Biology · Molecular Biology · Nucleic Acids and Protein Synthesis

RNA and Protein Synthesis

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Multiple choice questions — 140 questions

1 Which of the following is a regulatory protein?

(A) The protein responsible for dissolving the egg envelope during fertilization

(B) The group of light discs in the muscle fibre

(C) The protein that forms the Achilles tendon

(D) The filaments forming the semi-light zone in the muscle fibre

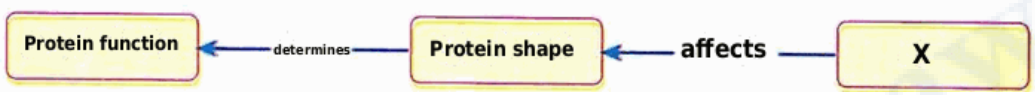
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2 Which regulatory protein has a role in returning the sarcomere to its original length?

(A) Actin (B) Myosin (C) Acetylcholine (D) Cholinesterase

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3 What does the letter (X) represent in the following diagram?



(A) Hydrogen bonds (B) Covalent bonds (C) Peptide bonds (D) Disulphide bonds

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4 Which of the following chemical bonds are found in both DNA and protein molecules?

(A) Hydrogen only

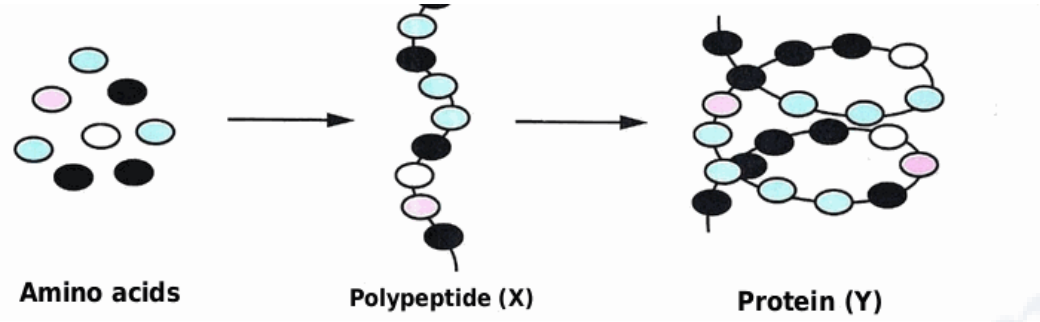
(B) Peptide only

(C) Covalent and peptide

(D) Hydrogen and covalent

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5 From the following figures, which show the formation of a protein:
What chemical bonds form each of (X) and (Y)?



(A) Peptide and hydrogen, respectively

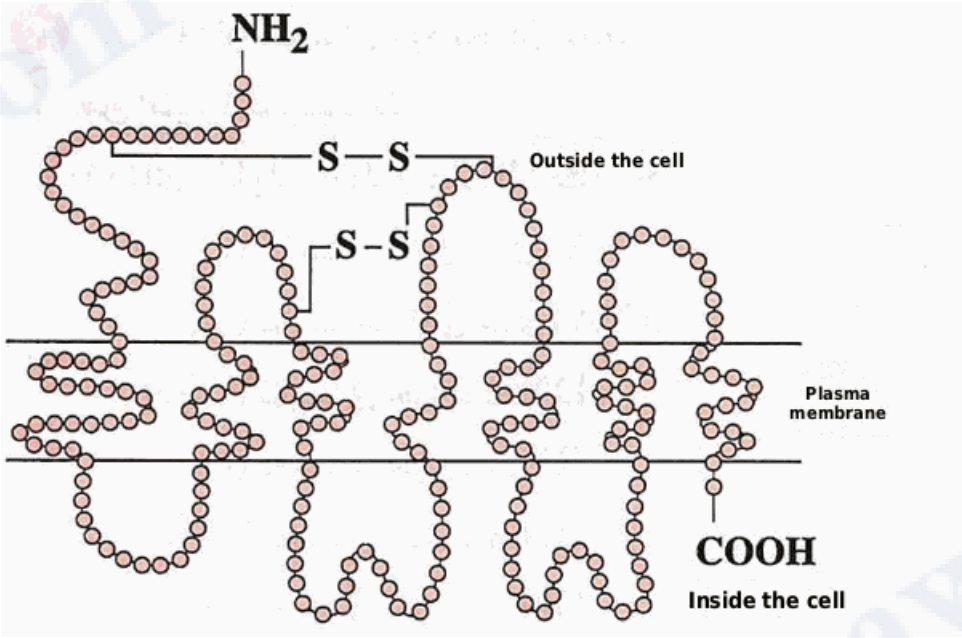
(B) Peptide only

(C) Hydrogen only

(D) Hydrogen and peptide, respectively

---

6 The opposite figure shows one of the components of the plasma membrane of the pituitary gland cells that secrete the hormones FSH and LH. Based on what you have studied, to which of the following does this component belong?



(A) Lipids (B) Carbohydrates (C) Proteins (D) Nucleic acids

7 In a laboratory experiment, the adenine nucleotide at the (3) end of all tRNA molecules was replaced by a cytosine nucleotide. What do you expect to happen?

(A) A change in the genetic code
(B) No pairing between the codon and the anticodon
(C) The amino acid will not bind to the tRNA molecule
(D) The shape of the tRNA molecule changes

8 Which of the following can be found in the nuclei of living cells?

(A) DNA only (B) DNA and protein only
(C) DNA and mRNA only (D) DNA, mRNA and protein

9 Which of the following statements applies to ribosomes?

(A) They are found in eukaryotic cells only
(B) They do not contain proteins
(C) Organelles responsible for building enzymes
(D) Organelles responsible for building steroids

10 How many types of nucleic acid nucleotides are there?

(A) 4 (B) 5 (C) 8 (D) Unknown

11 Which of the following becomes difficult in the absence of the genes responsible for forming histone proteins in the cell?

(A) Replication of the cell's DNA

(B) Identifying the DNA that stimulates division

(C) Identifying the codes from which enzymes will be built

(D) Packing the DNA molecule inside the nucleus

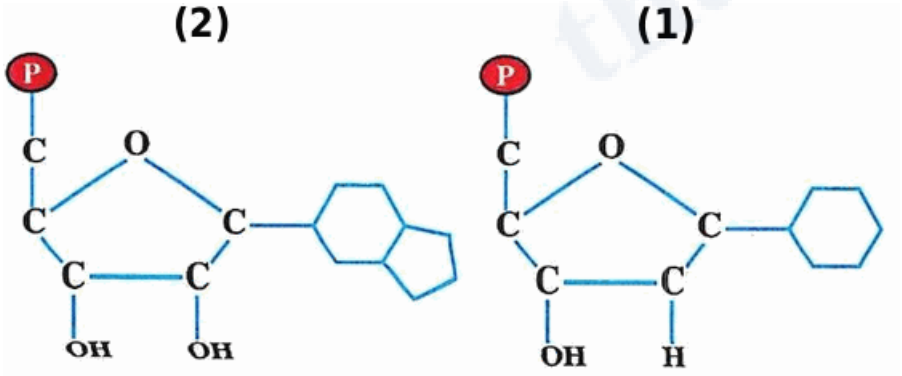
12 Which of the following represents the chemical composition of ribosomes?

(A) Amino acids only (B) Nucleic acids only

(C) Nucleic acids and amino acids (D) Amino acids and fatty acids

13 The two opposite figures show two types of nucleotides:

Which of the following applies to the two figures?



(A) (1) binds to (2) in a DNA molecule

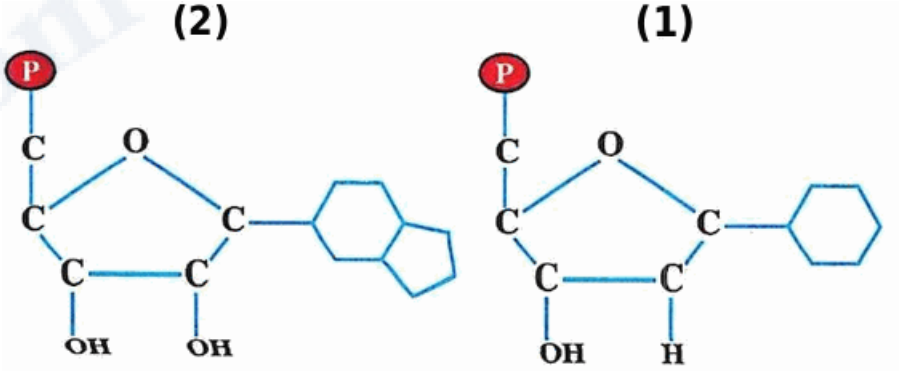
(B) (1) binds to (2) in an RNA molecule

(C) (1) is found in a DNA molecule, (2) is found in an RNA molecule

(D) (1) is found in an RNA molecule, (2) is found in a DNA molecule

14 The two opposite figures show two types of nucleotides:

Which of the following can the two nitrogenous bases in figures (1) and (2) represent, respectively?



(A) Cytosine / Adenine

(B) Guanine / Cytosine

(C) Uracil / Guanine

(D) Thymine / Cytosine

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15 Which of the following is a difference between a human skin cell and a beta cell of the pancreas?

(A) The number of chromosomes

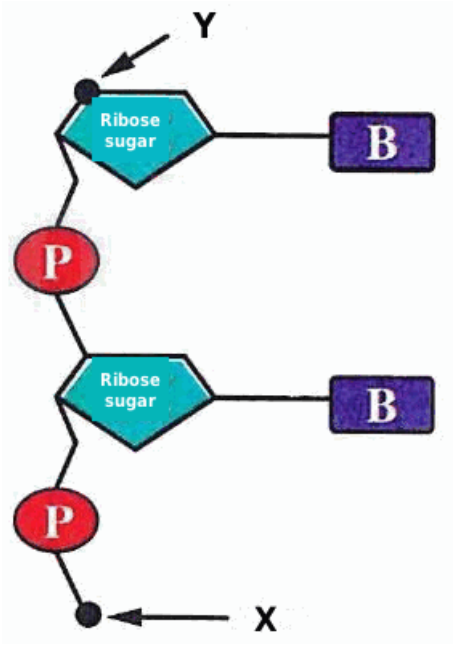
(B) The number of genes

(C) The sequence of nucleotides on the DNA molecules

(D) The genes from which mRNA is transcribed

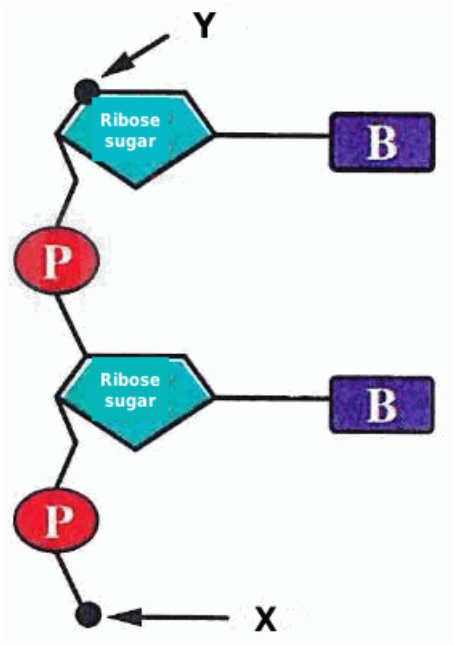
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16 The opposite figure represents part of a strand of a nucleic acid:
Which of the following can the letter (B) NOT stand for?



(A) Adenine (B) Thymine (C) Guanine (D) Uracil

17 The opposite figure represents part of a strand of a nucleic acid:
The letters (X) and (Y) in the opposite figure refer to the ..... and ..... carbon atoms, respectively.



(A) third / fifth (B) fifth / fifth (C) third / third (D) fifth / third

18 What is the first nucleotide triplet that follows the promoter on DNA when mRNA is transcribed?

(A) UAC (B) UAG (C) AUG (D) TAC

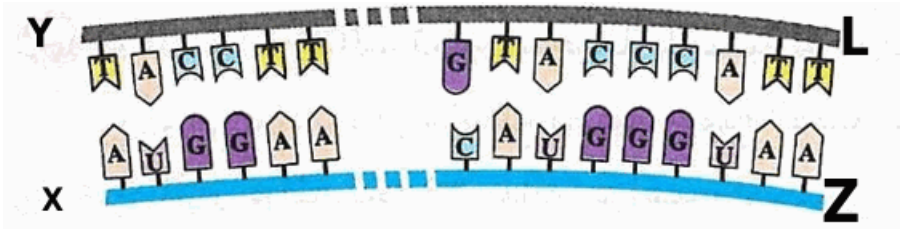
19 If a segment of a DNA strand contains the sequence:
5′.... ATTGCA ....3′
what is the sequence of the mRNA strand that will be transcribed?

(A) 3′.... UAACGU ....5′ (B) 5′.... AUUGCA ....3′
(C) 5′.... UAACGU ....3′ (D) 3′.... AUUCGA ....5′

20 Which of the following statements is NOT correct in eukaryotes?

(A) Translation starts during transcription
(B) In transcription, part of the DNA is used as a template from which an mRNA molecule is transcribed
(C) Translation starts after the transcription of mRNA is complete
(D) The poly-A tail follows the codon UAG

21 In the opposite figure, which of the following shows the direction in which the mRNA strand is built?

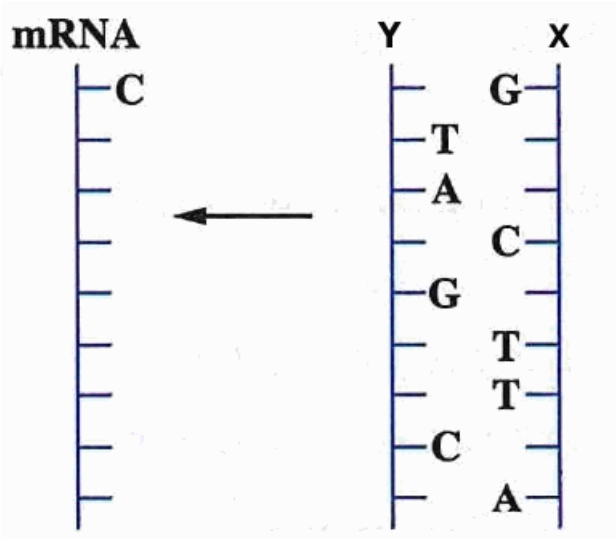


(A) X → Z (B) Y → L (C) L → Y (D) Z → X

22 In which of the following cases does RNA transcription NOT take place in eukaryotes?

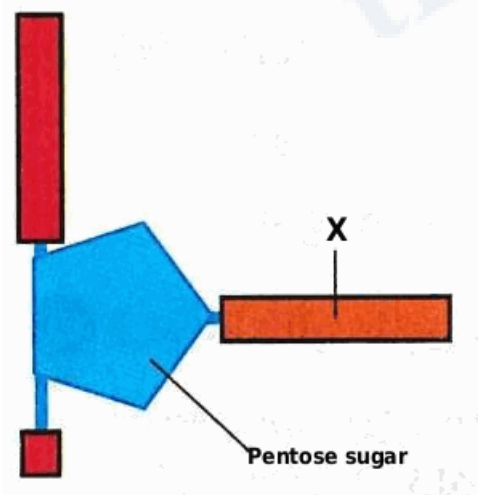
(A) The presence of non-histone regulatory proteins in DNA
(B) The coiling of nucleosome strands around protein
(C) Breaking the hydrogen bonds in the gene
(D) The activity of some enzymes inside the nucleus

23 From the opposite figure, what is the correct sequence of nucleotides of the mRNA formed by transcription?



(A) C-A-U-C-C-U-U-G-A
(B) C-T-A-G-G-A-A-C-T
(C) C-U-A-G-G-A-A-C-A
(D) C-U-A-G-G-A-A-C-U

24 In the opposite figure, which represents the building unit of the nucleic acid mRNA, to which of the following does part (X) bind?



(A) Its identical base on tRNA
(B) Its identical base on rRNA
(C) Its complementary base on tRNA
(D) Its complementary base on rRNA

25 If the number of nucleotides in an mRNA is 45, how many nucleotides are in the segment of the DNA molecule from which the mRNA was transcribed?

(A) 45
(B) 48
(C) 90
(D) 96

26 Which of the following represents the nucleotide triplet on the DNA strand for one of the stop codons?

(A) AAA (B) AGG (C) ACC (D) ATT

27 Which of the following determines the binding of a tRNA molecule to a particular amino acid?

(A) The nucleotide triplet on the DNA strand

(B) The anticodon on tRNA

(C) The codon on mRNA

(D) The amino acid attachment site on tRNA

28 Which of the following statements is correct for the nucleic acid mRNA?

(A) It is built in fragments, then the fragments are joined together

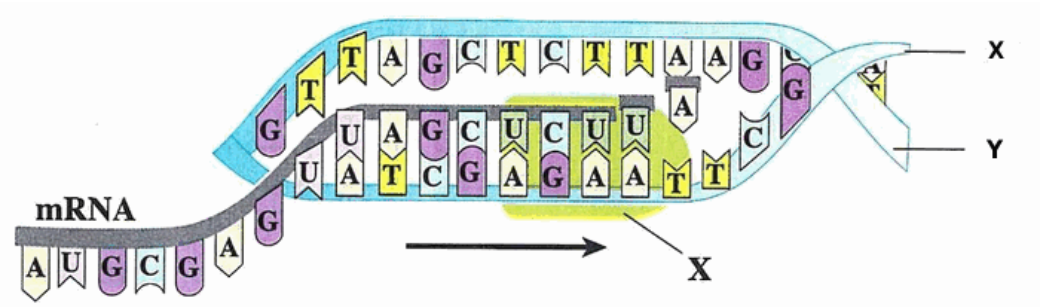
(B) The enzyme used to build it is the same one used during DNA replication

(C) It stays paired with the DNA template

(D) Nucleotides are polymerized in the direction $(5' \rightarrow 3')$

29 The following figure represents a biological process:

Where does the process shown in the figure take place in a cell from the root of a bean plant?



(A) In the nucleus only

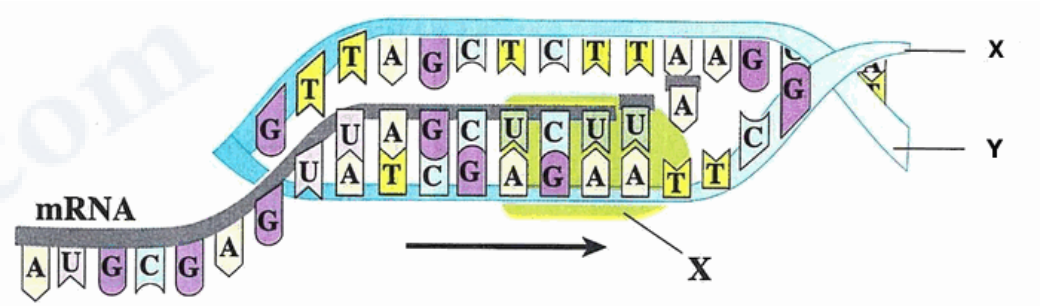
(B) In the cytoplasm only

(C) In the nucleus and the mitochondria

(D) In the nucleus, the mitochondria and the plastids

30 The following figure represents a biological process:

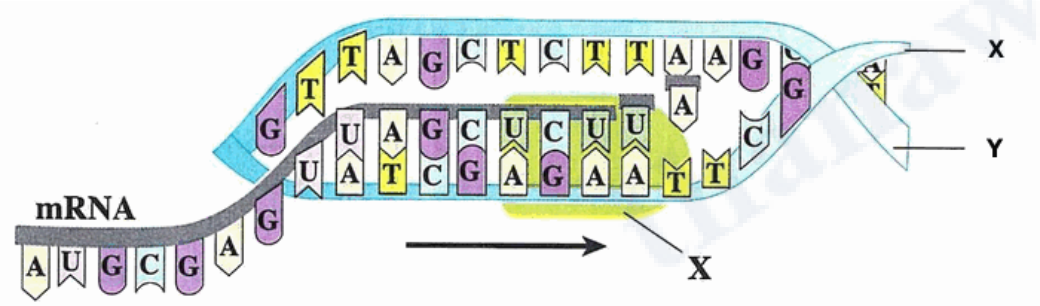
What does the letter (X) represent?



