Evolutionary Analysis, 5e (Herron/Freeman)
Chapter 1  A Case for Evolutionary Thinking: Understanding HIV

1) In which of the following regions has AIDS killed the largest number of individuals?
A) India
B) Sub-Saharan Africa
C) United States
D) China
E) United Kingdom
Answer: B
Section: 1.1
Skill: Knowledge/Comprehension

2) The HIV virus contains all of the following components except ________.
A) integrase
B) double-stranded RNA
C) single-stranded RNA
D) reverse transcriptase
E) protease
Answer: B
Section: 1.1
Skill: Knowledge/Comprehension

3) The acronym HIV stands for which of the following?
A) human intercellular virus
B) human immune virus
C) human immunodeficiency virus
D) human immunity virus
E) human immunodeficiency vector
Answer: C
Section: 1.1
Skill: Knowledge/Comprehension

4) Which of the following enzymes is responsible for transcribing viral RNA into DNA?
A) RNA polymerase
B) reverse transcriptase
C) DNA polymerase
D) reverse integrase
E) RNA duplicase
Answer: B
Section: 1.1
Skill: Knowledge/Comprehension

5) The proteins that enable the HIV virus to bind to cells are typically CD4 and CCR5. On what type of cells are these proteins typically observed?
A) plasma cells
B) dendritic cells
C) effector helper T cells
D) memory helper T cells
E) both C and D
Answer: E
Section: 1.1
Skill: Knowledge/Comprehension

6) The AIDS phase of HIV infection begins when the concentration of CD4 T cells in the blood drops below what concentration?
A) 2,000 cells per cubic millimeter
B) 1,000 cells per cubic millimeter
C) 500 cells per cubic millimeter
D) 200 cells per cubic millimeter
E) No CD4 T cells are observed.
Answer: D
Section: 1.1
Skill: Knowledge/Comprehension

7) Which of the following drug categories are used to treat HIV infections?
A) integrase inhibitors
B) protease inhibitors
C) reverse transcriptase inhibitors
D) DNAse inhibitors
E) fusion inhibitors
Answer: D
Section: 1.2
Skill: Knowledge/Comprehension

8) Coreceptor inhibitors block HIV infection by preventing which of the following?
A) binding of the HIV virion onto the plasma membrane
B) binding of the HIV virion onto the CCR5 receptor
C) binding of the HIV virion onto the gp120 protein
D) degrading the coreceptor so the virion cannot attach
E) binding of the HIV virion onto the CD4 receptor
Answer: B
Section: 1.2
Skill: Application/Analysis
9) What is the effect of the ∆32 allele of CCR5 on HIV binding?
A) appears on the surface of CD4 T cells, but the HIV virion is unable to infect the host cell
B) does not appear on the surface of CD4 T cells
C) appears on the surface of the CD4 T cells and inactivates the virion upon binding
D) interferes with binding of the virion to the CD4 receptor protein
E) appears on the surface of the CD4 T cells and causes the virion to lyse upon binding
Answer: B
Section: 1.3
Skill: Application/Analysis

10) The ∆32 allele of CCR5 is found at the highest frequency in which of the following populations?
A) Africans
B) Japanese
C) North Americans
D) Europeans
E) South Americans
Answer: D
Section: 1.3
Skill: Knowledge/Comprehension

11) HIV-1 is believed to have been transmitted to humans from which of the following organisms?
A) gorillas
B) sooty mangabeys
C) African green monkeys
D) chimpanzees
E) baboons
Answer: D
Section: 1.4
Skill: Knowledge/Comprehension

12) HIV-1 Group M is responsible for 95% of human infections. When is it estimated that HIV-1 Group M was transferred to humans?
A) 1980
B) 1960
C) 1930
D) 1995
E) 1900
Answer: C
Section: 1.4
Skill: Knowledge/Comprehension
13) Antibodies and killer T cells recognize HIV or HIV-infected cells by binding to short pieces of viral proteins displayed on the virus or the infected host cell. These short pieces of viral proteins are called ________.
A) coat proteins
B) virosomes
C) proteosomes
D) epitopes
E) episomes
Answer: D
Section: 1.5
Skill: Knowledge/Comprehension

14) Tetherin is an important protein produced by the host. What is the function of tetherin in protecting a host cell from HIV?
A) ties maturing virions to the membrane of the host cell, thereby preventing the release of the mature virus
B) binds the virus to the external host cell membrane, thereby preventing the virus from entering the host cell
C) binds the viral RNA to reverse transcriptase, thus preventing synthesis of the viral DNA
D) binds the two viral RNA strands together, thus preventing the transcription of viral DNA in the host cell
E) causes the maturing virions to aggregate together, thus preventing their release from the host cell
Answer: A
Section: 1.5
Skill: Application/Analysis

