DIRECTIONS: Read each question carefully at the beginning of the exam period. Ask for help if the question is unclear. The number in parentheses by each question is the points for that question. Enough space is given for each question for a complete answer. **Partial credit is given for partial answers. Please fill in your name and student ID now!!**

1. (12) Short Answer. Answer each of the following questions in the space provided.

   a) Describe the experiments done by Meselson and Stahl. What were their specific conclusions?
   Meselson and Stahl used heavy and light nitrogen to determine the mode of replication. Cells were grown in heavy N, then placed in light N for 2 DNA replications. The result is DNA were classified by weight using a cesium gradient centrifugation. Results: DNA replication is semi-conservative.

   b) Give an example of a degradative block from this class and say why it is a degradative block.
   A degradative block has an effect on an individual because the substrate is not degraded (toxic effect). Examples were Phenylketonuria or Alkaptonuria.

   c) Watson and Crick used several pieces of information in developing their model of DNA. **State three of them.**
   1. 3'-5' Phosphodiester Bonds link the nucleotides
   2. DNA which in nature with a helix (Franklin)
   3. Chargaff's rules set the relationship of bases
   4. Hydrogen bonds set the structure

   d) In a single sentence, describe the difference between inducible and repressible.
   Under the presence of a trigger, inducible systems are turned ON, repressible systems are turned OFF.

2. (4) Circle ALL that are likely functions of the upstream noncoding region in Eukaryotes (in either DNA or RNA).
   a) Intron Signals
   b) Operator Signals
   c) Translation Initiation Signals
   d) Transport Signals
   e) Where Guanine Cap is added

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3. (6) The following is the entire mRNA transcript for a Eukaryotic gene. Give the protein as translated from this mRNA.

\[5' \text{AGGACGGAGUUGAGCGAGGAGAUUGAGGUG} \text{AAAAAAAAAAA} 3'\]

\[N\text{ Met Arg Gln Asp C}\]

Label the N-Terminus and C-Terminus

4. (4) Here is a codon from some gene in a Prokaryote.

\[5' \text{CUU} 3'\]

a) Give all the possible tRNAs that could pair with this during translation (there are more spaces given than needed).

\[3' \text{GAA} 5' \quad 3' \text{GAG} 5' \quad 3' \text{GAR} 5' \quad 3' \quad 5' \quad 3' \quad 5'\]

5. (4) Circle the correct mRNA conformation when the attenuation system terminates transcription early. Consider these occurring at the time when the decision must be made to continue or stop.

6. (8) For each statement, determine whether it is true for Prokaryotes, Eukaryotes, or Neither. (Can be both)

\(P = \text{Prokaryotes} \quad E = \text{Eukaryotes} \quad X = \text{Neither} \) (Circle both B and E if true for BOTH)

- P E X rRNA is processed before use
- P E X Replication has several points of origin
- P E X Uses the rho factor in transcription
- P E X Has several genes per transcript

7. (4) In class, we discussed intron processing. Circle ALL of the following that are valid ways in which introns are spliced.

- Automatic splicing using enzymes
- Self-splicing
- Spliced in the cytoplasm
- Splicosomes that splice or don’t under control of the cell
- Uses snRNA in splicing
8. (6) This diagram shows a transcription bubble.

![Diagram of transcription bubble]

a) Add the RNA strand that is transcribed here. Be careful how you place it, as you will be counted off for any ambiguities.
b) Label all the 5' and 3' ends (6 total).

9. (8) The following is a small portion of a DNA molecule.

![DNA molecule diagram]

Answer the following questions.

a) Name the Purine in this base pair. **Guanine**
b) Circle the Pyrimidine Nucleotide.
c) Mark all 5' and 3' ends.
d) Mark the site that determines this nucleotide is DNA rather than RNA (there are two, mark only one).
10. (6) This is a diagram from your Course Packet concerning a typical Prokaryotic Operon.

In the space provided, give the letter that best represents that region.

a) ______ Cistron

b) ______ Cap Region

c) ______ Pribnow Box

11. (8) The following is a list of Nucleotide sequences or bases that have some genetic meaning. They may be useful on either the DNA or RNA, but if a specific sequence is given.

1. AUG 
2. GC Elements
3. Guanine Cap
4. Palindrome
5. Poly-A
6. Pribnow
7. Shine-Dalgarno
8. TATA
9. UGA
10. UAUA
11. ATG

Fill in the number of the sequence that is BEST described by the statement given. Each sequence may be used at most one time.

5. Added to the 3' end of a Eukaryotic transcript

7. Noncoding signal for Ribosomal attachment in Prokaryotes

9. Signal for termination of translation

8. Signal for Promotion in Eukaryotes closest to the transcript.
12. (16) The following is a story about Translation in Prokaryotes. Fill in the blanks with the appropriate terms.

The Shine-Dalgarno sequence, along with the start codon signal the small subunit of the ribosome and a charged tRNA to bind, giving you the initiation complex. The large subunit now binds with the first codon at the P site (full name) and the second codon at the A site (full name). P site transferase takes the amino acid from the first tRNA and moves it to the second tRNA. The now-uncharged tRNA now leaves through the E site (full name). Eventually a stop codon appears on the mRNA to signal termination, and the GTP-dependent release factor help to terminate translation.

13. (8) Genetic regulation in Prokaryotes can involve several attributes

1. The secondary structure of the mRNA is the key to regulation
2. Regulation occurs downstream from the transcription initiation site.
3. Is an Inducible system.
4. Control involves a protein (or proteins) that either bind or don’t to the DNA.

For each type of regulation, circle ALL attributes that are true for that type. Each attribute can be used more than one time, and each type of regulation may involve several attributes.

a) Attenuation Model  
b) Negative Control (Tryptophan Model)  
c) Negative Control (Lactose Model)  
d) Positive Control (Catabolite Repression Model)
14. (6) Answer the following questions by indicating the correct structure of location on this picture of a DNA model.

a) Circle and label ONE phosphate

b) Shade the major groove (everywhere it is visible).

### Coding Dictionary

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C = Cytosine, U = Uracil, A = Adenine, G = Guanine

Phosphate marker is indicated on the DNA model.