Review Questions-1

General concepts, history

What was the technique that Carl Woese used to identify another domain to classify m/o in?
How did Pasteur help resolve the debate on spontaneous generation?
What is the difference between Pasteurization and Tyndallization?
What kinds of organisms survive pasteurization? How is pasteurization different from sterilization?

What was the contribution of Carl Woese to the classification of organisms?
What domains did Woese divide microorganisms into? How did his research revolutionize the phylogenetic tree of microorganisms?
Why did Carl Woese choose rRNA as a molecule that could be studied for phylogeny?
What other molecules could be used instead? What surprising results did his study bring up?

Know the names and characteristics of some organisms (2 large, 2 typical and 2 unique in some way other than the large size) from the table in "BIG BACTERIA".

What is the importance of Koch's postulates?
What are the molecular Koch's postulates? How do they reinforce the original criteria that Koch put forward in determining the causal relationship between microorganisms and disease?

Why was the development of solid media a boon to microbiology?
Why did Agar quickly overtake gelatin as the most favored solidifying agent?

Microscopy and staining

Compare and contrast between light microscope and electron microscope (both TEM and SEM).
Know the resolutions limits, and magnifications achieved by each.
Since electron microscopes have higher magnification as compared to light microscopes, can you use it to observe a moving paramecium? What other kinds of microscopy can you use to observe such a specimen?
What are the different kinds of electron microscopes? Which kind would you use to study:

a. internal structure of the mitochondria
b. morphology of a bacterial cell

Why is Gram staining considered a differential staining technique?
Know the procedure of Gram staining. What is the current understanding about why Gram negative organisms do not retain the primary stain?
Why is it difficult to stain *Mycobacterium tuberculosis* using Gram staining technique?
Acid-fast staining is used specifically on bacterial strains that contain _____ in their cell wall.

Cell Structure and Function

What are the three basic shapes of bacterial cells?
Do all cells have rRNA? What is the purpose of rRNA?

What is the 'typical' size of a prokaryotic cell?
Compared to the 'typical' size, how many times is *Epulopiscium fishelsoni* bigger in volume?

What is the theoretical minimum genome size of a free-living organism?
What are *Nanobacteria*? Would you expect *Nanobacteria* to be free-living cells? Explain.

How are big bacteria like *Thiomargarita namebiensis* and *Epilopiscium fishelsoni* able to survive as prokaryotes in spite of their huge sizes?

Know the functions of Prokaryotic and Eukaryotic structures.
In which way are the prokaryotic ribosomes similar to the eukaryotic ribosomes and in which way are these different?

What is nucleoid? What are plasmids?

What is the major chemical component that differs in the plasma membrane of prokaryotes and eukaryotes? What is its function in the membrane?
What function does cholesterol have in the cell membranes of eukaryotes?
What do bacteria have instead of cholesterol in their membranes?
What makes the plasma membrane amphipathic?
What makes the plasma membrane selectively permeable?
What is the MAIN difference between a eubacterial and an archaebacterial plasma membrane?
Give two distinguishing characteristics of the Archael membranes.
What are the similarities and differences between passive diffusion, facilitated diffusion, active transport and group translocation?
What is passive transport? What kinds of molecules enter the cell through this kind of transport? Do you think that amino acids are passively transported into the cell?
What is facilitated diffusion? How is it different from active transport?
Why do microorganisms normally take up nutrients using transport proteins or permeases?
What advantage does a microorganism gain by employing active transport rather than facilitated diffusion?
How are molecules transported by the ABC transport mechanism?
How does the PTS transport system function? In what way is this system different from the ABC system? Which one of the transport systems is defective in patients having cystic fibrosis?
Compare (in a table) the similarities and differences between passive diffusion, facilitated diffusion, ABC transport and group translocation.

Prokaryotic cell wall

Sketch a Gram + ve and a Gram - ve cell wall. Highlight the characteristic feature(s) of each.
How do the Mycoplasmas differ from the G + ve and G - ve cells?
What is unique about the cell wall of Mycobacterium?

What is periplasmic space? What is the nature of the proteins that are present in the periplasmic space?
What are the major components of the cell walls of:
Plants, Fungi, Eubacteria, Archaebacteria

What is the advantage in having D amino acids in the cell wall?
What structure accounts for the negative charge and for toxicity in G +ve cells ?
Know in detail the structure of Gram positive and Gram negative cell walls.
What is the difference in the type of cross-linking found in the peptidoglycan of most Gram positive and Gram negative bacteria?
What is characteristic of the third amino acid in the peptidoglycan subunit?
What other amino acid can take the place of DAP (or lysine)? Why?
What are the components of LPS? What is the function of O antigen?
What makes LPS an endotoxin?
How is the outer membrane different from the plasma membrane?
Why are Archaebacteria resistant to the action of lysozyme?
What is the major difference between the cell wall of Archae and that of Eubacteria?

The polymerization of the new subunit of the peptidoglycan to the existing cell wall occurs outside the plasma membrane. Where does the energy for the transpeptidation step come from?
What is the function of bactoprenol?
What are autolysins? Why are they important?
What is the role of autolysins in the synthesis of bacterial cell walls?
Mention the different patterns of cell wall formation.
What is the role of penicillin binding proteins in cell wall synthesis?
Describe the role of Uridine diphosphate and bactoprenol in peptidoglycan synthesis.
Be familiar with the steps in PG synthesis.
Mention the step (s) at which he following inhibitors act: Cycloserine, penicillin, vancomycin, and bacitracin. Include in our answer whether these steps take place in cytoplasm or outside it i.e. whether the substance needs to enter the cytoplasm to function or not.
Penicillin inhibits transglycosylation and transpeptidation. True/False.
Mention one inhibitor that inhibits both the processes.
What are the similarities and differences between penicillin and lysozyme in terms of their action on the prokaryotic cell? Think of their action on the cell wall and whether these will work on growing/stationary cells.
What is the site of action of : a) lysozyme; b) penicillin?
What would happen to protoplasts in an isotonic, hypotonic and hypertonic environment?
If the cell wall is ruptured, what condition must be provided in order to keep the cell from lysing?