15) Early in the infection with HIV, most virions bind to the host cell using CCR5 as a coreceptor. As the infection progresses, the HIV population evolves to use an alternate coreceptor. What is the alternate coreceptor these X4 viruses utilize?
A) Tetherin
B) CCR5α
C) vpu
D) TRIM5α
E) CXCR4
Answer: E
Section: 1.5
Skill: Knowledge/Comprehension

16) In what region of the world is the incidence of infection with HIV highest?
Answer: Sub-Saharan Africa
Section: 1.1
Skill: Knowledge/Comprehension
17) Originally, HIV was thought to be restricted to transmission during homosexual contact between gay men. List other ways in which HIV is currently known to be transmitted.
Answer: HIV can be transmitted by heterosexual sex, oral sex, needle sharing, transfusion with contaminated blood products, other unsafe medical procedures, childbirth and breast-feeding.
Section: 1.1
Skill: Knowledge/Comprehension

18) What does the acronym AIDS stand for?
Answer: Acquired Immune Deficiency Syndrome
Section: 1.1
Skill: Knowledge/Comprehension

19) What viral coat protein typically binds first to the CD4 receptor on helper T cells?
Answer: gp120
Section: 1.1
Skill: Knowledge/Comprehension

20) When AZT is used to treat HIV infections, why does resistance to AZT usually develop?
Answer: Mutations present in the viral population, due to the lack of proofreading and high error rate of the viral reverse transcriptase, enable mutant virions to discriminate against the incorporation of AZT during transcription.
Section: 1.2
Skill: Application/Analysis

21) It has been observed that viral particles often revert (back mutate to non-AZT-resistant populations when treatment with AZT is discontinued. What is the most likely reason for this observation?
Answer: There is no more selective pressure applied to the viral population, and in the absence of AZT the viral particles that reproduce most efficiently have not evolved enough to have the ability to discriminate against AZT.
Section: 1.2
Skill: Application/Analysis

22) What is the molecular mechanism by which reverse transcriptase inhibitors, such as AZT, prevent viral replication?
Answer: These molecules are analogues of the nucleotide building blocks of DNA, and typically prevent binding or elongation of the of the transcribed DNA molecule.
Section: 1.2
Skill: Knowledge/Comprehension

23) In what host cell protein is the Δ32 mutation found, and what type of mutation is this?
Answer: The Δ32 mutation is found in the CCR5 coreceptor on CD4 helper T cells, and is a 32-base pair deletion.
Section: 1.3
Skill: Knowledge/Comprehension
24) Explain the phylogenetic relationship between humans, chimpanzees, and monkeys in the transmission of the current predominant deadly strain in humans, HIV-1.
Answer: HIV-1 is believed to have originated in monkeys as an SIV (simian immunodeficiency virus); SIV was passed from monkeys to chimpanzees, and SIV was passed to and mutated into HIV-1 sometime around 1930.
Section: 1.4
Skill: Knowledge/Comprehension

25) Explain the mechanism HIV uses to avoid destruction by antibodies present in the human immune system.
Answer: The virus is constantly mutating its surface proteins, and these frequent changes in epitopes on the viral surface prevent the host cell from being able to recognize the virus over time.
Section: 1.5
Skill: Application/Analysis

26) Following long periods of infection with HIV, an X4 strain often evolves. What evolutionary advantage does the X4 strain confer on the viral population, and what specific protein does this strain interact with?
Answer: The evolutionary advantage of this strain is that it can infect a different population of T cells. The alternate population of T cells contains the coreceptor CXCR4 instead of the CCR5 coreceptor.
Section: 1.5
Skill: Application/Analysis

27) What is the function of the product of the viral gene \textit{vpu} in human infections of HIV?
Answer: The viral gene \textit{vpu} (in a similar manner to the viral protein \textit{nef}) blocks the action of the host protein tetherin, which normally adheres to viral particles and attaches them to the host cell membrane and prevents their release.
Section: 1.5
Skill: Knowledge/Comprehension

28) What steps are involved in producing the HIV GP120 protein? List all processes and host cellular structures involved from the point of initial infection with viral RNA to the production of the mature virion outside of the host cell.
Section: 1.1
Skill: Application/Analysis

29) