Multiple Choice Questions

Subject: Microbiology

1. When rod shaped bacteria appear in pairs, it is known as?
   a) Diplobacilli
   b) Streptobacilli
   c) Diplococci
   d) Staphylococci

2. Surface area/volume ratio of bacteria is exceedingly low compared to the same ratio for larger organisms of similar shape.
   a) True
   b) False

3. Bacteria with less than a complete twist or comma shaped is known as?
   a) spirilla
   b) helical
   c) vibrioid
   d) spirochetes

4. Which of the following are functions of stalk?
   a) nutrient absorption
   b) motility
   c) attachment of the cells to surfaces
   d) human infection

5. Bacteria having cluster of flagella at both poles of cells are known as?
   a) Lophotrichous
   b) Peritrichous
   c) Amphitrichous
   d) Monotrichous

6. Salmonella typhi has which type of flagella arrangement?
   a) Amphitrichous
   b) Peritrichous
   c) Monotrichous
   d) Lophotrichous

7. The L Ring in a Gram-Negative bacterium flagella is associated with_______
   a) Peptidogycan
   b) Outer Membrane
   c) Cytoplasmic Membrane
   d) Cell Membrane

8. Which among the following acts as a transport protein for protons in flagellar motion?
   a) fli protein
   b) cGMP
   c) atp
   d) mot protein
9. F pilus has a major role as__________
   a) motility of the cell
   b) port of entry of genetic material during mating
   c) attachment to host cell
   d) human infection
10. The capsule of Klebsiella pneumoniae is composed of heteropolysaccharides.
    a) True
    b) False
11. When a bacteria swim towards a chemical, it is termed as__________
    a) positive chemotaxis
    b) phototaxis
    c) negative chemotaxis
    d) magnetotaxis
12. Which type of force drives the flagellar motion?
    a) Protonmotive force
    b) ATP driven
    c) Protonmotive and ATP driven
    d) No protonmotive nor ATP driven
13. Peptidoglycan layer is present in large quantity in?
    a) Gram-positive bacteria
    b) Gram-negative bacteria
    c) Fungi
    d) Algae
14. Peptidoglycan is made up of__________
    a) N-acetylglucosamine
    b) N-acetylmuramic acid
    c) N-acetylglucosamine, N-acetylmuramic acid
    d) N-acetylglucosamine, N-acetylmuramic acid, amino acids
15. Teichoic acid present in Gram-positive bacteria can bind to which ion?
    a) Fe ions
    b) Phosphorus ions
    c) Mg ions
    d) Sulphur ions
16. Cord factor is a__________
    a) protein
    b) teichoic acid derivative
    c) mycolic acid derivative
    d) carbohydrate
17. The outer membrane of the Gram-negative cell wall is anchored to the underlying peptidoglycan by means of which of the following?
    a) Braun’s Lipoprotein
    b) Phospholipids
    c) Proteins
    d) Lipopolysaccharides
18. Which among the following acts as receptors for bacteriophage attachment in Gram-negative bacteria?
19. Porins are special proteins act as channels in outer membrane of Gram-negative bacteria.
   a) True
   b) False

20. NAG and NAM of peptidoglycan layer is linked by __________
   a) beta-(1,4) glycosidic linkage
   b) alpha-(1,4) glycosidic linkage
   c) alpha-(1,6) glycosidic linkage
   d) beta-(1,6) glycosidic linkage

21. Gram-negative bacteria are more resistant to antibiotics due to the presence of?
   a) Thin peptidoglycan wall
   b) Outer lipopolysaccharide layer
   c) Porin proteins
   d) Teichoic acid

22. Which of the following are present in teichoic acids?
   a) ribitol residues
   b) glycerol residues
   c) glucose residues
   d) ribitol or glycerol residues

23. Bayer’s junctions are sites which help in joining which of the following?
   a) cytoplasmic membrane and outer membrane
   b) outer membrane and capsule
   c) cytoplasmic membrane and periplasmic space
   d) peptidoglycan layer and cytoplasmic membrane

24. Polyisoprenoid branched-chain lipids, are present in which of the following?
   a) Archaebacteria
   b) Eubacteria
   c) Archaebacteria and Eubacteria
   d) Cannot be determined

25. Cytoplasmic membrane and the cell material bounded by it plus the outer membrane of cell is known as ________
   a) Protoplast
   b) Cytoplast
   c) Spheroplast
   d) Cell membrane

