A. 20 points. True/false 2 pts each

<table>
<thead>
<tr>
<th>True</th>
<th>False</th>
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<tbody>
<tr>
<td>1. Hopanoids are the bacterial analogs of sterols that can strengthen the membrane.</td>
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<td>2. Cytochrome c is a membrane protein that carries only electrons.</td>
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<td>3. Heterocysts are specialized cells that cyanobacteria use to convert CO₂ to energy.</td>
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<td>4. Viruses can only infect eukaryotic cells</td>
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<td>5. Archaea are prokaryotes that do not make peptidoglycan</td>
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<td>6. A lyase enzyme transfers a functional group between two substrates.</td>
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<td>7. Thymine is found only in deoxyribonucleic acid.</td>
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<td>8. Cary Mullis received a Nobel Prize for designing the polymerase chain reaction.</td>
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<td>9. Because lipids contain both hydrophobic and hydrophilic units, they possess chemical properties which make ideal components of cell membranes.</td>
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<td>10. A proton motive force can be generated under aerobic conditions with oxygen as electron acceptor or under anaerobic conditions with sulfate as electron acceptor.</td>
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B. 20 points Multiple choice 2 points each. Circle the correct answer

1. The citric acid cycle (TCA) cycle has two major functions. These are
   1. generation of reduced nicotinamide adenine dinucleotide
   2. production of biosynthetic intermediates
   3. production of pyruvic acid.
   4. production of fatty acids.
   5. utilization of coenzyme H.
   A. 1,2
   B. 2,3
   C. 3,4
   D. 1,5
   E. 1,4

2. The person responsible for recognizing that cowpox could be used to immunize against smallpox was ______.
   A. van Leeweunhoek
   B. Mullis
   C. Jenner
   D. Koch
   E. Lister

3. Hydrogen bonding is important in which of the following?
   A. The proper folding of polypeptide chains
   B. The formation of double-stranded nucleic acids
   C. The formation of peptide bonds
   D. A and B above
   E. all of the above

4. Clostridium spores
   A. Are resistant to heat and desiccation
B. Look very similar to vegetative cells  
C. Can be metabolically inactive for long periods of time  
D. A and B  
E. A and C  

5. Arrange the following terms in the order they would be found if you traveled from the inside to the outside of a Gram negative cell possessing a capsule:  
1. periplasmic space  
2. phospholipid bilayer of the outer membrane  
3. O-polysaccharide  
4. cytoplasmic membrane  
5. capsule  
A. 5,3,2,1,4  
B. 4,3,1,2,5  
C. 5,2,3,1,4  
D. 4,1,2,3,5;  
E. 1,4,2,3,5  

6. Viruses:  
A. cannot infect bacteria  
B. are very small cells  
C. have metabolism of their own  
D. none of the above  
E. all of the above  

7. Electron transport components are located in  
A. the periplasmic space  
B. the ribosomes  
C. the glycocalyx (capsule area)  
D. the cell wall  
E. the cytoplasmic membrane  

8. Which best describes the reason that fermenting organisms carry out reactions which reduce pyruvate?  
A. Reduced NAD is toxic to cells.  
B. It is an unregulated reaction of no value.  
C. Cells must regenerate oxidized NAD.  
D. The cell generates energy from pyruvate reduction.  
E. Pyruvate is toxic to cells.  

9. The function of the bacterial cell wall is  
A. to prevent lysis of cells in dilute solutions  
B. to regulate the uptake of nutrients  
C. attachment to surfaces  
D. as a recognition site for phagocytosis  
E. to generate a membrane potential  

10. Phosphorus is needed by all bacteria. Its main use is  
1. for making energy-rich compounds  
2. as an electron acceptor  
3. as a component of cell walls  
4. as a component of nucleic acids  
5. in proteins  
A. 1, 3  
B. 1, 4  
C. 2, 4  
D. 1, 3, 4
C. Four short answer questions (total = 40 points)

1. (20) **Aerobic respiration:** Label the diagram below to show how a cell makes energy growing on glucose. **Include the following:** show the fate of the carbons in glucose, show the electron acceptor and its fate, show a soluble hydrogen carrier and an electron carrier, show the 2 places where ATP is made.

![Aerobic respiration diagram](image)

2. (5) What are Robert Koch’s postulates?

3. (12 points) This is a section of a cell that is >20 µm in diameter. Identify each of the labeled parts.

   a ________________________________  
   (needed for energy production)

   b ________________________________  
   (makes proteins)

   c ________________________________  

   Is this a eukaryote or a prokaryote?
4. (4 pts) What is the name of the molecule shown on the right?

Where might you find this molecule in the cell?

D. 20 points Fill in, 2 points each
The portion of the membrane of Gram negative bacteria that can make people ill is called ______________________. A molecule of sodium is being transported out of the cell at the same time that histidine is transported into the cell. What type of protein is involved in this process? ____________________________
Name two pyrimidines __________________ and ____________________________
Dipicolinic acid is a compound that is found only in what type of cell? ____________________
The C55 isoprenoid alcohol molecule in the membrane that is a carrier for peptidoglycan synthesis is ______________________. ____________________________ is a compound that breaks the β1-4 linkage of bacterial cell walls. In bacteria, glucose is transported into the cell via the______________ system.
Two types of secondary structures you might see in a protein include ______________________ and _______________________

E. Variable (25 points total)
1. (5) The functional group on the right is a ______________________
Give an example of a molecule that contains this type of functional group: ______________________
2. (5) Use the two amino acids below to construct the dipeptide glycine-glutamate (N-terminal glycine).

COOH
CH₂
CH₂
H₂N- C-COOH
H

H
H₂N-C-COOH
H

3. (5) Here is a portion of glycolysis. What is the significance of these steps – in other words, how will these reactions benefit the cell?
4. (5 pts) The figure on the right is a section of a cell that is about 1µm in diameter. Identify each of the labeled parts.

a. ______________________
b._______________________
c. ______________________
d. ______________________
e. Is this a gram positive or gram negative organism? (circle the correct answer)

5. (5) Refer to the electron tower at the right to answer the following questions.

\[ \text{NADH} + \text{H}^+ + \text{NO}_3^- \rightarrow \text{H}_2\text{O} + \text{NAD}^+ + \text{NO}_2^- \]

Calculate the \( \Delta G^\circ' \) for the reaction above using the equation. Show your work.

\[ \Delta G = -n \, F \, \Delta E^\circ' \]

What is \( \Delta E^\circ' \) ______________________

\( \Delta G^\circ' = \) __________

Is this reaction favorable energetically? __________