(A) DNA polymerase
(B) mRNA polymerase
(C) A tRNA molecule
(D) A polypeptide chain

31 The following figure represents a biological process:

What do the free groups (X) and (Y) represent, respectively?



(A) Phosphate / Hydroxyl
(B) Phosphate / Phosphate
(C) Hydroxyl / Phosphate
(D) Hydroxyl / Hydroxyl

32 A researcher inserted an mRNA molecule into the nucleus of an animal cell after removing its poly-A tail. Which of the following do you expect to happen?

(A) The mRNA will not be able to leave the nucleus for translation
(B) The mRNA molecule is digested inside the nucleus
(C) The mRNA molecule is digested when it leaves the nucleus
(D) The mRNA molecule is translated slowly

33 From your study of the following table, what do (1), (2) and (3) represent, respectively?

(3)	(2)	(1)
Has some paired bases	Has paired bases	No paired bases
Single strand, free ends	Double helix, joined ends	Single strand, free ends
Differs with the amino acid	Differs by organism	Differs from gene to gene

(A) mRNA / tRNA / plasmid
(B) mRNA / plasmid / tRNA
(C) tRNA / plasmid / mRNA
(D) plasmid / mRNA / tRNA

34 Which of the following choices is correct regarding the presence of the base adenine in the structure?

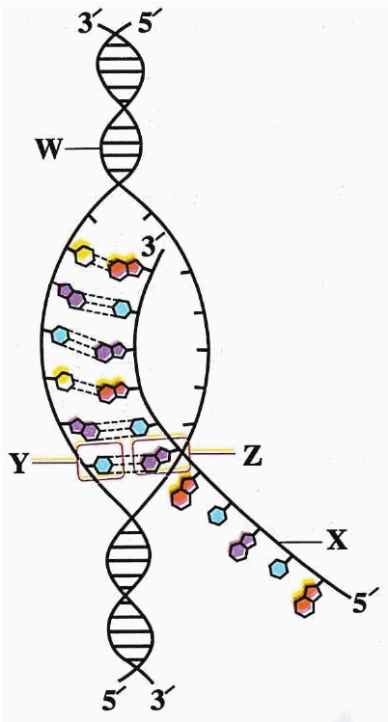
(A) Protein: yes, DNA: yes, RNA: yes, ATP: no
(B) Protein: no, DNA: yes, RNA: yes, ATP: no
(C) Protein: yes, DNA: yes, RNA: yes, ATP: yes
(D) Protein: no, DNA: yes, RNA: yes, ATP: yes

35 What is the nucleotide triplet of the code for the amino acid methionine on the non-template DNA strand?

(A) ATG
(B) TAC
(C) ATC
(D) TAG

36 Study the figure in front of you, which shows one of the vital processes in the cell, then answer:

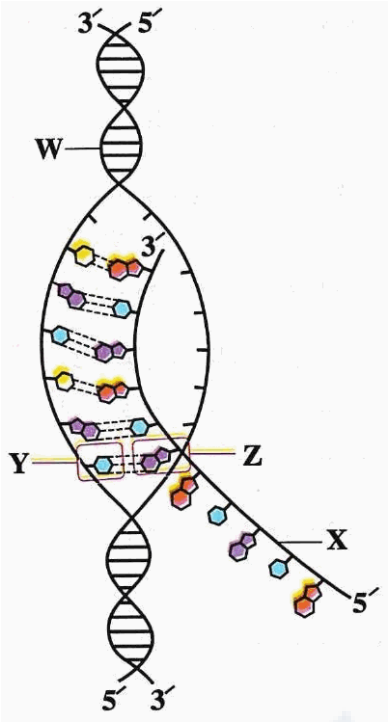
What is the name of the process that produces compound (X)?



(A) Transcription (B) Translation (C) Replication (D) Mutation

37 Study the figure in front of you, which shows one of the vital processes in the cell, then answer:

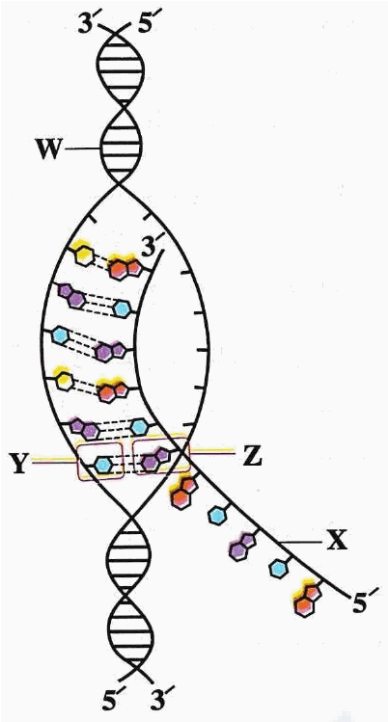
What type of chemical bonds join part (Y) to part (Z)?



(A) Hydrogen (B) Peptide (C) Covalent (D) Disulphide

38 Study the figure in front of you, which shows one of the vital processes in the cell, then answer:

Which of the following components can be part of the structure of part (Z)?



(A) Ribose and cytosine
(B) Ribose and guanine
(C) Deoxyribose and thymine
(D) Deoxyribose and adenine

39 Which of the following distinguishes tRNA from mRNA?

(A) Having a ribosome binding site
(B) Having hydrogen bonds between some bases
(C) The place of transcription
(D) The place where it works

40 Which of the following is responsible for transcribing mRNA from DNA?

(A) Ribosomes
(B) rRNA
(C) tRNA
(D) A type of regulatory protein

41 Which of the following statements is NOT correct?

(A) DNA contains hydrogen bonds

(B) RNA does not contain hydrogen bonds

(C) RNA bases may pair at some positions

(D) During translation, the codon AUG is at the 5′ end

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42 Which of the following does transcription require?

(A) Ribosomes, DNA, nitrogenous bases, RNA polymerase

(B) DNA, ribonucleotides, RNA polymerase, ATP

(C) mRNA, ribosomes, RNA polymerase, DNA

(D) Ribosomes, tRNA, ATP, DNA

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43 Which bonds are responsible for the tRNA molecule keeping its particular shape?

(A) Hydrogen bonds between adenine and thymine bases

(B) Covalent bonds between the nitrogenous bases and the pentose sugar

(C) Covalent bonds between the phosphate group and the pentose sugar

(D) Hydrogen bonds between some nitrogenous bases

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44 What happens when mRNA is inserted into a cork cell?

(A) It is broken down by the cell's enzymes

(B) Translation starts

(C) The ribosome binds to it but it is not translated

(D) Translation will not take place

---

45 The sequence of nucleotides in an mRNA molecule is necessary to determine the sequence of .....

(A) amino acids in the protein

(B) nucleotide triplets on DNA

(C) all the nucleotides of the gene

(D) nucleotides in tRNA

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46 Which of the following statements about histones is NOT correct?

(A) They are structural proteins formed in the cytoplasm

(B) They help fold the DNA

(C) They are part of the structure of ribosomes

(D) They carry positively charged parts

47 How many types of nucleotides are the same in DNA and RNA?

(A) Zero (B) 1 (C) 3 (D) 4

48 If the job of an enzyme in the cell is to prevent the transcription of a particular gene, which of the following choices represents the way this is done?

(A) Preventing RNA polymerase from binding to the start codon

(B) Preventing RNA polymerase from binding to the promoter

(C) Adding several adenine nucleotides to the end of RNA

(D) Preventing DNA polymerase from binding to the promoter

49 Which molecule is responsible for reading both the language of amino acids and the language of nucleotides?

(A) RNA polymerase (B) mRNA (C) tRNA (D) DNA

50 How many types of tRNA molecules are needed to build a polypeptide of 50 amino acids made of 15 types?

(A) 15 (B) 20 (C) 35 (D) 50

51 What is the smallest number of codes for all types of amino acids?

(A) 3 (B) 20 (C) 61 (D) 64

52 What happens to a gene so that the trait it expresses appears?

(A) It is replicated only

(B) It is transcribed only

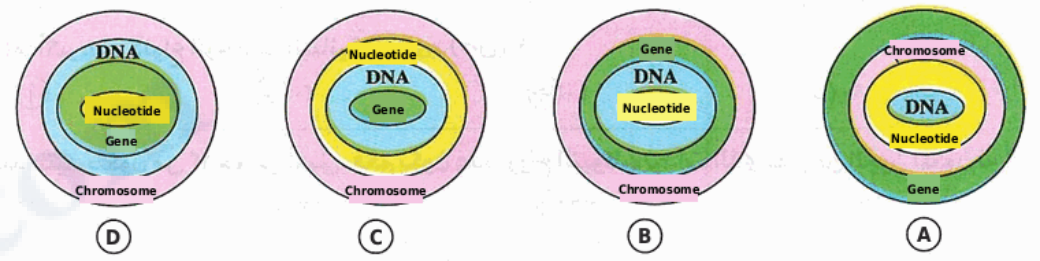
(C) It is translated only

(D) It is transcribed, then translated

53 Through which of the following is the genetic code carried from the nucleus to the cytoplasm?

(A) mRNA (B) tRNA (C) rRNA (D) DNA

54 Which of the following is a correct order?



55 How many nucleotides make up the code for an amino acid?

(A) 1 (B) 3 (C) 63 (D) 64

56 If a protein is made of 299 amino acids, how many complete turns are there in the DNA molecule from one of whose strands the mRNA will be transcribed to form this protein?

(A) 100 (B) 99 (C) 90 (D) 89

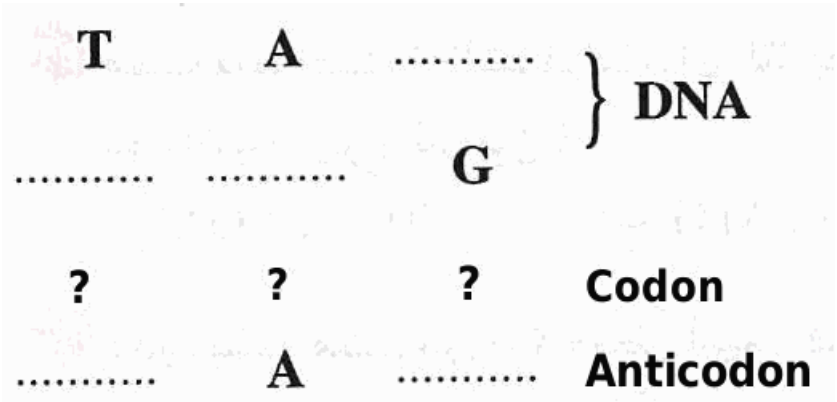
57 If the codes of the amino acids are as follows:

Glu = GAA – GAG , His = CAU – CAC , Pro = CCU – CCC – CCA – CCG

which of the following is the mRNA that codes for the protein made of (Glu – His – Pro)?

(A) GAA CAC CAG (B) GAA CAU CAG (C) GAG CAG CCC (D) GAA CAC CCG

58 What is the sequence of nitrogenous bases of the codon in the opposite figure?



(A) AUG (B) UAC (C) UUG (D) AUC

59 The opposite table shows the codes of four types of amino acids (X), (Y), (Z) and (L). What is the largest number of types of codons in the table that can be used to synthesize a polypeptide made of (3X), (3Y), (3Z) and (3L)?

Codons	Amino acids
CGU , CGC , CGA , CGG	X
UUG , UUA	Y
AUG	Z
AAG , AAA	L

(A) 4 (B) 8 (C) 9 (D) 12

60 If the number of nucleotides in a segment of a DNA molecule representing a gene is 270, how many amino acids can it code for?

(A) 44 (B) 45 (C) 90 (D) 135

61 A molecule (X) leaves the nucleus carrying the code for building molecule (Y), which is made of 90 building units:

How many nucleotides are in molecule (X) to form molecule (Y)?

(A) 90 (B) 180 (C) 273 (D) 546

62 A molecule (X) leaves the nucleus carrying the code for building molecule (Y), which is made of 90 building units:

What is the largest number of types of building units of molecule (Y)?

(A) 4 (B) 20 (C) 40 (D) 90

63 A polypeptide is made of 12 amino acids. How many nucleotide pairs make up the gene that codes for it?

(A) 12 (B) 13 (C) 36 (D) 39

64 What is the maximum number of types of codons found on an mRNA molecule?

(A) 61 (B) 62 (C) 63 (D) 64

65 Using the following table, answer:

If a segment of a DNA strand carrying the sequence (CGATGCGACATT) is exposed to a mutation that causes the loss of the part that codes for the amino acid threonine, which of the following choices is the correct sequence on the mRNA strand after this mutation?

Asparagine	Arginine	Leucine	Threonine	Alanine
GAC	CGA	CUG CUC	ACG ACC	GCU GCA

(A) ACGCUGUAA (B) GCUACGCUG (C) GCUCUGUAA (D) GCUACGUAA

66 Using the codon table, which two sequences in the following choices can be swapped without changing the type of protein?

(A) TGT , AGT (B) ATA , ATG (C) TCA , TTC (D) TTC , TTA

67 A polypeptide is made of 250 amino acids. How many codons are on the mRNA?

(A) 125 (B) 250 (C) 251 (D) 253

68 Which of the following statements is NOT correct?

(A) An mRNA molecule carries the genetic code for one protein

(B) DNA carries the genes of the organism

(C) A small part of the DNA in prokaryotes represents a code

(D) mRNA carries codons of three nucleotides

69 The template strand of a DNA molecule contains 500 thymine nucleotides, 350 guanine nucleotides and 250 cytosine nucleotides, out of a total of 3000 nucleotides in the double molecule. How many uracil nucleotides are in the transcribed mRNA?

(A) 350 (B) 400 (C) 500 (D) 900

70 If the sequence GUC in the genetic code is the codon for the amino acid valine, which of the following is correct about this sequence?

(A) It can be a codon for the amino acid alanine

(B) It matches the sequence CTG on the DNA template strand

(C) It has the anticodon CAG

(D) It matches the sequence CTG on the DNA non-template strand

71 If the number of nucleotides on the part of the DNA strand from which mRNA is transcribed equals (X), how many amino acids make up the resulting polypeptide?

(A) X (B) X - 1 (C) X - 3 (D) (X - 3) ÷ 3

72 Which of the following statements is correct?

(A) A gene can be defined as part of messenger RNA

(B) A codon is three consecutive nucleotides on transfer RNA

(C) In prokaryotes, RNA is transcribed in the nucleus

(D) RNA is transcribed from one of the two strands of deoxyribonucleic acid (DNA)

73 If we assume that the number of types of amino acids in all proteins is only 12, how many nucleotides would make up the code for an amino acid?

(A) 1 (B) 2 (C) 3 (D) 4

74 In the following mRNA sequence:
5′ AUGUACAAGGUCGGAUGA 3′
using the codon table, which of the following amino acid sequences will result from translation?

(A) Met , Tyr , Lys , Val , Gly

(B) Met , Arg , Leu , Glu , His , Val

(C) Met , Gly , Val , Lys , Tyr

(D) Met , Val , Lys , Tyr , Gly , Val

75 Which of the following statements is NOT correct?

(A) The codon AUG codes for the amino acid methionine in all living organisms

(B) All codons code for amino acids

(C) The number of types of codons that code for amino acids is 61

(D) The number of anticodons is 61

76 If you have the nitrogenous bases A – U – G, how many codons that code for an amino acid can be formed from these nitrogenous bases without repeating any of them?

(A) 3 (B) 4 (C) 5 (D) 6

77 The nucleotide sequence ATG on the non-template DNA strand is complementary to the nucleotide triplet on DNA for the .....

(A) stop codon

(B) start codon

(C) codon of an amino acid other than methionine

(D) amino acid binding site of the tRNA molecule

78 If there is a difference between the anticodon sequences and the nucleotide triplets on DNA from which the mRNA codon is transcribed, it is in the .....

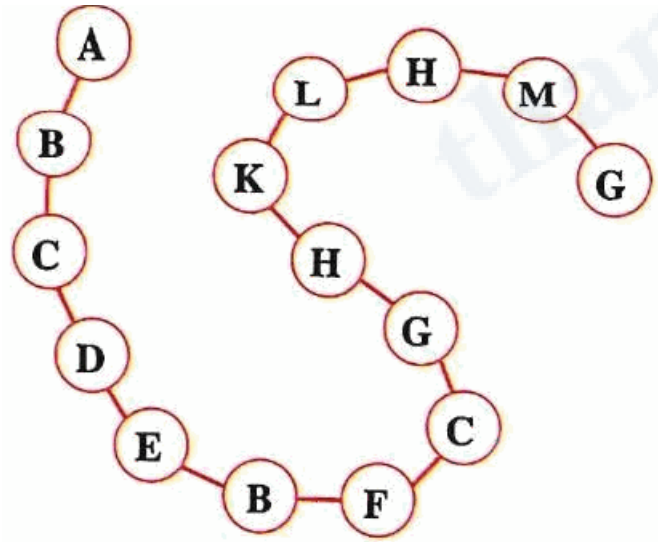
(A) thymine base

(B) adenine base

(C) any purine base

(D) any pyrimidine base

79 From the figure, which shows a polypeptide chain of a certain protein:
How many mRNA nucleotides make up this chain?



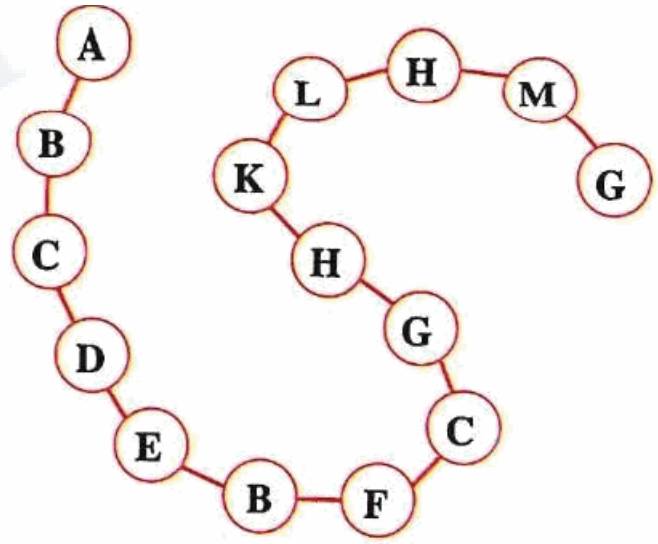
(A) 45

(B) 48

(C) 51

(D) 96

80 From the figure, which shows a polypeptide chain of a certain protein:
How many types of amino acids are used to build this chain?