26. Which among the following is associated with export of exocellular enzymes?
   a) central mesosomes
   b) peripheral mesosomes
   c) thylakoids
   d) nucleus
27. Ribosomes of prokaryotes have a sedimentation coefficient of?
   a) 90S
   b) 80S
   c) 50S
   d) 70S
28. Poly-beta-hydroxybutyrate (PHB) present in aerobic bacteria can serve as?
   a) a reserve carbon and energy source
   b) a reserve source of phosphate
   c) acceptor of oxygen
   d) provides buoyancy
29. Which among the following compound when added to cytoplasmic membrane helps in maintaining the rigidity of cell?
   a) lipopolysaccharide
   b) hopanoid
   c) phosphoglycerides
   d) amino acids
30. The nucleoid can be made visible under the light microscope by _________
   a) Methylene blue
   b) Iodine
   c) Nile blue
   d) Feulgen staining
31. What helps in the heat resistance of endospore?
   a) calcium-DPA complex
   b) water
   c) methylene
   d) calcium
32. Cysts also have high heat resistance like endospores.
   a) True
   b) False
33. Which of the following methods can be utilized for removing peripheral proteins of the cytoplasmic membrane?
   a) treatment by detergents
   b) osmotic shock
   c) heat application
   d) destruction of the membrane
34. Which of the following are true for cytoplasmic membrane?
   a) hydrophilic barrier
   b) hydrophobic barrier
   c) site of generation of protonmotive force
   d) hydrophobic barrier and site of generation of protonmotive force
35. The organisms which can use reduced inorganic compounds as electron donors are known as _________
   a) chemotrophs
   b) organotrophs
   c) lithotrophs
   d) phototrophs
36. Which of the following is nutritional characterization of Escherichia coli?
   a) Chemotrophic
   b) Organotrophic
   c) Autotrophic
   d) Chemotrophic, Organotrophic, Heterotrophic

37. Which of the following amino acids require sulphur for their synthesis?
   a) tryptophan
   b) methionine
   c) cystine
   d) methionine and cystine

38. Phosphorus is essential component of ________
   a) teichoic acid
   b) nucleotides
   c) phospholipids
   d) teichoic acid, nucleotides, phospholipids

39. Which of the following are trace elements?
   a) Potassium ion
   b) Sodium ion
   c) Copper ion
   d) Magnesium ion

40. Which of the following ions are cofactors for various enzymes?
   a) Potassium ion
   b) Iron ion
   c) Magnesium ion and Iron ion
   d) Calcium ion

41. "Red extreme halophiles", are members of the archaebacterial which cannot grow with less than 12 to 15 percent NaCl.
   a) True
   b) False

42. Which of the following are functions of water in the culture medium?
   a) nutrients must be in aqueous solution
   b) cofactor of enzymes
   c) provides resistance to sudden transient temperature changes
   d) it is a chemical reactant, nutrients must also be present in aqueous solution and provides resistance to sudden temperature changes.

Answer: d

Explanation: In case of bacteria, all nutrients must be in aqueous solution before they can enter the cells. The high specific heat of water provides resistance to sudden, transient temperature changes in the environment. Water is also a chemical reactant, being required for the many hydrolytic reactions carried out by a cell.

43. Chromatium okenii uses which of the following compound as electron donor?
   a) Hydrogen sulphide
   b) Fatty acids
   c) Alcohol
   d) Succinate
44. Which of the following bacteria can grow both as chemolithotrophs or as chemoorganotrophs?
   a) Nitrosomonas sp.
   b) Pseudomonas pseudoflava
   c) Rhodospirillum rubrum
   d) Chromatium okenii

45. Which of the following is a characteristic of beef extract?
   a) product resulting from the digestion of proteinaceous materials
   b) aqueous extract of lean beef tissue
   c) aqueous extract of yeast cells
   d) complex carbohydrate obtained from certain marine algae

46. Which of the following is used as a solidifying agent for media?
   a) Beef extract
   b) Peptone
   c) Agar
   d) Yeast extract

47. Which of the following is a rich source of B vitamins?
   a) Peptone
   b) Yeast extract
   c) Beef extract
   d) Agar

48. The isolation of gonorrhea-causing organism, Neisseria gonorrhoeae by the use of certain antibiotics in media is an example of which of the following?
   a) Selective media
   b) Differential media
   c) Enriched media
   d) Assay media

49. Nutrient broth, a liquid media contains beef extract and peptone respectively in how much amounts?
   a) 0.2%, 0.4%
   b) 0.1%, 0.6%
   c) 0.3%, 0.5%
   d) 0.7%, 0.3%

50. Which of the following instrument is used for sterilizing the media after it has been prepared?
   a) Autoclave
   b) Laminar Air Flow Chamber
   c) Inoculum Needle
   d) Incubator

51. Colony formation can be observed in liquid media broth.
   a) True
   b) False

52. Which of the following is a Complex media for fungal growth?
   a) Nutrient broth
   b) Luria-Bertani media
   c) Potato Dextrose Agar(PDA) media
   d) Mac Conkey Agar media
53. Which of the following are functions of Maintenance Media?
   a) used for assay of vitamins, amino acids
   b) used for determining the bacterial content
   c) used for determining the type of growth produced by bacteria
   d) used for the maintenance of the viability and physiological characteristics

54. Which of the following bacteria requires nicotinic acid as a growth factor in their media?
   a) Proteus vulgaris
   b) Nitrosomonas sp.
   c) E. coli
   d) Leuconostoc mesenteroides

55. The temperature that allows for most rapid growth during a short period of time is known as
   a) Minimum Temperature
   b) Maximum Temperature
   c) Optimum Temperature
   d) Growth Temperature

56. Mesophiles are group of bacteria that grow within the temperature range of?
   a) 0-20 degree Celsius
   b) 25-40 degree Celsius
   c) 45-60 degree Celsius
   d) more than 60 degree Celsius

57. Which of the following factors are responsible for the stability of thermophiles at high temperatures?
   a) increased leakage of cell components
   b) presence of large no. of polar amino acids and alpha-helix protein
   c) thermal stability of ribosomes
   d) presence of Inositol diphosphate and thermal stability of ribosomes

58. The bacterium Staphylococcus aureus is which type of bacteria?
   a) Psychrophile
   b) Mesophile
   c) Thermophile
   d) Mesophile and psychrophile

59. Microaerophilic bacteria require low levels of oxygen for growth.
   a) True
   b) False

60. The Reactive Oxygen Species (ROS) produced by some bacteria are degraded by which of the following enzymes?
   a) Peroxidase
   b) Lyase
   c) Catalase
   d) Superoxide dismutase, Catalase and Peroxidase

61. Which of the following ROS is a powerful oxidizing agent?
   a) Superoxide radical
   b) Hydrogen peroxide
   c) Hydroxyl radical
   d) Singlet oxygen
62. The GasPak system is suitable for which of the following?
   a) Aerobic bacteria
   b) Anaerobic bacteria
   c) Facultatively anaerobic bacteria
   d) Microaerophilic bacteria

63. Which of the following are functions of phosphates used in the preparation of media?
   a) they act as buffer
   b) source of phosphorous
   c) act as “reserve alkali”
   d) they act as buffer and is a source of phosphorous

64. The optimum pH for the growth of most bacteria lies between_______
   a) 5-9  
   b) 6.5-7.5  
   c) 2-3.5  
   d) 9-9.5

65. Growth of bacteria or microorganisms refer to ________________
   a) an increase in the size of an individual organism
   b) an increase in the mass of an individual organism
   c) changes in the total population
   d) an increase in number of cells

66. Transverse binary fission requires the formation of a crosswall.
   a) True
   b) False

67. Which of the following bacterial species divides by fragmentation?
   a) Bacillus subtilis
   b) Streptococcus faecalis
   c) Rhodopseudomonas acidophila
   d) Nocardia sp.

68. Rhodopseudomonas acidophila reproduces by which of the following methods?
   a) Binary fission
   b) Budding
   c) Fragmentation
   d) Sporulation

69. Streptomyces sp. show the budding mode of reproduction.
   a) True
   b) False

70. The synthesis of new membrane material during reproduction in Gram-positive cells is performed by which of the following organelles?
   a) Nucleus
   b) Mesosome
   c) Endoplasmic Reticulum
   d) Cytoplasmic membrane

71. Equatorial ridge formation in the cell wall takes place in which of the following bacteria?
   a) Streptomyces sp.
b) Bacillus subtilis  
c) Streptococcus faecalis  
d) Escherichia coli  

72. When septum formation occurs near the pole of cell then it results in the formation of daughter cell known as ________
   a) microcell  
b) macrocell  
c) minicell  
d) daughter cell  

73. A bleb or fold like formation occurs in which of the following bacteria?
   a) Rhodopseudomonas acidophila  
b) Bacillus subtilis  
c) E.coli  
d) Streptococcus faecalis  

74. Which of the following does not occur during binary fission in bacteria?
   a) Cell elongation  
b) Cytokinesis  
c) DNA duplication  
d) Spindle formation  

75. The portion of the growth curve where a rapid growth of bacteria is observed is known as __________
   a) Lag phase  
b) Logarithmic phase  
c) Stationary phase  
d) Decline phase  

76. The growth of bacterial population follows a geometric progression.
   a) True  
b) False  

77. In the growth equation: \( n = 3.3 \left( \log_{10} N - \log_{10} N_0 \right) \), \( n \) stands for__________
   a) total population  
b) initial population  
c) number of generations  
d) growth constant  

78. Lag phase is also known as __________
   a) period of initial adjustment  
b) transitional period  
c) generation time  
d) period of rapid growth  

79. The generation time for E.coli is ________
   a) 20 minutes  
b) 35 minutes  
c) 2 minutes  
d) 13 minutes  

80. During exponential phase, growth rate is ________
   a) same as generation time  
b) reciprocal of generation time
c) time required for population to double
d) rate of doubling population

81. In which of the following phase secondary metabolites are produced during growth?
   a) Lag phase
   b) Log/Exponential phase
   c) Stationary phase
   d) Death phase

82. Which phase shows reproduction rate equal to the equivalent death rate?
   a) Log phase
   b) Stationary phase
   c) Death phase
   d) Lag phase

83. Which of the following is used to grow bacterial culture continuously?
   a) Chemostat
   b) Hemostat
   c) Coulter-Counter
   d) Turbidostat

