

# D + E: DNA + PROTEIN SYNTHESIS

1. Which of the following is the correct matching of base pairs in DNA?

- A. cytosine—guanine; uracil—adenine
- B. cytosine—adenine; thymine—uracil
- C. adenine—guanine; cytosine—thymine
- D. adenine—thymine; guanine—cytosine

2. Which of the following is a component of a DNA molecule?

- A. ATP
- B. uracil
- C. ribose
- D. nucleotide

3. In DNA replication, the term “unzipping” refers to

- A. denaturing the DNA helix.
- B. unwinding the mRNA from the DNA after transcription.
- C. breaking the bonds between complementary DNA strands.
- D. breaking the bonds between the sugar and phosphate molecules.

4. Which of the following is a valid contrast between RNA and DNA?

	RNA	DNA
A.	helical	not helical
B.	sugar is ribose	sugar is deoxyribose
C.	found only in the nucleus	found in the nucleus and the cytoplasm
D.	thymine is one of its bases	uracil is one of its bases

5. Transcription is the production of

- A. a polypeptide chain.
- B. a new DNA molecule.
- C. multiple copies of a single type of enzyme.
- D. an RNA molecule complementary to a section of DNA.

6. If 20% of the base molecules are guanine, how many thymine molecules are present in a DNA molecule with 1 000 bases?

- A. 200
- B. 300
- C. 400
- D. 600

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Recombinant DNA is defined as DNA produced from

- A. RNA and a protein.
- B. DNA and hemoglobin.
- C. viral DNA and glucose.
- D. DNA of two different organisms.

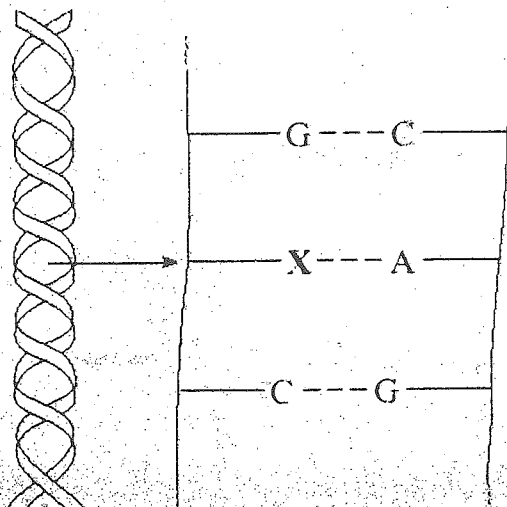
Use the following table to answer question 8

Three-letter codons of messenger RNA, and the amino acids specified by the codons			
AAU } Asparagine AAC }	CAU } Histidine CAC }	GAU } Asparatic acid GAC }	UAU } Tyrosine UAC }
AAA } Lysine AAG }	CAA } Glutamine CAG }	GAA } Glutamic acid GAG }	UAA } Stop UAG }
ACU } Threonine ACC } ACA } ACG }	CCU } Proline CCC } CCA } CCG }	GCU } Alanine GCC } GCA } GCG }	UCU } Serine UCC } UCA } UCG }
AGU } Serine AGC }	CGU } Arginine CGC } CGA } CGG }	GGU } Glycine GGC } GGA } GGG }	UGU } Cysteine UGC }
AGA } Arginine AGG }			UGA - Stop UGG - Tryptophan
AUU } Isoleucine AUC } AUA }	CUU } Leucine CUC } CUA } CUG }	GUU } Valine GUC } GUA } GUG }	UUU } Phenylalanine UUC }
AUG - Methionine			UUA } Leucine UUG }

8 Determine the sequence of amino acids produced by this DNA sequence: G G A G T T T T C

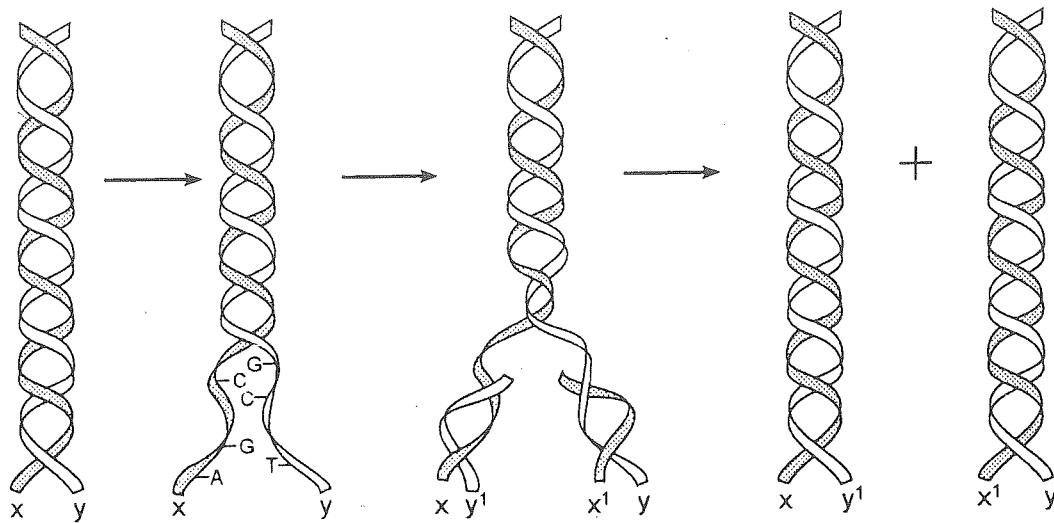
- A. Proline, Valine, Lysine.
- B. Glycine, Valine, Leucine.
- C. Proline, Glutamine, Lysine.
- D. Glycine, Glutamic acid, Leucine.

Use the following diagram to answer question 9



9. In the portion of the molecule shown above, which base should be in position X?  
 A. Uracil.  
 B. Adenine.  
 C. Guanine.  
 D. Thymine.

Use the following diagram to answer quest 10.



10. The process shown in the diagram above is

- A. hydrolysis.
- B. translation.
- C. replication.
- D. transcription.

11. DNA replication involves the breaking of bonds between

- A. bases.
- B. sugars and bases.
- C. phosphates and bases.
- D. sugars and phosphates.

12. When a foreign gene is incorporated into an organism's nucleic acid, the resulting molecule is called

- A. ATP.
- B. recombinant DNA.
- C. transfer RNA (tRNA).
- D. messenger RNA (mRNA).

13. Under experimental conditions, cells grown in a medium containing thymine would incorporate thymine into their DNA. If cells grown for a number of generations in a medium containing radioactive thymine were removed from this medium and allowed to replicate once using thymine that was not radioactive, what percent of these cells would now be radioactive?

- A. 0%
- B. 25%
- C. 50%
- D. 100%

Use the following table to answer question 14.

Three-letter codons of messenger RNA, and the amino acids specified by the codons			
AAU } AAC } Asparagine	CAU } CAC } Histidine	GAU } GAC } Asparatic acid	UAU } UAC } Tyrosine
AAA } AAG } Lysine	CAA } CAG } Glutamine	GAA } GAG } Glutamic acid	UAA } UAG } Stop
ACU } ACC } ACA } ACG } Threonine	CCU } CCC } CCA } CCG } Proline	GCU } GCC } GCA } GCG } Alanine	UCU } UCC } UCA } UCG } Serine
AGU } AGC } Serine	CGU } CGC } CGA } CGG } Arginine	GGU } GGC } GGA } GGG } Glycine	UGU } UGC } Cysteine
AGA } AGG } Arginine			UGA - Stop UGG - Tryptophan
AUU } AUC } AUA } Isoleucine	CUU } CUC } CUA } CUG } Leucine	GUU } GUC } GUA } GUG } Valine	UUU } UUC } Phenylalanine
AUG - Methionine			UUA } UUG } Leucine

14. A tRNA molecule with the anticodon GCU would be carrying the amino acid

- A. valine.
- B. alanine.
- C. tyrosine.
- D. arginine.

15. A polypeptide found in the cytoplasm of a cell contains 12 amino acids. How many nucleotides would be required in the mRNA for this polypeptide to be translated?

- A. 4
- B. 12
- C. 24
- D. 36

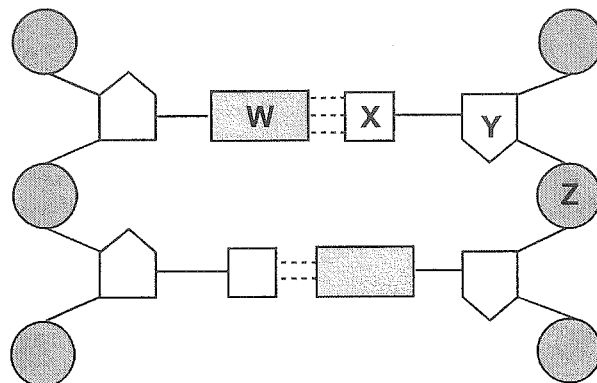
Use the following information to answer question 16.

1. Uracil bonds with adenine.
2. Complementary bonding between codon and anticodon.
3. DNA unzips.
4. mRNA joins with ribosome.

16. The correct order of the above during protein synthesis is

- A. 1, 2, 4, 3
- B. 1, 3, 2, 4
- C. 3, 1, 4, 2
- D. 3, 2, 1, 4

Use the following diagram to answer questions 17 and 18.



17. Which of the following correctly identifies the parts labelled W, X, Y and Z?

	W	X	Y	Z
A.	adenine	uracil	deoxyribose	phosphate
B.	adenine	thymine	phosphate	ribose
C.	guanine	cytosine	deoxyribose	phosphate
D.	base	ribose	cytosine	guanine

18. The parts labelled X, Y and Z in the diagram above make up

- A. a fatty acid.
- B. a nucleotide.
- C. an amino acid.
- D. a monosaccharide.

19. One DNA strand is attached to another DNA strand by

- A. hydrogen bonds between the bases.
- B. hydrogen bonds between the sugars.
- C. covalent bonds between the sugars and bases.
- D. covalent bonds between the sugars and the phosphates.

20. If the code for an amino acid is AGC on the DNA molecule, the anticodon on the tRNA would be

- A. AGC
- B. TGC
- C. UCG
- D. UGC

21. If the triplet code on a DNA molecule changes from ACT to AGC, the result is called

- A. mutation.
- B. metastasis.
- C. translation.
- D. transcription.

Use the following table to answer question 22.

Table of mRNA Codons					
1st position ↓	2nd position				3rd position ↓
	U	C	A	G	
U	phenylalanine phenylalanine leucine leucine	serine serine serine serine	tyrosine tyrosine stop stop	cysteine cysteine stop tryptophan	U C A G
C	leucine leucine leucine leucine	proline proline proline proline	histidine histidine glutamine glutamine	arginine arginine arginine arginine	U C A G
A	isoleucine isoleucine isoleucine methionine	threonine threonine threonine threonine	asparagine asparagine lysine lysine	serine serine arginine arginine	U C A G
G	valine valine valine valine	alanine alanine alanine alanine	aspartate aspartate glutamate glutamate	glycine glycine glycine glycine	U C A G

22. The genetic disorder sickle-cell anemia occurs when the amino acid valine takes the place of glutamate during translation of a hemoglobin chain. Using the table of codons above, determine the mutation in DNA that produces this disorder.

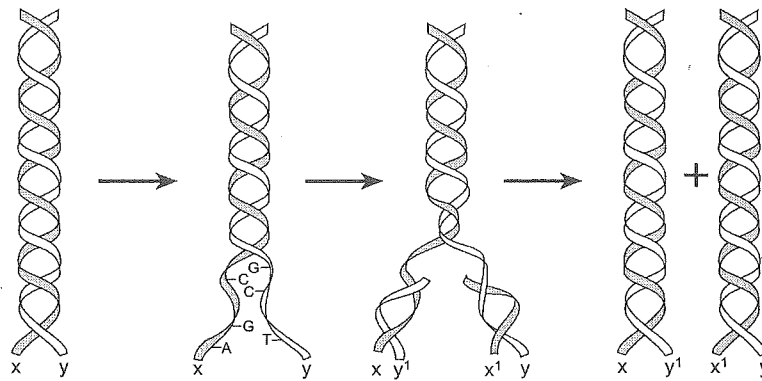
- A. CAG changes to CTC
- B. CTT changes to CAT
- C. CUC changes to CAG
- D. GAA changes to GUU

23. How many of the following molecules are produced at ribosomes?

- |   |
|---|
| <ul style="list-style-type: none"> <li>• glycogen</li> <li>• testosterone</li> <li>• phospholipids</li> <li>• salivary amylase</li> <li>• DNA polymerase</li> </ul> |
|---|

- A. one
- B. two
- C. three
- D. four

Use the following diagram to answer questions 24 and 25.



24. The diagram above represents

- A. DNA replication.
- B. mRNA translation.
- C. mRNA elongation.
- D. DNA transcription.

25. The process shown in the diagram occurs in the

- A. nucleus.
- B. nucleolus.
- C. ribosomes.
- D. rough endoplasmic reticulum.

Use the following information to answer question 26.

- uracil
- adenine
- thymine
- phosphate
- deoxyribose

26. RNA contains how many of the molecules above?

- A. one
- B. two
- C. three
- D. four

27. Amylase is synthesized at the

- A. nucleus.
- B. ribosome.
- C. lysosome.
- D. mitochondrion.

Use the following chart of mRNA codons to answer question 28.

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } AAC } Asparagine	CAU } CAC } Histidine	GAU } GAC } Aspartic acid	UAU } UAC } Tyrosine
AAA } AAG } Lysine	CAA } CAG } Glutamine	GAA } GAG } Glutamate	UAA } UAG } Stop
ACU } ACC } ACA } ACG } Threonine	CCU } CCC } CCA } CCG } Proline	GCU } GCC } GCA } GCG } Alanine	UCU } UCC } UCA } UCG } Serine
AGU } AGC } Serine	CGU } CGC } CGA } CGG } Arginine	GGU } GGC } GGA } GGG } Glycine	UGU } UGC } Cysteine
AGA } AGG } Arginine			UGA – Stop UGG – Tryptophan
AUU } AUC } AUA } Isoleucine	CUU } CUC } CUA } CUG } Leucine	GUU } GUC } GUA } GUG } Valine	UUU } UUC } Phenylalanine
AUG – Methionine			UUA } UUG } Leucine

28. Which DNA code represents the polypeptide chain:



- A. CTG, TGT, GGT
- B. CTA, GGT, AGT
- C. GAC, ACA, CCA
- D. CAU, UGA, GGU

29. Recombinant DNA can be made by joining together which of the following?

- A. rRNA and DNA
- B. mRNA and tRNA
- C. viral tRNA and viral DNA
- D. bacterial DNA and human DNA

30. In a solution of nucleotides made from a ground-up segment of DNA, adenine makes up 33% of the solution. What percentage of the solution would be guanine?

- A. 17%
- B. 33%
- C. 34%
- D. 67%



31. If radioactive nitrogen-15 were available during synthesis, it would show up in which of the following molecules?

- A. cellulose
- B. glycogen
- C. fatty acid
- D. hemoglobin

Use the following chart to answer question 32.

Three-letter codons of messenger RNA, and the amino acids specified by the codons			
AAU } AAC } - Asparagine	CAU } CAC } - Histidine	GAU } GAC } - Aspartic acid	UAU } UAC } - Tyrosine
AAA } AAG } - Lysine	CAA } CAG } - Glutamine	GAA } GAG } - Glutamic acid	UAA } UAG } - Stop
ACU } ACC } ACA } ACG } - Threonine	CCU } CCC } CCA } CCG } - Proline	GCU } GCC } GCA } GCG } - Alanine	UCU } UCC } UCA } UCG } - Serine
AGU } AGC } - Serine	CGU } CGC } CGA } CGG } - Arginine	GGU } GGC } GGA } GGG } - Glycine	UGU } UGC } - Cysteine
AGA } AGG } - Arginine			UGA - Stop UGG - Tryptophan
AUU } AUC } AUA } - Isoleucine	CUU } CUC } CUA } CUG } - Leucine	GUU } GUC } GUA } GUG } - Valine	UUU } UUC } - Phenylalanine
AUG - Methionine			UUA } UUG } - Leucine

32. A strand of DNA has the following bases:

C A C G G C C

If the adenine base was deleted, which amino acids would be coded for?

- A. valine, proline
- B. glycine, alanine
- C. proline, arginine
- D. glycine, arginine

33. Which of the following statements correctly describes DNA?

- A. Guanine bonds to cytosine and adenine bonds to uracil.
- B. Peptide bonds are found between guanine and cytosine.
- C. Hydrogen bonds are found between thymine and guanine.
- D. Nucleotides are composed of a sugar, a phosphate and a base.

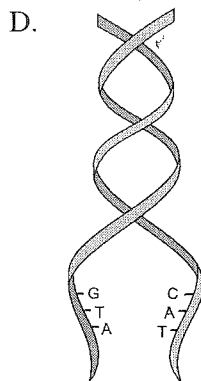
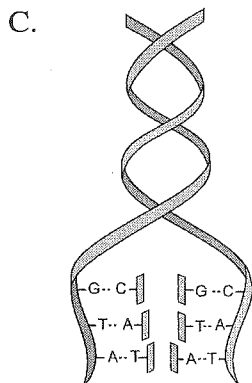
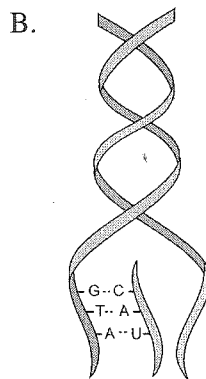
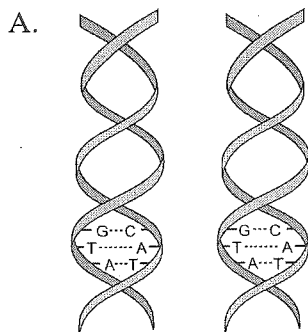
34. DNA replication produces

- A. two different strands of RNA.
- B. two identical molecules of DNA.
- C. an mRNA strand that has copied a gene.
- D. a parent DNA strand and a daughter tRNA strand.

