This exam consists of 40 multiple choice questions worth 2.5 points each, for a total of 100 points. Good luck.

1. Which of the following statements is false: Answer: e
   a) SWI-SNF activates transcription by moving nucleosomes from the promoter.
   b) HAT acetylates histones to activate transcription.
   c) HATs and HDACs modify the acetylation of lysines residues.
   d) HDAC reverses transcriptional activation due to HATs.
   e) Lowering the amount of histones also lowers gene transcription.

2. Methylation of __________ decreases gene transcription, and is the basis of imprinting. Answer: b
   a) adenine  b) cytosine  c) guanine  d) thymine  e) uracil

3. Which of the following transcription factors enhance transcription without binding to DNA? Answer: a
   a) Coactivator  b) Architectural  c) TFIID  d) Pol II  e) Zinc finger proteins

4. A transcription factor binds to the sequence TAAGCTAAGCCCTTG and inhibits transcription. What functional domains must this protein contain? (Note: no other transcription factor can bind this sequence) Answer: b
   a) Dimerization, DNA binding and activation.
   b) Repression and DNA binding.
   c) Repression, dimerization and DNA binding.
   d) DNA binding and activation.
   e) DNA binding.

5. Which cis sequence can function within an intron to regulate transcription? Answer: c
   a) CCAAT box  b) TATA box  c) enhancer  d) GC-rich box  e) Shine-Dalgarno sequence

6. The arabinose operon can only be expressed under the following conditions: Answer: b
   a) High levels of glucose, low levels of cAMP, low levels of arabinose.
   b) Low levels of glucose, high levels of cAMP, high levels of arabinose.
   c) Low levels of glucose, low levels of cAMP, low levels of arabinose.
   d) High levels of glucose, high levels of cAMP, low levels of arabinose.
   e) Low levels of glucose, high levels of cAMP, low levels of arabinose.

7. The lac operon is shown below. If a mutation caused a stop codon early in the lacZ coding region, how would this affect the expression of these proteins within the lac operon? Answer: c
   a) Upon induction, lacZ would not be expressed, but lacY, lacA and lacI would be expressed.
   b) Upon induction, neither lacZ or lacI would be expressed, but lacY and lacA would be expressed.
   c) Upon induction, lacZ, lacY and lacA would not be expressed, but lacI would be expressed.
   d) Upon induction, neither lacZ, lacY, lacA nor lacI would be expressed.
8. A partial diploid of genotype I+ P O Z Y / I P O Z Y will show: Answer: d
   a) Inducible production of ß-galactosidase and permease.
   b) Constant expression of ß-galactosidase and inducible expression of permease.
   c) Constant expression of ß-galactosidase and permease.
   d) Inducible expression of ß-galactosidase and constant expression of permease.
   e) Inducible expression of ß-galactosidase and no expression of permease.

9. The lac repressor binds to: Answer: a
   a) lactose and the operator  b) RNA polymerase  c) RNA polymerase and the operator
   d) ß-galactosidase, permease and transacetylase  e) the promoter and lactose

10. What is the function of chaperones? Answer: a
    a) To fold proteins into their proper conformation
    b) To move proteins into the endoplasmic reticulum
    c) To phosphorylate proteins
    d) To degrade unfolded proteins
    e) To guide the ribosome to mRNAs

11. When a release factor binds to a translation stop codon, what enzyme does it stimulate to release the protein? Answer: c
    a) EF-G  b) peptidase  c) peptidyl transferase  d) releasin  e) protein synthetase

12. If the following eukaryotic mRNA were properly modified and sent to the cytoplasm, what size protein (in amino acids) would it encode? Answer: e
    5'UCAGGACCUAUGGACCAUUGCUGGACCUCUUUGAGUGCUGUACCAUAUUAAGAUAGCCAUC 3'
    a) 6  b) 14  c) 10  d) 13  e) 7

13. Which statement describes the correct order of events in translation elongation? Answer: e
    a) The ternary complex binds to the A site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes ATP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.
    b) The ternary complex binds to the P site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes GTP to translocate the aminoacyl tRNA to the A site, tRNA leaves the E site.
    c) The ternary complex binds to the A site, EF-G leaves, peptidyl transferase forms a peptide bond, EF-Tu hydrolyzes GTP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.
    d) The ternary complex binds to the P site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes ATP to translocate the peptidyl tRNA to the A site, tRNA leaves the E site.
    e) The ternary complex binds to the A site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes GTP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.

14. Which statement describes the correct order of events in prokaryotic translation initiation? Answer: c
    a) IF1 and IF2 bind the 50S subunit, IF3-fMet-tRNA + mRNA bind the 50S subunit and IF2 leaves to form a 50S initiation complex, the 50S subunit binds and IF1 and IF3 leave to form the 70S initiation complex.
    b) IF1 and IF2 bind the 30S subunit, IF3-fMet-tRNA + mRNA bind the 30S subunit and IF2 leaves to form a 30S initiation complex, the 50S subunit binds and IF1 and IF3 leave to form the 70S initiation complex.
    c) IF1 and IF3 bind the 30S subunit, IF2-fMet-tRNA + mRNA bind the 30S subunit and IF3 leaves to form a 30S initiation complex, the 50S subunit binds and IF1 and IF2 leave to form the 70S initiation complex.
    d) IF1 and IF3 bind the 50S subunit, IF2-fMet-tRNA + mRNA bind the 50S subunit and IF3 leaves to form a 50S initiation complex, the 30S subunit binds and IF1 and IF2 leave to form the 70S initiation complex.
    e) IF1 and IF3 bind the 30S subunit, IF2-fMet-tRNA + mRNA bind the 30S subunit and IF3 leaves to form a 30S initiation complex, the 50S subunit binds and IF1 and IF2 leave to form the 70S initiation complex.
15. In prokaryotes, the ribosome selects the proper translation initiation codon using: Answer: d
   a) the 5’ mRNA cap.
   b) the aminoacyl tRNA binding site
   c) the Kozak sequence
   d) the Shine-Dalgarno sequence
   e) the 28S ribosomal RNA

16. A tRNA with the anticodon 5’ GCU 3’ would base pair with which codon(s)? Answer: c
   a) 5’ CGA 3’ and 5’ CGG 3’
   b) 5’ AGC 3’ only
   c) 5’ AGC 3’ and 5’ AGU 3’
   d) 5’ CA 3’ only
   e) 5’ CGA 3’, 5’ CGI 3’ and 5’ CGG 3’

17. How many different tRNA synthetases are there in a cell? Answer: b
   a) 64
   b) 20
   c) 61
   d) <64 & >20
   e) 18

18. The realization that there are more combinations of triplet codons than there are amino acids indicated that:
   a) The genetic code can’t be accounted for by triplet codons.
   b) Many codons are skipped during translation.
   c) The genetic code is degenerate.
   d) More amino acids are yet to be discovered.
   e) Proteins start from a fixed starting point.

19. A beta pleated sheet is an type of protein ____________ structure. Answer: b
   a) primary
   b) secondary
   c) tertiary
   d) Quaternary

20. How many different tRNAs are in a cell? Answer: d
   a) 64
   b) 20
   c) 61
   d) <64 & >20
   e) 18

21. Which statement best describes the process of prokaryotic transcription initiation? Answer: a
   a) Sigma factor directs RNA polymerase to the promoter by binding the –10 and –35 regions.
   b) Sigma factor directs RNA polymerase to the promoter by binding the TATA box.
   c) Rho directs RNA polymerase to the promoter by binding the –10 and –35 regions.
   d) TFIID directs RNA polymerase to the promoter by binding the TATA box.
   e) TFIID directs RNA polymerase to the promoter by binding the –10 and –35 regions.

22. Which event occurs while a eukaryotic mRNA is being transcribed? Answer: c
   a) The polyA tail is added
   b) Transport to the cytoplasm.
   c) Removal of introns.
   d) Translation.

23. A strong hairpin followed by a stretch of U nucleotides in the 3’ untranslated region of a prokaryotic RNA results in what? Answer: d
   a) Addition of a polyA tail
   b) Rho dependent termination of transcription.
   c) Translation of the RNA terminates.
   d) Rho independent termination of transcription.
   e) Sigma dependent termination of transcription.

24. Which nucleotide is at both the 5’ and 3’ ends of an intron? Answer: c
   a) A
   b) C
   c) G
   d) T
   e) U

25. Within the lariat formed during splicing, which nucleotide is involved in 5’, 3’ and 2’ phosphodiester bonds? Answer: a
   a) A
   b) C
   c) G
   d) T
   e) U
26. A polyA tail is added to:  
   a) All eukaryotic RNAs  
   b) Prokaryotic and Eukaryotic mRNAs  
   c) Eukaryotic mRNAs  
   d) Eukaryotic mRNAs and tRNAs  
   e) Prokaryotic and eukaryotic rRNAs.  
Answer: c

27. In the context of a whole chromosome, which of the following is correct?  
   a) RNAs from different genes can be transcribed off either strand, but always in 5'→3'.  
   b) RNAs from different genes can be transcribed off either strand, but always in 3'→5'.  
   c) The RNAs from all genes are always transcribed 5'→3' off the same DNA strand.  
   d) The RNAs from all genes are always transcribed 3'→5' off the same DNA strand.  
   e) RNAs from different genes can be transcribed off either strand, some 5'→3' and others 3'→5'.  
Answer: a