84. The average size of the cells in the exponential phase is ___________
   a) larger than the initial size
   b) smaller than the initial size
   c) equal to the initial size
   d) maybe smaller or larger than the initial size

85. Which of the following is an indirect method for measuring bacterial growth?
   a) Cell count
   b) Cell mass
   c) Cell activity
   d) Both Cell mass and Cell activity

86. Which of the following instrument is used for bacterial count?
   a) Petroff-Hausser counting chamber
   b) Microscope
   c) Chemostat
   d) Turbidostat

87. Which of the following method is used for viable count of a culture?
   a) Direct microscopic count
   b) Plate-count method
   c) Membrane-filter count
   d) Plate-count method and membrane-filter count

88. The number of bacteria per ml depends on the dilution of the sample.
   a) True
   b) False

89. Which of the following is the relationship between optical density and cell mass?
   a) exponentially proportional
   b) linearly proportional
90. How many cells present per millilitre in a bacterial culture can make the culture turbid?
   a) 1 cell
   b) 1000 cells
   c) 1 lakh cells
   d) 10^7 - 10^8 cells

91. A dead cell does not contribute to turbidity in the culture medium.
   a) True
   b) False

92. Which of the following is a direct measurement of growth?
   a) Determination of nitrogen content
   b) Turbidimetric methods
   c) Determination of Dry weight of cells
   d) Measurement of a specific chemical change produced on a constituent of the medium.

93. Which of the following method is used for enumeration of bacteria in vaccines and cultures?
   a) Microscopic Count
   b) Membrane filter
   c) Plate count
   d) Dry weight determination

94. Colony-forming units per ml is the unit of _____________
   a) Microscopic count
   b) Electronic enumeration
   c) Plate count
   d) Turbidimetric measurement

95. Isolation of pure culture refers to ___________
   a) purification of culture
   b) introduction of inoculum
   c) separation of a single colony
   d) to grow microorganisms on a surface

96. Enrichment media allows the growth of a large number of varied bacterial species.
   a) True
   b) False

97. Which of the following is not a physical method for selection of pure culture?
   a) Heat treatment
   b) pH of the media
   c) Cell size and motility
   d) Use of dilute media

98. In physical method of selection, endospore-forming bacteria can be obtained by heating the mixed culture to ____________
   a) 70 degree C for 10 minutes
   b) 80 degree C for 10 minutes
c) 60 degree C for 10 minutes  
d) 90 degree C for 10 minutes

99. Vibrio cholerae can grow in a medium with a pH of ______
   a) 5.5  
   b) 7.0  
   c) 8.5  
   d) 2.0

100. Disease-producing species occurring in a mixed culture can be selected by taking advantage of ______
   a) its pathogenic properties  
   b) special carbon source  
   c) special nitrogen source  
   d) toxic chemicals
Answer key with explanation

1. Answer: a
   Explanation: When bacilli occur in pairs, it is known as diplobacilli but when they form chains it is known as streptobacilli. Cocci are spherical shaped bacteria and not rod shaped.

2. Answer: b
   Explanation: Due to the small size of microorganisms, the surface area/volume ratio of bacteria is exceedingly high compared to the same ratio for larger organisms of similar shape. A relatively large surface through which nutrients can enter (or waste products leave) compared to a small volume of cell substance to be nourished accounts for the unusually high rate of growth and metabolism of bacteria.

3. Answer: c
   Explanation: Bacteria with less than a complete twist or turn have a vibrioid shape, whereas those with one or more complete turns have a helical shape. Spirilla are rigid helical bacteria whereas spirochetes are highly flexible.

4. Answer: c
   Explanation: Stalk are mainly nonliving ribbonlike or tubular appendages that are excreted by the cell. These stalks aid in attachment of the cells to surfaces.

5. Answer: c
   Explanation: In amphitrichous, flagella occur either singly or in clusters at both cell poles. Lophotrichous refers to a cluster of polar flagella, peritrichous is surrounded by lateral flagella and monotrichous is for a single polar flagellum.

6. Answer: b
   Explanation: Salmonella typhi has peritrichous type of flagella arrangement. In peritrichous, the bacteria is surrounded by lateral flagella.

7. Answer: b
   Explanation: The flagella in Gram-Negative bacteria has four basal rings. The L Ring of flagella is associated with the outer membrane. The P ring is associated with the peptidoglycan layer and both the M and S rings are associated with the cytoplasmic membrane.

8. Answer: d
   Explanation: The proton binds to the Mot protein and this changes the conformation of Mot protein. It results in releasing the ring and helps in flagellar motion. The fli protein helps in changing the direction of flagella.

9. Answer: b
   Explanation: Pili are hollow, filamentous appendages that are thinner and shorter. They do not function in motility and have other different
functions. One type known as F plus or sex plus serves as the port of entry of genetic material during bacterial mating.