(A) 9 (B) 10 (C) 11 (D) 15

81 Which of the following is the gene responsible for forming?

(A) Lipids (B) Steroid hormones
(C) Carbohydrates (D) Enzymes

82 Production of which of the following hormones stops when the ribosomes disappear from the cytoplasm of the cell?

(A) Insulin (B) Testosterone (C) Aldosterone (D) Cortisone

83 After a new amino acid is joined to the polypeptide chain, by how many nucleotides does the ribosome move along the mRNA strand?

(A) One nucleotide (B) Two nucleotides
(C) Three nucleotides (D) Four nucleotides

84 If the number of hydrogen bonds between the codon bases and the anticodon bases is 7, and the anticodon bases are pyrimidines, then the codon bases include .....

(A) three adenine bases (B) one guanine base
(C) one adenine base (D) three guanine bases

85 The opposite diagram represents two stages of protein synthesis in eukaryotes. Where does each of the two processes (X) and (Y) take place?

(A) (X): cytoplasm , (Y): ribosome
(B) (X): nucleus , (Y): cytoplasm
(C) (X): cytoplasm , (Y): cytoplasm
(D) (X): ribosome , (Y): nucleus

86 What is the smallest number of ribosomes needed to produce a polypeptide chain of 30 amino acids?

(A) 1 (B) 3 (C) 10 (D) 30

87 If an mRNA molecule in a bacterial strain contains 360 nucleotides, how many peptide bonds are in the polypeptide chain formed?

(A) 360 (B) 357 (C) 118 (D) 119

88 Which of the following is a difference between nerve cells and muscle cells in humans?

(A) Genetic makeup
(B) Chromosome number
(C) Gene expression
(D) Number of genes

89 Which of the following is NOT correct about protein synthesis?

(A) To synthesize different proteins, different ribosomes are needed on the mRNA
(B) The sequence of amino acids determines the function of the protein
(C) The sequence of nitrogenous bases in mRNA determines the sequence of amino acids in the protein
(D) The protein produced may not differ if a nitrogenous base in the nucleic acid is replaced

90 The opposite table shows nucleotide sequences on mRNA. What error could happen during transcription and lead to forming the shortest polypeptide chain?

1	2	3	4	5	6	7
AUG	UUU	GUU	CAA	UGU	AGU	UAG

(A) Deleting guanine from the third codon

(B) Replacing the cytosine base with uracil in the fourth codon

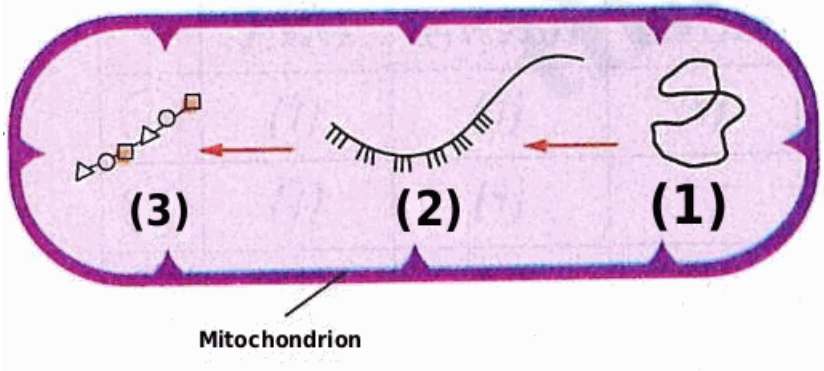
(C) Replacing the uracil base with cytosine in the second codon

(D) Replacing the uracil base with adenine in the fifth codon

91 Which of the following does translation NOT need?

(A) Amino acids (B) DNA (C) mRNA (D) tRNA

92 The opposite figure represents one of the vital processes that take place inside the organism to complete cellular respiration. What do the numbers (1), (2) and (3) represent, respectively?



(A) DNA / mRNA / respiratory enzyme (B) mRNA / DNA / respiratory enzyme

(C) respiratory enzyme / DNA / mRNA (D) mRNA / respiratory enzyme / DNA

93 What does the length of the polypeptide chain formed during translation depend on?

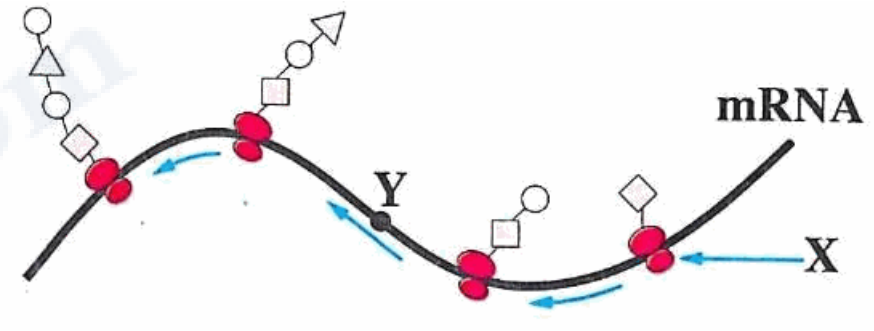
(A) The number of ribosomes

(B) The number of amino acids

(C) The number of tRNA

(D) The number of nucleotides making up the mRNA

94 From the opposite figure, which shows some stages of translation, how many amino acids are attached to structure (X) when it reaches point (Y)?



(A) 1 (B) 2 (C) 3 (D) 4

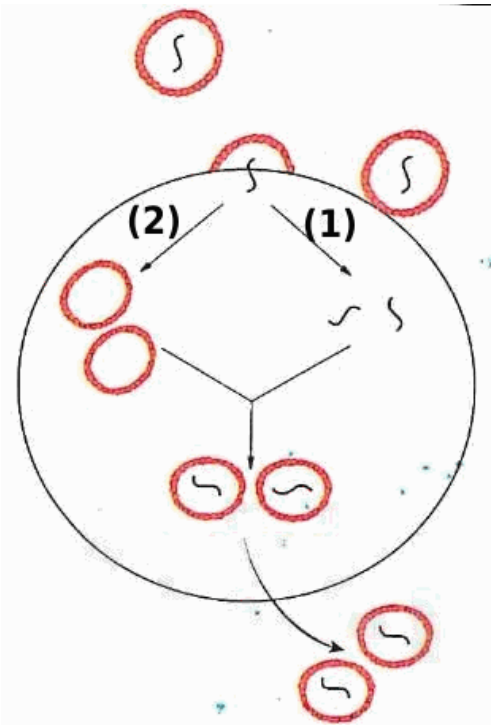
95 Which of the following can NOT be an anticodon?

(A) AUG (B) UAA (C) AUC (D) CCA

96 In the DNA sequence of a sickle-cell anaemia patient, adenine replaces thymine in the triplet CTC, making it CAC, so the amino acid valine is produced instead of glutamic acid. Which anticodon in the tRNA molecule carries valine?

(A) CAU (B) CUA (C) GAU (D) CAC

97 The opposite drawing shows the stages of reproduction of a virus inside the host cell. Which of the following expresses (1) and (2), respectively?



(A) RNA transcription / translation
(B) translation / RNA transcription
(C) replication / translation
(D) cloning / reverse transcription

98 If the sequence of amino acids in a polypeptide chain is: Serine → Lysine → Tyrosine → Asparagine, and the nucleotide sequences of some nucleic acid strands are shown in the table in front of you, using the codon table, which choice in the following table shows the nucleic acids involved in translation?

AGTTTTATATTG	(1)
AGUUUUAUAUUG	(2)
UCAAAAUAUAAC	(3)
GGTTTTGTAAAC	(4)

(A) DNA: (1) , mRNA: (2) , tRNA: (3)
(B) DNA: (1) , mRNA: (3) , tRNA: (2)
(C) DNA: (4) , mRNA: (3) , tRNA: (2)
(D) DNA: (4) , mRNA: (2) , tRNA: (3)

99 Which information about the following mRNA is correct?

5′ AUG UUU GGG CUA GGG CUA UAA 3′

(A) 6 types of tRNA take part in its translation

(B) The protein produced contains 7 amino acids

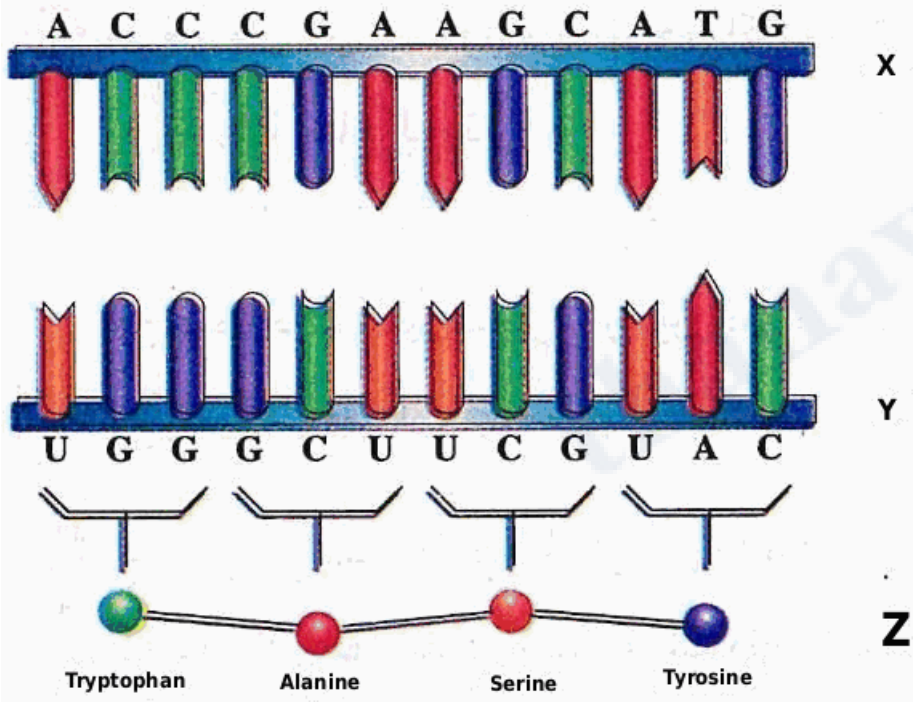
(C) The polypeptide chain formed contains 5 peptide bonds

(D) All codons code for amino acids

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100 Study the opposite figure, then answer:

Which of the following represents the part labelled (X)?



(A) A whole gene

(B) The first part of the gene

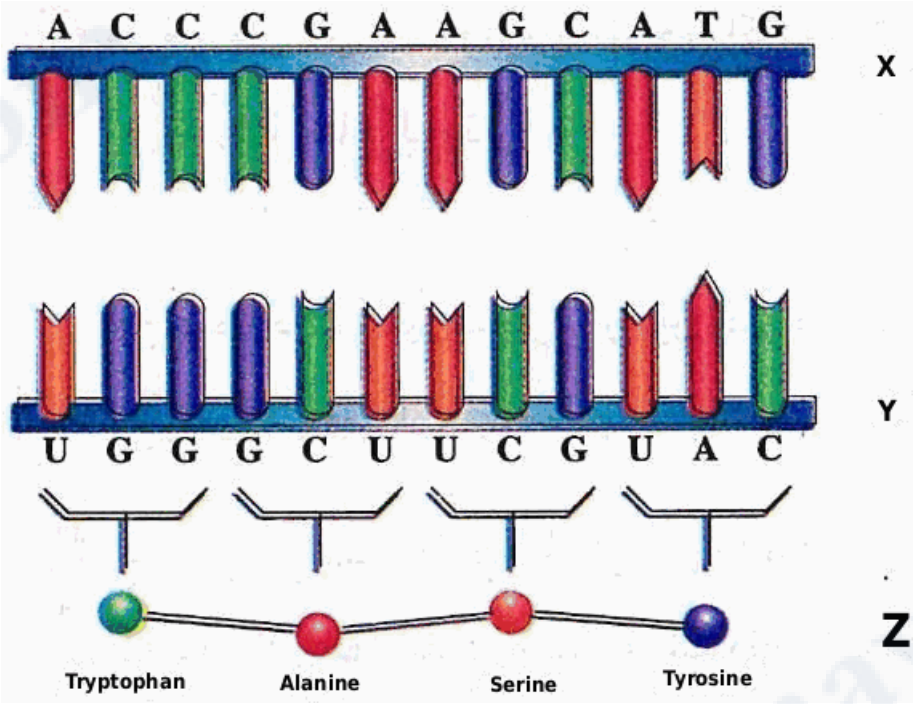
(C) The last part of the gene

(D) A part from the middle of the gene

---

101 Study the opposite figure, then answer:

How many water molecules are produced when chain (Z) is formed?



(A) 6 (B) 4 (C) 3 (D) Zero

---

102 When does the translation of mRNA start?

(A) When the small ribosomal subunit binds to the mRNA molecule

(B) When the bases of the anticodon of the methionine tRNA pair with the codon AUG

(C) When the large ribosomal subunit binds to the mRNA molecule

(D) When the large ribosomal subunit binds to the mRNA complex to which both the small ribosomal subunit and the tRNA carrying methionine are bound

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103 If the number of nitrogenous bases on the mRNA needed to form an enzyme is 51, then this enzyme contains .....

(A) 15 bonds of type (1) (B) 15 bonds of type (2)

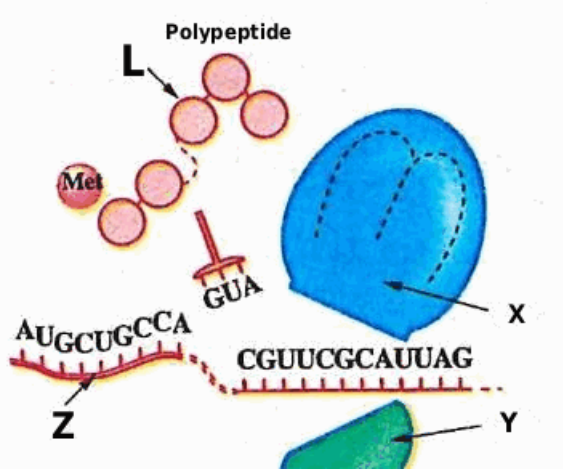
(C) 15 C = O groups (D) 15 NH_2 groups

---

104 Suppose a protein is synthesized using ribosomes from mouse cells, mRNA from a frog cell, tRNA from rabbit cells and amino acids from a bacterial cell. To which of the following organisms does the protein produced belong?

(A) The mouse (B) The frog (C) The rabbit (D) The bacteria

105 From the opposite figure, which shows one of the vital processes in the cell, what is affected first when the release factor reaches the codon UAG?



(A) X , Y (B) X , Y , Z , L (C) X , Y , L (D) X , L

106 Which of the following statements is NOT correct?

(A) In prokaryotic cells, both DNA and protein are found in the cytoplasm

(B) Yeast contains plasmids

(C) Some organelles of eukaryotes contain circular DNA

(D) In eukaryotic cells, DNA is found in the nucleus only and protein is found in the cytoplasm

107 Which of the following is a useful result of having more than one code for the same amino acid?

(A) Fast production of protein

(B) Protein is produced in large amounts

(C) Sometimes the same protein is synthesized even if a mutation happens in the gene

(D) Variety of proteins in cells

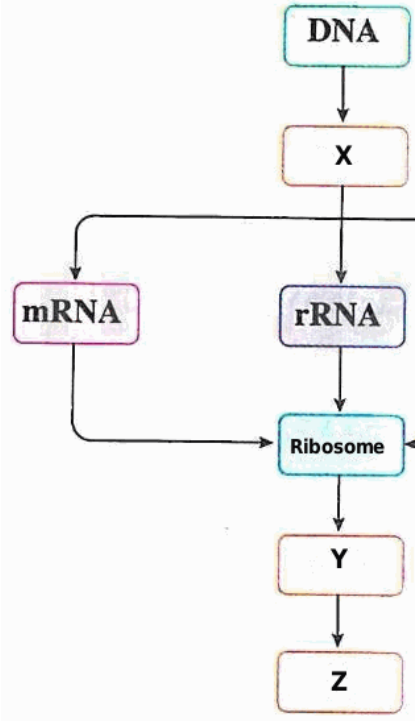
108 If an mRNA strand contains 50 nitrogenous bases of each type, and 3 types of them are in the stop codon, how many hydrogen bonds are formed during translation?

(A) 500 (B) 497 (C) 494 (D) 493

109 The nucleotide triplets that are not translated into an amino acid are known as .....

(A) the promoter (B) the start codon (C) stop codons (D) the poly-A tail

110 Which choice in the following table expresses (X), (Y) and (Z) in the diagram opposite it?



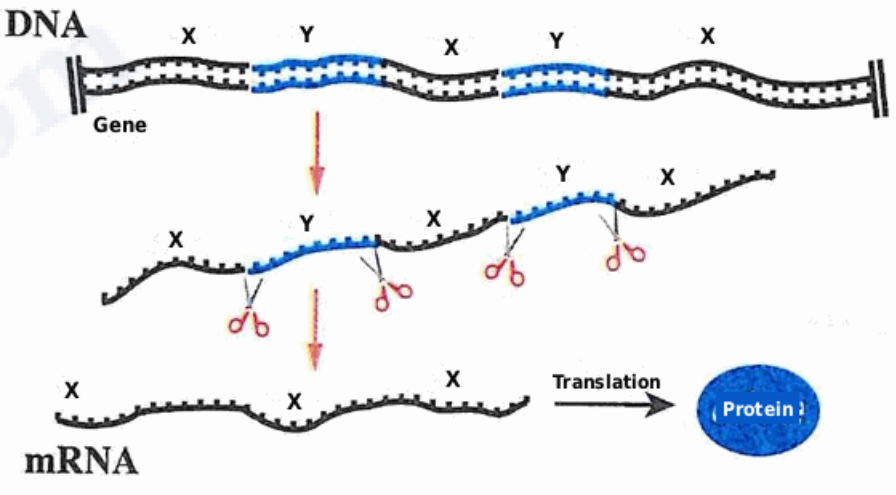
(A) X: DNA replication , Y: translation , Z: polypeptide chain

(B) X: transcription , Y: DNA replication , Z: translation

(C) X: translation , Y: polypeptide chain , Z: transcription

(D) X: transcription , Y: translation , Z: polypeptide chain

111 In the opposite figure, which of the following statements describes the parts of the gene labelled (Y)?



(A) Terminal granules of the DNA

(B) Sequences used in building the protein

(C) Sequences on the DNA molecule that are transcribed but not translated

(D) Sequences that are not part of the genome of this organism

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112 Which of the following statements is NOT correct?

(A) The poly-A tail is not translated

(B) The genetic material of the coronavirus is not translated

(C) The sequence TAC is transcribed and translated

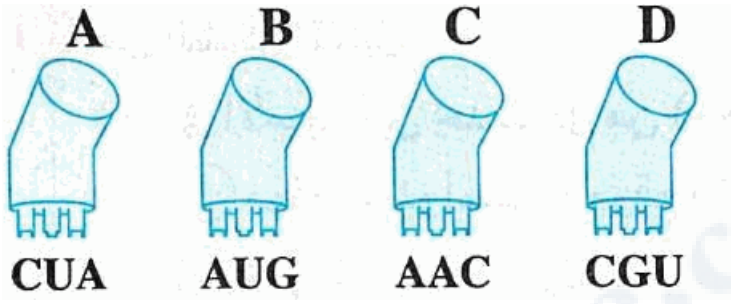
(D) The sequence ATC is transcribed but not translated

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113 From the sequence complementary to the following sequence:

5′...ATG-GCA-CTA-TTC-AAC-TAA...3′

which of the following types of tRNA is used in synthesizing the protein produced?



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114 Which of the following is not produced by transcription and is not translated?

(A) The sequence CCA on tRNA
(B) The sequence CGU
(C) The sequence AUG
(D) The poly-A tail

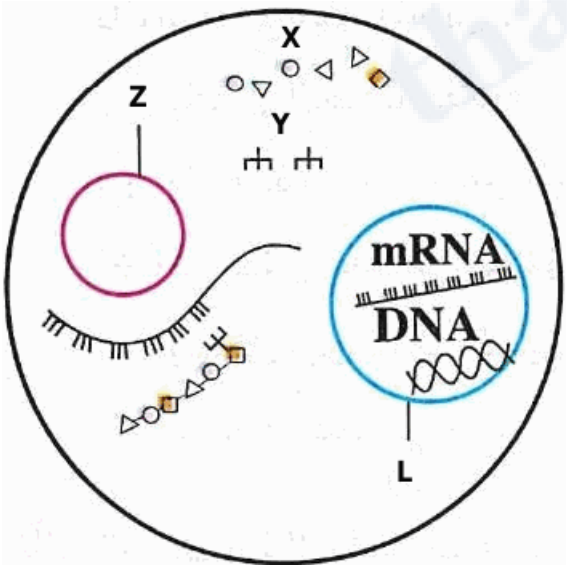
115 In which process is the language of codes changed into a sequence of amino acids?

(A) Bacterial transformation
(B) mRNA transcription
(C) DNA replication
(D) mRNA translation

116 Which of the following determines the protein produced by translating an mRNA molecule?

(A) The presence of rRNA
(B) The presence of the ribosome
(C) The sequence of nucleotides on the tRNA molecule
(D) The sequence of nucleotides on the DNA molecule

117 Which of the following correctly expresses the letters in the opposite figure?



(A) X: amino acids , Y: rRNA , Z: tRNA molecule , L: nucleus
(B) X: amino acids , Y: tRNA molecule , Z: ribosome , L: nucleus
(C) X: amino acids , Y: tRNA molecule , Z: nucleus , L: rRNA
(D) X: amino acids , Y: nucleus , Z: tRNA molecule , L: ribosome

118 Where does the translation of an mRNA molecule take place in a human liver cell?

(A) In the nucleus only
(B) In the cytoplasm only
(C) In the cytoplasm and the mitochondria
(D) In the cytoplasm and the nucleus

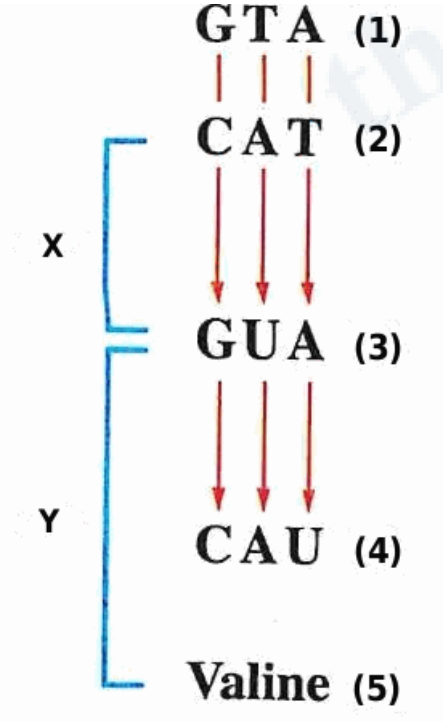
119 Which of the following codons does the release factor NOT bind to?

(A) UAA (B) AUG (C) UGA (D) UAG

120 Which of the following statements is NOT correct?

(A) In all living organisms, translation takes place in the cytoplasm
(B) Translation can start during transcription
(C) In eukaryotes, translation starts after transcription is complete
(D) In all living cells, transcription takes place in the nucleus

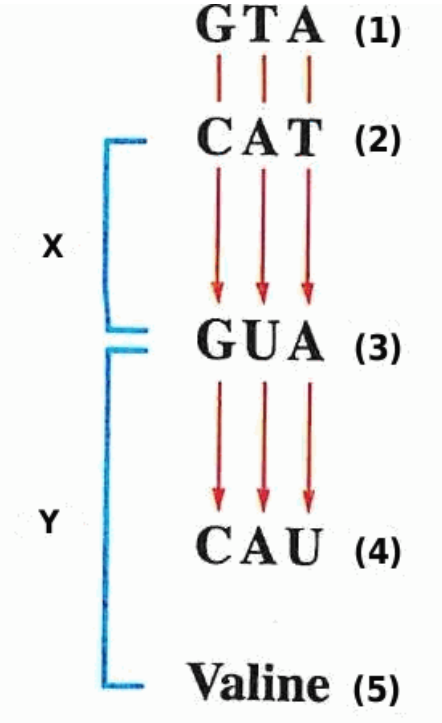
121 From the opposite figure:
In amoeba, where do (X) and (Y) take place, respectively?



(A) Aminoacyl site / Peptidyl site
(B) Nucleolus / Ribosome binding site
(C) Nucleus / Cytoplasm
(D) Cytoplasm / Ribosome

122 From the opposite figure:

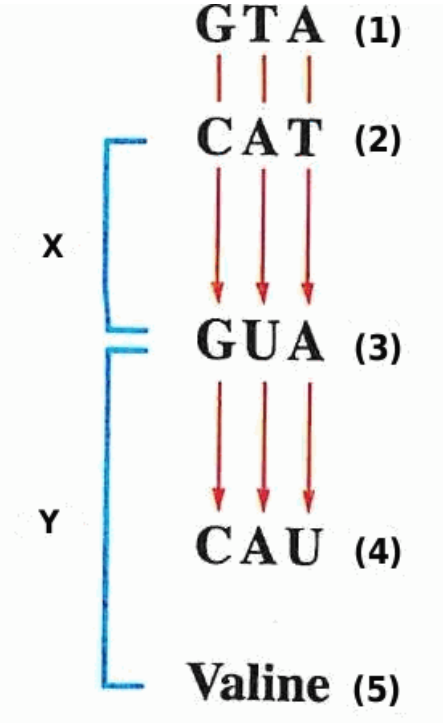
Which enzyme must be available to form structure (3)?



(A) RNA polymerase (B) Ligase (C) DNA polymerase (D) Helicase

123 From the opposite figure:

What happens when base (C) in part (2) is damaged after transcription?



(A) Part (3) is broken down

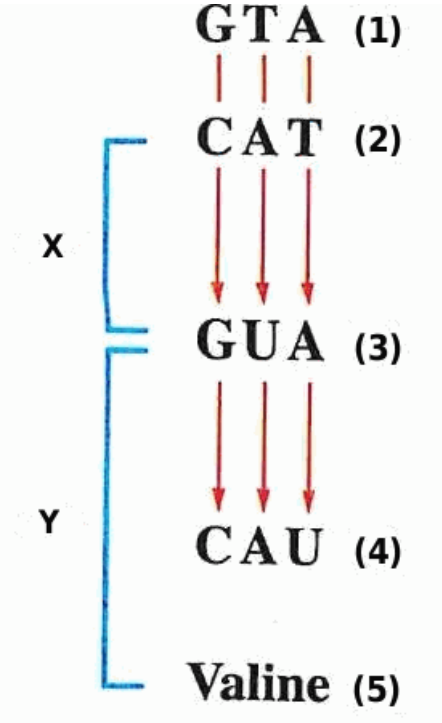
(B) Part (4) changes

(C) Part (3) does not change

(D) Part (5) changes

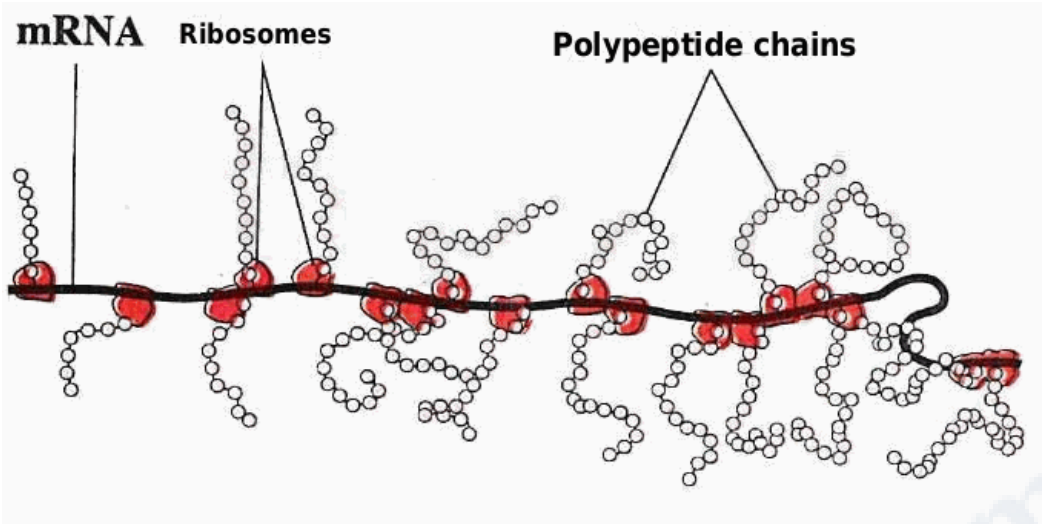
124 From the opposite figure:

At which of the following sites does part (5) bind to part (4)?



(A) The anticodon
(B) The 5′ end
(C) The sequence CAC
(D) The 3′ end

125 Which of the following statements is NOT correct about the opposite figure?



(A) It is common in gland cells
(B) It produces the same type of protein
(C) The number of ribosomes may reach 100
(D) The poly-A tail is broken down as soon as a polypeptide chain is produced

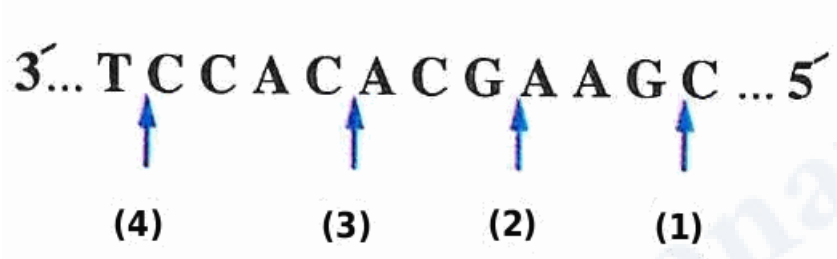
126 Photosynthesis inside the plant cell takes place with the help of a specialized group of enzymes that are formed in the .....

(A) nucleus (B) cytoplasm (C) nucleolus (D) chloroplast

127 If the sequence of nucleotides on an mRNA strand is as follows:
5´...G-C-U-C-C-A-A-A-A-C-C-A-G-C-U-U-G-A-A-A-A-A-A-A...3´
how many types of tRNA are needed to translate this strand?

(A) 3 (B) 5 (C) 6 (D) 8

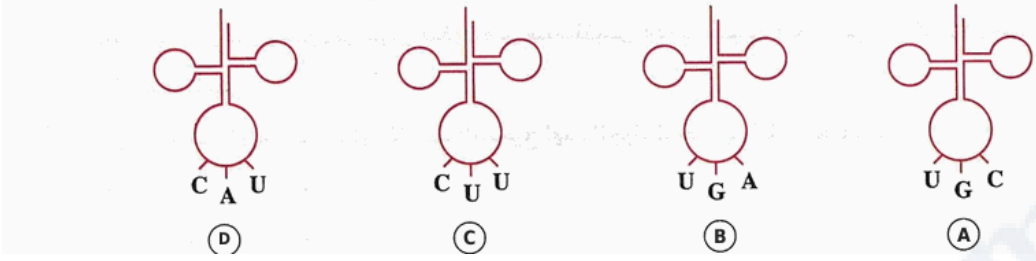
128 The following sequence shows part of a DNA strand. Where can a thymine base be inserted in this part to cause a mutation that stops translation?



(A) (1) (B) (2) (C) (3) (D) (4)

129 The opposite table represents the sequence of amino acid codes of the haemoglobin of a person suffering from a type of anaemia. Which of the following tRNA molecules is NOT involved in translation?

Valine	Proline	Threonine	Glutamic acid
GUA GUG	CCU CCC	ACU ACC	GAA GAG



130 Which of the following properties is NOT correct about mRNA?

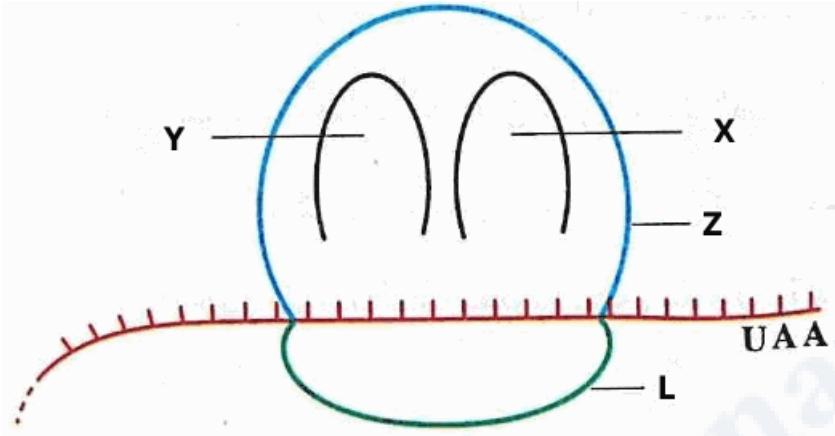
(A) It can be used in translation several times

(B) It is the least numerous type of RNA in the cell

(C) It is always transcribed in the nucleus

(D) A different mRNA is produced for each different protein

131 From the opposite figure, at which part does the release factor protein bind to the stop codon?



(A) X (B) Y (C) Z (D) L

132 When the ribosome reaches a stop codon on mRNA and a fault prevents the release factor protein from binding to the stop codon, which of the following can be obtained?

(A) The ribosome complex and the polypeptide chain attached to a tRNA molecule in site (P)

(B) The ribosome complex with the polypeptide chain and a free mRNA molecule

(C) The ribosome complex, a free polypeptide chain and an mRNA molecule

(D) The two ribosomal subunits separated, a tRNA molecule and the polypeptide chain

133 Which choice in the following table correctly expresses the direction in which ribosomes and replication enzymes move?

Replication enzymes	Ribosomes	
Cytoplasm → Nucleus	Cytoplasm → Nucleolus	(A)
Nucleus → Cytoplasm	Nucleolus → Cytoplasm	(B)
Cytoplasm → Nucleus	Nucleolus → Cytoplasm	(C)
Nucleus → Cytoplasm	Cytoplasm → Nucleolus	(D)

134 There are four genes (X), (Y), (Z) and (L) on a DNA molecule. If the work of the genes is as follows:

X: transcribed into an mRNA molecule made of 15 codons.

Y: transcribed into a tRNA molecule made of 75 nucleotides.

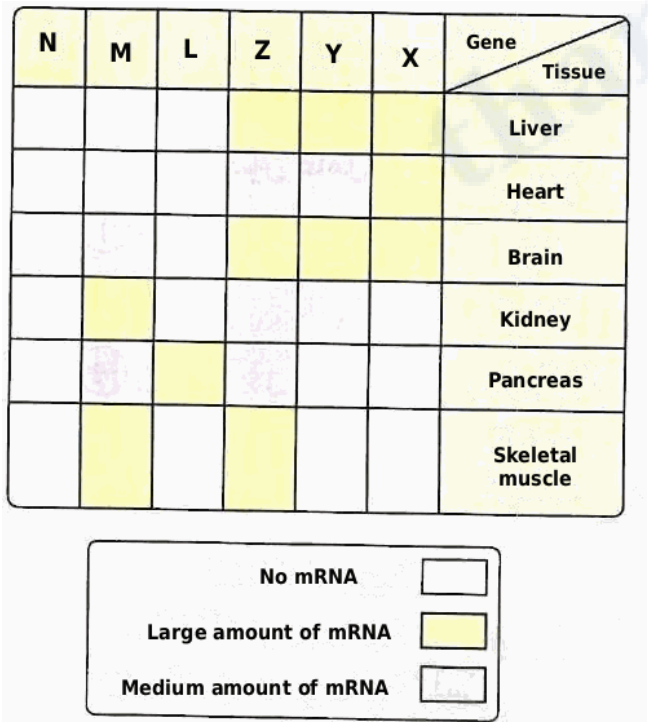
Z: transcribed, then translated into a polypeptide chain made of 75 amino acids.

L: transcribed, then translated to form a protein made of two identical polypeptide chains, each made of 23 amino acids.

Based on what you have studied, which of the following is the correct order of these genes by length, in ascending order?

(A) X → Y → Z → L (B) L → Z → Y → X (C) Z → L → X → Y (D) X → L → Y → Z

135 In a study by a researcher of six genes (X), (Y), (Z), (L), (M) and (N), the researcher collected 6 samples of different tissues from a mouse, determined the amount of mRNA of the six genes in each tissue and recorded the results in the opposite table. Which of the following genes is responsible for building the protein insulin?



(A) Z (B) L (C) M (D) N

136 Using the codon table, if the sequence on the DNA template strand is:

3′... ATGAACTTCATC ...5′

which of the following changes will NOT cause a mutation when it happens in this strand?

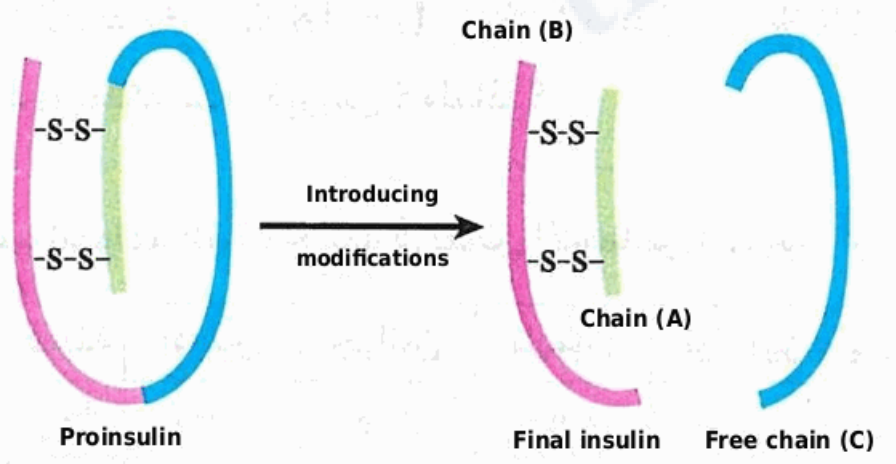
(A) 3′... ATGATCTTCATC ...5′
(B) 3′... ATTAACTTCATC ...5′
(C) 3′... ATGAACTTCATT ...5′
(D) 3′... ATGAACATCATC ...5′

137 In the human female, the gene for casein (milk protein) is found in .....

(A) the cells of the anterior lobe of the pituitary gland only
(B) the cells of the posterior lobe of the pituitary gland only
(C) the cells of the mammary glands only
(D) all body cells

138 Given that the insulin molecule is made of two polypeptide chains, chain (A) made of 21 amino acids and chain (B) made of 30 amino acids, and these two chains are joined together by two disulphide bonds, and the hormone insulin is produced in the beta cells of the pancreas in the way shown in the following figure:

Which of the following does the gene on DNA carry the code for?



