

**1) Page: 996    Ans: B**

RNA polymerase:

- A) binds tightly to a region of DNA thousands of base pairs away from the DNA to be transcribed.
- B) can synthesize RNA chains de novo (without a primer).**
- C) has a subunit called  $\lambda$  (lambda), which acts as a proofreading ribonuclease.
- D) separates DNA strands throughout a long region of DNA (up to thousands of base pairs), then copies one of them.
- E) synthesizes RNA chains in the 3' → 5' direction.

**2) Pages: 996-998    Ans: A**

Which of the following statements about *E. coli* RNA polymerase is *false*?

- A) Core enzyme selectively binds promoter regions, but cannot initiate synthesis without a sigma factor.**
- B) RNA polymerase holoenzyme has several subunits.
- C) RNA produced by this enzyme will be completely complementary to the DNA template.
- D) The enzyme adds nucleotides to the 3' end of the growing RNA chain.
- E) The enzyme cannot synthesize RNA in the absence of DNA.

**3) Page: 998    Ans: B**

The sigma factor of *E. coli* RNA polymerase:

- A) associates with the promoter before binding core enzyme.
- B) combines with the core enzyme to confer specific binding to a promoter.**
- C) is inseparable from the core enzyme.
- D) is required for termination of an RNA chain.
- E) will catalyze synthesis of RNA from both DNA template strands in the absence of the core enzyme.

**4) Pages: 999-1001    Ans: B**

After binding by *E. coli* RNA polymerase, the correct order of events for transcription initiation is:

- A) closed complex formation, open complex formation, promoter clearance, start of RNA synthesis.
- B) closed complex formation, open complex formation, start of RNA synthesis, promoter clearance.**
- C) open complex formation, closed complex formation, start of RNA synthesis, promoter clearance.
- D) start of RNA synthesis, closed complex formation, open complex formation, promoter clearance.
- E) start of RNA synthesis, open complex formation, closed complex formation, promoter clearance.

**5) Pages: 1000-1001    Ans: B**

Which one of the following statements about E. coli RNA polymerase (core enzyme) is false?

- A) It can start new chains de novo or elongate old ones.
- B) It has no catalytic activity unless the sigma factor is bound.**
- C) It uses nucleoside 5'-triphosphates as substrates.
- D) Its activity is blocked by rifampicin.
- E) Its RNA product will hybridize with the DNA template.

**6) Page: 1002                    Ans: E**

“Footprinting” or DNase protection is a technique used to identify:

- A) a region of DNA that has been damaged by mutation.
- B) E. coli cells that contain a desired, cloned piece of DNA.
- C) the position of a particular gene of a chromosome.
- D) the position of internally double-stranded regions in a single-stranded DNA molecule.
- E) the specific binding site of a repressor, polymerase, or other protein on the DNA.**

**7) Page: 1003                    Ans: B**

Which one of the following statements about eukaryotic RNA polymerases is correct?

- A) All three eukaryotic RNA polymerases recognize the same promoters as prokaryotic polymerases.
- B) None of the eukaryotic RNA polymerases recognizes prokaryotic promoters.**
- C) Only eukaryotic RNA polymerase I recognizes prokaryotic promoters.
- D) Only eukaryotic RNA polymerase II recognizes prokaryotic promoters.
- E) Only eukaryotic RNA polymerase III recognizes prokaryotic promoters.

**8) Pages: 1003-1005    Ans: B**

Which of the following is not known to be involved in initiation by eukaryotic RNA polymerase II?

- A) DNA helicase activity
- B) DNA polymerase activity**
- C) Formation of an open complex
- D) Protein binding to specific DNA sequences
- E) Protein phosphorylation

**9) Page: 1007                    Ans: B**

Processing of a primary mRNA transcript in a eukaryotic cell does not normally involve:

- A) attachment of a long poly(A) sequence at the 3' end.
- B) conversion of normal bases to modified bases, such as inosine and pseudouridine.**
- C) excision of intervening sequences (introns).
- D) joining of exons.
- E) methylation of one or more guanine nucleotides at the 5' end.

**10) Page: 1008            Ans: C**

The 5'-terminal cap structure of eukaryotic mRNAs is a(n):

- A) 7-methylcytosine joined to the mRNA via a 2',3'-cyclic linkage.
- B) 7-methylguanosine joined to the mRNA via a 5' → 3' diphosphate linkage.
- C) 7-methylguanosine joined to the mRNA via a 5' → 5' triphosphate linkage.**
- D) N6-methyladenosine joined to the mRNA via a 5' → 5' phosphodiester bond.
- E) O6-methylguanosine joined to the mRNA via a 5' → 5' triphosphate linkage.

**11) Page: 1009            Ans: B**

The excision (splicing) of many group I introns requires, in addition to the primary transcript RNA:

- A) a cytosine nucleoside or nucleotide and a protein enzyme.
- B) a guanine nucleoside or nucleotide (only).**
- C) a protein enzyme only.
- D) a small nuclear RNA and a protein enzyme.
- E) ATP, NAD, and a protein enzyme.