10. Answer: a
   Explanation: Heteropolysaccharides are usually synthesized from sugar precursors that are activated within the cell, attached to a lipid carrier molecule, transported across the cytoplasmic membrane and polymerized outside the cell. The capsule of Klebsiella pneumoniae is an example of heteropolysaccharides.

11. Answer: a
    Explanation: When a bacteria swims towards or away from chemical compounds, the phenomenon is known as bacterial chemotaxis. Swimming towards a chemical is termed as positive chemotaxis; swimming away is negative chemotaxis.

12. Answer: a
    Explanation: It is found that flagellar motor is driven by the proton motive force, i.e., the force derived from the electrical potential and the hydrogen-ion gradient across the cytoplasmic membrane.

13. Answer: a
    Explanation: Gram-positive bacteria usually have a much greater amount of peptidoglycan in their cell walls than do Gram-negative bacteria. It may account for 50 percent or more of the dry weight of the wall of some Gram-positive species, but only about 10 percent of the wall of Gram-negative bacteria.

14. Answer: d
    Explanation: Peptidoglycan differs somewhat in composition and structure from one species to another, but it is basically a polymer of N-acetylg glucosamine, N-acetylmuramic acid, Amino acids like-L-alanine, D-alanine, D-glutamate and a diaminoo acid.

15. Answer: c
    Explanation: Teichoic acid bind magnesium ions and there is some evidence that they help to protect bacteria from thermal injury by providing an accessible pool of these cations for stabilization of the cytoplasmic membrane.

16. Answer: c
    Explanation: Cord factor (trehalose dimycolate) is a mycolic acid derivative which is toxic and plays an important role in the diseases caused by C.diphtheriae and M.tuberculosis.

17. Answer: a
    Explanation: The outer membrane of the Gram-negative cell wall is anchored to the underlying peptidoglycan by means of Braun’s lipoproteins. The membrane is a bilayered structure consisting mainly of phospholipids, proteins and lipopolysaccharides (LPS).
18. Answer: b
Explanation: The polysaccharide O antigens which extend like whiskers from the membrane surface into the surrounding medium. Many of the serological properties of Gram-negative bacteria are attributable to O antigens like they can serve as receptors for bacteriophage attachment.

19. Answer: a
Explanation: The outer membrane can allow smaller molecules such as nucleosides, oligosaccharides, monosaccharides, peptides and amino acids to pass across by means of channels in special proteins called porins.

20. Answer: a
Explanation: N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM) of peptidoglycan layer are linked by beta-(1, 4) glycosidic linkage. Each strand contains from 10 to 65 disaccharide units.

21. Answer: b
Explanation: Gram-negative bacteria consists of an outer membrane made up of lipopolysaccharides beneath the thin peptidoglycan layer. The outer membrane serves as a barrier to various external chemicals and enzymes that could damage the cell. It also protects the bacteria from antibiotics.

22. Answer: d
Explanation: The teichoic acids are water soluble polymers, containing ribitol or glycerol residues joined through phosphodiester linkages. The glycerol or ribitol is joined to a sugar residue such as glucose, galactose or N-acetyl glucosamine.

23. Answer: a
Explanation: The cytoplasmic membrane and outer membrane are joined at sites termed Bayer’s junctions. In these regions, the outer surface of the cytoplasmic membrane is continuous with the inner surface of the outer membrane creating pores that vary in diameter from 25 to 50 nm.

24. Answer: a
Explanation: In Archaebacteria, the lipids are polyisoprenoid branched-chain lipids, in which long-chain branched alcohols (phytanols) are ether linked to glycerol. In Eubacteria, the phospholipids are phosphoglycerides, in which straight-chain fatty acids are ester-linked to glycerol.

25. Answer: c
Explanation: A protoplast is that portion of a bacterial cell consisting of the cytoplasmic membrane and the cell material bounded by it. When the cell has two membranes, the cytoplasmic membrane of the protoplast plus the outer membrane of the cell wall, the cell is called a spheroplast rather than protoplast.

26. Answer: b
Explanation: Peripheral mesosomes show only a shallow penetration into the cytoplasm, are not restricted to a central location, and are not
associated with nuclear material and they are involved in export of exocellular enzymes such as penicillinase.

27. Answer: d
Explanation: Ribosomes of prokaryotes have a sedimentation coefficient of 70S and are composed of two subunits, a 50S and a 30S subunit. But the ribosomes of eukaryotes have a sedimentation coefficient of 80S and are composed of a 60S and a 40S subunit.

28. Answer: a
Explanation: A polymer found in aerobic bacteria, especially under high-carbon, low-nitrogen culture conditions, is a chlorofoam-soluble, lipid like material, poly-beta-hydroxybutyrate (PHB), which can serve as a reserve carbon and energy source.

29. Answer: b
Explanation: Hopanoids are hydrophobic chemical compounds which when added to cytoplasmic membrane forms a stable and hard compound that helps in maintaining the rigidity of cell.

30. Answer: d
Explanation: Bacteria consist of nucleotide, consisting of a single, circular DNA molecule in which all the genes are linked and it is not a discrete nucleus. The nucleoid can be made visible under the light microscope by Feulgen staining, which is specific for DNA.

