1. **The two strands of a double stranded DNA molecule are complementary to each other, but run in opposite directions. To describe this phenomenon, we say that the two strands are:**
   a. Bidirectional
   b. Antiparallel
   c. Semi-conservative
   d. Oncogenic
   e. Truncated

2. **Which direction does the DNA polymerase read the template DNA strand during genome replication?**
   a. 5′ to 3′
   b. 3′ to 5′
   c. Both a) and b) because DNA polymerase can read in either direction
   d. The DNA polymerase reads both directions at the same time
   e. None of the above are correct

3. **RNA is needed during the replication of the DNA genome by DNA polymerases.**
   a. True
   b. False

4. **Translation:**
   a. Forms peptide bonds between nucleotides
   b. Assembles amino acids into protein using an RNA template
   c. Requires DNA polymerase
   d. Assembles RNA nucleotides into protein using a DNA template
   e. Requires primase

5. **True or False: Transduction is an example of horizontal gene transfer.**
   a. True
   b. False

6. **A bacterium dies and its cell breaks open releasing its chromosome. Sometime later, another bacterium takes up a fragment of that chromosome and combines it with its own genetic material. This is best described as:**
   a. Transduction
   b. Transcription
   c. Conjugation
   d. Transformation
   e. Translation

7. **R plasmids are _____ that contain the genetic information for _____.**
   a. genes, replication
   b. DNA molecules, drug resistance
   c. viruses, interferon
   d. RNA molecules, conjugation
   e. More than one of the above

8. **A spontaneous mutation always changes protein function**
   a. True
   b. False

9. **All viruses have:**
   a. DNA
   b. RNA
   c. Lipids
   d. Protein
   e. All of the above

10. **Which of the following viruses is associated with the late complication “subacute sclerosing panencephalitis”?**
    a. Hepatitis B
    b. Hepatitis C
    c. Measles
    d. Varicella-Zoster virus
    e. Polio

11. **True or False: In order for a virus to infect a host cell, it must first bind to specific receptors on the host cell surface. If a potential host cell lacks that specific receptor, then it probably can't be infected by that virus!**
    a. True
    b. False

12. **Viruses:**
    a. Can't normally be viewed using the compound light microscope
    b. Can infect plants and animals, but not bacteria
    c. Are usually larger than prokaryotic cells
    d. Often contain both DNA and RNA
    e. More than one of the above

13. **True or False: viruses replicate by a process called "binary fission", in which one virus divides to make two viruses that are identical to each other.**
    a. True
    b. False

14. **A latent viral infection typically displays which of the following patterns?**
    a. An acute period of disease, followed by a symptomless period, then reactivation of the infectious disease at a later time
    b. An acute period of disease, followed by a symptomless period, with serious complications occurring years later in the absence of infectious virus particles
    c. An acute period of disease after which high levels of infectious virus can be demonstrated at all times. Disease symptoms may or may not be present
    d. An acute period of disease after which the virus is eliminated and the host becomes immune to that virus for life

15. **Which of the following statements concerning viruses is correct:**
    a. Viral genomes are much larger than bacterial genomes
    b. The viral capsid is formed from the host cell cytoplasmic membrane
    c. Viral protein synthesis requires the viral capsid to enter into the host cell nucleus
    d. Infection with an enveloped virus often leaves the host cell intact following virus release
    e. None of the above statements are correct

16. **A prion is:**
    a. a virus that infects bacteria
    b. an appendage found on some bacterial cells
    c. a chemical produced by T helper cells
    d. an infectious protein particle
    e. a specific type of exotoxin

17. **Which statement about the innate immune system is false?**
    a. It normally develops at the time a child proceeds into adolescence
    b. It has no memory component
    c. It only acts against specific microorganisms
    d. It does not involve leukocytes
    e. More than one of the above

18. **Eosinophils carry out what role in innate immunity:**
    a. Secrete chemoattractants
    b. Phagocytize foreign material and bring it to the adaptive immune system for 'inspection'
    c. Responsible for killing infected body cells and tumor cells
    d. Migrate into tissues to destroy invading bacteria
    e. None of the above

19. **True or False: Although uncomfortable, fever can help protect the body by increasing the rate at which macrophages engulf and destroy bacteria.**
    a. True
    b. False

20. Interferons are small molecules that:
a. Interfere with bacterial cell division
b. Are released by natural killer cells when they encounter a parasite
c. Signal cells to produce anti-viral proteins
d. Interfere with normal function of the immune system

21. Which class of antibody would you expect to be produced first in response to a sexually transmitted infection?
a. IgG
b. IgD
c. IgE
d. IgA
e. IgM

22. True or False: T helper cells are required by both the humoral branch and cell-mediated branch of the adaptive immune system.
a. True
b. False

23. Which of the following is a function of T helper cells?
a. To find and destroy cancer cells
b. To stimulate clonal expansion in B cells
c. To attack large pathogens like parasitic worms
d. To produce antibodies against dangerous antigens
e. More than one of the above

24. MHC class II molecules are found:
a. On the surface of T helper cells
b. On the F_c fragment of antibodies
c. On the surface of some, but not all immune system cells
d. On the surface of all nucleated body cells
e. On antigens that are able to elicit a type III hypersensitivity reaction

25. A secondary antibody mediated immune response will:
a. Occur very slowly
b. Begin producing IgM against the specific antigen first, and will only produce IgG a few days later
c. Produce relatively low levels of antibody, when compared to a primary response
d. Produce memory B cells
e. Likely not occur fast enough to fight off an infection, leaving most of the work to the innate branch of the immune system

