15.E: Microbial Mechanisms of Pathogenicity (Exercises)

15.1: Characteristics of Infectious Diseases

Multiple Choice

Which of the following would be a sign of an infection?

A. muscle aches
B. headache
C. fever
D. nausea

C

Which of the following is an example of a noncommunicable infectious disease?

A. infection with a respiratory virus
B. food poisoning due to a preformed bacterial toxin in food
C. skin infection acquired from a dog bite
D. infection acquired from the stick of a contaminated needle

B
During an oral surgery, the surgeon nicked the patient’s gum with a sharp instrument. This allowed *Streptococcus*, a bacterium normally present in the mouth, to gain access to the blood. As a result, the patient developed bacterial endocarditis (an infection of the heart). Which type of disease is this?

A. iatrogenic  
B. nosocomial  
C. vectors  
D. zoonotic

A

Which period is the stage of disease during which the patient begins to present general signs and symptoms?

A. convalescence  
B. incubation  
C. illness  
D. prodromal

D

A communicable disease that can be easily transmitted from person to person is which type of disease?

A. contagious  
B. iatrogenic  
C. acute  
D. nosocomial

A

**Fill in the Blank**

A difference between an acute disease and chronic disease is that chronic diseases have an extended period of ________.

illness

A person steps on a rusty nail and develops tetanus. In this case, the person has acquired a(n) ________ disease.
Short Answer

Brian goes to the hospital after not feeling well for a week. He has a fever of 38 °C (100.4 °F) and complains of nausea and a constant migraine. Distinguish between the signs and symptoms of disease in Brian’s case.

Critical Thinking

Two periods of acute disease are the periods of illness and period of decline. (a) In what way are both of these periods similar? (b) In terms of quantity of pathogen, in what way are these periods different? (c) What initiates the period of decline?

In July 2015, a report was released indicating the gram-negative bacterium Pseudomonas aeruginosa was found on hospital sinks 10 years after the initial outbreak in a neonatal intensive care unit. P. aeruginosa usually causes localized ear and eye infections but can cause pneumonia or septicemia in vulnerable individuals like newborn babies. Explain how the current discovery of the presence of this reported P. aeruginosa could lead to a recurrence of nosocomial disease.

15.2: How Pathogens Cause Disease

Multiple Choice

Which of the following is a pathogen that could not be identified by the original Koch’s postulates?

A. Staphylococcus aureus  
B. Pseudomonas aeruginosa  
C. Human immunodeficiency virus  
D. Salmonella enterica serovar Typhimurium

C

Pathogen A has an ID$_{50}$ of 50 particles, pathogen B has an ID$_{50}$ of 1,000 particles, and pathogen C has an ID$_{50}$ of $1 \times 10^6$ particles. Which pathogen is most virulent?

A. pathogen A  
B. pathogen B  
C. pathogen C
Which of the following choices lists the steps of pathogenesis in the correct order?

A. invasion, infection, adhesion, exposure  
B. adhesion, exposure, infection, invasion  
C. exposure, adhesion, invasion, infection  
D. disease, infection, exposure, invasion

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Fill in the Blank

A(n) _________ pathogen causes disease only when conditions are favorable for the microorganism because of transfer to an inappropriate body site or weakened immunity in an individual.

opportunistic

The concentration of pathogen needed to kill 50% of an infected group of test animals is the _________.

LD<sub>50</sub>

A(n) _________ infection is a small region of infection from which a pathogen may move to another part of the body to establish a second infection.

focal

Cilia, fimbriae, and pili are all examples of structures used by microbes for _________.

adhesion

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Critical Thinking

Diseases that involve biofilm-producing bacteria are of serious concern. They are not as easily treated compared with those involving free-floating (or planktonic) bacteria. Explain three reasons why biofilm formers are more pathogenic.

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A microbiologist has identified a new gram-negative pathogen that causes liver disease in rats. She suspects that the bacterium’s fimbriae are a virulence factor. Describe how molecular Koch’s postulates could be used to test this hypothesis.

Acupuncture is a form of alternative medicine that is used for pain relief. Explain how acupuncture could facilitate exposure to pathogens.

15.3: Virulence Factors

Multiple Choice

Which of the following would be a virulence factor of a pathogen?

A. a surface protein allowing the pathogen to bind to host cells
B. a secondary host the pathogen can infect
C. a surface protein the host immune system recognizes
D. the ability to form a provirus

A

You have recently identified a new toxin. It is produced by a gram-negative bacterium. It is composed mostly of protein, has high toxicity, and is not heat stable. You also discover that it targets liver cells. Based on these characteristics, how
would you classify this toxin?

A. superantigen
B. endotoxin
C. exotoxin
D. leukocidin

C

Which of the following applies to hyaluronidase?

A. It acts as a spreading factor.
B. It promotes blood clotting.
C. It is an example of an adhesin.
D. It is produced by immune cells to target pathogens.

A

Phospholipases are enzymes that do which of the following?

A. degrade antibodies
B. promote pathogen spread through connective tissue.
C. degrade nucleic acid to promote spread of pathogen
D. degrade cell membranes to allow pathogens to escape phagosomes

D

Fill in the Blank

The glycoprotein adhesion gp120 on HIV must interact with __________ on some immune cells as the first step in the process of infecting the cell.

CD4

Adhesins are usually located on __________ of the pathogen and are composed mainly of __________ and __________.
surface; proteins; sugars

The Shiga and diphtheria toxins target __________ in host cells.

protein synthesis

Antigenic __________ is the result of reassortment of genes responsible for the production of influenza virus spike proteins between different virus particles while in the same host, whereas antigenic __________ is the result of point mutations in the spike proteins.

shift; drift

**Critical Thinking**

Two types of toxins are hemolysins and leukocidins. (a) How are these toxins similar? (b) How do they differ?

Imagine that a mutation in the gene encoding the cholera toxin was made. This mutation affects the A-subunit, preventing it from interacting with any host protein. (a) Would the toxin be able to enter into the intestinal epithelial cell? (b) Would the toxin be able to cause diarrhea?

**15.4: Aseptic Techniques**

**Multiple Choice**

Which of the following is a major virulence factor for the fungal pathogen *Cryptococcus*?

A. hemolysin
B. capsule
C. collagenase
D. fimbriae

B

Which of the following pathogens undergoes antigenic variation to avoid immune defenses?

A. *Candida*
B. *Cryptococcus*
C. *Plasmodium*
D. Giardia

C

Fill in the Blank

_Candida_ can invade tissue by producing the exoenzymes _________ and _________.

protease and phospholipase

The larval form of _Schistosoma mansoni_ uses a _________ to help it gain entry through intact skin.

protease

Short Answer

Describe the virulence factors associated with the fungal pathogen _Aspergillus_.

Explain how helminths evade the immune system.