31. Answer: a
Explanation: All endospores contain large amounts of dipicolinic acid (DPA). It occurs in combination with large amounts of calcium and is probably located in the central part of the spore. The calcium-DPA complex play a role in the heat resistance of endospores.

32. Answer: b
Explanation: Cysts are dormant, thick-walled, desiccation-resistant forms that develop by differentiation of a vegetative cell and which can later germinate under suitable conditions. In some ways cysts resemble endospores but they do not have the high heat resistance of endospores.

33. Answer: b
Explanation: Peripheral proteins are loosely attached to cytoplasmic membrane and can be removed by mild treatments such as osmotic shock. On the other hand, integral proteins can be removed only by destruction of the membrane, as with treatment by detergents.

34. Answer: d
Explanation: The cytoplasmic membrane is a hydrophobic barrier to penetration by most water-soluble molecules. Because of its impermeability to protons, the cytoplasmic membrane is the site of generation of the proton motive force.
35. Answer: c
   Explanation: Organisms which can use reduced inorganic compounds as electron donors are termed as lithotrophs. Some organisms which use organic compounds as electron donors are called organotrophs.

36. Answer: d
   Explanation: Escherichia coli are chemotrophic, organotrophic, and heterotrophic organism. This means they rely on chemical compounds for their energy and uses organic compounds as electron donors. They also require organic compounds as their carbon source and are hence heterotrophic.

37. Answer: d
   Explanation: Sulphur is needed for synthesis of certain amino acids like methionine and cystine.
   Some bacteria require organic sulphur compounds, some are capable of utilizing inorganic sulphur compounds and some can even use elemental sulphur.

38. Answer: d
   Explanation: Phosphorus, usually supplied in the form of phosphate, is an essential component of nucleotides, nucleic acids, phospholipids, teichoic acids, and other components.

39. Answer: c
   Explanation: Trace elements are those elements which are needed at very low concentrations such as Zinc ion, Copper ion, Manganese ion, Nickel ion, Cobalt ion, Boron ion, Molybdenum ion.
   They always occur as contaminants of other components of culture media in amounts sufficient to support bacterial growth.

40. Answer: c
   Explanation: Among the trace elements, iron ion, magnesium ion, zinc ion, manganese ion and copper ion are known to be cofactors for various enzymes.

41. Answer: a
   Explanation: Most bacteria do not require Na ion, but certain marine bacteria, cyanobacteria and photosynthetic bacteria do require it. For those members of the archaeobacteria known as the “red extreme halophiles”, the requirement is astonishing: they cannot grow with less than 12 to 15 percent NaCl. They require this high level of NaCl for maintenance of the integrity of their cell walls and for the stability and activity of certain of their enzymes.

42. Answer: d
   Explanation: In case of bacteria, all nutrients must be in aqueous solution before they can enter the cells. The high specific heat of water provides resistance to sudden, transient temperature changes in the environment. Water is also a chemical reactant, being required for the many hydrolytic reactions carried out by a cell.
43. Answer: a
Explanation: Chromatium okenii are photolithotrophs i.e., they are phototrophic bacteria that uses inorganic compounds as their source of electrons. They use Hydrogen Sulphide as its electron donor, oxidizing it to elemental sulphur.

44. Answer: b
Explanation: Pseudomonas pseudoflava can grow either as chemolithotrophs or chemoorganotrophs. They can use either the organic compound glucose or the inorganic compound hydrogen as its source of electrons.

45. Answer: b
Explanation: Beef extract, a complex raw material used as ingredient for preparing bacteriological media is an aqueous extract of lean beef tissue concentrated to a paste.

46. Answer: c
Explanation: Agar is used as a solidification agent for media and is not considered a source of nutrient to the bacteria. Agar dissolved in aqueous solutions, gels when the temperature is reduced below 45 degree Celsius.

47. Answer: b
Explanation: Yeast extract which is an aqueous extract of yeast cells is a very rich source of the B vitamins and it also contains apart from it organic nitrogen and carbon compounds.

48. Answer: a
Explanation: The isolation of gonorrhea-causing organism, Neisseria gonorrhoeae, from a clinical specimen is facilitated by the use of media containing certain antibiotics; these antibiotics do not affect N. gonorrhoeae but do inhibit the growth of contaminating bacteria. This is an example of selective media as it allows the growth of only a particular microorganism.

49. Answer: c
Explanation: Nutrient broth which is the most widely used media in general bacteriological work, contains 0.3 percent beef extract and 0.5 percent peptone. It may also contain if required 0.8 percent NaCl to maintain the salt concentration.

50. Answer: a
Explanation: Autoclave is a type of pressure cooker which has steam at 121.5 degree Celsius and under 15 psi pressure. This steam kills all the microbes present in the media and sterilizes it.

51. Answer: b
Explanation: If microbial growth is found in liquid media, then the media shows turbidity but no colony formation can be observed. But in solid media microbial growth can be observed by colony formation as the media is already turbid due to the presence of agar powder.

52. Answer: c
Explanation: Complex media is a chemically undefined media where the
exact composition is not known. For fungal growth, complex media used is Potato Dextrose Agar (PDA) media.

53. Answer: d
Explanation: Satisfactory maintenance of the viability and physiological characteristics of culture over time may require a medium different from that which is optimum for growth. Prolific, rapid growth may also be associated with rapid death of the cells at the end of the growth phase. Thus, a maintenance medium is required then.

54. Answer: a
Explanation: Proteus vulgaris require nicotinic acid as a growth factor in their media along with glucose as a carbon source and also Ammonium Chloride.

55. Answer: c
Explanation: The temperature that allows for most rapid growth during a short period of time (12 to 24 hrs) is known as the optimum temperature. Maximum temperature for growth lies very close to the optimum temperature whereas minimum temperature for growth is usually much lower than the optimum.

56. Answer: b
Explanation: Mesophiles grow best within a temperature range of 25 to 40 degree Celsius. All bacteria that are pathogenic for humans and warm-blooded animals are mesophiles, most growing best at about body temperature (37 degree Celsius).

57. Answer: d
Explanation: Factors that have been implicated in the ability to grow at high temperature is an increased thermal stability of ribosomes. The cytoplasmic membrane of thermophiles also contains Inositol diphosphate or Inositol triphosphate which can tolerate high temperature and maintains the fluidity of the membrane.

58. Answer: b
Explanation: Staphylococcus aureus is a mesophilic bacteria which can grow in the temperature range of 6.5-46 degree Celsius and has an optimum temperature at 30-37 degree Celsius.

59. Answer: a
Explanation: Microaerophilic bacteria require low levels of oxygen for growth but it cannot tolerate the level of oxygen present in an air atmosphere.

60. Answer: d
Explanation: In some cases, oxygen may accept large number of free electrons and produces Reactive Oxygen Species (ROS). They are harmful as they degrade macromolecules required for growth and nutrition. But aerobic bacteria contains three different enzymes-Superoxide dismutase, Catalase and Peroxidase which eliminates the different ROS.

61. Answer: b
Explanation: Superoxide radicals form toxic substances such as hydrogen peroxide. Hydrogen peroxide is not a free radical, but it is a powerful oxidizing agent.
62. Answer: b
Explanation: GasPak Jar is a system for anaerobic bacteria. In this jar media is inoculated and placed in the jar. To this water is added, causing the evolution of Hydrogen gas and Carbon dioxide. The Hydrogen gas reacts with oxygen on the surface of the palladium catalyst, forming water and establishing anaerobic conditions.

63. Answer: d
Explanation: The phosphates are used widely in the preparation of media because they are the only inorganic agents that buffer in the physiologically important range around neutrality and that are relatively non-toxic to microorganisms. In addition, they provide a source of phosphorous, which is an essential element of growth.

64. Answer: b
Explanation: pH is an important physical condition controlling the growth of bacteria. For most bacteria, the optimum pH for growth lies between 6.5 and 7.5. This pH of the media is maintained by using a buffer into the medium.

65. Answer: d
Explanation: Growth denotes the increase in number of cells beyond that present in the original inoculum. It does not refer to an increase in size or mass of an individual organism.

66. Answer: a
Explanation: The most important mode of cell division in the usual growth of bacterial population is transverse binary fission, in which a single cell divides after developing a transverse septum (crosswall).

67. Answer: d
Explanation: Bacteria that produce extensive filamentous growth, such as Nocardia sp. reproduce by fragmentation of the filaments into small bacillary or coccoid cells, each of which gives rise to new growth.

68. Answer: b
Explanation: Rhodopseudomonas acidophila reproduce by budding, a process in which a small protuberance (bud) develops at one end of the cell; this enlarges and eventually develops into a new cell which separates from the parent.

69. Answer: b
Explanation: Streptomyces sp. produce many spores per organism by developing crosswalls (septation) at the hyphen tips and then each spore gives rise to a new organism.

70. Answer: b
Explanation: The first step in reproduction is an inward growth of the cytoplasmic membrane at the middle of the cell. A mesosome which is usually attached to the cytoplasmic membrane in Gram-positive cells, have a role in the synthesis of new membrane material.

71. Answer: c
Explanation: In Streptococcus faecalis, all of the new wall material formed by the dividing cell is made during synthesis of the septum which begins beneath an equatorial ridge in the cell wall.
72. Answer: c
Explanation: In some mutants of E.coli and B.subtilis, septum forms near the pole resulting in a very small daughter cell termed as minicell which lacks DNA and therefore cannot multiply.

73. Answer: c
Explanation: In E.coli a bleb or fold of the outer membrane occurs at the site where the septum will be formed; it is not evident in the final stages of septum formation. The cytoplasmic membrane and the peptidoglycan layer grow inward in the early stages but the cytoplasmic membrane does not invaginate until the final stages of septum formation.