26. Which of the following best describes the role of cytotoxic T lymphocytes in immune function.
a. They produce large amounts of IgG
b. They release histamine in response to allergens
c. They release perforins to poke holes in the membrane of abnormal self-cells
d. They produce interferon to protect body cells from exotoxins
e. More than one of the above

27. The term "Microbial antagonism" describes the process by which:
a. Phagocytic granulocytes produce extracellular enzymes to digest invading microorganisms
b. Pathogenic microbes cause damage to host cells after they have invaded tissues
c. Members of the normal microbiota produce anti-microbial substances that prevent the growth of human pathogens
d. Viruses cause visible changes to an infected host cell
e. Opportunistic pathogens cause disease when the host is in a weakened state

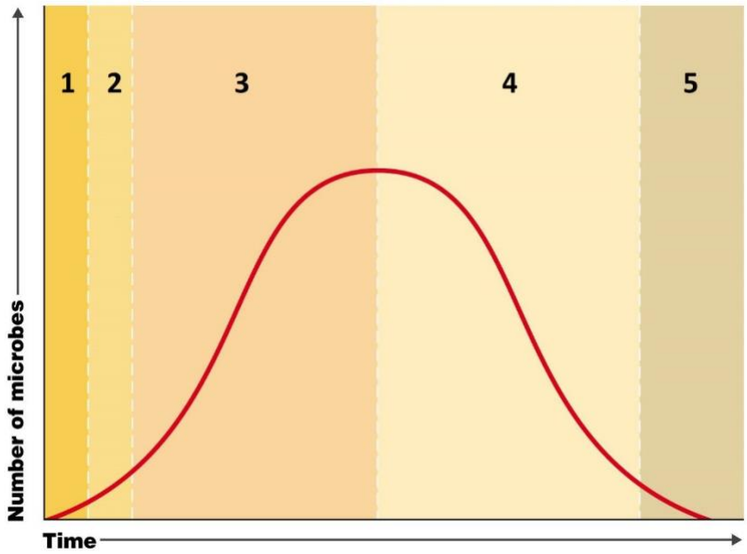
28. Which of the following microorganisms is famous for causing severe inflammation of the colon in patients being administered large dosages of antibiotics?
a. *Clostridium difficile*
b. *Salmonella enterica*
c. *Corynebacterium diphtheriae*
d. *Vibrio cholerae*
e. E. coli

29. An LD50 value refers to:
a. The number of microorganisms required to cause disease in 50% of infected individuals
b. The amount of toxin required to cause death in 50% of infected individuals
c. The likelihood of contracting a disease in 50% of infected individuals
d. The likelihood of death in 50% of diseased individuals
e. None of the above

30. Which of the following statements does not correctly describe bacterial endotoxin?
a. It is found only in Gram negative bacteria
b. It is only released when the bacterial cell dies
c. It is made of protein
d. It is not generally as toxic as bacterial exotoxins

31. Which statement is true of the toxin involved in the disease tetanus?
a. It is produced only by *Clostridium botulinum*
b. It is a lethal enterotoxin
c. It enters the body through the respiratory tract
d. It is not as potent as endotoxin
e. It is a protein

Examine the graph shown below to answer the following question



32. The graph shown above tracks the number of microbes present over time, during a typical illness, and shows that a typical illness can be divided into five distinct stages. During which of the numbered stages shown on the graph would you expect a patient to show signs or symptoms of disease?
a. Stage 3 only
b. Stages 3 and 4
c. Stages 2, 3 and 4
d. Stages 1, 2, 3 and 4
e. Stages 1, 2, 3, 4 and 5

33. Allergic contact dermatitis is due to:
a. Sensitized T cells
b. IgG
c. IgE
d. IgM
e. All of the above

34. Which of the following conditions can occur as a result of autoimmune disease?
a. Acquired immunodeficiency disease
b. Hemolytic disease of the newborn
c. Immune complex formation
d. Systemic anaphylaxis
e. Rheumatoid arthritis

35. Influenza vaccines often contain an additive called an adjuvant. The purpose of the adjuvant is to:
   a. Stimulate the immune system leading to an enhanced immune response toward the vaccine
   b. Inactivate live microorganisms in the vaccine to make sure they don't cause the disease the vaccine was designed to prevent
   c. Prevent inflammation at the site where the vaccine was injected
   d. Preserve the vaccine so that it can be stored for years until it is needed

36. True or False: an attenuated vaccine generally requires booster shots every 10 years or so.
   a. True
   b. False

37. A vaccine that consists of bacterial cell wall fragments (and does not contain any whole bacteria) would be referred to as a:
   a. Conjugate vaccine
   b. Toxoid vaccine
   c. Attenuated vaccine
   d. Subunit vaccine
   e. Inactivated vaccine

38. Conjugated vaccines were developed to address the following:
   a. To deal with poor immune response of children to vaccines based on capsular polysaccharides
   b. To create a more effective means of passive immunization
   c. To satisfy the need to conclusively demonstrate Robert Koch's 3rd postulate
   d. To stabilize the vaccine for storage at room temperature
   e. To allow the vaccine to be autoclaved prior to injection

39. What is the purpose of receiving a booster shot?
   a. Suppress the immune response
   b. Stabilize subunit vaccines
   c. Precipitates the antigen into clumps
   d. Causes a slow release of antigen in the body over time
   e. Refresh memory cell population

40. Potential disadvantages of toxoid vaccines include:
   a. In some cases, live microorganisms in the vaccine can mutate, reverting to a form that can cause disease
   b. They usually elicit a fairly weak response and a number of injections are required to achieve full immunity
   c. They generally elicit a poor immune response in young children
   d. They have the potential to cause disease in patients with weakened immune systems
   e. More than one of the above