35. The number of adenine bases in a DNA molecule equals the number of thymine bases because
- A. DNA contains equal numbers of all four bases.
  - B. thymine always follows adenine on each DNA strand.
  - C. DNA is made of alternating adenine and thymine bases.
  - D. adenine on one strand bonds to thymine on the other strand.

36. The product of transcription is
- A. DNA.
  - B. protein.
  - C. mRNA.
  - D. a ribosome.

37. Which of the following represents complementary base pairing in DNA replication?



38. Which of the following base pairs would form between mRNA and tRNA during protein synthesis?

- A. adenine—uracil
- B. uracil—guanine
- C. thymine—adenine
- D. cytosine—thymine

39. Nucleic acids which have genes from two different organisms are called

- A. transfer RNA.
- B. ribosomal RNA.
- C. messenger RNA.
- D. recombinant DNA.

40. Where is the site of protein synthesis?

- A. nucleus
- B. vacuole
- C. ribosome
- D. Golgi bodies

Use the following table to answer question 41.

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } AAC } Asparagine	CAU } CAC } Histidine	GAU } GAC } Asparatic acid	UAU } UAC } Tyrosine
AAA } AAG } Lysine	CAA } CAG } Glutamine	GAA } GAG } Glutamate	UAA } UAG } Stop
ACU } ACC } ACA } ACG } Threonine	CCU } CCC } CCA } CCG } Proline	GCU } GCC } GCA } GCG } Alanine	UCU } UCC } UCA } UCG } Serine
AGU } AGC } Serine	CGU } CGC } CGA } CGG } Arginine	GGU } GGC } GGA } GGG } Glycine	UGU } UGC } Cysteine
AGA } AGG } Arginine			UGA - Stop UGG - Tryptophan
AUU } AUC } AUA } Isoleucine	CUU } CUC } CUA } CUG } Leucine	GUU } GUC } GUA } GUG } Valine	UUU } UUC } Phenylalanine
AUG - Methionine			UUA } UUG } Leucine

41. A single base mutation causes the amino acid leucine to replace tryptophan in the primary structure of a protein. The base in the DNA that changes to cause this mutation is

- A. adenine.
- B. guanine.
- C. cytosine.
- D. thymine.

Use the following chart to answer questions 42 and 43.

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } AAC } Asparagine	CAU } CAC } Histidine	GAU } GAC } Aspartic acid	UAU } UAC } Tyrosine
AAA } AAG } Lysine	CAA } CAG } Glutamine	GAA } GAG } Glutamate	UAA } UAG } Stop
ACU } ACC } ACA } ACG } Threonine	CCU } CCC } CCA } CCG } Proline	GCU } GCC } GCA } GCG } Alanine	UCU } UCC } UCA } UCG } Serine
AGU } AGC } Serine	CGU } CGC } CGA } CGG } Arginine	GGU } GGC } GGA } GGG } Glycine	UGU } UGC } Cysteine
AGA } AGG } Arginine			UGA - Stop UGG - Tryptophan
AUU } AUC } AUA } Isoleucine	CUU } CUC } CUA } CUG } Leucine	GUU } GUC } GUA } GUG } Valine	UUU } UUC } Phenylalanine
AUG - Methionine			UUA } UUG } Leucine

42. Read the following DNA sequence left to right.

T A T C T T

Which amino acid sequence is coded for?

- A. tyrosine, valine
- B. isoleucine, valine
- C. tyrosine, glutamate
- D. isoleucine, glutamate

43. If a cell grown in the presence of radioactively-labelled uracil is actively producing protein containing lysine, which of the following is correct?

- A. The lysine produced is radioactive.
- B. The codons for lysine are radioactive.
- C. The DNA code for lysine is radioactive.
- D. The anticodons for lysine are radioactive.

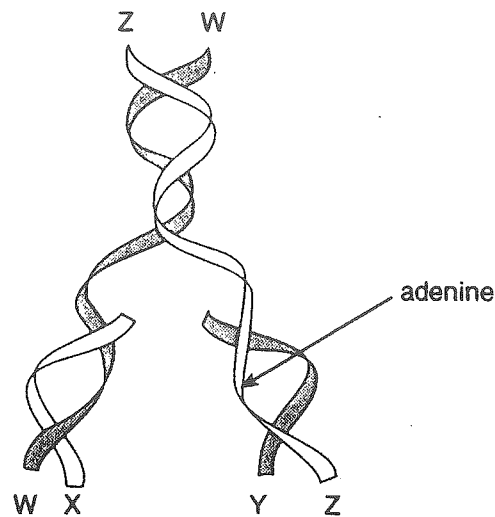
44. One difference between DNA and RNA is that RNA

- A. is helical.
- B. is single stranded.
- C. contains deoxyribose.
- D. contains the bases C, G, A, T.

