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MULTIPLE CHOICE (5 points each)

CIRCLE THE LETTER NEXT TO THE SINGLE BEST ANSWER.

101. On one strand of DNA the nucleotide sequence is 5'-ATGC-3'. The complementary sequence in the other strand must be

- |   |            |   |            |
|---|------------|---|------------|
| a | 5'-CGTA-3' | d | 5'-ATCG-3' |
| b | 5'-GCAT-3' | e | 5'-TACG-3' |
| c | 3'-ATGC-5' |   |            |

102. The "C-value paradox" refers to the unexpected observation that

- a salamanders have more DNA per cell than bacteria
- b mitochondrial genomes are similar in size to bacterial genomes
- c closely related organisms can have very different genome sizes
- d genome size varies greatly among prokaryotes
- e most DNA in eukaryotes does not code for genes

103. An experiment that definitively showed DNA was the genetic material involved

- a labeling *E. coli* DNA with heavy nitrogen.
- b injecting mice with a disease-causing organism.

- c inducing mutations that affected arginine synthesis in *Neurospora*.
  - d using DNase to prevent the transformation of benign bacteria by dead virulent bacteria.
  - e changing protein coats of tobacco mosaic viruses.
104. Which of the following features is NOT true of nucleosomes?
- a They contain five different kinds of histone proteins.
  - b New histones are made while the DNA is replicated and assembled immediately into new nucleosomes.
  - c They form a “spool”, which the DNA wraps around about 30 times.
  - d They are the only proteins that are part of the chromatin.
  - e They are characteristic of eukaryotic chromosomes, but not of viral or bacterial chromosomes.
105. For a prokaryotic chromosome, which of the following is true?
- a RNAs can be transcribed off either DNA strand, depending on the gene, but are always made 5' > 3'.
  - b RNAs can be transcribed off either DNA strand, depending on the gene, but are always made 3' > 5'.
  - c RNAs from all genes are synthesized 5' > 3' off the same DNA strand.
  - d RNAs from all genes are synthesized 3' > 5' off the same DNA strand.
  - e Different genes can be transcribed off either strand, some in the 5' > 3' direction and some in the 3' > 5' direction.
106. Which of the following events is responsible for setting the frame of translation?
- a Attachment of the large ribosomal subunit to the small subunit
  - b mRNA alignment with the small ribosomal subunit
  - c mRNA alignment with the initial Met-tRNA
  - d Ribosome “hopping” down the mRNA three bases at a time
  - e RNA-RNA base pairing between the ribosome and the Shine-Delgarno sequence in the transcript
107. If DNA polymerases could add nucleotides in the 3' to 5' direction during replication, there would be no need for
- a DNA ligase
  - b RNA primers
  - c Okazaki fragments
  - d gyrase
  - e helicase
108. For double stranded DNA, which is NOT true?
- a  $[A] / [T] = 1$
  - b  $[C] / [G] = 1$
  - c  $[A] + [G] = [T] + [C]$
  - d  $[A] + [T] = [G] + [C]$
  - e  $[A] + [C] = [T] + [G]$
109. Eukaryotic chromosomal replication
- a is unidirectional.
  - b occurs from a single, unique origin, called *oriC*.
  - c depends on specific termination sequences.

- d involves a  $\theta$  -shaped conformation.
- e has many replication forks.

110. Proteins were once thought to be the genetic material because they

- a have 20 kinds of subunits (amino acids).
- b could transform nonvirulent bacteria into virulent forms.
- c have more complex 3D structures than nucleic acids.
- d are large molecules.
- e make up the bulk of a chromosome.

111. A sample of normal double-stranded frog DNA was found to have a guanine content of 18%. What is the expected proportion of adenine?

