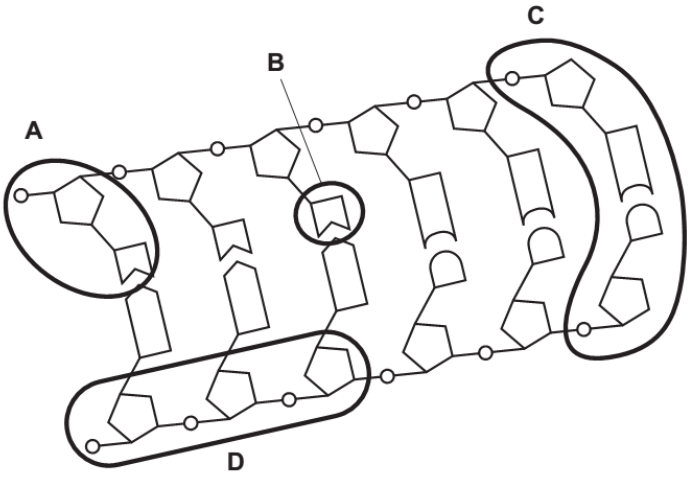
A	tRNA	AAG
	mRNA	UUC
B	tRNA	TTG
	mRNA	UUC
C	tRNA	UUC
	mRNA	AAG
D	tRNA	UUC
	mRNA	TTG

9700/01/M/J/05

12

21 The diagram shows part of a DNA molecule.

Which part is a nucleotide?

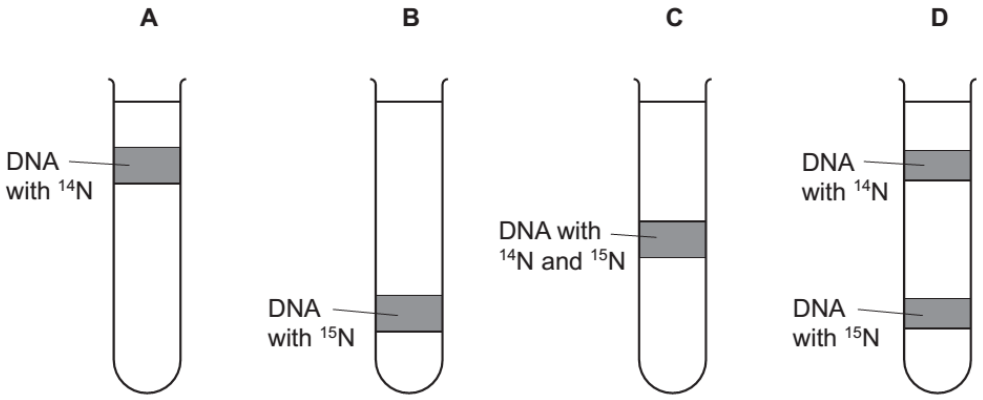


9700/01/M/J/06

13

22 Bacteria were grown for many generations in a medium containing a heavy isotope of nitrogen, ^{15}N. They were then transferred to a medium containing the light isotope of nitrogen, ^{14}N. They were given time to replicate DNA and divide once. Their DNA was extracted, spun in a centrifuge and observed using ultra violet light. The DNA with the ^{15}N settled at a lower depth than the DNA with the ^{14}N.

Which shows the predicted results after one generation in the medium with the light isotope?



9700/01/M/J/06

14

23 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

9700/01/M/J/06

15

24 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

9700/01/M/J/06

16

20 Which type of sugar and bonds are found in a DNA molecule?

	type of sugar	bonds linking complementary bases
A	hexose	hydrogen
B	hexose	peptide
C	pentose	hydrogen
D	pentose	peptide

9700/01/M/J/07

17

21 A length of double-stranded DNA contains 120 nucleotides and codes for polypeptide X.

What is the maximum length of polypeptide X?

A 20 amino acids

B 40 amino acids

C 60 amino acids

D 120 amino acids

9700/01/M/J/07

18

22 In a DNA molecule, the base sequence AGT codes for the amino acid serine.

What is the base sequence of the anti-codon on the tRNA to which serine becomes attached?

A AGU

B GAU

C TCA

D UCA

9700/01/M/J/07

19

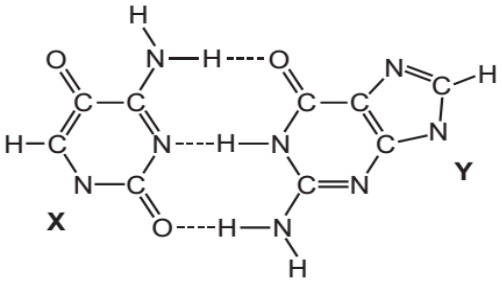
21 The RNA triplet UAG acts as a stop codon terminating the synthesis of a polypeptide. The diagram shows a strand of DNA which codes for four amino acids.

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

9700/01/M/J/08

20

23 The diagram shows two bases, **X** and **Y**, joined by hydrogen bonds (----) in DNA.



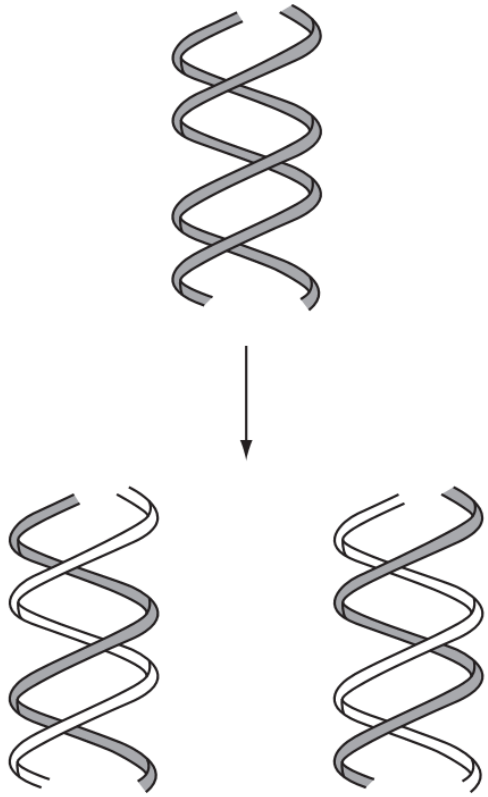
What are the correct bases?