45. The role of ribosomes in protein synthesis is to

- A. split the two strands of DNA apart.
- B. check for and replace faulty codons.
- C. carry amino acids to the site of translation.
- D. provide a site for mRNA and tRNA to join together.

Use the following diagram to answer question 46.



46. If adenine is located on strand Z as shown, then on strand X at the same location must be

- A. uracil.
- B. adenine.
- C. thymine.
- D. cytosine.

47. Disorganized and uncontrolled cell growth is called

- A. anaplasia.
- B. metastasis.
- C. vascularization.
- D. contact inhibition.

48. Which of the following is **not** one of the recognized "seven danger signals" that may indicate the presence of cancer?

- A. headache
- B. persistent cough
- C. a sore that will not heal
- D. change in a mole's appearance

49. During carcinogenesis, an initiator

- A. triggers metastasis.
- B. promotes vascularization.
- C. brings about DNA mutation.
- D. provides an environment for tumour formation.

50. A virus may be able to bring about carcinogenesis since it can

- A. denature DNA.
- B. add a gene to the host cell.
- C. reproduce within the host cell.
- D. cause the death of its host cell.



Use the following chart of mRNA codons to answer question 53.

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } Asparagine AAC }	CAU } Histidine CAC }	GAU } Asparatic acid GAC }	UAU } Tyrosine UAC }
AAA } Lysine AAG }	CAA } Glutamine CAG }	GAA } Glutamate GAG }	UAA } Stop UAG }
ACU } Threonine ACC ACA ACG }	CCU } Proline CCC CCA CCG }	GCU } Alanine GCC GCA GCG }	UCU } Serine UCC UCA UCG }
AGU } Serine AGC }	CGU } Arginine CGC CGA CGG }	GGU } Glycine GGC GGA GGG }	UGU } Cysteine UGC }
AGA } Arginine AGG }			UGA – Stop UGG – Tryptophan
AUU } Isoleucine AUC AUA }	CUU } Leucine CUC CUA CUG }	GUU } Valine GUC GUA GUG }	UUU } Phenylalanine UUC }
AUG – Methionine			UUA } Leucine UUG }

53. A segment of hemoglobin has the following sequence of amino acids:

**leucine–threonine–proline–glutamate–glutamate**

The same segment of hemoglobin found in people who have sickle-cell anemia has the following sequence:

**leucine–threonine–proline–valine–glutamate**

a) Using the chart above, explain how DNA is different in people with sickle-cell anemia.

(2 marks)

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b) State two environmental agents that can change the DNA.

(2 marks)

- i) \_\_\_\_\_
- ii) \_\_\_\_\_

54. a) What is the purpose of transcription during protein synthesis?

(1 mark)

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b) What occurs during translation?

(3 marks)

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55. What is produced as a result of each of the following during protein synthesis?

RNA bases and DNA bases join together by complementary base pairing.

(1 mark)

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Transfer RNA joins to messenger RNA at the ribosome.

(1 mark)

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56. a) Define recombinant DNA.

(1 mark)

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b) Give two uses of recombinant DNA.

(2 marks)

i) \_\_\_\_\_

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ii) \_\_\_\_\_

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c) In which organelle of a human cell would recombinant DNA be found?

(1 mark)

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57. Give a role of each of the following nucleic acids in the production of an enzyme.

(4 marks: 1 mark each)

DNA:

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mRNA:

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rRNA:

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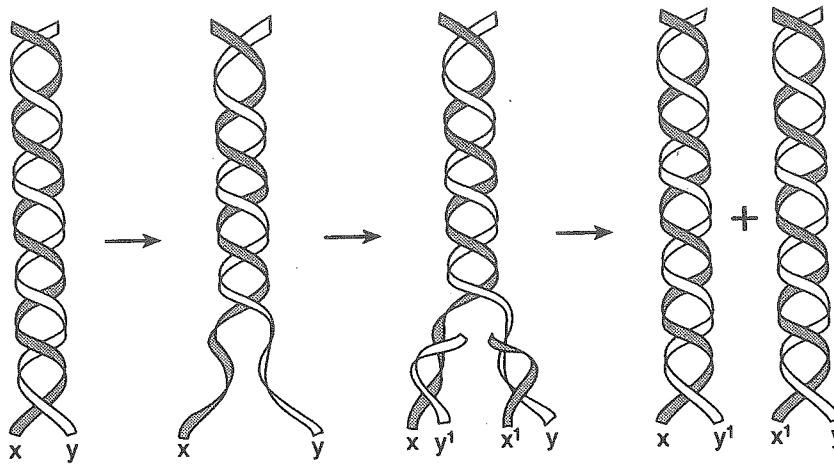
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tRNA:

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58 a) Name and describe the process shown below.  
 (4 marks: 1 mark for name; 3 marks for description)



Name: \_\_\_\_\_

Description: \_\_\_\_\_

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b) How could a virus affect the molecule shown in the diagram above? (1 mark)

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59. Using the table below, list **three** differences between RNA and DNA.  
 (3 marks: 1 mark for each contrasting pair)

RNA	DNA

60. a) In an experiment conducted to study protein synthesis, radioactive thymine and radioactive uracil were added to a culture of human cells. A few hours later, the culture was analyzed and radioactive mRNA was found.

i) Explain how an mRNA molecule is produced. (2 marks)

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ii) Explain why the mRNA produced is radioactive. (1 mark)

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b) In a different experiment, radioactive uracil was added to a culture of human cells undergoing DNA replication. What will be the characteristic of the resulting DNA in terms of radioactivity? Explain. (2 marks)

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61. Complete the following table showing the products and locations of the cellular processes indicated. (4 marks)

	Translation	Replication
Product		
Location		

62. Give **one** role of each of the following in the production of a protein. (4 marks: 1 mark each)

DNA:

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mRNA:

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tRNA:

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rRNA:

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63. Tissue sample **A** is taken from a mole on the skin that shows abnormal growth while tissue sample **B** is composed of normal skin cells. Describe how the cells in tissue sample **A** are different from those in tissue sample **B**. (3 marks)

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64. Give the purpose of each of the following steps in the process of protein synthesis.

a) Ribosome moving along a mRNA: (1 mark)

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b) Adenine bonding to thymine: (1 mark)

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c) An amino acid bonding to a specific tRNA: (1 mark)

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d) Forming of peptide bonds: (1 mark)

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65. Give one role of each of the following in the process of translation. (3 marks: 1 mark each)

tRNA: \_\_\_\_\_

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Ribosome: \_\_\_\_\_

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mRNA: \_\_\_\_\_

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66. Using the chart below, contrast DNA and mRNA.

(3 marks: 1 mark for each contrasting pair)

	DNA	mRNA
TYPE OF SUGAR		
NUMBER OF STRANDS		
BASES		

67. Describe the structure of DNA. (You may use a labelled diagram to answer this question.)

(4 marks)

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68. a) Define recombinant DNA.

(1 mark)

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b) Describe two uses for recombinant DNA.

(2 marks)

i) \_\_\_\_\_

\_\_\_\_\_

ii) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

69. State one role for each of the following molecules in the process of protein synthesis. (3 marks)

DNA:

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mRNA:

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tRNA:

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70. Describe one way in which each of the following pairs of molecules are functionally related in the process of protein synthesis. (4 marks: 1 mark each)

DNA and mRNA:

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mRNA and tRNA:

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tRNA and amino acids:

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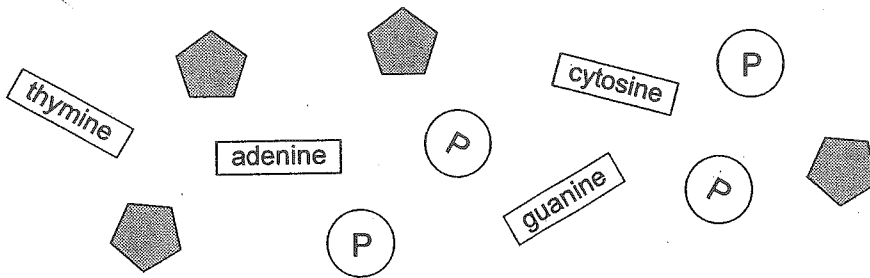
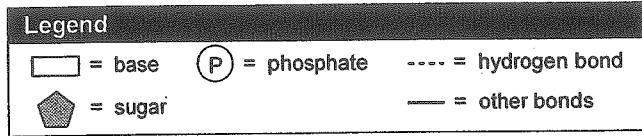
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protein and rRNA:

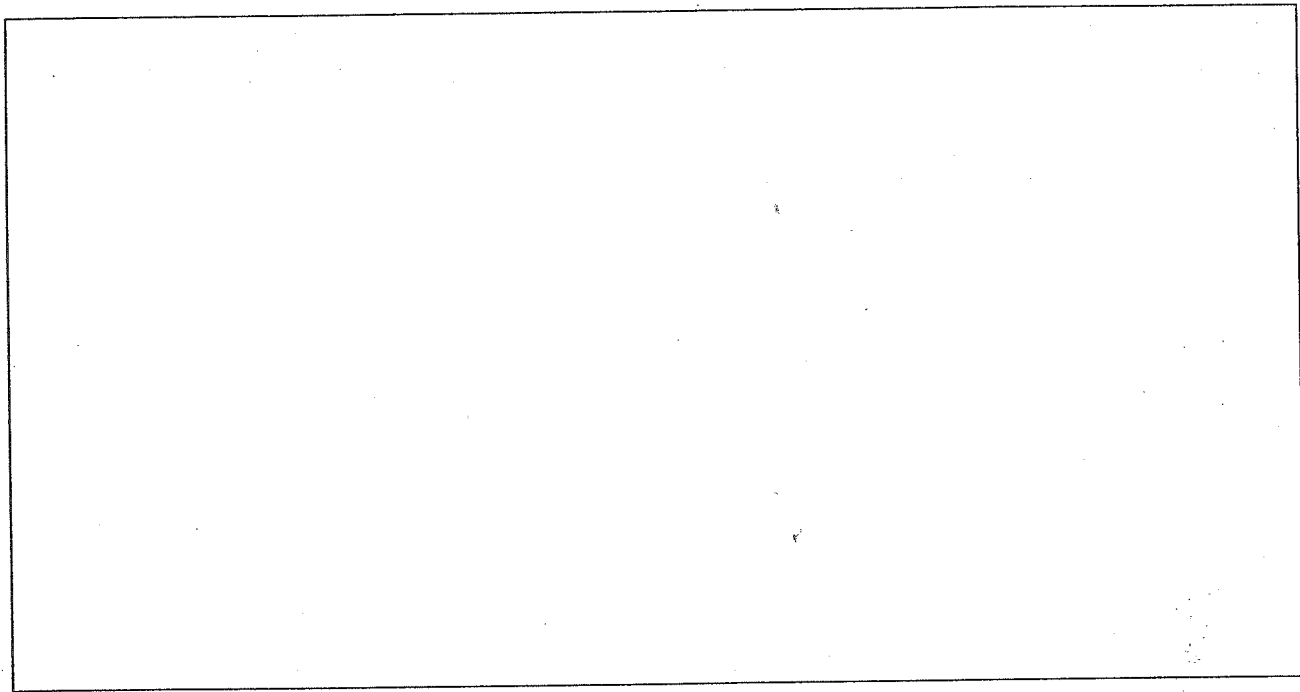
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71. The symbols shown below represent parts of a DNA molecule. Construct the DNA molecule by redrawing the parts to make a complete section. (4 marks)



Draw your diagram below using a pencil.



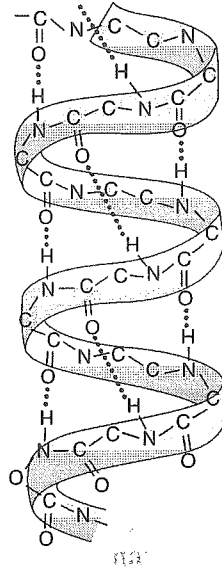
72. Complete the following table comparing DNA and RNA. (3 marks: 1 mark each)

	DNA	RNA
Bases	C, G, A, T	
Location in cell		nucleus and cytoplasm
Number of strands	2	



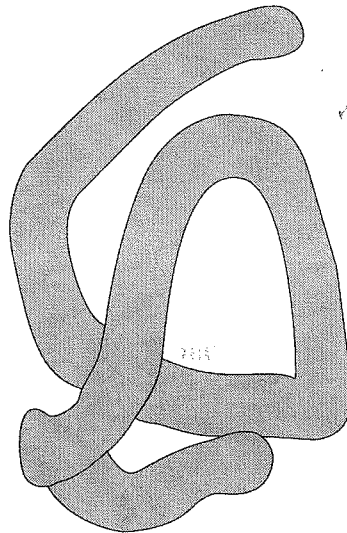
73. Levels of protein structure differ according to the types of bonds that hold them together. As an enzyme is synthesized, these bonds form to give the protein its final 3-dimensional shape. For each of the following diagrams, name the level of protein structure and describe the type of bonding responsible.

(6 marks: 1 mark each for level; 1 mark each for description)



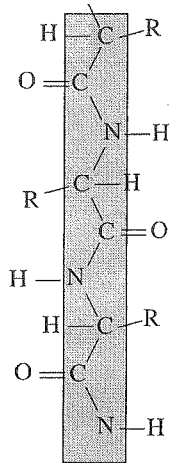
Level of protein structure: \_\_\_\_\_

Description of bonding: \_\_\_\_\_



Level of protein structure: \_\_\_\_\_

Description of bonding: \_\_\_\_\_



Level of protein structure: \_\_\_\_\_

Description of bonding: \_\_\_\_\_

\_\_\_\_\_