(A) Proinsulin
(B) The free chain (C) only
(C) The final insulin only
(D) The final insulin and a free chain (C)

139 Enzyme (X) helps form the protein melanin, which forms the skin colour pigment. The following sequence shows part of the gene that forms enzyme (X):

3′... GAGAAACAGACCTACGTA ...5′

Using the previous genetic codes, which of the following sequences shows albinism (absence of melanin)?

UGG	AUG	AGG AGA	UUU UUC	CAU CAC	CUU CUC CUA CUG	GUC GUA GUG GUU	Genetic code
Tryptophan	Methionine	Arginine	Phenylalanine	Histidine	Leucine	Valine	Amino acid

(A) 3′... GAGAAACAAACCTACGTA ...5′
(B) 3′... GAGAAATACACCTACGTA ...5′
(C) 3′... GAGAAACATACCTACGTA ...5′
(D) 3′... GAGAAACACACCTACGTA ...5′

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140 Which of the following causes a true mutation when it happens in human reproductive cells?

(A) Damage to two opposite bases in the middle of the DNA at the same time
(B) Replacing a codon with another codon in mRNA
(C) Replacing a nucleotide with another of a different type in DNA
(D) Deleting a codon in the middle of mRNA

Essay questions — 12 questions

1 Analysing the genetic material of a virus gave the following results for the percentages of its nitrogenous bases:

A = 18 % , C = 32 % , U = 18 % , G = 32 %

What type of nucleic acid does this virus have? Why?

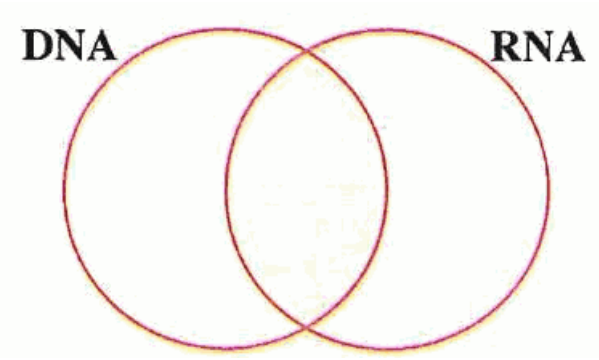
2 The following table shows the percentages of nitrogenous bases in some nucleic acids. Answer the following:

(1) What are the percentages of the nitrogenous bases in (X) and (Y)?

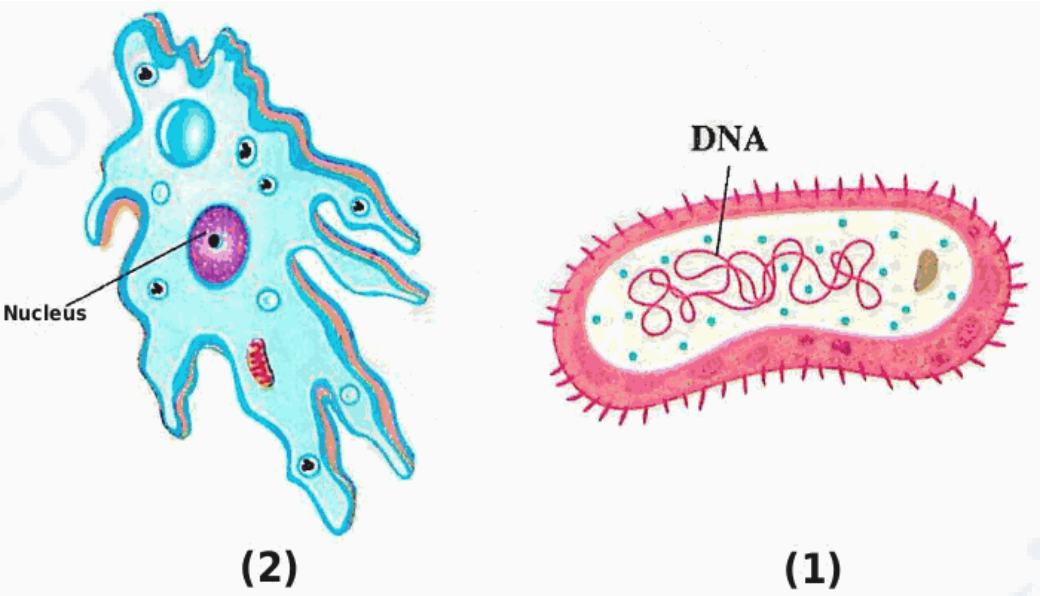
(2) What is the type and nature of the nucleic acid in the three samples? Why?

Uracil	Cytosine	Thymine	Guanine	Adenine	Sample
0%	X%	35%	15%	35%	(1)
0%	40%	15%	40%	Y%	(2)
20%	15%	0%	35%	30%	(3)

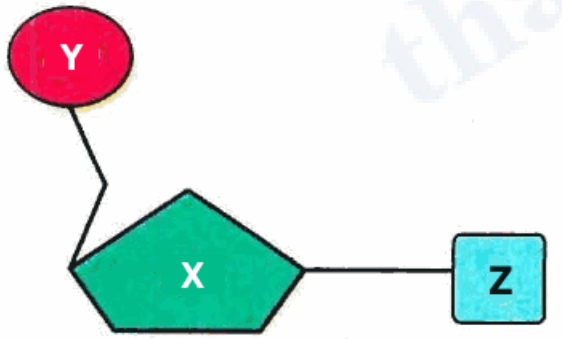
3 From the opposite figure, what can be written in the shaded part?



4 The two opposite figures represent two organisms, one prokaryotic and the other eukaryotic. Which of them is faster in gene expression? Explain.

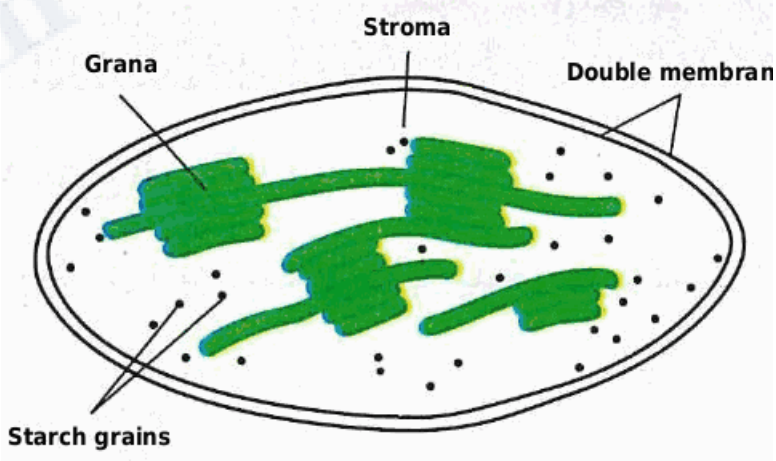


5 From the opposite figure, which symbol represents one of the letters of the genetic code? Explain.



6 "Translation takes place in several places in the cells of a bean leaf." How correct is this statement? Explain.

7 The figure in front of you represents the structure of a chloroplast that cannot carry out photosynthesis because the enzymes for this process are absent. Why is the chloroplast unable to form these enzymes?



8 A researcher identified the sequence AAC in a long strand of an mRNA molecule inside the nucleus. If the sequence AAC in the genetic code is the codon of the amino acid asparagine, is it necessary that asparagine will appear in the protein produced by translating this mRNA? Explain your answer.

9 The following sequence shows an mRNA molecule:
5′ A-G-A-C-C-A-U-A-C-A-A-U-U-A-G 3′
Will this sequence be translated into a polypeptide chain or not? Why?

10 If the sequence of nitrogenous bases in a segment of one of the two strands of a DNA molecule is as follows:
3′ ... G-C-T-C-G-A-A-C-A ... 5′
and the codons of some amino acids are as follows:
Valine GUC , Arginine CGA , Tyrosine UAU , Cysteine UGU , Methionine AUG , Alanine GCU
deduce the sequence of amino acids in the polypeptide chain produced according to the genetic information carried in the DNA segment above.

11 The opposite figure represents part of protein synthesis. Answer:

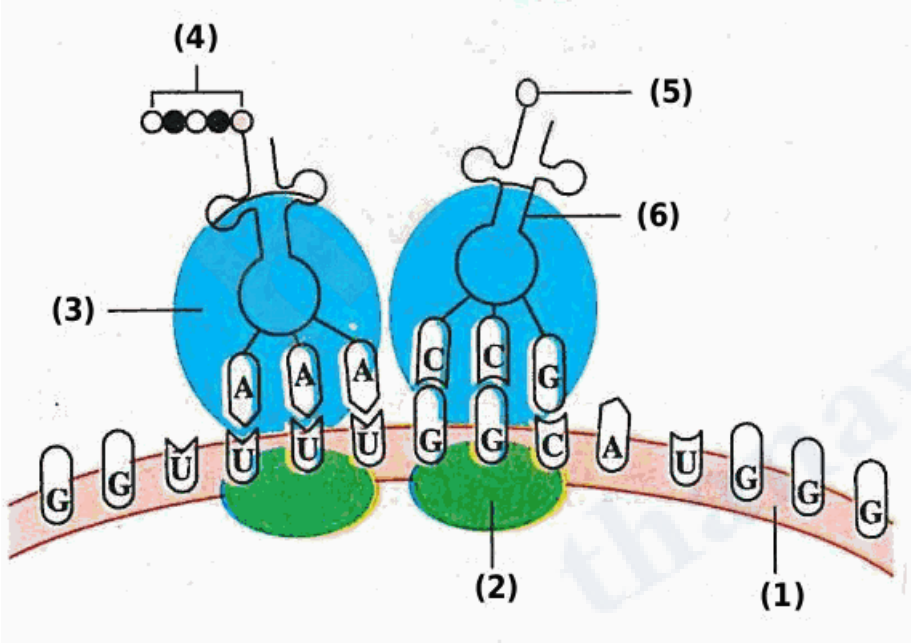
(1) What is the importance of structure (3) in forming the peptide bond?

(2) Where does part (2) bind to part (1) at the start of this process?

(3) What is the role of structure (6) in this process?

(4) What do the numbers (4) and (5) represent?

(5) What is the chemical composition of (2) and (3)? Show where their main components are formed inside the cell.



12 A polypeptide chain is made of 25 amino acids. If three nitrogenous bases in the gene are replaced by the triplet ATC, which is transcribed into a codon in the middle of the mRNA that will be translated into this chain,

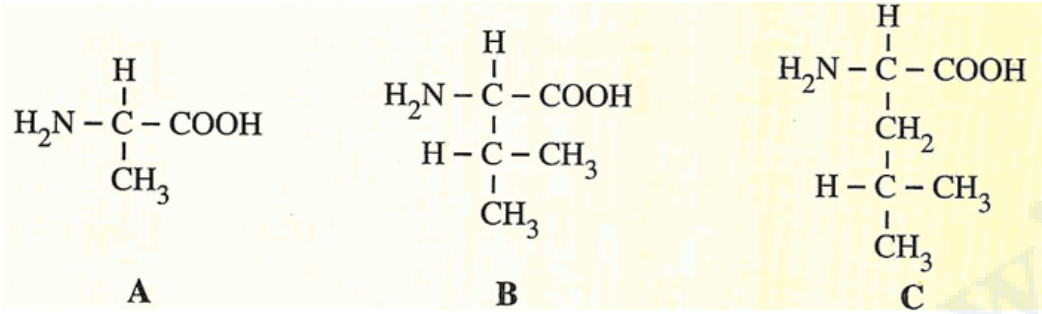
how many amino acids will be in the polypeptide chain? Explain.

Past exam questions — 59 questions

1 Which of the following proteins is part of the structure of scales in reptiles and fish? (2nd session 2021)

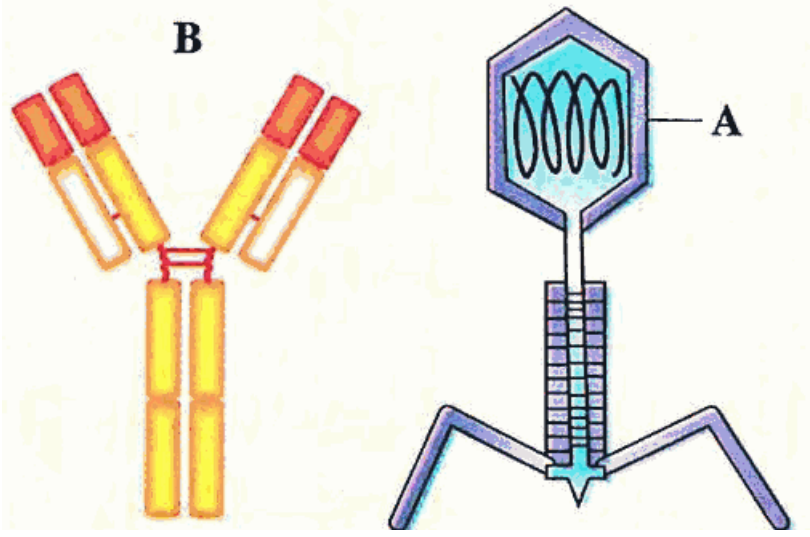
(A) Myosin (B) Actin (C) Keratin (D) Collagen

2 Which of the following describes the three different molecules (A, B, C)? (Sample exam / 1st session 2025)



(A) Protein building units
(B) Structural proteins
(C) Regulatory proteins
(D) Alkyl groups (R)

3 From the two opposite figures, which of the following statements is correct about the proteins labelled with the letters (A) and (B)? (Sample exam 2026)



(A) Both are regulatory proteins that take part in specific reactions
(B) Both are structural proteins that take part in building the organism
(C) Protein (A) is structural and protein (B) is regulatory
(D) Protein (A) is regulatory and protein (B) is structural

4 Which of the following is correct about the antibody in humans? (Sample exam 2026)

(A) It belongs to the non-histone proteins

(B) It is always made of two types of peptide chains

(C) It is part of the structure of specific cell structures

(D) Its genes are found in B cells only

---

5 What distinguishes the hormone insulin from histones? (Sample exam 2026)

(A) It is produced by the transcription and translation of mRNA

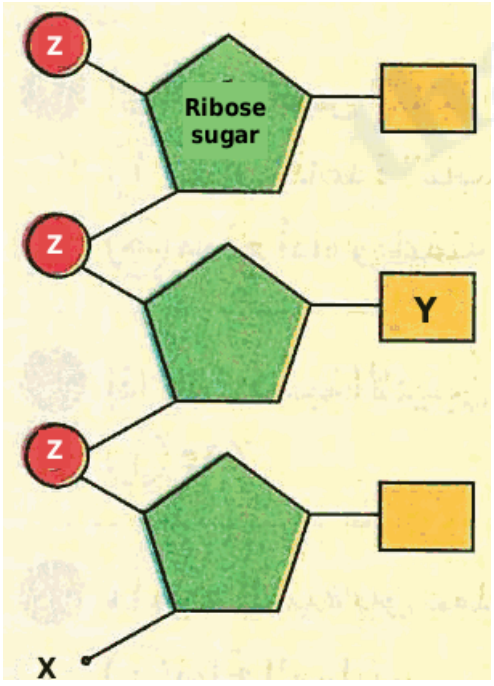
(B) It regulates the internal state of the body

(C) It contains peptide bonds

(D) It supports and protects cells

---

6 Study the opposite figure, which shows a strand of a nucleic acid, then identify what the two symbols (X) and (Y) refer to, respectively. (Trial exam / June 2021)



(A) Phosphate group / Guanine

(B) Hydroxyl group / Thymine

(C) Phosphate group / Uracil

(D) Hydroxyl group / Cytosine

---

7 What processes must take place in the cell to complete the building of the two ribosomal subunits? (Trial exam / June 2021)

(A) Transcription of mRNA in the nucleus and its translation in the cytoplasm into 70 types of polypeptide

(B) Transcription of rRNA in the nucleolus and its combining with 70 types of polypeptide in the cytoplasm

(C) Transcription of rRNA in the nucleolus and translation of mRNA in the cytoplasm into 70 types of polypeptide

(D) Transcription of rRNA in the nucleus and its combining with 70 types of polypeptide in the cytoplasm

---

8 What is the sequence of nucleotides in the gene needed to transcribe the last nine nucleotides of a tRNA molecule? (1st session 2022)

(A) TACGATTTC (B) CCATACGAT (C) TACGATCCA (D) GATCTTGGT

---

9 Translation in prokaryotic cells may take place during transcription. What can be concluded about prokaryotes during translation? (1st session 2022)

(A) The two DNA strands are paired in all regions

(B) The two DNA strands are separated in some regions

(C) The DNA is wound around histone proteins

(D) The DNA is attached to structural non-histone proteins

---

10 What is the similarity between tRNA and DNA in prokaryotes? (1st session 2022)

(A) Adenine binding with thymine

(B) Parts of the molecule fold to form loops

(C) Having 3′ and 5′ ends

(D) Guanine binding with cytosine

---

11 What distinguishes mRNA from tRNA and rRNA? (2nd session 2022)

(A) It contains ribose sugar

(B) It is transcribed from DNA by RNA polymerase

(C) It can be translated

(D) It is transcribed from one of the DNA strands

12 Which of the following cells cannot produce proteins? (Trial exam 2023)

(A) Red blood cells (B) Nerve cells (C) White blood cells (D) Mast cells

13 Which of the following properties distinguishes rRNA from both tRNA and mRNA in eukaryotes? (Trial exam 2023)

(A) The absence of the base thymine
(B) Having many copies of its genes
(C) The place where it does its function
(D) Its building units

14 If the percentage of adenine in an rRNA molecule is 15%, what is the percentage of pyrimidines in this molecule? (1st session 2023, Sample exam 2025)

(A) 15%
(B) 35%
(C) 50%
(D) It must be tested chemically

15 What is the similarity between transcription and translation in prokaryotic cells? (1st session 2023)

(A) The products of the two processes
(B) The building units used in each of them
(C) The place where each of the two processes takes place
(D) The type of enzymes used in each of them

16 Which type / types of RNA molecules are chemically stable even though they are single-stranded? (2nd session 2023)

(A) mRNA only (B) tRNA only (C) tRNA , rRNA (D) mRNA , tRNA

17 A fault in one of the rRNA genes in a cell resulted in forming 3 types of rRNA instead of 4. What is the result of this? (2nd session 2023)

(A) Protein translation stops in this cell
(B) Only 69 types of the polypeptides needed to build ribosomes are formed
(C) The two ribosomal subunits are formed correctly
(D) mRNA does not carry the code for building 70 types of polypeptide to the cytoplasm

18 Which of the following genes is common to all eukaryotes? (2nd session 2023)

(A) mRNA genes only
(B) tRNA genes only
(C) mRNA genes , tRNA genes
(D) tRNA genes , rRNA genes

