

1. The sequence of the mRNA transcript of gene X is 5'-UUCGACAUUC-3'. What is the sequence of the corresponding DNA coding strand? (2 points)
2. Please list the components of eukaryotic ribosomes. (3 points)
3. Please describe the Wobble concept? Which nucleotide is the most flexible one in the Wobble concept? (3 points)
4. Please write the start codon and stop codon in eukaryotes. (4 points)
5. What sequences/sites are necessary for splicing to occur? (4 points)
6. Please describe the role of IRES sequences in translation. (3 points)
7. Based on two DNA recombination, one can create conditional knockout mice. In conditional knockout mice, the interested gene was specifically disrupted in the specific organ or tissue. Please describe these two DNA recombination. (4 points)
8. What is the role of the 5'-cap during eukaryotic translation? What happens to mRNA molecules that are missing a cap? (4 points)
9. What are the genetic consequences of branch migration occurring during recombination? (4 points)
10. What is the role of insulators in the regulation of transcription? (4 points)
11. All eukaryotes have introns, but bacteria do not have introns. Please describe the advantage of introns. (6 points)
12. Your project is to study the biological function of gene X in bacteria by creating various bacteria gene X mutants. You successfully get three different mutants, including missense, nonsense and frameshift mutants. You have antibody against protein X and can be used in Western blot. However, you mislabel the DNA sequence and western blot results of three mutants. From the pattern of western blot result, how do you know which one is a missense mutation, which one is a nonsense mutation, and which one is a frameshift mutation? Please also describe the pattern of western blot result for each mutant. (9 points)
13. Please describe the principles of the following techniques. (4 points each)
 - 1) Electrophoretic mobility-shift assay
 - 2) Real-time polymerase chain reaction
 - 3) Site-directed mutagenesis
14. The RNA interference (RNAi) machinery is widespread in eukaryotes. Please describe the biological function(s) of RNAi (4 points) and the mechanism of RNAi resulted from siRNA (8 points).
15. Why has evolution selected for the presence of thymine instead of uracil in DNA? (4 points)
16. Describe the substrates and cofactors for DNA-dependent DNA polymerases and the mechanistic steps of DNA synthesis catalyzed by DNA polymerases. (8 points)
17. Please list the proteins participating in DNA synthesis at the replication fork and describe how their activities are coordinated. (10 points)
18. Please explain why DNA microsatellites are prone to mutations. (4 points)