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 now!!

1. (24) Short Answer. Answer each of the following questions in the space provided.
   a) What were the conclusions for Meselson and Stahl’s experiment?
      DNA replication is semi-conservative
   
   b) What were the results of Chargaff’s experiments?
      Various Concentrations:  
      \[ A + G = C + T \]
      \[ A = T \]
      \[ G = C \]
   
   c) Is Alkaptonuria a biosynthetic block or a degradative block? Defend your choice.
      Degradative Block.
      Alkapton cannot be degraded and that buildup causes problems: Arthritic symptoms; Black Urine.
   
   d) We are going to create a Prokaryotic system for producing human insulin. We have isolated the human gene and can incorporate it into a Prokaryotic cell. We want the insulin to be produced only when we add lactose to the medium.
      What is the Trigger?  \underline{Lactose} 
      This system is (circle one) \underline{Inducible} Repressible. Explain why you chose the answer you did.
      We want the system to be turned on when lactose is present \( \Rightarrow \) Inducible
   
   e) Define Cis-elements and Trans-acting Factors.
      Cis-elements are signals (sequences) on the DNA indicating the start of the gene. Trans-acting Factors (Transcription Factors) are proteins that attach to the cis-elements or to other TF’s to help induce or repress transcription.
   
   f) List the three main processes in the Central Dogma.
      Replication
      Transcription
      Translation
2. (9) For each of the following structures: i) Circle whether the structure is most likely found only in Prokaryotes, only in Eukaryotes, or Could be either Prokaryotic or Eukaryotic; and ii) If you choose either Prokaryotic or Eukaryotic, give a single sentence justification.

3' CGT TGA CGT GAT CAA TCA AAG GTATAACA 5'

a) 5' GCA ACT GCA CTA TAG TGT CTC ATG TCT TCC CAT ATG T 3'
   i) Most likely: Likely Prokaryotic Likely Eukaryotic Could be either
   ii) Justification (Prokaryotic or Eukaryotic, only)
   Prokaryotic + Eukaryotic DNA is the same

b) 5' ACG GAUGUUA CCG ACG GCC CGA AUAA UAG GAA AAA AAA AAA AAA A 3'
   i) Most likely: Likely Prokaryotic Likely Eukaryotic Could be either
   ii) Justification (Prokaryotic or Eukaryotic, only)
   Poly-A tails are indicative of Eukaryotic mRNAs

c) N - fMet Ala Ala Thr Ile Leu Tyr Phe Phe - C
   i) Most likely: Likely Prokaryotic Likely Eukaryotic Could be either
   ii) Justification (Prokaryotic or Eukaryotic, only)
   Initial fMet is only in Prokaryotes

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

5' AGCCA AUGC CCA AUGC CAG GGA UAA CUG AACA GAA 3'

N Met Pro Met Cln Gly C

Label the N-Terminus and C-Terminus

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

5' CGA 3'

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

3' GCU 5' 3' GCI 5' 3' 5' 3' 5' 3' 5' 3' 5' 5' 3'
5. (6) Consider regulation of the lac operon in Prokaryotes. Each situation can be classified as Positive/Negative Control, as Inducible/Repressible, and whether the operon is currently On/Off. For each situation, consider only the part of the operon described, all other components are considered to be on. Circle one from each category.

<table>
<thead>
<tr>
<th>Catabolite Repression with a low concentration of Glucose</th>
<th>Positive/Negative</th>
<th>Inducible/Repressible</th>
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<td>Lac Operon with a high concentration of Lactose</td>
<td>Positive/Negative</td>
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6. (6) Consider Attenuation of the his cistron.

   a) Why does the leader peptide contain a large number of Histidine codons? We want the rate of translation to be indicative of the Histidine concentration.

   b) What would be the effect if all the Histidine codons were replaced with Proline codons? The rate of Histidine production would be determined by Proline concentration.

7. (6) This diagram shows a transcription bubble.

   ![Diagram of transcription bubble]

   a) Identify all three strands as DNA or RNA.
   b) Label all the 5' and 3' ends (6 ends).
   c) The direction of transcription is (circle) LEFT TO RIGHT  RIGHT TO LEFT

8. (4) The following are two bases. One of them is a purine, the other is a pyrimidine. Indicate which is which. Also name the bases as either Guanine or Thymine.

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<td><img src="image" alt="Base Structure 3" /></td>
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9. (24) The following is a list of Nucleotide sequences or enzymes that have some genetic meaning. They may be useful with either the DNA, RNA, or proteins.

1. -35
2. ATG
3. AUG
4. CAAT
5. Exon
6. GC Elements
7. GTP-dependent release factor
8. Guanine Cap
9. Intron
10. Optimal Context
11. Palindrome
12. Poly-A
13. Prihnow
14. Rho
15. RNA polymerase I
16. RNA polymerase II
17. RNA polymerase III
18. Shine-Dalgarno sequence
19. sigma
20. stop codon
21. TATA
22. transcription factors
23. UAUA

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

10 Helps in the efficiency of translation initiation in Eukaryotes. Not the start codon.
20 Signal for termination of translation.
11 Used for rho-independent termination in Prokaryotes.
13 Signals the physical attachment of RNA polymerase in Prokaryotes
14 Helps to terminate transcription in some cases in Prokaryotes \( (11 \text{ is also true}) \)
16 Transcribes the hnRNA in Eukaryotes.
7 Enzyme responsible for assisting termination of translation.
11 Helps in the attachment of the ribosome to the mRNA in Prokaryotes (part of the mRNA). \( (3 \text{ is also true}) \)

10. (3) The following DNA is (circle one) \( \boxed{ \text{LEFT HANDED} } \) \( \text{RIGHT HANDED} \).
11. (9) Complete the following drawing of a Prokaryotic replication fork by adding the leading and lagging strands. Include exactly two Okazaki Fragments. Label all ends of any DNA strands as 5' or 3'.

Locate the following by drawing the indicated figure:

a) DNA Polymerase III (Squares)

b) Helicase (Circles)

c) Gyrase (Triangles)

### Coding Dictionary

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