74. Answer: d
Explanation: Binary fission is a form of asexual reproduction which starts with cell elongation followed by division of cytoplasm (cytokinesis) and nucleus and finally DNA duplication occurs resulting in the formation of two daughter cells.

75. Answer: b
Explanation: A typical growth curve has four regions. An initial period of no growth known as lag phase, followed by rapid growth known as logarithmic phase. No growth is observed in stationary phase and death phase.

76. Answer: a
Explanation: The bacteria show growth by following binary fission as means of reproduction. Thus, if we start with a single bacterium, the increase in population is by geometric progression.

77. Answer: c
Explanation: In the above formula, n stands for the number of generations that have taken place after the growth.

78. Answer: a
Explanation: In the lag phase, the bacteria maybe deficient in enzymes or coenzymes which must first be synthesized and thus time is required for adjustments in the physical environment. So it is also known as period of initial adjustment.

79. Answer: a
Explanation: The generation time for E.coli at a temperature of 37 degree Celsius lies in the range of 15-20 minutes generally.

80. Answer: b
Explanation: During exponential growth, the growth rate (R) i.e., the number of generations per hour, is the reciprocal of the generation time g. Growth rate is the slope of the straight line obtained when the log number of cells is plotted against time.

81. Answer: c
Explanation: During the stationary phase, there is complete utilization of
the nutrients present in media and thus produce secondary metabolites which are then used in different industries.

82. Answer: b
Explanation: In stationary phase there is a complete cessation of division and thus the reproduction rate is balanced by an equivalent death rate.

83. Answer: a
Explanation: Chemostat is used for continuous cultivation. This system depends on the fact that the concentration of an essential nutrient within the culture vessel will control the growth rate of the cells.

84. Answer: b
Explanation: During the exponential phase, the cells divide steadily at a constant rate and thus give a straight line. So the average size of cells goes on decreasing than the initial size due to binary fission.

85. Answer: c
Explanation: Cell activity is an indirect method for measuring bacterial growth by relating the degree of biochemical activity to the size of the population.

86. Answer: a
Explanation: Bacteria can be counted easily and accurately with the Petroff-Hauser counting chamber. This is a special slide accurately ruled into squares that are 1/400 mm2 in area. A suspension of unstained bacteria can be counted in the chamber, using a phase contrast microscope.

87. Answer: d
Explanation: The main disadvantage of direct counting of cell numbers is that there is no way to determine whether the cells being counted are viable. To determine the viable count of a culture, we must use a technique that allows viable cells to multiply, such as the plate-count method or membrane-filter method.

88. Answer: a
Explanation: In the plate count method, the formula used is as follows: Number of bacteria per ml = Number of colonies counted on plate X dilution of sample. Thus number of bacteria directly depends on the dilution of sample.

89. Answer: b
Explanation: The photoelectric colorimeter used for measuring bacterial population, measures optical density (a function of light intensity) which is almost linearly proportional to cell mass.

90. Answer: d
Explanation: Bacteria in a suspension absorb and scatter the light passing through them, so that a culture of more than 107 to 108 cells per millilitre appears turbid to the naked eye. Then a spectrophotometer or colorimeter can be used for turbidimetric measurements.

91. Answer: b
Explanation: Both dead as well as living cells contribute to turbidity. However, turbidity cannot be measured for cultures grown in deeply colored media or cultures that contain suspended material other than bacteria.
92. Answer: c
   Explanation: To measure the dry weight of cells is the most direct approach for quantitative measurement. All others are indirect methods and is applicable only in special circumstances.

93. Answer: a
   Explanation: Membrane count is used for enumeration of bacteria in vaccines and cultures. Even electronic enumeration is used in this application.

94. Answer: c
   Explanation: Since the plate count method is used in the enumeration of bacteria in milk, water, foods, soil etc, the unit in which growth is measured is colony-forming units per ml as the bacteria forms colonies in the petri dish.

95. Answer: c
   Explanation: To study the characteristics of one species, that species must be separated from all the other colonies of species, i.e., it must be isolated in pure culture.

96. Answer: b
   Explanation: Enrichment media is a selective method used for the enhancement of growth of a particular bacterial species.

97. Answer: d
   Explanation: Use of dilute media is a chemical method of selection in which a mixed culture was inoculated into a very dilute medium to isolate a particular bacterial colony.

98. Answer: b
   Explanation: To select for endospore-forming bacteria, a mixed culture can be heated to 80 degree C for 10 minutes before being used to inoculate culture media. Vegetative cells will be killed by this treatment but endospores will survive and subsequently germinate and grow.

99. Answer: c
   Explanation: Vibrio cholerae, cholera causing bacterium can be selected from a medium with a ph of 8.5; most intestinal bacteria are unable to grow at this pH.

100. Answer: a
   Explanation: In the biological method of selection, a disease producing species occurring in a mixed culture can often be selected by taking advantage of its pathogenic properties. Others are chemical methods of selection.