**12) Page: 1009            Ans: E**

A branched ("lariat") structure is formed during:

- A) attachment of a 5' cap to mRNA.
- B) attachment of poly(A) tails to mRNA.
- C) processing of preribosomal RNA.
- D) splicing of all classes of introns.
- E) splicing of group II introns.**

**13) Page: 1010            Ans: E**

Splicing of introns in nuclear mRNA primary transcripts requires:

- A) a guanine nucleoside or nucleotide.
- B) endoribonucleases.
- C) polynucleotide phosphorylase.
- D) RNA polymerase II.
- E) small nuclear ribonucleoproteins (snurps).**

**14) Page: 1020            Ans: E**

Which one of the following statements about mRNA stability is true?

- A) Degradation always proceeds in the 5' to 3' direction.
- B) Degradation of mRNA by polynucleotide phosphorylase yields 5'-nucleoside monophosphates.
- C) In general, bacterial mRNAs have longer half-lives than do eukaryotic mRNAs.
- D) Rates of mRNA degradation are always at least 10-fold slower than rates of mRNA synthesis.
- E) Secondary structure in mRNA (hairpins, for example) slows the rate of degradation.**

**15) Pages: 996-998**

List one basic property that distinguishes RNA polymerases from DNA polymerases, and list one basic property they share.

**Ans:** Among the distinguishing characteristics: RNA polymerase does *not* require a primer, but DNA polymerase does; RNA polymerase lacks the 3' → 5' proofreading exonuclease activity present in DNA polymerase. Among the shared properties: both enzymes use nucleoside triphosphates as substrates, require Mg<sup>2+</sup> and Zn<sup>2+</sup>, produce an antiparallel complement to the template, and synthesize nucleic acids in the direction 5' → 3'.

**16) Pages: 999-1001**

Describe the sequence of events in the initiation of transcription by *E. coli* RNA polymerase.

**Ans:** The core enzyme plus  $\sigma$  subunit, called holoenzyme, binds to the promoter region forming a closed complex (i.e., in which the DNA double helix is not unwound). This is converted to an open complex by the unwinding of a short region of the promoter. Synthesis of the RNA chain begins within the complex. The complex then moves along the DNA away from the promoter region and the  $\sigma$  subunit dissociates.

**17) Pages: 1003-1005**

Describe briefly the process of initiation by eukaryotic RNA polymerase.

**Ans:** One transcription factor (TBP) binds specifically to the TATA region of the promoter. A second factor (TFIIB) binds to the first factor, and RNA polymerase binds to the TFIIB-TBP complex. Additional factors bind to produce the complete closed complex that is converted to the open complex by the action of DNA helicases. Phosphorylation of the polymerase results in a conformational change that results in the actual initiation of the RNA chain. (See Fig. 26-9, p.1004.)

**18) Pages: 1007-1017**

Name four general types of postsynthetic processing reactions that are observed in RNA. Briefly (one sentence or less) point out an example of each type. In your example, identify the type of RNA molecule involved (tRNA, mRNA, rRNA, etc.), the type of “processing” involved, and whether the example is characteristic of eukaryotes or prokaryotes, or both. Do not describe specific genes, sequences, complicated structures, or enzymes.

**Ans:** Posttranscriptional reactions on mRNA in eukaryotes include: (1) the removal of introns, (2) the addition of a 5' cap, and (3) addition of a poly(A) tail. In prokaryotes and eukaryotes, tRNAs have sequences that are (4) trimmed and (5) spliced, (6) bases already incorporated into tRNA are modified (yielding, for example, pseudouridine and inosine), and (7) a 3'-CCA sequence is sometimes added to the tRNA. Eukaryotic tRNA is also subject to intron splicing and posttranscriptional modification of some bases. In prokaryotes and eukaryotes, preribosomal RNAs are (8) cleaved to form individual rRNAs.

**19) Pages: 1017-1019**

Define ribozymes and briefly describe the structure and function of two ribozymes.

**Ans:** Ribozymes are enzymes that consist in part or entirely of RNA. RNase P, which contains both protein and RNA, cleaves extra nucleotides from the 5' end of tRNA molecules. The enzymatic activity is contained entirely in the RNA portion. Group I introns are RNA sequences in primary transcripts that catalyze their own excision, without any involvement of catalytic proteins. Small RNAs associated with certain RNA viruses of plants also contain self-splicing RNA sequences. The enzyme peptidyl transferase (see Chapter 27), which forms peptide bonds during protein synthesis on ribosomes, is a ribozyme in which the essential catalytic component is RNA.

**20) Pages: 996, 1022**

Compare transcription and reverse transcription in terms of the following characteristics:

	<u>Reverse Transcription</u>	<u>Transcription</u>
(a) direction of polynucleotide synthesis		
(b) nature of template		
(c) nature of primer		
(d) incorporated nucleotides		

**Ans:**

	<u>Reverse Transcription</u>	<u>Transcription</u>
(a) direction of polynucleotide synthesis	<b>5' → 3'</b>	<b>5' → 3'</b>
(b) nature of template	<b>RNA or DNA</b>	<b>DNA</b>
(c) nature of primer	<b>tRNA</b>	<b>none</b>
(d) incorporated nucleotides	<b>dNTPs</b>	<b>NTPs</b>