I. What is the secretion system in the bacteria? (2%) Did Sec pathway exist in all three domains? (1%) What kinds of the secretion systems are dependent on the Sec system? (3%) ABC transporter is the type I secretion system and what is its uniqueness? (2%) What is the uniqueness of the type IV protein secretion pathways? (2%)

II. What is the DNA oligo-nucleotide? (2%) What is the site-directed mutagenesis? (2%) The study of phages useful in biotechnology, give an example. (2%) What is the Z-ring in bacteria and its role? (2 %) What is the biofilm and its role? (2%)

III. RNA was the first of the information molecules to arise during evolution. What is the evidence to support this hypothesis? (3%) *Streptomyes coelicolor* has a linear chromosome. No genes encode essential protein near the ends of its chromosome. Why is this? (3%) The *ara* operon of *E. coli* is an inducible operon that is regulated by a dual-function regulatory protein, the AraC. Explain its role for gene regulation. (2%) What is the quorum sensing and why bacteria would have this system? (2%)

IV. Regulation of Trp attenuator: Explain the attenuation.(2%) Four regions (1~ 4) in the leader sequence; 1 and 2 forms transcription pause loop and 3 and 4 forms terminator loop. When [tryptophan] is high, what it has been occurred? (2%) When [tryptophan] is low, what it has been occurred? (2%) What is the riboswitch and please give a reason for why bacteria have this kind regulation? (2%)What is the diauxic growth for the bacteria; explain it. (2%)

V. What is an Hfq protein doing as an RNA chaperone? (2%) What are the auxotrophs and prototrophs? (2 %) What is an electroporation and what is an artificial transformation? (2%) What is the directed mutation and what is the adaptive mutation?(2%) What is the thymine dimmer and how do the bacteria can fix it?(2%)

VI. Describe some ways to identify a prokaryotic species. (5%)
Describe the contents of "Bergey's Manual of Systematic Bacteriology" and what the information could be offered? (5%)

VII. What is the difference between exotoxins and endotoxins? (2%) Give one proposed mechanism by which endotoxins cause fever. (2%) Describe the mechanism of each type of exotoxin: (1)A-B toxins (2) membrane-disrupting toxins (3) superantigens. (6%)

VIII. What is antimicrobial peptide? (2%) What is β-lactamase? (2%) Describe four major mechanisms by which bacteria become resistant to chemotherapeutic agents. (6%)

IX. What are the following microorganisms and how are they diagnosed?
(1) *Vibrio cholerae* O:139, (2) *Salmonella enterica*, (3) *E. coli* O157:H7,
(4) *Giardia lamblia*, (5) *Helicobacter pylori* (10%)

X. Explain the following terms and give some examples: (1) bioplastics, (2) biofuels, (3) biomass, (4) white biotechnology, (5) metabolic engineering (10%)

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