19 Where is rRNA built in a plant cell? (1st session 2024)

(A) Nucleolus (B) Nucleus (C) Cytoplasm (D) Ribosomes

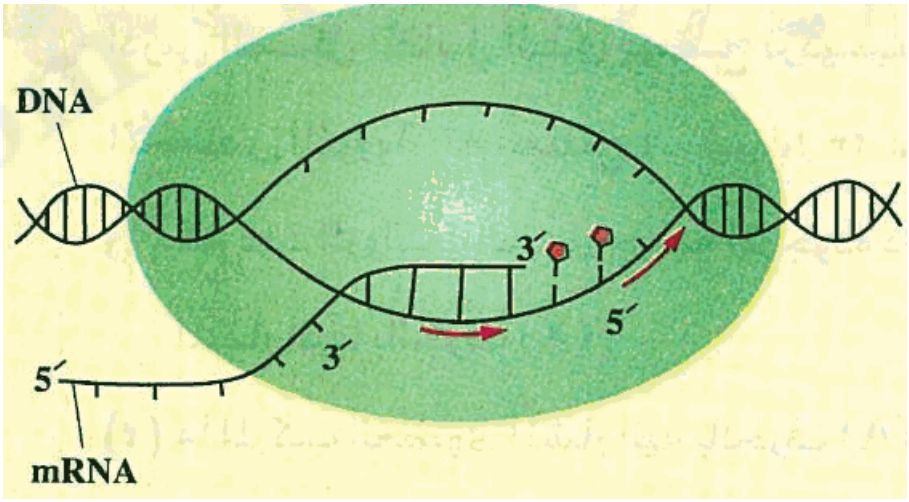
20 What distinguishes the (3′) end of messenger RNA? (2nd session 2024)

(A) It contains three stop codons
(B) The ribosome binds to it at the start of translation
(C) It has a higher percentage of adenine bases
(D) It is transcribed first by RNA polymerase

21 Which of the following describes the promoter sequence? (2nd session 2024)

(A) It is transcribed into a complementary sequence of nucleotides on the mRNA strand
(B) A sequence of nucleotides that does not carry a code
(C) A sequence at which the replication of the DNA strand starts
(D) There is more than one copy of it for each gene

22 Study the opposite figure, then deduce how many enzymes take part in the process shown in the figure. (2nd session 2024)



(A) Three
(B) Two
(C) One
(D) It cannot be determined from the figure

---

23 Rifampicin is an antibiotic used to treat tuberculosis. It works by inhibiting the ribosomal RNA polymerase enzyme in bacteria. Which of the following processes is directly inhibited by this antibiotic? (Sample exam 2025)

(1) DNA replication , (2) transcription , (3) ATP synthesis

(A) (1), (2) and (3) (B) (1) and (2) only (C) (1) and (3) only (D) (2) only

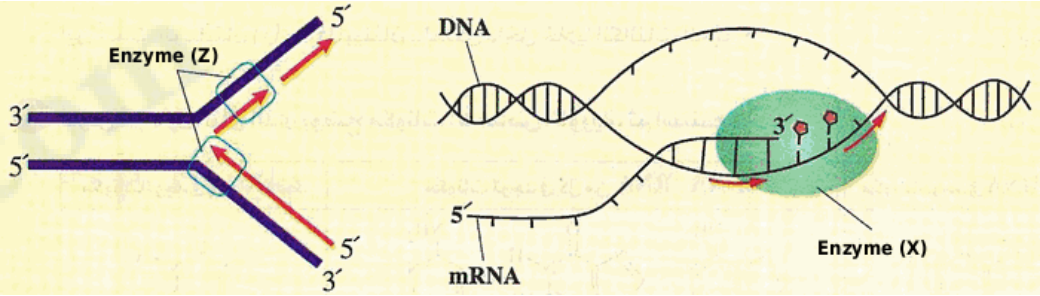
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24 Human chromosome number (1) probably contains 2000 genes that provide the instructions needed to build a number of proteins. How many promoters are on this chromosome? (Sample exam 2025)

(A) One (B) 1000 (C) 2000 (D) 4000

---

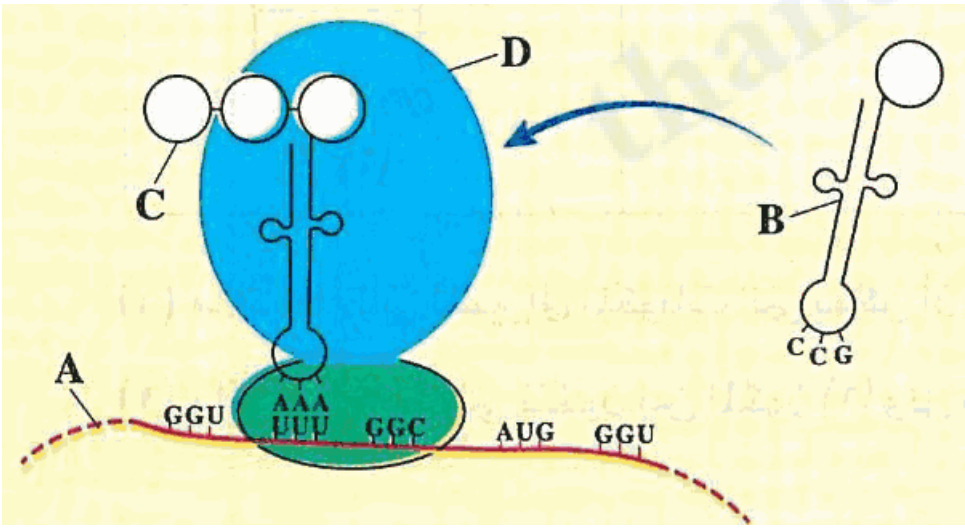
25 From studying the figures shown:
deduce what can distinguish enzyme (X) from enzyme (Z). (Sample exam 2025)



(A) The building units used to build the growing strand
(B) The type of single-ring bases in the nucleotides added to the new strand
(C) The type of double-ring bases in the nucleotides added to the new strand
(D) The direction in which nucleotides are added to the new growing strand

---

26 Where is each of the two structures labelled with the letters (A) and (D) built, respectively? (Sample exam 2025)



(A) Nucleus / Nucleolus
(B) Nucleus / Cytoplasm
(C) Cytoplasm / Nucleolus
(D) Nucleolus / Nucleus

---

27 How many nitrogenous bases distinguish tRNA molecules from each other in structure? (1st session 2025)

(A) Zero
(B) 3
(C) 6
(D) An undetermined number

---

28 Which of the following enzymes separates the two strands of the DNA molecule during the transcription of a tRNA molecule in eukaryotes? (1st session 2025)

(A) Helicase enzymes
(B) DNA polymerase
(C) tRNA polymerase
(D) mRNA polymerase

29 What is the main role of ribosomal RNA (rRNA)? (2nd session 2025)

(A) It carries genetic information from the nucleus to the cytoplasm
(B) It builds the polypeptide chains that make up proteins
(C) It binds to the codons of amino acids
(D) It modifies the structure of other ribonucleic acids

30 Which of the following is a similarity between DNA replication and RNA transcription? (2nd session 2025)

(A) The type of enzymes used in the two processes
(B) The number of enzymes used in the two processes
(C) The end at which nucleotides are added to the new strand
(D) The types of building units used in the two processes

31 If we assume that a cell has lost the ability to produce uracil but can produce thymine normally, which of the following vital processes will be directly affected? (Sample exam 2026)

(A) DNA replication
(B) Transcription
(C) Translation
(D) Repair of gene mutations

32 How does rRNA differ from the other types of RNA? (Sample exam 2026)

(A) Some of its parts can bind to each other by hydrogen bonds
(B) It carries the code for building polypeptide chains
(C) It does not bind to the other types of RNA by hydrogen bonds
(D) It binds to the amino acid during translation

33 Which of the following is a reason for having more than one type of RNA inside the cell? (Sample exam 2026)

(A) They are transcribed from different genes on DNA

(B) The order of the nitrogenous bases differs in each of them

(C) One of them carries the genetic code permanently

(D) Each of them has a different role in building protein

---

34 After looking at the opposite codon table, if the anticodon of an amino acid is (GCA), identify the name of the amino acid carried ..... (1st session 2021)

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		STOP	STOP	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asp	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

(A) Arginine (B) Alanine (C) Valine (D) Proline

---

35 What is the similarity between the codons (AUG) and (UAA) on an mRNA strand? (2nd session 2021)

(A) They have anticodons

(B) They are translated into amino acids

(C) They have a role in any translation process

(D) They are repeated in the same mRNA molecule to be translated

---

36 What is the result of having more than one codon for most amino acids in the genetic code? (1st session 2023, Sample exam 2025)

(A) Reducing the negative effects of gene mutations

(B) Increasing the variety of proteins

(C) Reducing the negative effects of chromosomal mutations

(D) Translating the same codon into more than one amino acid

---

37 Each amino acid in the protein is determined by ..... (Sample exam 2025)

(A) many genes

(B) the nucleotide

(C) the mRNA molecule

(D) the codon

---

38 The opposite sequence shows the order of the amino acids in part of a polypeptide from left to right. Which of the following DNA segments represents the gene that forms the sequence of amino acids shown in the table? (Trial exam / June 2021)

First	Second	Third	Fourth	Fifth
Tryptophan	Arginine	Serine	Valine	Lysine
UGG	CGG	AGU	GUU	AAA

(A) 5′...ACCGCCTCACAATTTATT...3′ / 3′...TGGCGGAGTGTTAAATAA...5′

(B) 3′...ACCGCCTCACAATTTATT...5′ / 5′...TGGCGGAGTGTTAAATAA...3′

(C) 3′...ACTACCGCCTCACAATTT...5′ / 5′...TGATGGCGGAGTGTTAAA...3′

(D) 5′...TTTCAATCAGCCACCACT...3′ / 3′...AAAGTTAGTCGGTGGTGA...5′

---

39 In one of the cells of an organism, a change happened in the DNA. After mRNA was transcribed from one of the two strands, translation started and then stopped in the middle of the mRNA molecule. How do you explain this? (Trial exam / June 2021)

(A) Different bases were lost at different times from the DNA

(B) A purine base was lost from one of the two DNA strands

(C) Two opposite bases were lost at the same time in the two DNA strands

(D) Two opposite bases were lost at different times in the two DNA strands

---

40 The opposite table shows the genetic code of some different amino acids. If the sequence of nucleotides on one of the DNA strands is:

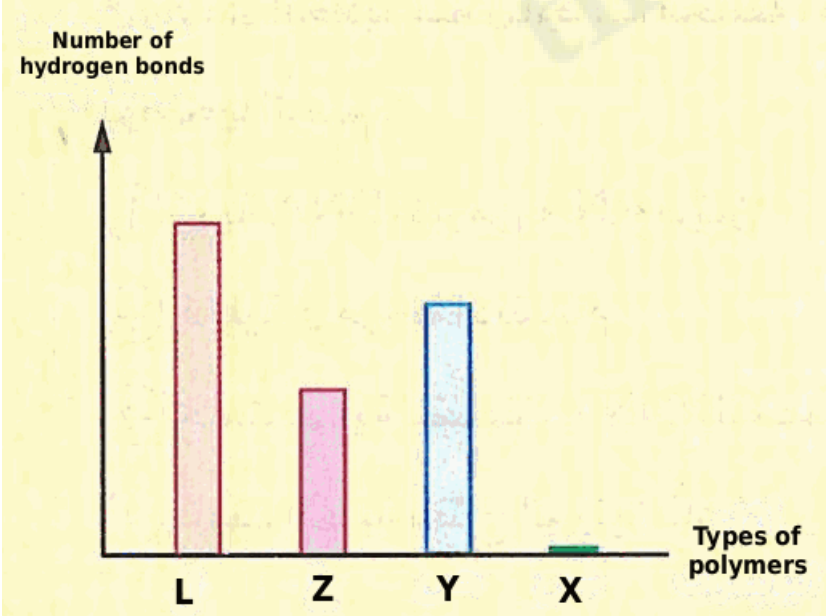
3′...TACTCTGTTAGAATC...5′

and during the transcription of mRNA the base (T) (shown by the arrow) was replaced by the base (C), what is the result of this? (Trial exam / June 2021)

Genetic code			Amino acid name
UCC	AGU	UCU	Serine
AGG	CGC	AGA	Arginine
CCA	CCC	CCU	Proline

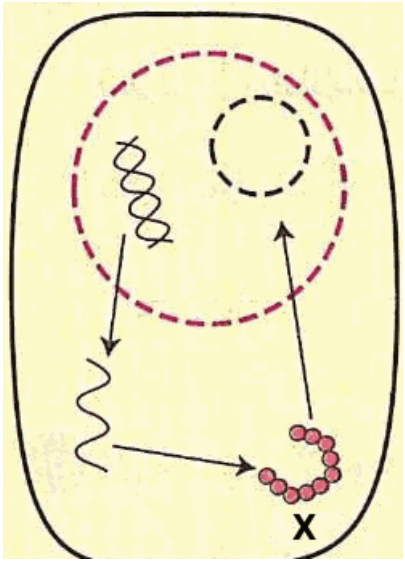
(A) The type of protein changes
(B) The same protein is formed
(C) Translation stops
(D) Transcription of mRNA stops

41 Study the opposite graph, then identify which symbol refers to the mRNA polymer during translation. (Trial exam / June 2021)



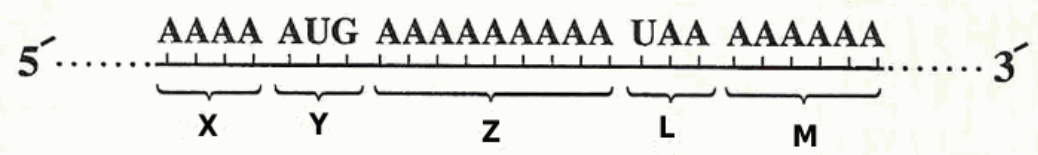
(A) X
(B) Y
(C) Z
(D) L

42 The drawing in front of you shows a group of vital processes that take place inside a cell. For the nucleic acid to produce structure (X), it needs to carry out two successive processes. Deduce the two processes, in order ..... (1st session 2021)



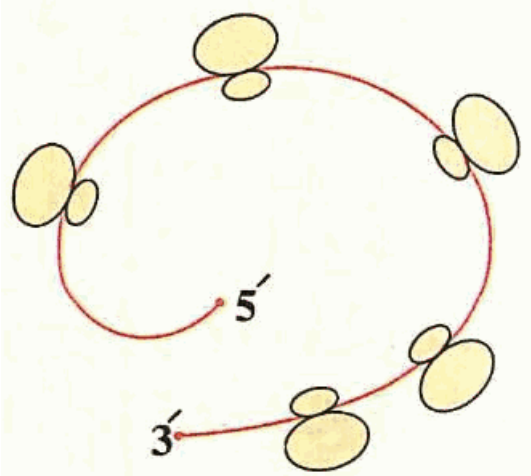
(A) Replication / Transcription
(B) Replication / Translation
(C) Transcription / Translation
(D) Transcription / Replication

43 Study the mRNA strand in front of you, then identify:
Which of the following parts bind to the anticodon of tRNA during translation? (2nd session 2021)



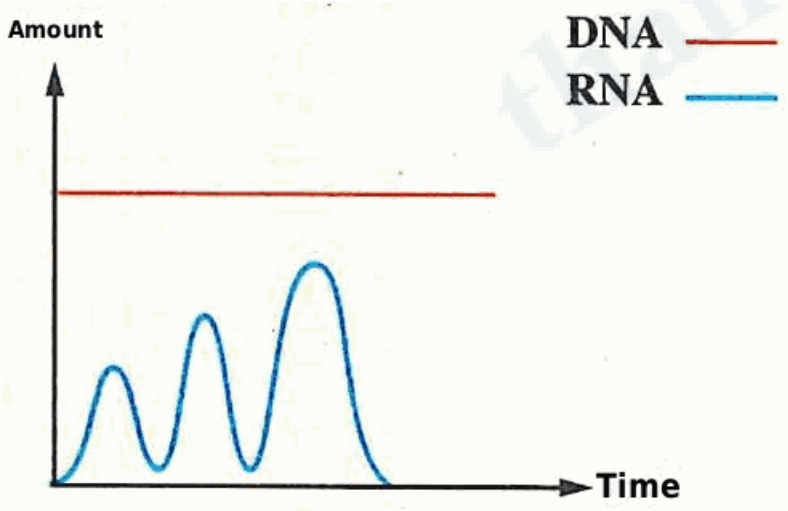
(A) Y , Z
(B) Z , L
(C) L , M
(D) X , Y

44 Study the opposite figure, then identify what the figure represents. (2nd session 2022)



(A) Polyribosome mRNA (polysome)
(B) End of translation
(C) Poly-A tail
(D) Start of translation

45 The opposite graph shows the amounts of DNA and RNA in a cell at different times. What fact does the graph show? (2nd session 2022)



(A) The amount of DNA is twice that of RNA
(B) The cell is in the division stage
(C) DNA replication takes place during transcription
(D) The cell produced protein three times

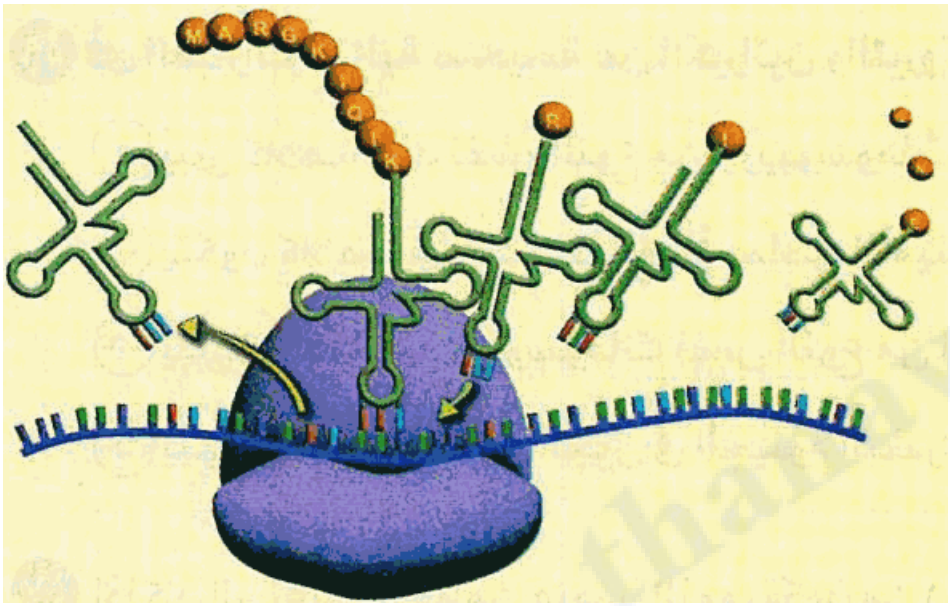
46 If the haemoglobin molecule is made of 4 polypeptide chains, two known as alpha chains and two known as beta chains, how many types of ribosomes and how many types of genes are needed to build the haemoglobin molecule, respectively? (2nd session 2023)