	X	Y
A	adenine	cytosine
B	adenine	uracil
C	cytosine	guanine
D	cytosine	thymine

9700/01/M/J/08

21

22 The diagram shows a process involving DNA.



What is the name of the process and the stage in the cell cycle at which it occurs?

	process	stage
A	replication	interphase
B	replication	prophase
C	transcription	interphase
D	transcription	prophase

9700/01/M/J/08

22

24 Part of the amino acid sequences in normal and sickle cell haemoglobin are shown.

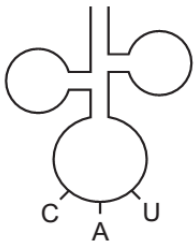
normal haemoglobin	sickle cell haemoglobin
thr-pro-glu-glu	thr-pro-val-glu

Possible mRNA codons for these amino acids are

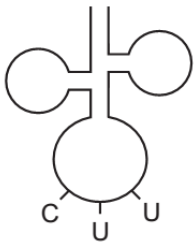
glutamine (glu) GAA GAG	proline (pro) CCU CCC
threonine (thr) ACU ACC	valine (val) GUA GUG

Which tRNA molecule is **not** involved in the formation of this part of the sickle cell haemoglobin?

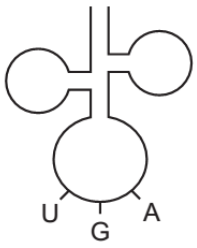
A



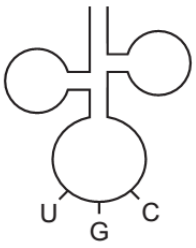
B



C



D



9700/01/M/J/08

23

20 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 CAU **B** CUA **C** GAU **D** GUA

9700/01/M/J/09

24

21 Which statements are correct about DNA transcription and translation?

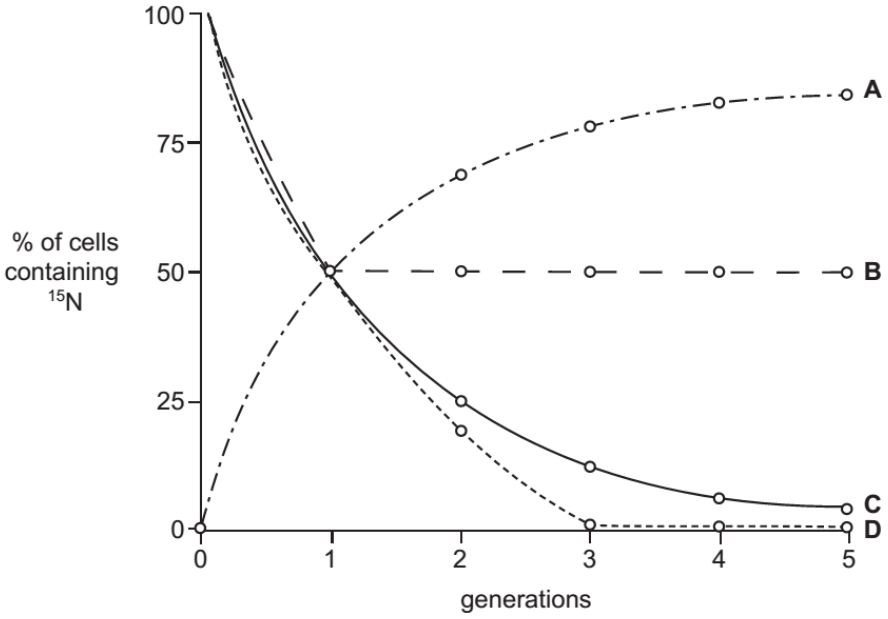
	transcription	translation
A	is semi-conservative	produces mRNA
B	produces mRNA	is semi-conservative
C	occurs at the surface of ribosomes	produces mRNA
D	produces mRNA	occurs at the surface of ribosomes

9700/01/M/J/09

25

22 Bacteria were cultured in a medium containing heavy nitrogen (^{15}N) until all the DNA was labelled. These bacteria were then grown in a medium containing only normal nitrogen (^{14}N) for five generations. The percentage of cells containing ^{15}N in each generation was estimated.

Which curve provides evidence that DNA replication is semi-conservative?



9700/01/M/J/09

26

23 The table shows the sugars and some bases found in RNA and DNA.

Which is correct?

	RNA	DNA
A	ribose	thymine
B	ribose	uracil
C	thymine	deoxyribose
D	uracil	ribose

9700/01/M/J/09

27

21 What would be the result of analysing part of a DNA molecule?

A hexose sugars and phosphates in equal proportion, and an equal number of cytosine and guanine bases

B nucleotides and phosphates in equal proportion, and an equal number of adenine and cytosine bases

C pentose sugars and phosphates in equal proportion, and an equal number of adenine and thymine bases

D twice as many phosphates as pentose sugars, and an equal number of adenine and guanine bases

9700/11/M/J/10

28

22 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 steps in their experiment but they are in the wrong order.

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 steps in the experiment?

A P → Q → R → S → T

B P → S → T → R → Q

C S → P → T → Q → R

D S → R → Q → P → T

9700/11/M/J/10

29

23 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

9700/11/M/J/10

30

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What is the base sequence of the anti-codon on the tRNA to which serine becomes attached?

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9700/11/M/J/10

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9700/12/M/J/10

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9700/12/M/J/10

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9700/12/M/J/10

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9700/12/M/J/10

35

21 The mechanism of action of four drugs that inhibit DNA replication is stated below.

- Aphidicholine inhibits DNA polymerase.
- Cytarabine is converted into a molecule that can substitute for a DNA nucleotide and also inhibits DNA repair mechanisms.
- Epirubicin inhibits an enzyme involved in the unwinding of DNA and separation of strands.
- Hydroxycarbamide inhibits an enzyme involved in the production of deoxyribonucleotides.

Which row correctly matches a drug to an explanation of the mechanism of action?

	explanation of mechanism of action			
	decreased pool of available nucleotides inhibits chain elongation	DNA strands not available as templates for transcription	DNA damaged during replication and cell death occurs	exposed DNA template strands unable to be copied
A	aphidicholine	epirubicin	cytarabine	hydroxycarbamide
B	epirubicin	cytarabine	hydroxycarbamide	aphidicholine
C	hydroxycarbamide	aphidicholine	epirubicin	cytarabine
D	hydroxycarbamide	epirubicin	cytarabine	aphidicholine

9700/11/M/J/11

36

22 The following events occur during transcription.

1 Bonds break between complementary bases.

2 Bonds form between complementary bases.

3 Sugar-phosphate bonds form.

4 Free nucleotides pair with complementary nucleotides.

Before the mRNA leaves the nucleus, which events will have occurred twice?

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

9700/11/M/J/11

37

23 Which type of sugar and types of bonds are found in a DNA molecule?

	type of sugar	types of bonds
A	non-reducing	hydrogen and ionic
B	non-reducing	hydrogen and peptide
C	reducing	covalent and hydrogen
D	reducing	hydrogen and peptide

9700/11/M/J/11

38

21 The table shows 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 following amino acid sequence.

glutamic acid – asparagine – threonine – proline

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

A GGAAATACCCTT

B CAAAATACCCCT

C CTTTTATGGGGA

D CTTTTATCCGGA

9700/12/M/J/11

39

22 What does the enzyme RNA polymerase synthesise?

A a polypeptide from an mRNA template

B a strand of DNA from an mRNA template

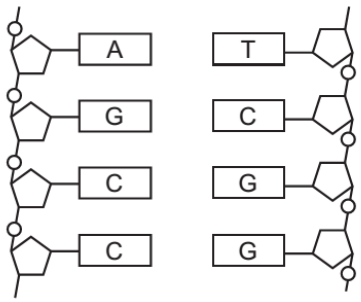
C mRNA from a DNA template

D mRNA from a tRNA template

9700/12/M/J/11

40

23 The diagram shows part of a DNA molecule.



How many hydrogen bonds are involved in holding these strands of DNA together?

A 11 **B** 9 **C** 8 **D** 4

9700/12/M/J/11

41

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2 Bonds form between complementary bases.

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4 Free nucleotides pair with complementary nucleotides.

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

9700/13/M/J/11

42

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3 Sugar-phosphate bonds form.

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9700/13/M/J/11

43

30 The mechanism of action of four drugs that inhibit DNA replication is stated below.

- Aphidicholine inhibits DNA polymerase.
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B	epirubicin	cytarabine	hydroxycarbamide	aphidicholine
C	hydroxycarbamide	aphidicholine	epirubicin	cytarabine
D	hydroxycarbamide	epirubicin	cytarabine	aphidicholine

9700/13/M/J/11

44	**20** Which statement describes a process that occurs during protein synthesis? **A** Transcription is the linking together of a tRNA molecule and a specific amino acid. **B** Transcription is the linking together of free DNA nucleotides. **C** Translation is the linking together of amino acids coded for by mRNA. **D** Translation is the synthesis of an mRNA molecule by base pairing of nucleotides with DNA. 9700/11/M/J/12
45	**21** During semi-conservative replication of DNA in eukaryotic cells, the following processes occur. 1 Free nucleotides are hydrogen bonded to those on the exposed strand. 2 Hydrogen bonds are broken between the complementary base pairs. 3 The cell receives the signal to begin to divide. 4 Covalent bonds form between adjacent nucleotides on the same strand. 5 The DNA double helix is unwound. Which shows the correct order of some of the processes? **A** $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$ **B** $3 \rightarrow 2 \rightarrow 4 \rightarrow 5$ **C** $5 \rightarrow 2 \rightarrow 1 \rightarrow 4$ **D** $5 \rightarrow 2 \rightarrow 3 \rightarrow 1$ 9700/11/M/J/12
46	**22** A length of double-stranded DNA contains 120 nucleotides and codes for polypeptide X. What is the maximum length of polypeptide X? **A** 20 amino acids **B** 40 amino acids **C** 60 amino acids **D** 120 amino acids 9700/11/M/J/12
47	**20** A peptide consists of ten amino acids of four different kinds. What is the theoretical minimum number of different tRNA molecules required to translate the mRNA for this peptide? **A** 4 **B** 10 **C** 12 **D** 30 9700/12/M/J/12

48	**21** Which statements about tRNA structure are correct? 1 There is a binding site for the attachment of a specific amino acid, as well as a different binding site for the attachment to the ribosome, in order to allow translation to occur. 2 There is a ribose-phosphate backbone with strong covalent phosphodiester bonds and areas within the polynucleotide chain where base-pairing by hydrogen bonding occurs. 3 There is a section known as an anticodon that contains the same triplet of bases as the triplet of DNA bases that has been transcribed to produce the mRNA codon. **A** 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3 9700/12/M/J/12
49	**23** A length of double-stranded DNA contains 120 nucleotides and codes for polypeptide X. What is the maximum length of polypeptide X? **A** 20 amino acids **B** 40 amino acids **C** 60 amino acids **D** 120 amino acids 9700/13/M/J/12
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51

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3 The cell receives the signal to begin to divide.

4 Covalent bonds form between adjacent nucleotides on the same strand.

5 The DNA double helix is unwound.

Which shows the correct order of some of the processes?

A $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$

B $3 \rightarrow 2 \rightarrow 4 \rightarrow 5$

C $5 \rightarrow 2 \rightarrow 1 \rightarrow 4$

D $5 \rightarrow 2 \rightarrow 3 \rightarrow 1$

9700/13/M/J/12

52

22 What is the **maximum** number of hydrogen bonds in a length of DNA containing 700 base pairs?

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

9700/11/M/J/13

53

23 Which type of molecule is always the end product of transcription?

A amino acid

B functional protein

C mRNA

D polypeptide

9700/11/M/J/13

54

24 The table gives tRNA anticodons for four amino acids.

amino acid	tRNA anticodon
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 complementary to the mRNA from which this polypeptide was formed?

A CTTTTATGGGGA

B CUUUUAUGGGGA

C GAAAATACCCCT

D GAAAAUACCCCU

9700/11/M/J/13

55

22 What is the **maximum** number of hydrogen bonds in a length of DNA containing 700 nucleotides?

A 350 **B** 700 **C** 1050 **D** 2100

9700/12/M/J/13

56

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

A amino acid

B mRNA

C polypeptide

D tRNA

9700/12/M/J/13

57

24 A polypeptide molecule contains the amino acid sequence:

glycine – leucine – lysine – valine.

The table shows DNA codes for these amino acids.

glycine	leucine	lysine	valine
CCC	GAA	TTT	CAA

Which tRNA 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

9700/12/M/J/13

58

22 One gene provides the code for the production of which molecule?

A amino acid

B DNA

C nucleotide

D polypeptide

9700/13/M/J/13

59

23 A polypeptide has the amino acid sequence glycine – arginine – lysine – serine.

The table gives possible tRNA anticodons for each amino acid.

amino acid	tRNA anticodons
arginine	UCC GCG
glycine	CCA CCU
lysine	UUC UUU
serine	AGG UCG

Which sequence of bases on DNA would code for the polypeptide?

A CCACGCAAGAGC

B CCTTCCTTCTCG

C GGAAGGAAAAGC

D GGTTGGTTGTGC

9700/13/M/J/13

60

24 What is the **minimum** number of hydrogen bonds in a length of DNA containing 700 nucleotides?

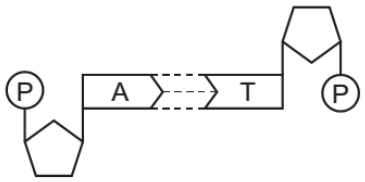
A 350 **B** 700 **C** 1050 **D** 1400

9700/13/M/J/13

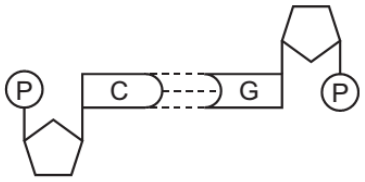
61

21 Which diagram represents a correct base pair of DNA?

A

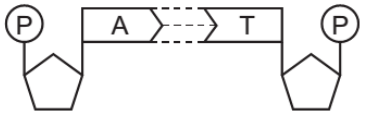


B



C

D



9700/11/M/J/14

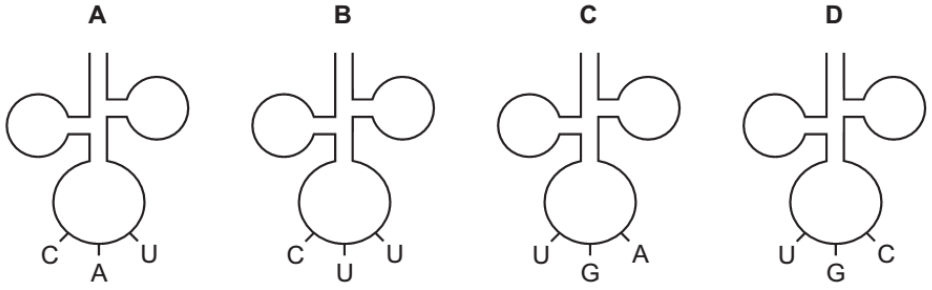
62 **22** Part of the amino acid sequences in normal and sickle cell haemoglobin are shown.

normal haemoglobin	sickle cell haemoglobin
thr-pro-glu-glu	thr-pro-val-glu

Possible mRNA codons for these amino acids are shown below.

glutamine (glu) GAA GAG	proline (pro) CCU CCC
threonine (thr) ACU ACC	valine (val) GUA GUG

Which tRNA molecule is **not** involved in the formation of this part of the sickle cell haemoglobin?

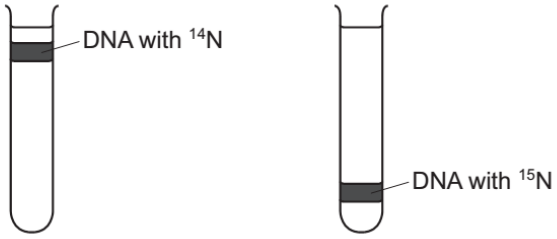


9700/11/M/J/14

63 **23** Two sets of bacteria were grown using different types of nitrogen-containing growth media.

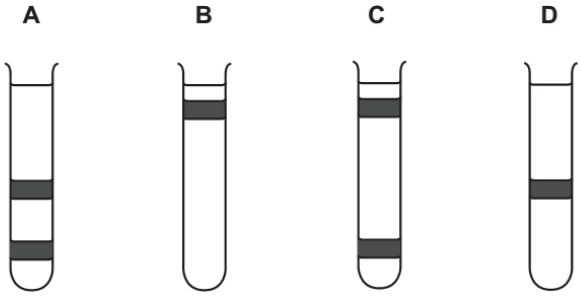
One set was grown in a medium containing the 'heavy' isotope of nitrogen, ^{15}N, until all the DNA was labelled. The other set were grown in a medium containing the 'light' isotope of nitrogen, ^{14}N, until all the DNA was labelled.

The DNA from each set of bacteria was extracted and centrifuged. The diagram shows the position in the centrifuge tubes of this DNA.



Bacteria with ^{15}N labelled DNA were transferred to a medium containing ^{14}N and allowed to reproduce once. The DNA of the new generation of bacteria was extracted and centrifuged.

Which tube shows the position of DNA from this new generation of bacteria?



9700/11/M/J/14

67

20 Which nucleic acid bases are pyrimidines?

A adenine and guanine

B adenine, cytosine and thymine

C cytosine, thymine and uracil

D guanine, cytosine and uracil

9700/12/M/J/14

68

21 What is the correct sequence for the processes involved in the formation of an enzyme in a cell?

A transcription → condensation → translation → ionic bonding

B translation → hydrogen bonding → transcription → condensation

C transcription → translation → condensation → ionic bonding

D translation → transcription → ionic bonding → hydrogen bonding

9700/12/M/J/14

69

22 A short piece of DNA fifteen 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	6		3	
strand 2			4	

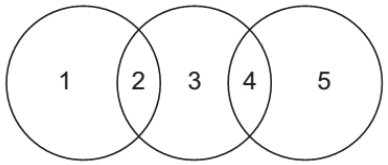
How many nucleotides containing adenine (A) were present in strand 2?

A 2 **B** 3 **C** 4 **D** 6

9700/12/M/J/14

70

22 The diagram shows some relationships between different nucleic acid bases.



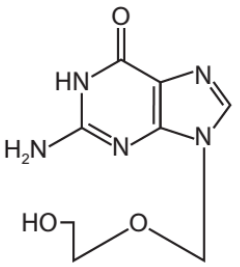
Which row is correct?

	1	2	3	4	5
A	adenine	purine	cytosine	pairs with	guanine
B	cytosine	purine	guanine	pairs with	uracil
C	guanine	pairs with	cytosine	pyrimidine	thymine
D	thymine	pairs with	uracil	pyrimidine	adenine

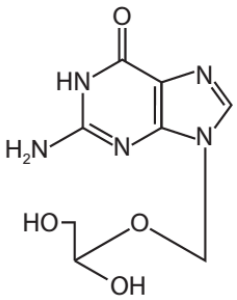
9700/13/M/J/14

71

23 The diagram shows the structures of some drugs that have a similar structure to nucleotides. The presence of these drugs reduces nucleic acid synthesis.



acyclovir



gancyclovir

Which statement explains how these drugs reduce nucleic acid synthesis?

A Increasing the concentration of these drugs results in the increased length of the nucleic acid.

B They are non-competitive inhibitors of the enzymes that catalyse the synthesis of DNA or RNA.

C They bind to pyrimidine nucleotides and the base pair is the wrong size.

D They replace purine nucleotides causing the synthesis of incomplete nucleic acids.

9700/13/M/J/14

72

24 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

9700/13/M/J/14

73

20 Which row shows two pairs of nucleotides formed during transcription?

	first base pair transcribed		second base pair transcribed	
	bases	number of hydrogen bonds	bases	number of hydrogen bonds
A	AU	2	CG	2
B	AU	2	CG	3
C	AU	2	TU	2
D	AU	3	CG	2

9700/11/M/J/15

74

21 Which row correctly identifies the features of DNA and RNA molecules?

	DNA and RNA contain both purine and pyrimidine bases	DNA and RNA both contain a pentose sugar	hydrogen bonds form between bases in some RNA
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✗

key
✓ = correct statement
✗ = incorrect statement

9700/11/M/J/15

75

22 Two polynucleotide strands make up a DNA molecule.

What is a correct description?

A The percentage of cytosine is 50% of that of guanine in the whole molecule.

B The percentage of cytosine is the same as that of guanine in each strand.

C The percentage of cytosine is the same as that of guanine in the whole molecule.

D The percentage of cytosine is the same in each strand of the molecule.

9700/11/M/J/15

76

20 What is needed to transcribe DNA?

A DNA ligase

B DNA polymerase

C ribosomes

D RNA polymerase

9700/12/M/J/15

77

21 In a ribosome, which bond holds together two adjacent amino acids?

A disulfide

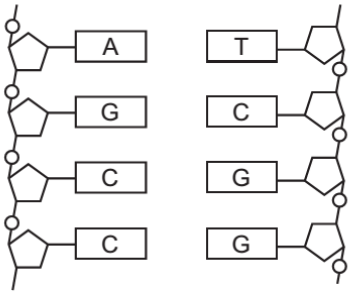
B hydrogen

C ionic

D peptide

9700/12/M/J/15

78 **22** The diagram shows part of a DNA molecule.



How many hydrogen bonds are involved in holding these strands of DNA together?

A 11 **B** 9 **C** 8 **D** 4

9700/12/M/J/15

79 **20** Which row correctly describes adenine?

	complementary base	component on nucleotide strand it is attached to	ring structure
A	thymine	deoxyribose	double
B	thymine	phosphate	single
C	uracil	phosphate	double
D	uracil	ribose	single

9700/13/M/J/15

80 **21** Which row shows two pairs of nucleotides formed when mRNA is translated?

	first base pair translated		second base pair translated	
	bases present	number of hydrogen bonds	bases present	number of hydrogen bonds
A	AT	2	TU	2
B	AU	2	AT	2
C	AU	2	GC	3
D	AU	3	GC	3

9700/13/M/J/15

81

22 Sickle cell anaemia is caused by a mutation in an allele of the gene that codes for the β-globin polypeptide of haemoglobin.

The diagram shows the sequence of bases in a small section of the coding strand of DNA for both the HbA (normal) and HbS (sickle cell) β-globin alleles.

HbA CTGACTCCTGAGGAGAAGTCT

HbS CTGACTCCTGTGGAGAAGTCT

How will the mutation in the HbS allele result in the production of an altered version of the β-globin polypeptide?

A A tRNA molecule with the anticodon GUG will hydrogen bond to the altered codon on mRNA.

B All the amino acids coded for after the mutation will differ from those in the HbA protein.

C mRNA transcribed from the HbS allele will contain the codon CAC instead of the codon CTC.

D The ribosome will be unable to continue translation of the HbS mRNA after the altered codon.

9700/13/M/J/15

82

19 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

9700/1/O/N/02

83

20 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

9700/1/O/N/02

84

21 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

9700/1/O/N/02

85

22 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 TCCCCGCAAAAG

D GAAAAUACCCCU

9700/1/O/N/02

86

19 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

9700/01/O/N/03

87

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

synthetic mRNA used	polypeptide produced
UUUUUUUUUUUU	phenylalanine-phenylalanine-phenylalanine-phenylalanine
AAAAAAAAAAAA	lysine-lysine-lysine-lysine
UUUAAAUUUAAA	phenylalanine-lysine-phenylalanine-lysine

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

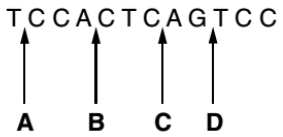
	phenylalanine	lysine
A	AAA	TTT
B	AAA	UUU
C	TTT	GGG
D	UUU	AAA

9700/01/O/N/03

88

21 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?



9700/01/O/N/03

89

22 Which enzyme rejoins sections of DNA in genetic engineering?

A DNA ligase

B DNA polymerase

C restriction enzyme

D reverse transcriptase

9700/01/O/N/03

90

22 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

9700/01/O/N/04

91

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

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

9700/01/O/N/04

92

24 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

9700/01/O/N/04

93

25 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.

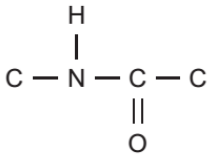
9700/01/O/N/04

94

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

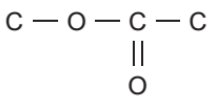
A

B



C

D



9700/01/O/N/05

95

22 Tuberculosis (TB) is treated with a combination of antibiotics including rifampicin and streptomycin.

- rifampicin inhibits polymerisation of bacterial RNA
- streptomycin binds to and inhibits bacterial ribosomes

Which stages of protein synthesis are inhibited by rifampicin and streptomycin?

	rifampicin	streptomycin
A	transcription	transcription
B	transcription	translation
C	translation	transcription
D	translation	translation

9700/01/O/N/05

96

23 A polypeptide has the amino acid sequence glycine – arginine – lysine – serine.

The table gives possible tRNA anticodons for each amino acid.

amino acid	tRNA anticodons
arginine	UCC GCG
glycine	CCA CCU
lysine	UUC UUU
serine	AGG UCG

Which sequence of bases on DNA would code for the polypeptide?

A CCACGCAAGAGC

B CCTTCCTTCTCG

C GGAAGGAAAAGC

D GGTTGGTTGTGC

9700/01/O/N/05

97

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

Which base is adenine?

sample	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

9700/01/O/N/05

98

20 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

9700/01/O/N/06

99

21 A culture of bacteria had all its DNA labelled with the heavy isotope of nitrogen, ^{15}N. The culture was then allowed to reproduce using nucleotides containing normal ^{14}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
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**

9700/01/O/N/06

100

22 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

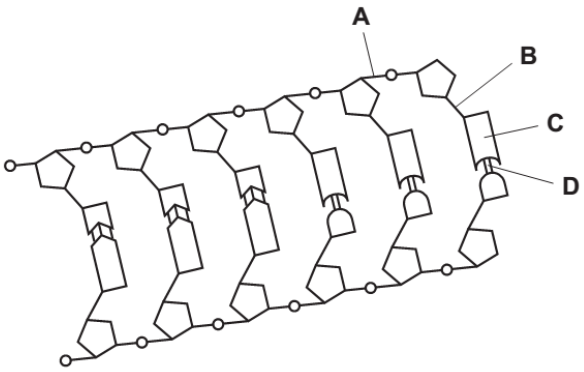
D when the ribosome reaches the end of the tRNA molecule

9700/01/O/N/06

101

20 The diagram shows part of a DNA molecule.

Where are hydrogen bonds found?



9700/01/O/N/07

102

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

A amino acid

B DNA

C mRNA

D polypeptide

9700/01/O/N/07

103

22 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

9700/01/O/N/07

104 **23** Some antibacterial drugs can affect the synthesis of proteins.

antimicrobial drug	rifampicin	streptomycin	tetracycline
mode of action	binds to RNA polymerase	genetic code misread during translation	prevents binding of tRNA to ribosome

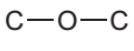
Which is the correct set of immediate effects of these drugs?

antimicrobial drug	rifampicin	streptomycin	tetracycline
A	defective protein synthesised	mRNA does not bind to ribosome	amino acids not added to growing chain
B	mRNA not synthesised	defective protein synthesised	amino acids not added to growing chain
C	mRNA not synthesised	mRNA does not bind to ribosome	transcription prevented
D	transcription prevented	defective protein synthesised	mRNA does not bind to ribosome

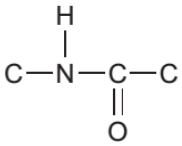
9700/01/O/N/07

105 **20** Which diagram shows the bond linking the individual units of a nucleic acid?

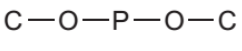
A



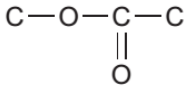
B



C



D



9700/01/O/N/08

106 **21** 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

9700/01/O/N/08

107 **22** 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 GAAAAUACCCCU

9700/01/O/N/08

108 **21** 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

9700/11/O/N/09

109 **22** 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

9700/11/O/N/09

110 **23** 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

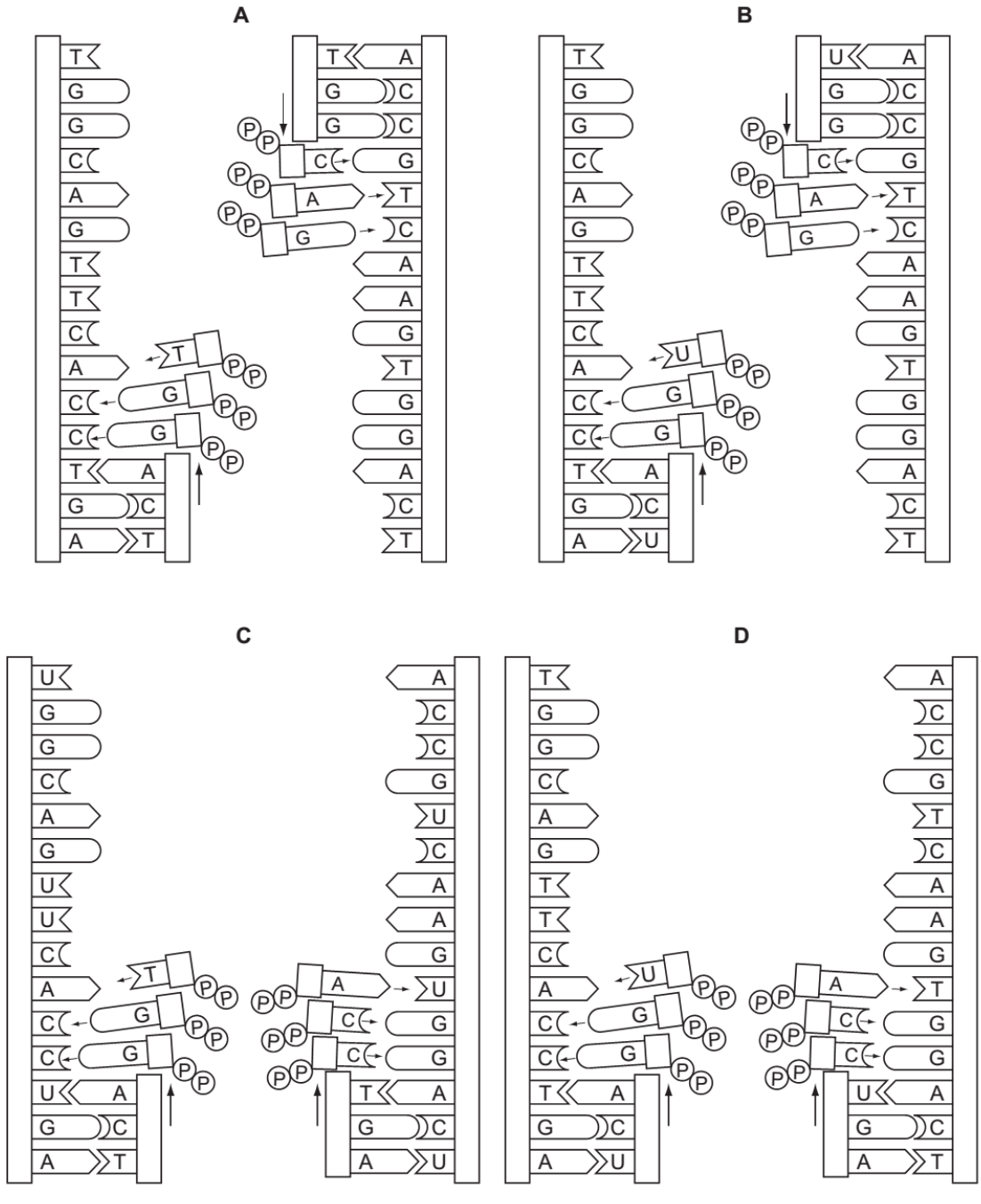
C a strand of DNA using DNA as a template

D a strand of mRNA using DNA as a template

9700/11/O/N/09

111

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



9700/11/O/N/09

112

21 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

9700/12/O/N/09

113

22 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

9700/12/O/N/09

114

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

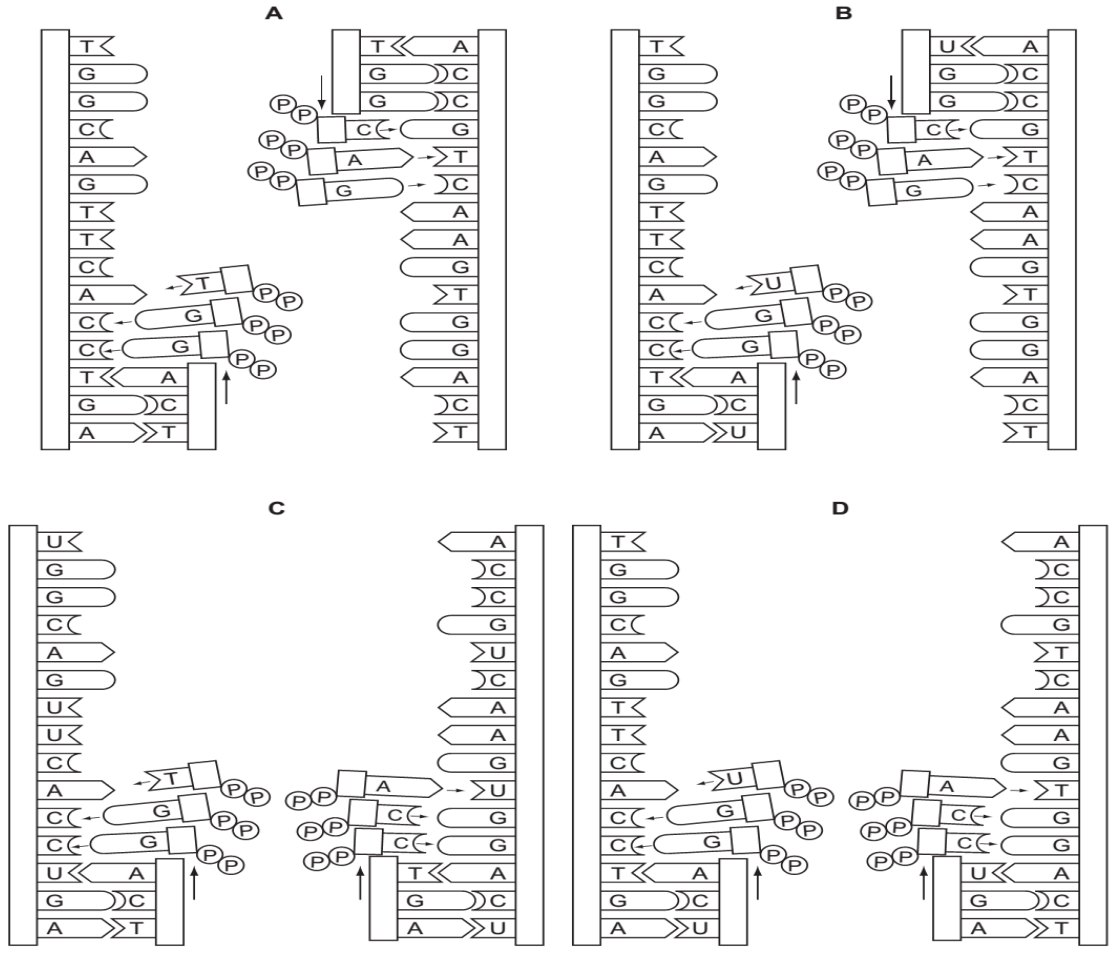
What is the theoretical minimum number of tRNA molecules required to translate the mRNA for this peptide?

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

9700/12/O/N/09

115

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



9700/12/O/N/09

116

20 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

9700/11/O/N/10

117

21 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.

9700/11/O/N/10

118

22 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

9700/11/O/N/10

119 **23** 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
A	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	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
C	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
D	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

9700/11/O/N/10

120 **19** 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	27.8	22.5
bull spleen	27.9	22.7	27.3	22.1
bull sperm	28.6	22.2	27.2	22.0
rat bone marrow	28.7	21.4	28.4	21.5
yeast	31.3	18.7	32.9	17.1

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.

9700/12/O/N/10

121

20 Which row shows the correct combination?

	triplet code	codon	anticodon
A	DNA	mRNA	tRNA
B	DNA	tRNA	mRNA
C	mRNA	DNA	tRNA
D	tRNA	mRNA	DNA

9700/12/O/N/10

122

21 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.

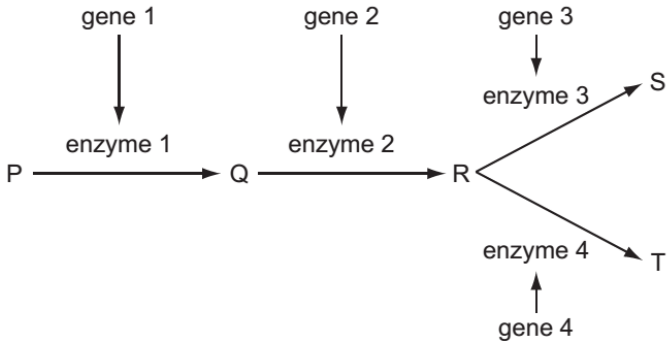
In which pattern would the DNA be found after the first and after the second generations?

	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

9700/12/O/N/10

123

22 S and T are products of a biochemical pathway. A different enzyme, coded for by different specific genes, catalyses each step in the pathway.



What is the possible outcome to the pathway if a mutation in gene 3 leads to an inactive enzyme?

A There is a decrease in the activity of gene 1 and gene 2.

B There is an accumulation of product S.

C There is an increase in the rate of reaction of enzyme 4.

D There is an increase in the production of T.

9700/12/O/N/10

124

29 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
A	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	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
C	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
D	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

9700/13/O/N/10

125

31 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.

9700/13/O/N/10

126

33 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

9700/13/O/N/10

127

34 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

9700/13/O/N/10

128

20 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

9700/11/O/N/11

129

21 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

9700/11/O/N/11

130

22 Which molecule has its synthesis directly controlled by DNA?

A amylase

B cholesterol

C glycogen

D phospholipid

9700/11/O/N/11

131

23 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

9700/11/O/N/11

132

20 In a genetic engineering experiment, a piece of double-stranded DNA containing 12×10^3 nucleotides coding for specific polypeptide is transcribed and translated.

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

A 6×10^3 **B** 4×10^3 **C** 2×10^3 **D** 1×10^3

9700/12/O/N/11

133

21 What is the correct sequence for the processes involved in the formation of an enzyme in a cell?

A transcription → condensation → translation → ionic bonding

B translation → hydrogen bonding → transcription → condensation

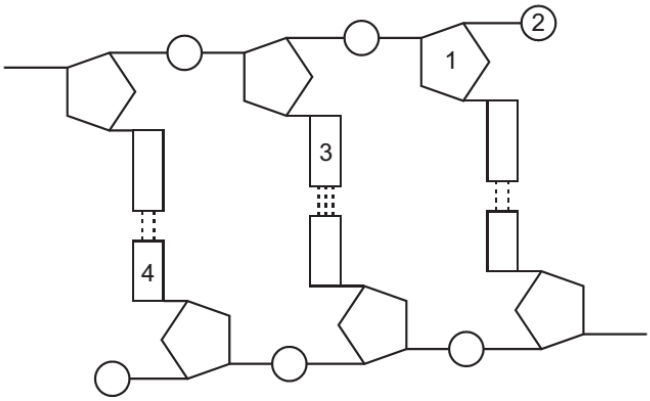
C transcription → translation → condensation → ionic bonding

D translation → transcription → ionic bonding → hydrogen bonding

9700/12/O/N/11

134

22 The diagram shows part of a DNA molecule.



Which row correctly identifies the structures labelled 1, 2, 3 and 4?

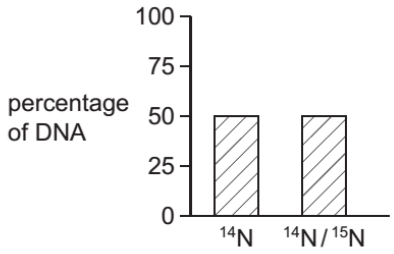
	1	2	3	4
A	cytosine	phosphate	guanine	deoxyribose sugar
B	deoxyribose sugar	phosphate	adenine	cytosine
C	deoxyribose sugar	phosphate	cytosine	thymine
D	phosphate	deoxyribose sugar	cytosine	adenine

9700/12/O/N/11

135

23 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.

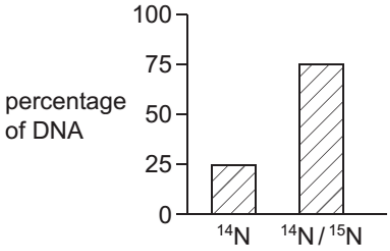
Some bacteria from the medium with ^{15}N were transferred into a medium of ^{14}N. The bacteria were allowed to divide twice. The graph shows the percentages of ^{14}N and ^{15}N in the DNA of these bacteria.



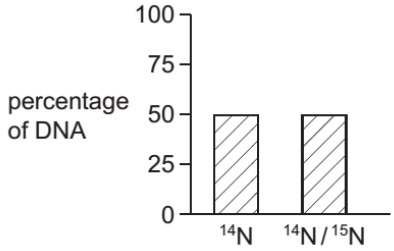
Some bacteria from the medium with ^{15}N were transferred into a medium of ^{14}N. The bacteria were allowed to divide three times.

What would be the percentages of ^{14}N and ^{15}N in the DNA extracted from these bacteria?

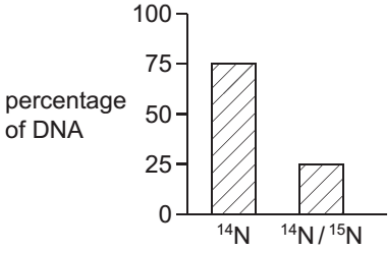
A



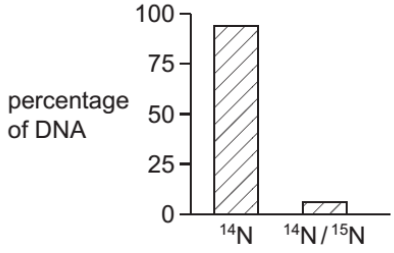
B



C



D



9700/12/O/N/11

136

29 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

9700/13/O/N/11

137

30 Which molecule has its synthesis directly controlled by DNA?

A amylase

B cholesterol

C glycogen

D phospholipid

9700/13/O/N/11

138

31 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.

9700/13/O/N/11

139

32 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

9700/13/O/N/11

140

33 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

9700/13/O/N/11

141

20 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

9700/11/O/N/12

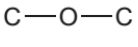
142 **21** Which features of DNA enable it to meet these requirements as a molecule of inheritance?

	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

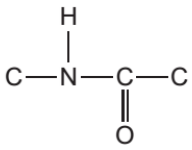
9700/11/O/N/12

143 **22** Which diagram shows the bond linking the individual units of a nucleic acid?

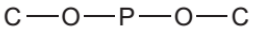
A



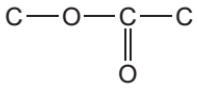
B



C



D



9700/11/O/N/12

144 **21** 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

9700/12/O/N/12

145 **22** Which row in the table correctly shows situations in which **both** DNA and RNA are both involved?

	replication	transcription	translation
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ involved

✗ not involved

9700/12/O/N/12

146 **23** 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'.

9700/12/O/N/12

147 **19** 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
A	1	3
B	2	3
C	3	1
D	3	2

9700/13/O/N/12

148 **20** 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
A	fibrous	amino acids	tRNA
B	fibrous	bases	DNA
C	globular	nucleotides	DNA
D	globular	triplets	mRNA

9700/13/O/N/12

149

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

A condensation

B polymerisation

C replication

D transcription

9700/13/O/N/12

150

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

9700/11/O/N/13

151

21 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

9700/11/O/N/13

152

19 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

9700/12/O/N/13

153

20 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

9700/12/O/N/13

154

21 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

9700/12/O/N/13

155

19 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

9700/13/O/N/13

156

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

A anticodon

B codon

C gene

D nucleotide

9700/13/O/N/13

157

21 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

9700/13/O/N/13

158

17 Laboratory mice whose *p53* genes had been switched off developed tumours.

When their *p53* genes were switched on again, the tumour cells stopped dividing and died within a few days. Healthy cells in the mice were unaffected.

What do these observations suggest?

A *p53* protein speeds up the mitotic cell cycle

B *p53* protein causes all cells to die

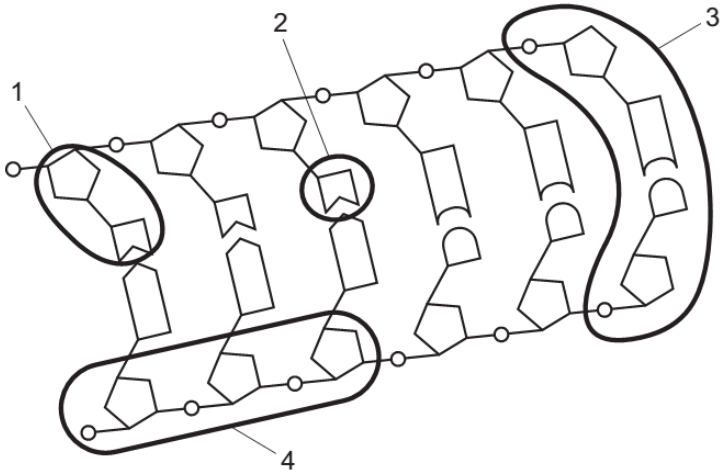
C the *p53* gene acts as a tumour suppressor gene

D the *p53* gene encourages the growth of tumours

9700/11/O/N/14

159

18 The diagram shows part of a DNA molecule.



Which regions contain phosphate groups?

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

9700/11/O/N/14

160

19 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.

9700/11/O/N/14

161

20 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

9700/11/O/N/14

162

5 Which sequence shows some of the stages in the production and secretion of an enzyme?

A Golgi apparatus → ribosome → rough endoplasmic reticulum → mRNA

B mRNA → smooth endoplasmic reticulum → Golgi apparatus → vesicle

C ribosome → rough endoplasmic reticulum → vesicle → Golgi apparatus

D smooth endoplasmic reticulum → mRNA → vesicle → ribosome

9700/12/O/N/14

163

21 Which type of sugar and types of bonds are found in a DNA molecule?

	type of sugar	types of bonds
A	non-reducing	hydrogen and ionic
B	non-reducing	hydrogen and peptide
C	reducing	covalent and hydrogen
D	reducing	hydrogen and peptide

9700/12/O/N/14

164

22 Which nucleic acid bases are purines?

A adenine and cytosine

B cytosine and thymine

C guanine and adenine

D uracil and cytosine

9700/12/O/N/14

165

23 A short piece of DNA 15 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		6		3
strand 2				4

How many nucleotides containing guanine were present in strand 1?

A 2 **B** 3 **C** 4 **D** 6

9700/12/O/N/14

166

19 Which structural feature of the DNA molecule varies?

A the arrangement of the sugar-phosphate groups

B the double helical arrangement

C the number of hydrogen bonds between base pairs

D the pairing of the purines with pyrimidines

9700/13/O/N/14

167

20 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

9700/13/O/N/14

168

21 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

9700/13/O/N/14