BIOL 2104, Winter 2010: Final Exam, Sample Multiple Choice Questions

***NOTE: this is NOT the length of the final exam. These are *sample* multiple choice questions for material covered *since* the second midterm. The final exam will have 36 multiple choice and 8 written answer questions covering topics from the entire course. See the two midterms and associated practice midterms to review multiple choice questions pertaining to the first 2/3rds of the course. For samples of written answer questions, see collection of assigned questions associated with each topic from throughout the term (summaries).**

1) You have a piece of DNA that includes the following sequence:

5′-ATAGGCATTCGATCCGGATAGCAT-3′
3′-TATCCGTAAGCTAGGCCTATCGTA-5′

Which of the following RNA molecules could be transcribed from this piece of DNA?
a. 5′-UAUCCGUAAGCUAGGCCUAUGCUA-3′
b. 5′-AUAGGCAUUCGAUCCGGAUAGCAU-3′
c. 5′-UACGAUAGGCCUAGCUUACGGAUA-3′
d. more than one of the above

2) The sigma (σ) subunit of bacterial RNA polymerase _____.
a. contains the catalytic activity of the polymerase
b. remains part of the polymerase throughout transcription
c. recognizes promoter sites in the DNA
d. recognizes transcription termination sites in the DNA

3) Which of the following DNA sequences could be the template for a piece of mRNA with the sequence: 5'-UGCCGACGUAGG-3'

a. 5'-TGCCGACGTAGG-3'
b. 3'-TGCCGACGTAGG-5'
c. 5'-ACGGCTGCATCC-3'
d. 3'-ACGGCTGCATCC-5'

4) The functional equivalent of the TATA binding protein in prokaryotes is:
a. sigma subunit b. holoenzyme c. Rho factor d. TFIID e. CAP-cAMP

5) Which type of RNA are structural components of spliceosomes, the nuclear structures that excise introns from nuclear genes?
a. tRNA b. hnRNA c. rRNA d. mRNA e. snRNA

6) How many triplet codons can be made from the four ribonucleotides A, U, G, and C containing one or more uracils?
a. 28/64 b. 16/64 c. 27/64 d. 37/64 e. none of the previous

7) The anticodon of a tRNA is 5'-UUG-3'. What codon(s) can be theoretically recognized by this tRNA?
a. 5'-CAA-3' only b. 5'-CAA-3' and 5'-CAG-3' c. 5'-AAC-3' only
d. 5'-AAC-3' and 5'-GAC-3' e. 5'-CAC-3' only

8) It is possible to convert the Cys that is a part of Cys-tRNA^{Cys} to Ala by a catalytic reduction. If the resulting Ala-tRNA^{Cys} were added to a mixture of (1) ribosomes, (2) all the other tRNAs and amino acids, (3) all of the cofactors and enzymes needed to make protein *in vitro*, and (4) mRNA for hemoglobin, where in the newly synthesized hemoglobin would the Ala from Ala-tRNA^{Cys} be incorporated?

a. Nowhere; this is the equivalent of a nonsense mutation
b. Wherever Ala normally occurs
c. Wherever Cys normally occurs
d. Wherever either Ala or Cys normally occurs
e. Wherever the dipeptide Ala-Cys normally occurs

9) How many different mRNAs could specify the amino acid sequence met-arg-ala-trp?

a. 12 b. 81 c. 1 d. 48 e. 24

10) Which of the following is a feature of the "Wobble" hypothesis?

a. A naturally occurring tRNA can read both arginine and lysine codons
b. A tRNA can recognize only one codon.
c. Some tRNAs can recognize codons that specify two different amino acids, if both are nonpolar.
d. The third base in a codon always forms a normal Watson-Crick base pair.
e. The "wobble" occurs in the first base of the anticodon.

11) The Shine-Dalgarno sequence found in prokaryotic systems resides on the ___ end of _____ and is the _____ site.

a. 3'; peptidyl-tRNA; EF-Tu
b. 3'; stop codons; RF-3
c. 3'; 16S rRNA; IF-3 binding
d. 5'; mRNA; ribosome binding
e. 3'; aminoacyl-tRNA; formyl methionine binding

12) Which amino acid would you expect a tRNA with the anticodon 5′-CUU-3′ to carry?

a. lysine b. glutamic acid c. leucine d. phenylalanine e. arginine

13) Which of the following pairs of codons might you expect to be read by the same tRNA as a result of wobble?

a. CUU and UUU b. GAU and GAA c. CAC and CAU d. AAU and AGU

14) A mutation in the tRNA for the amino acid lysine results in the anticodon sequence 5′-UAU-3′ (instead of 5′-UUU-3′). Which of the following aberrations in protein synthesis might this tRNA cause?

a. read-through of stop codons
b. substitution of lysine for isoleucine
c. substitution of lysine for tyrosine
d. substitution of lysine for phenylalanine

15) A strain of yeast translates mRNA into protein inaccurately. Individual molecules of a particular protein isolated from this yeast strain have variations in the first 11 amino acids compared with the sequence of the same protein isolated from normal yeast cells, as shown in the figure below.

normal sequence	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	Ile	Lys
variants	Met	Thr	Ala	**Ala**	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Thr	Ala	**Gly**	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Thr	Ala	**Val**	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	**Ala**	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	**Gly**	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	**Val**	Lys

What is the most likely cause of this variation in protein sequence?

a. a mutation in the DNA coding for the protein
b. a mutation in the anticodon of the isoleucine tRNA ($tRNA^{Ile}$)
c. a mutation in the isoleucyl-tRNA synthetase that decreases its ability to distinguish between different amino acids
d. a mutation in the isoleucyl-tRNA synthetase that decreases its ability to distinguish between different tRNA molecules

16) In eukaryotes, but *not* in prokaryotes, ribosomes find the start site of translation by _____.

a. scanning along the mRNA from the 5′ end
b. binding directly to a ribosome-binding site preceding the initiation codon
c. recognizing an AUG codon as the start of translation
d. binding an initiator tRNA

17) You have discovered an alien life form that surprisingly uses DNA as its genetic material, makes RNA from DNA, and reads the information from RNA to make protein using ribosomes and tRNAs, which read triplet codons. Because it is your job to decipher the genetic code for this alien, you synthesize some artificial RNA molecules and examine the protein products produced from these RNA molecules in a cell-free translation system using purified alien tRNAs and ribosomes.