(A) 1 / 2
(B) 1 / 4
(C) 4 / 1
(D) 4 / 4

47 Which of the following is NOT found at the (5′) end of the structure of an mRNA molecule? (1st session 2024)

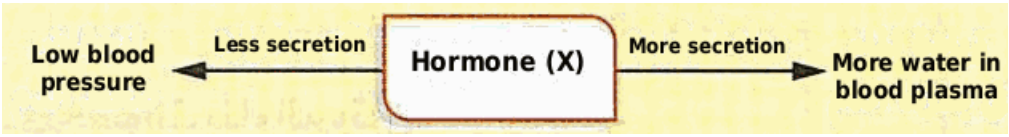
(A) The ribosome binding site
(B) A small ribosomal subunit
(C) The start codon
(D) A free phosphate group

48 The opposite figure represents one of the steps of protein synthesis. Study it, then deduce where the tRNA molecule carrying the polypeptide chain is in the figure. (1st session 2024)



(A) Opposite the start codon
(B) Opposite the codon that follows the start codon
(C) At site (A) of the large ribosomal subunit
(D) At site (P) of the large ribosomal subunit

49 Study the following diagram, then deduce:
Where is the hormone labelled (X) synthesized in the human body? (1st session 2024)



(A) On the ribosomes of hypothalamus cells
(B) On the ribosomes of the cells of the posterior lobe of the pituitary gland
(C) Inside the nuclei of the cells of the posterior lobe of the pituitary gland
(D) Inside the nuclei of hypothalamus cells

50 Where does the amino acid bind to the tRNA molecule? (2nd session 2024)

(A) In the nucleus
(B) In the cytoplasm
(C) At the aminoacyl site
(D) At the peptidyl site

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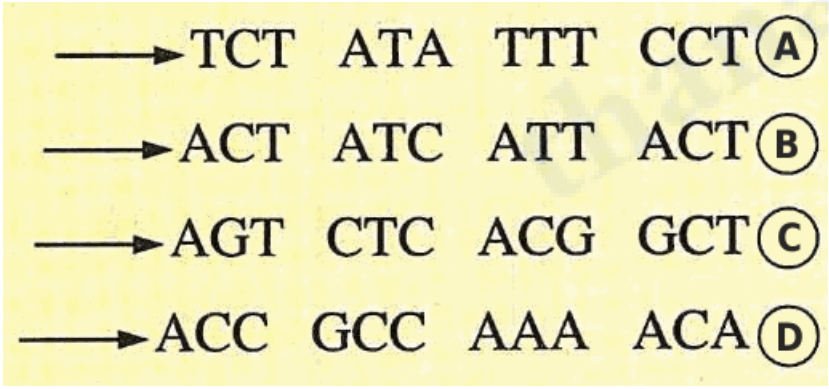
51 The protein haemoglobin is produced by immature red blood cells, but the liver cells of the same organism do not produce haemoglobin. Why? (Sample exam 2025)

(A) The gene responsible for haemoglobin is missing in liver cells
(B) The haemoglobin gene is switched off in liver cells
(C) A mutation happened in the haemoglobin gene in liver cells
(D) The haemoglobin gene is activated in liver cells

---

52 What is the sequence on DNA from which mRNA is transcribed but which is not translated into amino acids? (Sample exam 2025)

(Note that the arrow shows the direction of translation.)



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53 Which of the following statements is correct about keratin and thyroxine? (1st session 2025)

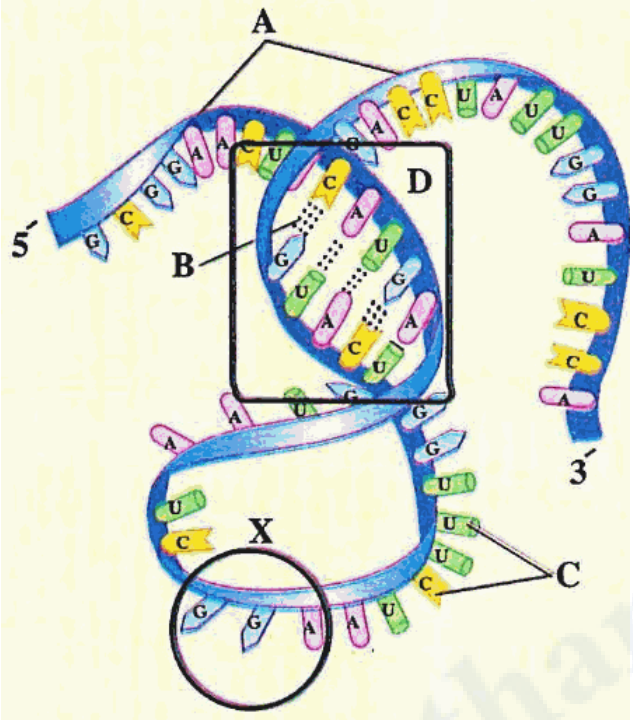
(A) Both are built on the same type of ribosomes
(B) Both are made of the same sequence of amino acids
(C) Both are built on the ribosomes of the same type of cells
(D) Both are built from the same gene in the human genome

---

54 Study the opposite figure, which shows the structure of one type of nucleic acid, then deduce: (1st session 2023, Sample exam 2025)

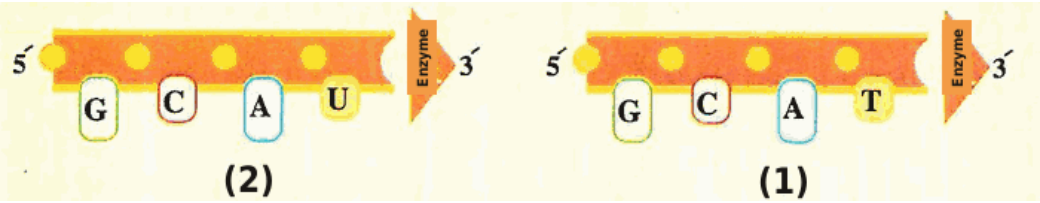
(1) How many hydrogen bonds are there inside the circle labelled (X)?

(2) What is the organic compound labelled (A)?



55 Study the following figure, which shows two processes that take place inside the cells of living organisms, then deduce: (Trial exam 2023)

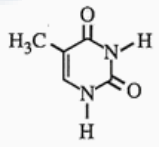
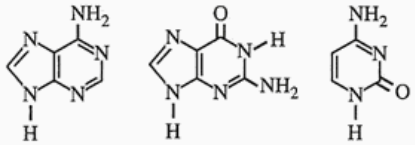
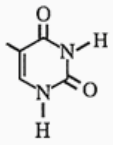
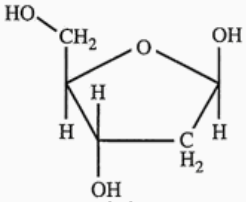
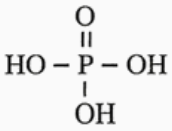
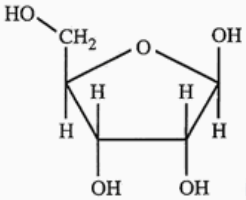
Where do processes (1) and (2) shown in the figure take place inside the cells of living organisms?



56 Study the following table, which shows the components of nucleic acids, then deduce: (2nd session 2023)

(1) Which numbers refer to the components that can be joined by double hydrogen bonds?

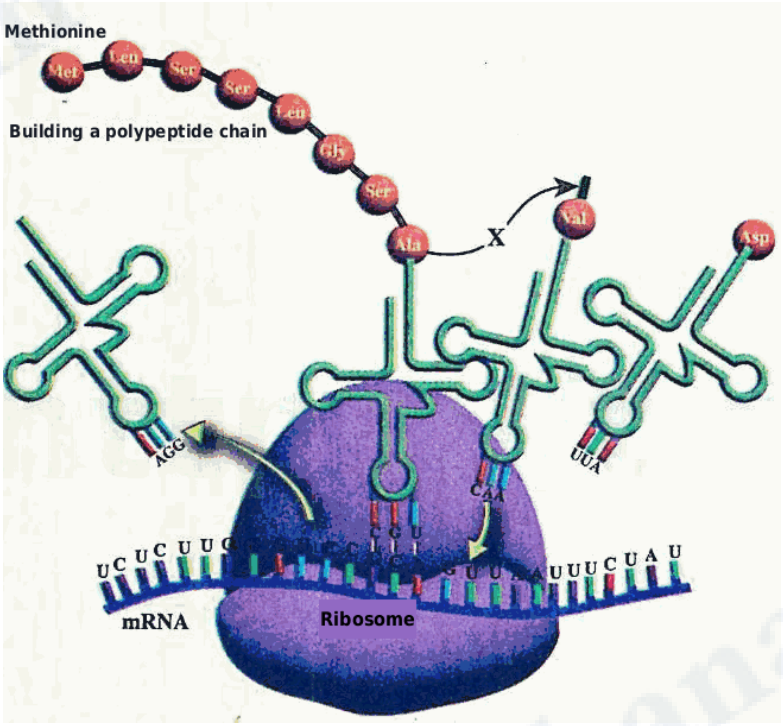
(2) What type of bonds form between component (6) and each of components (2) and (7)?

Components in DNA only	Components in both DNA and RNA	Components in RNA only
 (1)	 (2) Guanine (3)	 (4)
 (5)	 (7)	 (6)

57 If one molecule of growth hormone is made of 191 amino acids, what is the maximum number of ribosomes and of tRNA molecules, and the minimum number of mRNA molecules, needed to build 10 molecules of growth hormone? (1st session 2025)

Explain your answer regarding the number of ribosomes.

58 The opposite figure shows one of the steps of building protein. What is the name and type of the reaction shown by the arrow labelled (X)? And what is the result of this reaction? (2nd session 2025)



59 Which is more dangerous to the life of the organism: (Sample exam 2026)
an error during DNA replication or an error during translation? Explain your answer.

Answer key and solutions

Multiple choice questions

1 A	2 D	3 A	4 D	5 A	6 C	7 C	8 D	9 C	10 C
11 D	12 C	13 C	14 A	15 D	16 B	17 C	18 D	19 B	20 A
21 A	22 B	23 D	24 C	25 C	26 D	27 B	28 D	29 C	30 B
31 A	32 C	33 B	34 D	35 A	36 A	37 A	38 B	39 B	40 D
41 B	42 B	43 D	44 D	45 A	46 C	47 A	48 B	49 C	50 A
51 B	52 D	53 A	54 D	55 B	56 C	57 D	58 A	59 B	60 A
61 C	62 B	63 D	64 B	65 C	66 B	67 C	68 C	69 B	70 C
71 D	72 D	73 B	74 A	75 B	76 B	77 B	78 A	79 B	80 C
81 D	82 A	83 C	84 B	85 B	86 A	87 C	88 C	89 A	90 B
91 B	92 A	93 D	94 B	95 C	96 D	97 C	98 B	99 C	100 D
101 C	102 D	103 B	104 B	105 A	106 D	107 C	108 D	109 C	110 D
111 C	112 B	113 D	114 D	115 D	116 D	117 B	118 C	119 B	120 D
121 C	122 A	123 C	124 D	125 D	126 D	127 A	128 C	129 A	130 C
131 A	132 A	133 C	134 D	135 B	136 C	137 D	138 A	139 B	140 A

1 **Answer (A)**

The enzyme that dissolves the egg envelope is a regulatory protein; the other choices are structural or contractile proteins.

2 **Answer (D)**

The enzyme cholinesterase breaks down acetylcholine, so the sarcomere returns to its length.

3 **Answer (A)**

Hydrogen bonds affect the shape of the protein, and the shape determines its function.

4 **Answer (D)**

DNA has covalent and hydrogen bonds, and protein has peptide (covalent) and hydrogen bonds.

5 **Answer (A)**

(X) is a polypeptide whose amino acids are joined by peptide bonds.

(Y) is a protein folded by hydrogen bonds in addition to the peptide bonds.

6 **Answer (C)**

The plasma membrane contains hormone receptors, which are proteins.

7 **Answer (C)**

The (3) end of tRNA is the amino acid binding site.

8 **Answer (D)**

The nucleus contains DNA, mRNA is transcribed from it, and it also contains proteins such as histones.

9 **Answer (C)**

Ribosomes build proteins, including enzymes.

10 **Answer (C)**

4 in DNA and 4 in RNA, so the total is 8.

11 **Answer (D)**

DNA is wound around histones, so it is packed inside the nucleus.

12 **Answer (C)**

A ribosome is made of rRNA and proteins.

13 **Answer (C)**

(1) has a deoxyribose sugar (H instead of OH), so it is in DNA, and (2) has a ribose sugar, so it is in RNA.

14 **Answer (A)**

(1) is a single-ring pyrimidine base (cytosine) in DNA, and (2) is a double-ring purine base (adenine) in RNA.

15 **Answer (D)**

All body cells have the same genes and the same number of chromosomes, but the genes from which mRNA is transcribed differ.

16 **Answer (B)**

The sugar is ribose, so the molecule is RNA and does not contain thymine.

17 **Answer (C)**

18 **Answer (D)**

The first triplet after the promoter on the template is TAC, from which the start codon AUG is transcribed.

19 **Answer (B)**

20 **Answer (A)**

In eukaryotes, translation starts in the cytoplasm after transcription is complete and mRNA has left the nucleus.

21 **Answer (A)**

22 **Answer (B)**

Transcription needs DNA to be uncoiled, not coiled around protein.

23 **Answer (D)**

Strand (X) is the template, so the mRNA is complementary to it: C-U-A-G-G-A-A-C-U.

24 **Answer (C)**

(X) is a nitrogenous base in the codon; it binds to its complementary base in the anticodon on tRNA.

25 **Answer (C)**

mRNA is transcribed from one strand (45 nucleotides), and the DNA segment is double-stranded, so it has 90 nucleotides.

26 **Answer (D)**

The stop codons are UAA, UAG and UGA, so the matching template triplets are ATT, ATC and ACT.

27 **Answer (B)**

28 **Answer (D)**

RNA polymerase adds nucleotides to the $(3')$ end, so it is built in the direction $5' \rightarrow 3'$.

29 **Answer (C)**

A root cell does not contain chloroplasts, so transcription takes place in the nucleus and the mitochondria.

30 **Answer (B)**

The enzyme that builds mRNA is RNA polymerase.

31 **Answer (A)**

32 **Answer (C)**

The poly-A tail protects mRNA from digestive enzymes in the cytoplasm, so without it, it is digested after leaving the nucleus.

33 **Answer (B)**

(1) A single strand with no paired bases that differs from gene to gene is mRNA.
(2) A closed double helix that differs from organism to organism is the plasmid.
(3) A single strand with some paired bases is tRNA.

34 **Answer (D)**

Adenine is part of DNA, RNA and ATP, and is not found in protein.

35 **Answer (A)**

The methionine codon is AUG and its template is TAC, so the non-template strand is ATG.

36 **Answer (A)**

Compound (X) is an RNA strand formed from a DNA template; this is transcription.

37 **Answer (A)**

Parts (Y) and (Z) are two opposite bases joined by hydrogen bonds.

38 **Answer (B)**

39 **Answer (B)**

tRNA folds on itself and some of its bases pair by hydrogen bonds, while mRNA is a single strand.

40 **Answer (D)**

mRNA is transcribed by the enzyme RNA polymerase, which is a regulatory protein.

41 **Answer (B)**

RNA contains hydrogen bonds between paired bases, as in tRNA.

42 **Answer (B)**

Transcription needs DNA as a template, ribonucleotides, RNA polymerase and energy from ATP.

43 **Answer (D)**

The shape of tRNA is kept by hydrogen bonds between some of its paired bases.

44 **Answer (D)**

Cork cells are dead, so translation does not take place in them.

45 **Answer (A)**

The sequence of mRNA bases determines the order of amino acids in the protein.

46 **Answer (C)**

Histones are structural proteins formed in the cytoplasm; they carry a positive charge and fold DNA, but they are not part of ribosomes.

47 **Answer (A)**

A DNA nucleotide has deoxyribose sugar and an RNA nucleotide has ribose sugar, so no nucleotide is the same.

48 **Answer (B)**

RNA polymerase binds to the promoter to start transcription, so preventing its binding prevents the gene from being transcribed.

49 **Answer (C)**

tRNA carries the amino acid and recognizes mRNA by its anticodon, so it reads both languages.

50 **Answer (A)**

Each type of amino acid has its own type of tRNA, so 15 types are needed.

51 **Answer (B)**

There are 20 types of amino acids, so the smallest number is 20 codes.

52 **Answer (D)**

The gene is transcribed into mRNA, then translated into a protein through which the trait appears.

53 **Answer (A)**

mRNA carries the code from the nucleus to the cytoplasm.

54 **Answer (D)**

The chromosome contains DNA, DNA contains genes, and the gene is made of nucleotides.

55 **Answer (B)**

The genetic code is three nucleotides.

56 **Answer (C)**

(299 + 1 stop codon) × 3 = 900 nucleotides on the strand; a turn is 10 pairs, so the number of turns is 90.

57 **Answer (D)**

Glu: GAA or GAG, His: CAU or CAC, Pro: CCU, CCC, CCA or CCG; this applies to choice (D).

58 **Answer (A)**

The template strand is TAC, so the codon is AUG and the anticodon is UAC.

59 **Answer (B)**

3X use up to 3 different codons, 3Y up to 2, 3Z one codon and 3L up to 2: the total is 8.

60 **Answer (A)**

270 ÷ 2 = 135 pairs, and 135 ÷ 3 = 45 codons, one of which is a stop codon, so 44 amino acids remain.

61 **Answer (C)**

(90 amino acids + a stop codon) × 3 = 273 nucleotides.

62 **Answer (B)**

Protein is made of only 20 types of amino acids.

63 **Answer (D)**

(12 + a stop codon) × 3 = 39.

64 **Answer (B)**

65 **Answer (C)**

The template CGA TGC GAC ATT is transcribed into GCU ACG CUG UAA.
When TGC (the threonine codon ACG) is lost, the sequence becomes GCU CUG UAA.

66 **Answer (B)**

ATA is transcribed into UAU and ATG into UAC, and both code for tyrosine.

67 **Answer (C)**

250 codons for amino acids + a stop codon = 251.

68 **Answer (C)**

The codon (code) is three nucleotides on mRNA, and the part of DNA that represents a gene strand is the gene.

69 **Answer (B)**

The template strand has 1500 nucleotides: A = 1500 − (500 + 350 + 250) = 400.
Each A in the template is matched by U in the mRNA, so the number of U = 400.

70 **Answer (C)**

The anticodon is complementary to the codon: GUC is matched by CAG.

71 **Answer (D)**

The number of codons = X ÷ 3, one of which is a stop codon, so the number of amino acids is (X − 3) ÷ 3.

72 **Answer (D)**

RNA is transcribed from one of the two DNA strands (the template strand).

73 **Answer (B)**

4 bases in pairs = 16 possibilities, which is enough for 12 amino acids, so two nucleotides are enough.

74 **Answer (A)**

AUG = Met, UAC = Tyr, AAG = Lys, GUC = Val, GGA = Gly, then UGA is a stop codon.

75 **Answer (B)**

There are stop codons that do not code for any amino acid.

76 **Answer (B)**

AUG, AGU, GUA and GAU code for amino acids, while UAG and UGA are stop codons, so the number is 4.

77 **Answer (B)**

ATG on the non-template strand is complementary to TAC on the template strand, from which the start codon AUG is transcribed.

78 **Answer (A)**

The anticodon on tRNA contains uracil instead of the thymine found in DNA, so the difference is in the thymine base.

