1. Which RNA polymerase in eukaryotes is primarily responsible for transcribing mRNA?
   A. RNA polymerase I
   B. RNA polymerase II
   C. RNA polymerase III
   D. DNA polymerase β

2. The role of the TATA-binding protein (TBP) during transcription initiation is to:
   A. Terminate transcription at the poly(A) site
   B. Open the DNA double helix
   C. Bind the TATA box and recruit transcription factors
   D. Elongate the RNA strand

3. Which of the following best describes the 5’ cap added to eukaryotic pre-mRNA?
   A. A poly(U) tail for mRNA degradation
   B. A 5’-5’ triphosphate linkage with a methylated guanine
   C. A phosphorylated ribose sugar
   D. A hairpin loop structure for translation

4. Which of the following RNA processing steps does **not** occur in prokaryotes?
   A. Removal of introns
   B. Ribosome binding
   C. Transcription termination
   D. RNA synthesis

5. Spliceosomes are composed of:
   A. Ribosomes and RNA polymerase
   B. DNA and histones
   C. snRNPs and small nuclear RNA
   D. tRNA and helicase

6. The conserved sequence at the 5’ splice site of introns is typically:
   A. AAUAAA
   B. GU
   C. AG
   D. AUG

7. What is the function of the poly(A) tail in eukaryotic mRNA?
   A. Initiates DNA replication
   B. Signals translation initiation
   C. Stabilizes mRNA and enhances translation
   D. Promotes splicing

8. Which factor is responsible for phosphorylation of the C-terminal domain (CTD) of RNA Pol II?
   A. TFIID
   B. Mediator
   C. TFIIH
   D. RNase H

9. Transcription termination in eukaryotes often involves:
   A. rho-dependent release
   B. Recruitment of DNA ligase
   C. Cleavage of the transcript followed by polyadenylation
   D. RNA polymerase degradation

10. Which statement about alternative splicing is true?
    A. It only occurs in prokaryotic mRNA
    B. It allows for the production of multiple proteins from one gene
    C. It prevents mRNA from being exported from the nucleus
    D. It eliminates 5' and 3' UTRs from mRNAs

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11. Compare transcription initiation in eukaryotes vs. prokaryotes with reference to core promoter elements and involved proteins.

12. Explain the significance of CTD phosphorylation in RNA polymerase II during transcription.

13. List the major steps in eukaryotic RNA processing and briefly describe the function of each.

14. Describe the molecular signals required for 3’ polyadenylation of pre-mRNA.

15. What role does the spliceosome play in pre-mRNA processing, and how does it recognize intron-exon boundaries?

16. Define the term “cotranscriptional processing” and give two examples.

17. Discuss the importance of the 5’ cap in translation initiation and mRNA stability.

18. A mutation causes failure in U1 snRNP binding. Predict the consequence on RNA splicing.

19. What is the role of the branch point A in the splicing mechanism?

20. Describe how RNA polymerase II is different from RNA polymerases I and III in terms of function and products.

21. A gene is found to have five exons and can produce three different protein isoforms. Explain how this is possible.
22. A drug that inhibits TFIIH helicase activity is introduced in cells. Predict the impact on transcription.
23. A researcher deletes the polyadenylation signal of a gene. What effect would this likely have on the mRNA transcript?
24. Explain why mutations in splice site consensus sequences can lead to disease phenotypes.
25. A eukaryotic cell is engineered to express an mRNA without a 5’ cap. What would happen to this mRNA in the cytoplasm?