Message	Peptides produced
poly UA	... Tyr-Cys-Tyr-Cys ...
poly UC	... Phe-Lys-Phe-Lys ....
poly UAC	... Ile-Ile-Ile-Ile ... + ... Ser-Ser-Ser-Ser.... + ... Pro-Pro-Pro-Pro ...
poly UCA	... Ala-Ala-Ala-Ala ... + ... His-His-His-His... + ... Val-Val-Val-Val ...
poly AUA	... Arg-Arg-Arg-Arg ... + ... Glu-Glu-Glu-Glu... + ... Tyr-Tyr-Tyr-Tyr ...

From this information, which of the following peptides can be produced from poly UAUC?

a. Ile-Phe-Val-Tyr b. Tyr-Ser-Phe-Ala c. Ile-Lys-His-Tyr d. Cys-Pro-Lys-Ala

18) After treating cells with a mutagen, you isolate two mutants. One carries alanine and the other carries methionine at a site in the protein that normally contains valine. After treating these two mutants again with mutagen, you isolate mutants from each that now carry threonine at the site of the original valine. Assuming that all mutations caused by the mutagen are due to single nucleotide changes, what is the codon used for alanine at the affected site?

a. GCG b. GCU c. GCC d. GCA
e. cannot deduce from the information given

19) Protein X is found to bind to a certain gene's promoter only when substance A is not present. The gene can be transcribed in the presence of both X and A. It is not transcribed in the presence of X alone. Protein X is a/an _____. Substance A is a/an _____.

a. repressor; inducer b. repressor; corepressor c. activator; inducer
d. activator; corepressor e. enhancer; ligand

20) Which is true about an operator constitutive (O^c) mutation?

a. An O^c mutation on the host chromosome can affect the expression of structural genes on a F' plasmid
b. The O^c mutation prevents the expression of a diffusible product that regulates the *lac* operon
c. An *F' I+P+O^{c}Z-Y+A-/I+P+O+Z+Y+A+* partial diploid expresses all the enzymes of the *lac* operon constitutively
d. The O^c mutations act only in *cis*
e. An *F' I+P+O^{c}Z+Y+A+/I+P+O+Z-Y-A-* partial diploid is inducible for the three enzymes of the *lac* operon.

21) The tryptophan operon of *E. coli* is repressed by tryptophan added to the growth medium. The tryptophan repressor:

a. binds to RNA polymerase when tryptophan is present.
b. binds to the *trp* operator in the absence of tryptophan.
c. binds to the *trp* operator in the presence of tryptophan.
d. is an attenuator.

22) Which of the following statements is true of the attenuation mechanism used to regulate the tryptophan biosynthetic operon in *E. coli*?

a. Attenuation is the only mechanism used to regulate the *trp* operon.
b. One of the enzymes in the Trp biosynthetic pathway binds to the mRNA and blocks translation when tryptophan levels are high.
c. The leader polypeptide plays a direct role in causing RNA polymerase to attenuate transcription.
d. Trp codons in the leader peptide gene allow the system to respond to tryptophan levels
e. When tryptophan levels are low, the *trp* operon transcripts are attenuated (halted) before the operon's structural genes are transcribed.

23) Which of the following types of gene regulation occurs in eukaryotes only?
a. positive regulation b. chromatin remodeling c. transcription attenuation
d. negative regulation e. glucose repression

24) All are correct about enhancer sequences in eukaryotic cells EXCEPT:
a. they can occur either upstream or downstream to the gene.
b. they can be in either orientation (bi-directional).
c. enhancer function is dependent on recognition by a specific transcription factor.
d. specific transcription factor binding at an enhancer can stimulate transcription by interacting with mediator.
e. all are correct.

25) A mutation in the codon UCG to UAG is described as:
a. missense b. synonymous c. silent d. frameshift e. nonsense

26) In base-excision repair, the first enzyme to act is:
a. AP endonuclease.
b. excision exonuclease (deoxyribophosphodiesterase)
c. DNA glycosylase.
d. DNA ligase.
e. DNA polymerase.

27) Which of the following repair pathways do NOT involve the use of a homology-dependent repair system?
a. base excision repair b. repair by photolyases c. SOS Repair
d. nucleotide excision repair e. mismatch repair

28) Base-pair substitutions in which involve the replacement of a purine in one strand of DNA with the other purine and the replacement of a pyrimidine in the complementary strand with the other pyrimidine are known as:
a. isomers b. transitions c. transversions d. inversions e. none of these

29) Which of the following terms would NOT be used to describe a human with Patau Syndrome, who has three copies of chromosome 13? (more than one answer is possible)
a. polyploid b. triploid c. aneuploid d. euploid
e. 2n+1 f. trisomy 12

30) Which of the following is most likely to produce an abnormality such as sterility or even death in most cases?
a. euploidy b. allopolyploidy c. aneuploidy d. amphidiploidy