79 **Answer (B)**

The chain has 15 amino acids, so the number of mRNA nucleotides = $(15 + \text{a stop codon}) \times 3 = 48$.

80 **Answer (C)**

The different letters are A, B, C, D, E, F, G, H, K, L, M, which is 11 types.

81 **Answer (D)**

The gene carries the code for building protein, and enzymes are proteins.

82 **Answer (A)**

Insulin is a protein that needs ribosomes to be built, while the other hormones are steroids.

83 **Answer (C)**

Each amino acid is matched by a codon of three nucleotides, so the ribosome moves 3 nucleotides.

84 **Answer (B)**

Each pyrimidine base forms two bonds (U with A) or three (C with G), so a total of 7 bonds means: one C and two U.

So the codon includes one guanine base and two adenine bases.

85 **Answer (B)**

(X) is the transcription of mRNA, which takes place in the nucleus, and (Y) is the translation of protein, which takes place in the cytoplasm.

86 **Answer (A)**

One ribosome is enough to build the polypeptide chain.

87 **Answer (C)**

360 ÷ 3 = 120 codons, one of which is a stop codon, so there are 119 amino acids and 118 peptide bonds.

88 **Answer (C)**

All body cells have the same genes; the difference is in the genes that are expressed.

89 **Answer (A)**

Ribosomes are similar and build different proteins according to the mRNA they read.

90 **Answer (B)**

Replacing C with U in the fourth codon CAA turns it into UAA, a stop codon, so the chain stops after 3 amino acids.

91 **Answer (B)**

Translation needs mRNA, tRNA and amino acids, while DNA is used in transcription.

92 **Answer (A)**

(1) The mitochondrial DNA is transcribed into (2) mRNA, which is translated into (3) the respiratory enzyme.

93 **Answer (D)**

The length of the chain is determined by the number of mRNA codons, that is, by the number of its nucleotides.

94 **Answer (B)**

95 **Answer (C)**

The stop codon UAG has no tRNA, so there is no anticodon AUC.

96 **Answer (D)**

The template CAC is transcribed into the codon GUG (valine), so the anticodon is CAC.

97 **Answer (C)**

(1) Making copies of the genetic material of the virus = replication.

(2) Building the coat proteins = translation.

98 **Answer (B)**

The codons of the sequence Serine → Lysine → Tyrosine → Asparagine are UCA AAA UAU AAC, which is mRNA (3).

The template on DNA is (1), and the anticodons on tRNA are (2).

99 **Answer (C)**

6 codons are translated (up to the stop codon UAA), so there are 6 amino acids and 5 peptide bonds.

100 **Answer (D)**

101 **Answer (C)**

Chain (Z) has 4 amino acids, so there are 3 peptide bonds and 3 water molecules are released.

102 **Answer (D)**

Translation starts when the complex is complete: large subunit + small subunit + mRNA + methionine tRNA.

103 **Answer (B)**

51 ÷ 3 = 17 codons, one of which is a stop codon, so there are 16 amino acids and 15 peptide bonds.

The peptide bond is between the C of the carboxyl group and N, which is type (2).

104 **Answer (B)**

The type of protein is determined by the mRNA, which was taken from the frog.

105 **Answer (A)**

106 **Answer (D)**

In eukaryotes, DNA is found in the nucleus, the mitochondria and the plastids.

107 **Answer (C)**

More than one code for the same amino acid may mean that a mutation does not change the amino acid, so the same protein is produced.

108 **Answer (D)**

If all bases were paired, the bonds would be: $50 \times (2 + 2 + 3 + 3) = 500$.

The stop codon does not pair with an anticodon, and its bases are 3 types, as in UAG: 2 + 2 + 3 = 7, so 493 remain.

109 **Answer (C)**

Stop codons are not translated into an amino acid.

110 **Answer (D)**

DNA is transcribed (X) into mRNA, rRNA and tRNA, then translation (Y) takes place on the ribosome, producing the polypeptide chain (Z).

111 **Answer (C)**

Parts (Y) are cut out by enzymes after transcription and do not appear in the mature mRNA, so they are transcribed but not translated.

112 **Answer (B)**

The genetic material of the coronavirus is RNA, which is translated directly inside the cell.

113 **Answer (D)**

The codons are: AUG GCA CUA UUC AAC UAA. The anticodon for the codon GCA is CGU, so tRNA (D) is used.

114 **Answer (D)**

The poly-A tail is added after transcription; it is not transcribed from DNA and is not translated.

115 **Answer (D)**

Translation is changing the mRNA codons into a sequence of amino acids.

116 **Answer (D)**

The DNA sequence determines the mRNA sequence, and from it the sequence of amino acids.

117 **Answer (B)**

118 **Answer (C)**

Translation takes place in the cytoplasm and in the mitochondria, which have their own ribosomes.

119 **Answer (B)**

The release factor binds to the stop codons UAA, UAG and UGA, while AUG is the start codon.

120 **Answer (D)**

Prokaryotic cells have no nucleus, so transcription takes place in their cytoplasm.

121 **Answer (C)**

(X) is transcription, which takes place in the nucleus, and (Y) is translation, which takes place in the cytoplasm.

122 **Answer (A)**

(3) is the mRNA produced by transcribing DNA, and it needs RNA polymerase.

123 **Answer (C)**

Damage after transcription is complete does not affect the mRNA that has already formed.

124 **Answer (D)**

The amino acid binds to tRNA at its 3′ end.

125 **Answer (D)**

The poly-A tail protects the mRNA and stays on it; it is not broken down as soon as the chain is produced.

126 **Answer (D)**

127 **Answer (A)**

The codons are: GCU CCA AAA CCA GCU UGA (stop). The different types are GCU, CCA and AAA only, which is 3 types of tRNA.

128 **Answer (C)**

Inserting T at (3) makes the second triplet ACT, which is transcribed into the stop codon UGA, so translation stops.

129 **Answer (A)**

The amino acids are Glu, Thr, Pro and Val, and their anticodons match figures (B), (C) and (D).
In (A), the anticodon UGC matches ACG, which is not one of the codons in the table.

130 **Answer (C)**

mRNA may also be transcribed in the mitochondria and the plastids, not only in the nucleus.

131 **Answer (A)**

Site (A) is empty when the ribosome reaches the stop codon, so the release factor protein binds to it.

132 **Answer (A)**

Without the release factor, the ribosome will not leave the mRNA and its two subunits will not separate, so the chain stays attached to tRNA in site (P).

133 **Answer (C)**

Ribosomes are built in the nucleolus and move to the cytoplasm, while replication enzymes are made in the cytoplasm and move to the nucleus.

134 **Answer (D)**

X = 45 nucleotides, L = 72 $(23 \times 3 + 3)$, Y = 75 and Z = 228 $(75 \times 3 + 3)$.
The ascending order is: X, L, Y, Z.

135 **Answer (B)**

Insulin is formed in the pancreas only, and gene (L) is the one with a large amount of mRNA in the pancreas only.

136 **Answer (C)**

The last codon ATC is transcribed into UAG, which is a stop codon, and changing it to ATT is transcribed into UAA, which is also a stop codon, so the protein does not change.
The other changes produce an early stop codon.

137 **Answer (D)**

All body cells contain all the genes, but the gene works only in the mammary glands.

138 **Answer (A)**

The gene carries the code for proinsulin; then changes after translation give the final insulin and chain (C).

139 **Answer (B)**

The third codon on the template, CAG, matches GUC (valine).

In (B) it changes to TAC, which is AUG (methionine), so the amino acid changes and melanin is not formed.

In the others, the code changes to GUU, GUA or GUG, which are all valine.

140 **Answer (A)**

Damage to two opposite bases at the same time cannot be repaired, so a change happens in the gene that is passed on through the generations.

Essay questions

1 **Model answer**

Ribonucleic acid (RNA) / because its nucleotides contain the nitrogenous base uracil (U).

2 **Model answer**

(1) X: 15%, Y: 5%

(2) Sample (1) is DNA / because thymine is present, and it is a double helix because the percentages of adenine and thymine are equal, and those of guanine and cytosine are equal.

Sample (2) is DNA / because thymine is present, and it is a single strand because the percentages of adenine and thymine are not equal.

Sample (3) is RNA / because uracil is present.

3 **Model answer**

The properties shared by the nucleic acid RNA and the nucleic acid DNA:

The building unit is the nucleotide.

The number of phosphate groups in the structure of the nucleotides.

The purine nitrogenous bases adenine (A) and guanine (G).

The pyrimidine nitrogenous base cytosine (C).

4 **Model answer**

(1) The bacteria / because in bacteria (prokaryotes) translation takes place during the transcription of mRNA, while in amoeba (2) (eukaryotes) translation does not start until the transcription of mRNA is complete, so translation takes longer.

5 **Model answer**

Z / because (Z) represents one of the nitrogenous bases, which determines the type of nucleotide, and nucleotide triplets represent genetic codes.

6 **Model answer**

The statement is correct / because translation takes place on the ribosomes in the cytoplasm (free and attached to the endoplasmic reticulum), and also on the ribosomes inside the mitochondria and the chloroplasts.

7 **Model answer**

The absence of the DNA molecules that carry the genes for forming the enzymes (proteins) needed to carry out photosynthesis.

8 **Model answer**

No, it is not necessary for asparagine to appear in the protein produced / because the sequence AAC may be split between two neighbouring codons, each of which codes for a different amino acid, or it may be part of a DNA segment that does not carry a code.

9 **Model answer**

No / because there is no start codon (AUG).

10 **Model answer**

The sequence of nitrogenous bases in the segment of the mRNA strand transcribed from the DNA segment:

5′ … C-G-A-G-C-U-U-G-U … 3′

So the sequence of amino acids in the polypeptide chain is (arginine - alanine - cysteine).

11 **Model answer**

(1) Structure (3), "the large ribosomal subunit", contains the enzyme that activates the peptidyl transfer reaction, which forms a peptide bond.

(2) Part (2), "the small ribosomal subunit", binds to the ribosome binding site at the start of part (1), "mRNA", in the cytoplasm of the cell.

(3) Structure (6), "tRNA", carries amino acids from the cytoplasm to the ribosomes to build protein.

(4) (4) The polypeptide chain, (5) the amino acid glycine attached to a tRNA molecule.

(5) Each of (2), "the small ribosomal subunit", and (3), "the large ribosomal subunit", is made of: four different types of rRNA, formed inside the nucleolus, and 70 types of polypeptide formed inside the cytoplasm.

12 **Model answer**

12 amino acids / because the triplet (ATC) will be transcribed into a stop codon (UAG) in the middle of the mRNA (codon number 13).

Past exam questions

1 C	2 A	3 C	4 B	5 B	6 D	7 C	8 D	9 B	10 D
11 C	12 A	13 B	14 D	15 C	16 B	17 A	18 D	19 A	20 C
21 B	22 C	23 D	24 C	25 B	26 A	27 B	28 C	29 B	30 C
31 B	32 C	33 D	34 A	35 C	36 A	37 D	38 B	39 C	40 B
41 A	42 C	43 A	44 A	45 D	46 A	47 B	48 D	49 A	50 B
51 B	52 A	53 A	54 —	55 —	56 —	57 —	58 —	59 —	

1 **Answer (C)**

Keratin is a structural protein found in scales, hair and nails.

2 **Answer (A)**

The three molecules are amino acids (an amine group, a carboxyl group and an R group), which are the building units of protein.

3 **Answer (C)**

(A) The protein coat of the virus is a structural protein.

(B) The antibody is a regulatory (defensive) protein.

4 **Answer (B)**

The antibody is made of two heavy chains and two light chains, that is, two types of peptide chains.

5 **Answer (B)**

Insulin is a hormone that regulates the blood sugar level, while histones are structural proteins around which DNA is wound.

6 **Answer (D)**

The sugar is ribose, so the nucleic acid is RNA and does not contain thymine.
(X) is at the end of the chain at carbon atom 3′, so it is a hydroxyl group, and (Y) is a nitrogenous base such as cytosine.

7 **Answer (C)**

The two ribosomal subunits are made of rRNA, which is transcribed in the nucleolus, and 70 types of polypeptide translated from mRNA in the cytoplasm.

8 **Answer (D)**

The 3′ end of a tRNA molecule ends with the sequence CCA,
so the gene from which it is transcribed ends with the complementary sequence GGT, as in (D).

9 **Answer (B)**

Translation takes place during transcription, and transcription needs the two DNA strands to be separated in the region of the gene, so the two strands are separated in some regions.

10 **Answer (D)**

In tRNA some of its bases bind to each other, and guanine binds with cytosine in both cases.
Prokaryotic DNA is circular with no ends, and tRNA does not contain thymine.

11 **Answer (C)**

mRNA is the only type that is translated into protein.

12 **Answer (A)**

Mature red blood cells have no nucleus and no ribosomes, so they do not produce proteins.

13 **Answer (B)**

There are many copies of the rRNA genes in DNA, because the cell needs large numbers of ribosomes.

14 **Answer (D)**

rRNA is a single strand, so the percentages of complementary bases are not equal, and the pyrimidines can only be found by chemical analysis.

15 **Answer (C)**

Prokaryotes have no nucleus, so transcription and translation take place in the cytoplasm.

16 **Answer (B)**

Parts of tRNA fold and their bases bind by hydrogen bonds, so it is stable even though it is single-stranded.

17 **Answer (A)**

The ribosome needs 4 types of rRNA, so ribosomes are not formed and protein translation stops.

18 **Answer (D)**

All eukaryotes need tRNA and rRNA to translate proteins, so their genes are common.
mRNA genes differ according to the proteins each organism produces.

19 **Answer (A)**

rRNA is transcribed inside the nucleolus.

20 **Answer (C)**

A poly-A tail is added to the 3′ end of mRNA, so the percentage of adenine bases in it is higher.

21 **Answer (B)**

The promoter is a sequence to which RNA polymerase binds to start transcription, and it does not carry a code.

22 **Answer (C)**

The figure shows transcription, which is carried out by one enzyme, RNA polymerase, which separates the two strands and builds mRNA.

23 **Answer (D)**

Inhibiting RNA polymerase stops transcription directly.

24 **Answer (C)**

Each gene has one promoter, so the number of promoters = the number of genes = 2000.

25 **Answer (B)**

(X) is RNA polymerase, which adds uracil, and (Z) is DNA polymerase, which adds thymine.
So they differ in the type of single-ring bases added.

26 **Answer (A)**

(A) is mRNA, which is transcribed in the nucleus, and (D) is the large ribosomal subunit, which is built in the nucleolus.

27 **Answer (B)**

tRNA molecules are similar in structure and differ in three bases, which form the anticodon.

28 **Answer (C)**

The RNA polymerase that transcribes tRNA is the one that separates the two DNA strands and builds the molecule.

29 **Answer (B)**

rRNA is part of the structure of ribosomes, which build polypeptide chains.

30 **Answer (C)**

In both replication and transcription, nucleotides are added to the 3′ end of the new strand.

31 **Answer (B)**

Uracil is part of RNA only, so transcription is directly affected.

32 **Answer (C)**

mRNA binds to tRNA by hydrogen bonds between the codon and the anticodon, while rRNA does not bind to the other types by these bonds.

33 **Answer (D)**

There is more than one type of RNA because each has a different role in building protein.

34 **Answer (A)**

The anticodon GCA matches the codon CGU,
and the codon CGU in the table codes for arginine.

35 **Answer (C)**

AUG is the start codon and UAA is a stop codon, and each of them has a role in any translation process.

36 **Answer (A)**

If a base in the codon changes, the new codon may code for the same amino acid, so the negative effects of gene mutations are reduced.

37 **Answer (D)**

Each amino acid is determined by a codon (three bases) on mRNA.

38 **Answer (B)**

The codons UGG CGG AGU GUU AAA are transcribed from the strand
3′...ACCGCCTCACAATTT...5′
followed by a stop codon, so the correct segment is (B).

39 **Answer (C)**

Translation stopping in the middle means a stop codon appeared, and a change in both strands together makes the change permanent in the DNA.

40 **Answer (B)**

The original mRNA: AUG AGA CAA UCU UAG
The replacement changes AGA to AGG, and both are arginine, so the same protein is formed.

41 **Answer (A)**

mRNA is a single strand that does not bind to itself by hydrogen bonds, so it has the smallest number of bonds.

42 **Answer (C)**

DNA is transcribed into mRNA (transcription), then translated into protein (X) on the ribosomes (translation).

43 **Answer (A)**

(Y) is the start codon AUG and (Z) are the codons of the amino acids; they bind to the anticodons.
(L) is the stop codon UAA, which has no matching tRNA.

44 **Answer (A)**

Several ribosomes translate one mRNA molecule at the same time: a polyribosome (polysome).

45 **Answer (D)**

The amount of DNA is constant, and the amount of RNA rising three times shows it was transcribed to build protein three times.

46 **Answer (A)**

One type of ribosome builds all proteins, and the chains are of two types (alpha and beta), so two types of genes are needed.

47 **Answer (B)**

At the 5′ end of mRNA there are the ribosome binding site, the start codon and a free phosphate group.

The small ribosomal subunit is not part of its structure.

48 **Answer (D)**

The tRNA molecule carrying the polypeptide chain is at site (P).

49 **Answer (A)**

Hormone (X) is the antidiuretic hormone; it is synthesized on the ribosomes of hypothalamus cells, then stored in the posterior lobe of the pituitary.

50 **Answer (B)**

The amino acid binds to the tRNA molecule in the cytoplasm.

51 **Answer (B)**

The haemoglobin gene is present in all cells, but it is switched off in liver cells.

52 **Answer (A)**

53 **Answer (A)**

Keratin and thyroxine are built on the same type of ribosomes, because all cells have one type of them.

54 **Model answer**

(1) Zero.

(2) The sugar-phosphate backbone of transfer RNA (tRNA).

55 **Model answer**

In eukaryotic cells: process (1), "DNA replication", and process (2), "RNA transcription", take place inside the nucleus; mRNA and tRNA are transcribed inside the nucleus, while rRNA is transcribed inside the nucleolus.

In prokaryotic cells: process (1), "DNA replication", and process (2), "RNA transcription", take place in the cytoplasm.

56 **Model answer**

(1) (1) with (2), (4) with (2).

(2) Between (6) and (2) a covalent bond, between (6) and (7) a covalent bond.

57 **Model answer**

Maximum number of ribosomes = 10 ribosomes / because each ribosome will be used to build one protein molecule (one molecule of growth hormone).

Maximum number of tRNA molecules = 191 × 10 = 1910 molecules.

Minimum number of mRNA molecules = one molecule, translated 10 times to build 10 molecules of growth hormone.

58 **Model answer**

Reaction (X): the peptidyl transfer reaction, a reaction that forms a peptide bond (condensation), activated by an enzyme in the large ribosomal subunit.

Result: the polypeptide chain moves from the tRNA at site (P) to bind to the amino acid (Val) carried on the tRNA at site (A), so the chain grows by one amino acid, and the empty tRNA is released from the ribosome.

59 **Model answer**

An error during DNA replication is more dangerous, because it causes a permanent change in the genetic information (a mutation) that passes to the cells produced by division and may be inherited by the next generations, and it appears in all the proteins produced from this gene.

An error in translation affects only one protein molecule and is not inherited.