- a 9%                      d 68
- b 32%                    e 82%
- c 36%

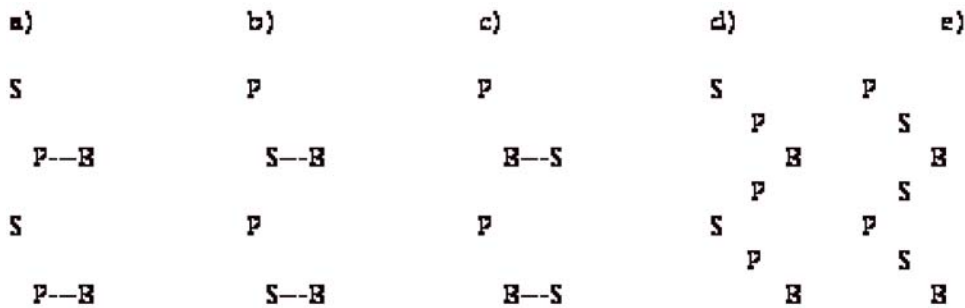
112. Which of the following statements about tRNAs is incorrect?

- a There are between one and four tRNAs for each of the 20 amino acids.
- b tRNAs always adopt a clover-leaf conformation.
- c During initiation, the tRNA anticodon basepairs to a complementary sequence of the ribosomal RNA.
- d tRNAs participate in both stable and transient RNA:RNA base pairings.
- e All of the above statements are correct

113. Which of the following statements about anticodons is incorrect?

- a Each type of tRNAs has a unique anticodon.
- b There are specific anticodons that bind to start and stop codons.
- c Each anticodon consists of three bases.
- d Anticodons may include modified bases.
- e Anticodon “wobble” pairing results in degeneracy of the genetic code.

114. Which of the following pictures best represents an RNA nucleotide chain, where S = sugar, P = phosphate, and B = nitrogenous base (A, G, C, or U)?



FILL-IN-THE-BLANK

115. (15 points) List the names and functions of three enzymes that must help the DNA polymerases during replication.

Name	Function
_____	_____
_____	_____
_____	_____

116. (15 points) List three important features of the genetic code

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

117. (21 points) In the chart below indicate by a "+" if the characteristic is present in at least some members of the group. Use a "0" if the characteristic is not found in any members of the group.

	Bacteria	Viruses	Eukaryotes
(a) Lots of noncoding DNA	___	___	___
(b) Ribosomal RNA genes	___	___	___
(c) DNA as its genetic material	___	___	___
(d) RNA as its genetic material	___	___	___
(e) Circular chromosomes	___	___	___
(f) 5' cap on mRNAs	___	___	___
(g) Multiple introns	___	___	___

118. (11 points) The percentages of different bases in the genetic materials of an RNA virus, a DNA virus, and a giraffe were measured by a not-too-bright lab technician, who lost the sample identification tags. Identify the source of each nucleic acid sample, giving a reason for your choice.

Sample	Adenine	Cytosine	Guanine	Thymine	Uracil
(a)	28.0	22.0	22.0	0.0	28.0
(b)	21.0	29.0	29.0	21.0	0.0
(c)	27.0	24.0	26.0	23.0	0.0

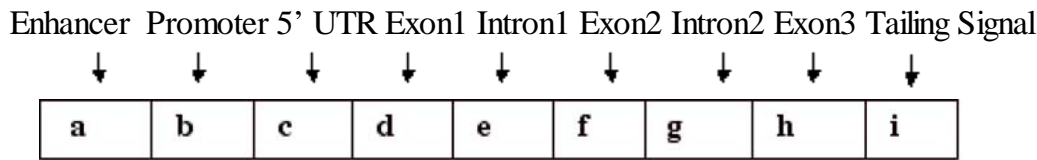
Sample (a) is from a \_\_\_\_\_ because \_\_\_\_\_

Sample (b) is from a \_\_\_\_\_ because \_\_\_\_\_

Sample (c) is from a \_\_\_\_\_ because \_\_\_\_\_

### SHORT PROBLEMS

119. (12 points) Shown below is the structure of a mouse gene, divided into segments labeled **a-i**. The gene contains three exons, two introns, a promoter, an enhancer and an AAUAAA tailing signal, all inside different segments. Use the drawing to answer the questions below.



