

Name _____

Use complete sentences when requested. There are 105 possible points on this exam. The multiple choice questions are worth 2 points each. All other questions have the points indicated.

1. Based on Chargaff's rules, which of the following are possible base compositions for double-stranded DNA?
- | | %A | %G | %C | %T | %U |
|----|----|----|----|----|----|
| A) | 25 | 85 | 85 | 25 | 0 |
| B) | 20 | 20 | 20 | 20 | 20 |
| C) | 85 | 15 | 15 | 85 | 0 |
| D) | 35 | 35 | 15 | 15 | 15 |
- E) none of the above or more than one of the above, circle all correct answers
2. In the Watson-Crick model of DNA structure (now called B-form DNA):
- A) a purine in one strand always hydrogen bonds with a pyrimidine in the other strand.
 B) A–T pairs share three hydrogen bonds.
 C) G–C pairs share two hydrogen bonds.
 D) the 5' ends of both strands are at one end of the helix.
 E) the bases occupy the exterior of the helix.
 F) None of these or more than one of these, circle all of the correct answers
3. The double helix of DNA in the B-form is stabilized by:
- A) covalent bonds between the 3' end of one strand and the 5' end of the other.
 B) hydrogen bonding between the phosphate groups of two side-by-side strands.
 C) hydrogen bonds between the riboses of each strand.
 D) nonspecific base-stacking interaction between two adjacent bases in the same strand.
 E) ribose interactions with the planar base pairs.
 F) None of these or more than one of these, circle all correct answers
4. Triple-helical DNA structures can result from Hoogsteen interactions. These interactions are primarily:
- A) covalent bonds involving deoxyribose.
 B) covalent bonds involving the bases.
 C) hydrogen bonds involving deoxyribose.
 D) hydrogen bonds involving the bases.
 E) hydrophobic interactions involving the bases.
 F) None of these or more than one of these, circle all of the correct answers
5. The deoxyribonucleotide polymer (5')TAGGACAA(3') could form a double-stranded structure with:
- A) (5')ATGGTCAA(3').
 B) (5')AACTGGTA (3').
 C) (5')ATCCTGTT (3').
 D) (5')AUCCUGUU (3').
 E) (5')TTGTCCTA (3')
 F) None of these or more than one of these, circle all of the correct answers
6. The t_m (melting temperature) for a double-stranded DNA
- A) Is lower if there is less GC content than AT content
 B) Is determined by measuring the absorbance at 280 nm vs temperature
 C) Is higher if there is more GC content than AT content

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- D) Is determined by observing the solid DNA becoming a liquid
E) None of these or more than one of these, circle all correct answers
7. When you are writing a paragraph, which of the following is the best way to organize the information?
- A) Put the most interesting information in the first sentence, then add supporting details.
B) Put supporting details, then the most interesting information, then clarify the information.
C) Gradually add ideas as you think of them.
D) Introduce the topic, use supportive details and then finish with the most interesting information.
E) All of these are great ways to organize a paragraph.
8. The biological role of restriction enzymes is to:
- A) aid recombinant DNA research.
B) degrade foreign DNA that enters a bacterium.
C) restrict the damage to DNA by ultraviolet light.
D) make bacteria resistant to antibiotics.
E) restrict the size of DNA in certain bacteria.
9. What must an expression vector contain?
- A) A gene that codes for a repressor
B) A site that will bind to ribosomal RNA
C) An operator
D) A promoter
E) None of these or more than one of these, circle all of the correct answers.
10. One type of "Next Generation Sequencing" is 454 Pyro Sequencing. This method includes:
- A) A fluorescent molecule on the terminal phosphate is released when base is incorporated into a growing strand
B) Minute changes in pH are detected each time a base is added.
C) Pyrophosphate is added to ADP_γS with ATP sulfurylase the product, ATP is used by luciferase to generate light
D) Each base has a different fluorescent label. Bridge amplification is used to immobilize the DNA on solid support.
E) Each base has a different label. DNA is modified with a poly A tail that binds to poly T on a flow cell.
11. (8 points) A plasmid that encodes resistance to ampicillin and tetracycline is digested with the restriction enzyme *Bam*HI, which cuts the plasmid at a single site in the tetracycline-resistance gene. The DNA is then annealed with a *Bam*HI digest of human DNA, ligated, and used to transform *E. coli* cells.
- (a) What antibiotic would you put in an agar plate to ensure that the cells of a bacterial colony contain the plasmid?
- (b) How can you select the clones that contain the human DNA? Explain what you would do and what the results would be if the clone contained human DNA.

12. (16 points) Vectors are used to move foreign DNA into a cell where it can be copied or used to express proteins. For each of the following vectors, list the essential components, where the DNA is carried (what kind of cell) and what is the size of the foreign DNA that is delivered to the host cell

Vector = Plasmid	List
Essential components	
What is this vector used for? What kind of cell does it carry DNA to?	
How does the vector get into the cell?	
What size of foreign DNA can be delivered to the host cell?	
Vector = bacteriophage	List
Essential components	
What is this vector used for? What kind of cell does it carry DNA to?	
How does the vector get into the cell?	
What size of foreign DNA can be delivered to the host cell?	
Vector = BAC	List
Essential components	
What is this vector used for? What kind of cell does it carry DNA to?	
How does the vector get into the cell?	
What size of foreign DNA can be delivered to the host cell?	
Vector = YAC	List
Essential components	
What is this vector used for? What kind of cell does it carry DNA to?	
How does the vector get into the cell?	
What size of foreign DNA can be delivered to the host cell?	

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13. (10 points) In order to determine if a mutation has occurred, DNA is sequenced using the Sanger (dideoxy) method. **Briefly explain how this method works** and then give the sequence of DNA that is represented by the following gel. Be sure to label the 5' and 3' end of the DNA.

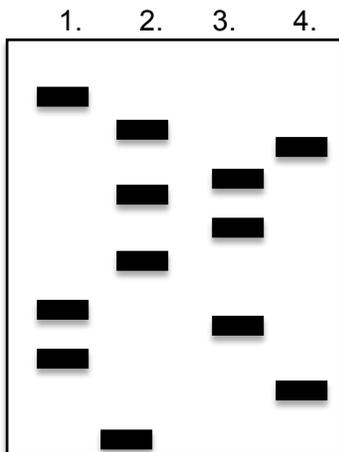


Figure1, DNA sequencing gel for a dodecamer (12 bases) of DNA..

Lane 1: dATP, dGTP, dCTP, dTTP, ddGTP

Lane 2: dATP, dGTP, dCTP, dTTP, ddTTP

Lane 3.: dATP, dGTP, dCTP, dTTP, ddATP

Lane 4: dATP, dGTP, dCTP, dTTP, ddCTP

14. (8 points) Compare and contrast DNA polymerase and DNA ligase. What reactions do they catalyze? How are they similar? How are they different? Provide details in complete sentences.

15. (10 points) Draw the structures for dGMP and cytidine. Circle the atoms that form the hydrogen bonds when guanine pairs with cytosine.

16. (10 points) Describe how PCR works. What is needed? Explain the process that is used. What is in the reaction vial? What are the products? Provide details in complete sentences.

17. (8) Put the following terms in the columns provided. If the term is related to STRs put it in the STRs column. If the term is related to RFLPs, put it in the RFLPs column. There are extra boxes
Terms: CODIS, restriction enzymes, fluorescently labelled DNA probes, PAGE electrophoresis, fluorescently labelled primers, PCR, capillary electrophoresis

RFLPs	STRs

11. (10 points) What type of mutation is the most likely to cause a serious problem for the cell? Describe the mutation and what happens to the DNA. Provide details in complete sentences.