28. What modification occurs at the 5' end of an mRNA?  
   a) A 5-methylGuanosine cap is added through a 5'-3' linkage.  
   b) A 7-methylAdenine cap is added through a 3'-3' linkage.  
   c) A 7-methylGuanosine cap is added through a 5'-3' linkage.  
   d) A 7-methylAdenine cap is added through a 5'-5' linkage.  
   e) A 7-methylGuanosine cap is added through a 5'-5' linkage.  
Answer: e

29. Which statement correctly matches the three RNA polymerases with RNAs they synthesize?  
   a) RNA pol I & mRNA, RNA pol II & rRNA, RNA polIII & tRNA  
   b) RNA pol I & rRNA, RNA pol II & mRNA, RNA polIII & tRNA  
   c) RNA pol I & tRNA, RNA pol II & mRNA, RNA polIII & rRNA  
   d) RNA pol I & rRNA, RNA pol II & tRNA, RNA polIII & mRNA  
   e) RNA pol I & tRNA, RNA pol II & rRNA, RNA polIII & mRNA  
Answer: b

30. Below is a diagram showing a fragment of DNA in which the lower strand serves as a template for mRNA synthesis:  
   Answer: a  
   
   5' CATGCCGATC 3'  
   3' GTACGGCTAG 5'  

   The transcribed mRNA can be represented by:  
   a) 5' CAUGCCGUAUC 3'  
   b) 5' GUACCGCUAG 3'  
   c) 3' CAUGCCGAUC 5'  
   d) 5' CUAGCCGUAC 3'  
   e) 5' GAUCGGCAUG 3'  

Answer: a

31. Which statement best describes telomerase function?  
   a) Lengthens the 3' strand at the end of a chromosome using an RNA template.  
   b) Lengthens the 3' strand at the end of a chromosome using the 5' DNA strand as a template.  
   c) Lengthens the 5' strand at the end of a chromosome using an RNA template.  
   d) Lengthens the 5' strand at the end of a chromosome using the 3' DNA strand as a template.  
   e) Lengthens the 3' strand at the end of a chromosome without a template.  
Answer: a

32. If a 1000 kilobase DNA fragment has 10 evenly spaced replication origins and DNA polymerase synthesizes DNA at 1 kilobase per second, how many seconds will it take to complete the replication of this DNA fragment?  
   a) 50  
   b) 100  
   c) 10  
   d) 40  
   e) 20  
Answer: a

33. Which statement best describes the characteristics of an Okazaki fragment?  
   a) A DNA primed RNA fragment formed on the leading strand.  
   b) An RNA primed DNA fragment formed on the leading strand.  
   c) An RNA primed DNA fragment formed on the lagging strand.  
   d) A DNA primed RNA fragment formed on the lagging strand.  
   e) An RNA primed RNA fragment formed on the lagging strand.  
Answer: c
34. Which factor removes positive supercoils ahead of the replication fork?  
   Answer: b  
   a) SSBP  b) Topoisomerase  c) DNA polymerase  d) RNA primase  e) DNA helicase

35. Which factor unwinds the DNA helix?  
   Answer: e  
   a) SSBP  b) Topoisomerase  c) DNA polymerase  d) RNA primase  e) DNA helicase

36. Base pairing in DNA is restricted to two base pairs, represented as follows (numbers between the bases signify the number of hydrogen bonds). Which of the following is correct?  
   Answer: c  
   a) A3T & G2C  b) A2C & G3T  c) T2A and C3G  d) A3G & C2T  e) A2T & C2G

37. If a piece of normal double stranded DNA has an adenine content of 34%, what proportion of cytosine do you expect?  
   Answer: b  
   a) 34%  b) 16%  c) 68%  d) 32%  e) 25%

38. Which researcher (or researchers) labeled DNA with heavy nitrogen to show that DNA was semiconservatively replicated?  
   Answer: b  
   a) Avery, McCarty and McLeod  b) Meselson and Stahl  c) Hershey and Chase  d) Griffith  e) Chargaff

39. The molecule shown at the right is a __________.  
   a) Deoxythymidine 5’-monophosphate  b) Cytidine 5’-monophosphate  c) Deoxyadenine 5’-monophosphate  d) Uridine 5’-monophosphate  e) Deoxycytidine 5’monophosphate

40. Which researcher (or researchers) showed that DNA from a virulent S strain is what converted the R strain from non-virulent to virulent?  
   Answer: a  
   a) Avery, McCarty and McLeod  b) Meselson and Stahl  c) Hershey and Chase  d) Griffith  e) Chargaff