

BIOL 2104, Winter 2014: Final Exam, Sample Multiple Choice Questions

***NOTE: this is NOT the length or format of the final exam. These are 26 *sample* multiple choice questions for material covered *since* the second midterm. The final exam will have 30 multiple choice and 6 written answer questions covering topics from the entire course (Lectures 1-25). 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 practice questions associated with each topic from throughout the term (Summaries/Terms to Know/Practice Questions), plus written answer questions from midterm 2, sample midterm 2, and midterm 2 take-home assignment.**

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

5' -ATAGGCATTTCGATCCGGATAGCAT-3'
3' -TATCCGTAAGCTAGGCCTATCGTA-5'

Which of the following RNA molecules could be transcribed from this piece of DNA?

- 5'-UAUCCGUAAGCUAGGCCUAUGC UA-3'
 - 5'-AUAGGCAUUCGAUCCGGAUAGCAU-3'
 - 5'-UACGAUAGGCCUAGCUUACGGUAU-3'
 - more than one of the above
- 2) The sigma (σ) subunit of bacterial RNA polymerase _____.
- contains the catalytic activity of the polymerase
 - remains part of the polymerase throughout transcription
 - recognizes promoter sites in the DNA
 - recognizes transcription termination sites in the DNA
- 3) What is the amino acid sequence that will be created from this RNA? (assume that the ribosome is recruited to the template although the Shine-Dalgarno sequence is not shown)
- 5'-CAUUAUGCCCGGAGGCACCGUCCAAU-3'
- Met-Pro-Gly-Gly-Thr-Val-Gln
 - His-Tyr-Ala-Arg-Arg-His-Arg-Pro
 - His-Ile-Leu-Tyr-Met-Cys-Ala-Pro-Pro-Arg-Gly-Glu-Arg-Gly-Ala
 - Met-Cys-Ala-Pro-Pro-Arg-Gly-Glu-Arg-Gly-Ala
- 4) The base composition of a viral genome was found to be 11% A, 32% G, 18% U and 39% C. This genome is likely:
- double stranded DNA
 - double stranded RNA
 - single stranded RNA
 - single stranded DNA
 - impossible to tell
- 5) How many triplet codons can be made from the four ribonucleotides A, U, G, and C containing one or more uracils?
- 28/64
 - 16/64
 - 27/64
 - 37/64
 - none of the previous
- 6) The anticodon of a tRNA is 5'-UUG-3'. What codon(s) can be theoretically recognized by this tRNA?
- 5'-CAA-3' only
 - 5'-CAA-3' and 5'-CAG-3'
 - 5'-AAC-3' only
 - 5'-AAC-3' and 5'-GAC-3'
 - 5'-CAC-3' only

- 7) How many different mRNAs could specify the amino acid sequence met-arg-ala-trp?
a. 12 b. 81 c. 1 d. 48 e. 24
- 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) 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.
- 10) 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
- 11) 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
- 12) Which of the following occurs as the ribosome shifts down the mRNA by a distance of one codon?
a. the tRNA that was in the A site picks up another amino acid
b. the tRNA that was in the A site releases the growing polypeptide chain
c. the tRNA that was in the A site moves into the P site
d. the tRNA that was in the P site moves into the A site
e. the tRNA that was in the P site picks up another amino acid

- 13) 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
- 14) 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
- 15) In eukaryotes, but *not* in prokaryotes, ribosomes find the start site of translation by _____.
 a. scanning along the mRNA from the 5' end cap
 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
- 16) You have discovered an alien life form that 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

17) 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

18) A mutation in the codon UCG to UAG is described as:

- a. missense b. synonymous c. silent d. frameshift e. nonsense

19) Two strains of bacteria, $a b^+$ and $a^+ b$, are grown together resulting in the production of some $a^+ b^+$ recombinants. $a^+ b^+$ recombinants are produced when these two strains are grown on *opposite* arms of a U-tube. However, no recombinants are produced if DNase I is added. What parasexual process is likely to be responsible for the formation of the $a^+ b^+$ recombinants when these strains are grown together?

- a. conjugation b. transduction c. transformation
d. none of the previous

20) In a generalized transduction system the donor is $A^+ B^+ C^-$ and the recipient is $A^- B^- C^+$. The donor allele A^+ is initially selected after transduction and transductants are then scored for the other alleles present. From the results given at right the gene order is:

- a. A C B b. C A B c. A B C
d. A is linked to C but B is unlinked e. none of the above

| | |
|-----------|-----|
| $B^- C^+$ | 50 |
| $B^+ C^-$ | 18 |
| $B^+ C^+$ | 4 |
| $B^- C^-$ | 27 |
| | 100 |

21) The following table includes data from an interrupted conjugation experiment.

| <u>Marker</u> | <u>Time when recombinants were first found (minutes)</u> |
|---------------|--|
| man^+ | 12 |
| his^+ | 24 |
| thr^+ | 16 |
| tyr^+ | 16 |

The best map of the Hfr based on the above information is

- a. man — his ————— thr ————— tyr —————>
b. tyr — thr ————— his ————— man ————>
c. his — thr/tyr ————— man ————>
d. man — thr/tyr ————— his —————>
e. man — thr ————— tyr ————— his —————>

22) In a cross, Hfr $arg^+ met^+ mal^+$ X $F^- arg^- met^- mal^-$, mal is known to be transferred later than arg and met . To determine the order of the genes, mal^+ exconjugants were selected and the arg and met phenotypes were as follows.

| | |
|---------------------|-----|
| $Met^+ Arg^+ Mal^+$ | 375 |
| $Met^- Arg^- Mal^+$ | 149 |
| $Met^- Arg^+ Mal^+$ | 32 |
| $Met^+ Arg^- Mal^+$ | 0 |

Using the above data, the order of the three genes is:

- a. $mal - arg - met \longrightarrow$ b. $met - arg - mal \longrightarrow$
 c. $arg - met - mal \longrightarrow$ d. $met - mal - arg \longrightarrow$
 e. $mal - met - arg \longrightarrow$

23) The distance between met and arg in the above question (#22) is:

- a. 26.8 m.u. b. 5.8 m.u. c. 39.7 m.u. d. 32.6 m.u. e. 8.5 m.u.

24) 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

25) 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.

26) The Catabolite Activator Protein (CAP) binds cAMP with the greatest efficiency and subsequently promotes transcription of the lac operon under which of the following conditions?

- a. high lactose levels b. low lactose levels c. high glucose levels
 d. low glucose levels e. glucose and lactose levels are irrelevant