A) Which segment or segments of the gene will be included in the initial RNA transcript? List all appropriate letters.

B) Which segment or segments of the gene will be found in the mature processed transcript? List all appropriate letters.

C) Will “extra” RNA (that is not transcribed from the gene) be added to the mRNA, and if so, to which segment or segments?

D) What segment or segments of the gene will contain the translation initiation codon?

120. (16 points) Consider the following piece of messenger RNA:

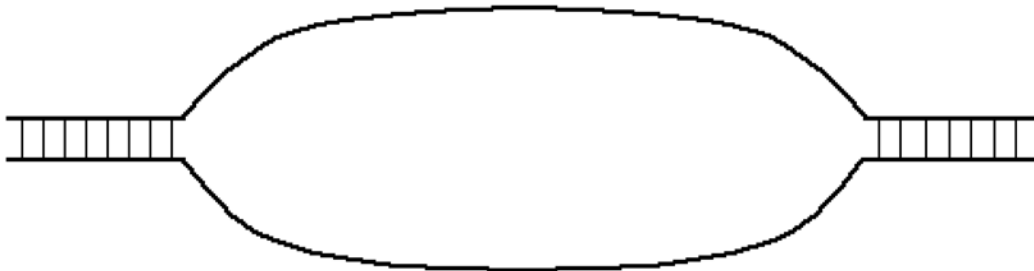
5'-AUGGAGUCGUUAAACCGGUGAUCGU-3'

A) Draw both strands of the segment of DNA from which this mRNA was transcribed. Mark the 3' and 5' ends of both strands, and place a star next to the template strand.

B) Using the codon chart, give the amino acid sequence of the protein that would be produced by translating this mRNA. Mark the amino and carboxy ends of the sequence.

C) Suppose that the underlined U is mutated to an A. What is the new amino acid sequence?

121. (20 points) Draw in the newly synthesized DNA strands in the replication bubble shown below (lines or arrows are fine, don't draw every nucleotide). Label the following features: 1) origin(s) of replication; 2) Okazaki fragments; 3) RNA primers; 4) leading and lagging strands; 5) polarities of old and new strands. You can use the numbers of the features as labels



Key to Exam 1

Bot/Zoo 342

Fall 2003

101. b      102. c      103. d      104. d  
 105. a      106. c      107. c      108. d  
 109. e      110. a      111. b      112. c  
 113. b      114. b

115. Possible answers include:

- 1) Helicase - unwinds DNA helix, separates strands
- 2) Gyrase (Topoisomerase) - relieves extra twists in DNA ahead of replication fork
- 3) RNA polymerase (Primase) - lays down RNA primer for DNA pol to extend
- 4) Ligase - seals gaps between nucleotides in DNA sugar-phosphate

backbone

5) Telomerase - extends repeats on ends of linear chromosomes

6) Single-strand binding proteins (not really enzymes, but I allowed this answer) - keeps DNA strands separate after helicase unwinds them

116. The genetic code (not the genetic material) is triplet, continuous, non-overlapping, degenerate, punctuated only by start/stop signals, and nearly universal.

117.

a	0	0	+
b	+	0	+
c	+	+	+
d	0	+	0
e	+	+	+ or 0
f	0	0	+
g	0	0	+

118. A) RNA virus it has uracil not thymine  
B) giraffe A=T and G=C, so DNA is double-stranded  
C) DNA virus A not= T, G not= C, so DNA is single-stranded

119. A) c, d, e, f, g, h, (i optional)  
B) d, f, h (i optional)  
C) Yes-c and/or i  
D) d

120. A) 3'-TACCTCAGCAATTTGGCCACTAGCA-5' \*  
5'-ATGGAGTCGTTAAACCGGTGATCGT-3'

B) N-Met-Glu-Ser-Leu-Asn-Arg-C  
C) N-Met-Glu-Ser-C

121.

See Figures 3.6 and 3.9 in text.