Capsule, Flagella, Endospore

What is a capsule? What is it usually made up of?
Name important advantages provided to the bacterial cell by the capsule?
In what ways does the capsule help the cell? What is the composition (macromolecule) of capsule?
Why does the 'smooth' form of *Streptococcus pneumoniae* cause pneumonia whereas the 'rough' form does not?

What are the different patterns of flagella distribution?
What is the function of flagella in bacteria?
How is the flagella synthesized?
How does flagella grow?
Be familiar with the flagellar ultra structure. Know the composition and function of each part.
How is the bacterial flagellum different from the eukaryotic one?
What is chemotaxis?
In what direction does the flagella have to move in order for the cell to show a "run" instead of a "tumble"?
What drives the flagellar motion? What provides the energy for flagella to move?

What are endospores?
Why does a microorganism form endospores?
What triggers the formation of endospores?
How (and why) are they formed? How do they germinate?
What are the different reasons proposed on why endospores are so resistant?
Know the ultra structure of endospore.
What are the names of the four layers of endospores (as seen under electron microscope)?
Which of these layers makes endospores impermeable? What is it made up of?
What makes endospores so resistant?
Know the various stages in the germination of an endospore into a vegetative cell.
How would you destroy the endospores of pathogenic organisms?
Endospores can be looked under the light microscope by simple / differential staining Technique. Circle the correct answer.
Endospore germination takes longer time than spore formation. True/false.

What are the major differences between Eubacteria, Archae and Eukarya?

Nutrition, Growth and Control

List the chemical elements needed by the cell in "large" amounts, and in trace amounts.
What are prototrophs and auxotrophs?
A m/o that requires the same nutrients as most naturally occurring organisms of that species is called a(n) _____. How is it different from an auxotroph?
Difference between m/o based on their nutritional requirement: Sources of carbon, energy,

and electrons.
What are the major nutritional types of m/o?
What are growth factors? Name three major classes of growth factors.

Based on the source of C, H, and energy, which category does each kind of microorganism (m/o) belong to?
The m/o gets energy from oxidation of organic or inorganic compounds _____
The m/o gets H/e^- from organic molecules _____
The m/o gets carbon from reduced organic molecules _____
The m/o gets H/e^- from reduced inorganic molecules _____

What is the difference between complex and synthetic medium?**
What is the difference between selective, differential, and enrichment media?**
What are the different ways for obtaining a pure culture?**
Why would you prefer to pick up cells from the edge of the colony rather than from its center?**
Why do we need solid medium, instead of liquid medium, to grow bacteria?**

Growth curve. What are the 4 phases of growth in a batch culture? Explain which of these phases represents balanced growth and which phase represents unbalanced growth.
What is generation time/doubling time? How can you determine the generation time from an organism's growth curve?
Do microorganisms grow arithmetically or exponentially? What is the significance of this Growth pattern?
Sketch a typical growth curve and briefly describe each of the different phases of the growth curve.

Which of the following is a reason for the occurrence of a lag phase in a bacterial growth curve?

The cells may be old and depleted of ATP, essential cofactors, and ribosomes, which must be synthesized before growth can begin.
The current medium may be different from the previous growth medium; therefore, the cells must synthesize new enzymes to utilize different nutrients.
The organisms may have been injured and thereby may require time to recover.
All of the above are potential reasons for the occurrence of a lag phase.

Measurement of microbial growth by cell number and cell mass.**

Effect of environmental factors on growth: osmolarity, pH, temp, oxygen, pressure, radiation.
M/O that grow well in salty environment are called _____
M/O are classified into different groups based on the optimum temperature at which they grow and the range of temperature that they can tolerate. Mention each of these groups.
How does a psychrophile tolerate low temperatures and how does a thermophile survive at high temperatures?
Which M/O will grow well at 25 ^oC?
a. Psychrophiles b. Mesophile c. Thermophiles d. Hyperthermophiles

What is the difference between obligate anaerobes, aerotolerant anaerobes, facultative anaerobes, aerobes, and microaerophiles?
What are the various groups of micro organisms based on their interaction (dependence on) with oxygen. For each group mention whether these have the following enzymes: SOD and catalase.

Organisms that are not affected by increased pressure are _____, while those which grow more rapidly at increased pressure are _____
What is 'Quorum sensing' and what is its significance?

Which of the following would you use if you wanted to reduce the number of m/o to a level that is considered safe?

a. Antiseptic b. Sterilization
c. Disinfection d. Sanitization

Which of the following methods can kill all the micro organisms: Sterilization, disinfection, treatment with antiseptic or sanitization?

Distinguish between sterilization, disinfection and pasteurization.
Disinfectants are usually more toxic than antiseptics.
What are the different conditions that influence the activity of an antimicrobial agent?
What are the different physical and chemical methods used to control m/o?

What is Tyndallization? How does this overcome the limitations of boiling/heating?
Will tyndallization kill all the endospores? Explain.

Give examples of antibiotics which function to kill bacteria, or to prevent bacteria from growing, respectively.
Is penicillin a bacteriostatic or a bactericidal antibiotic?

What is the mechanism of action of the following antibiotics:

a.Vancomycin b.Penicillin c.Cycloserine d.Bacitracin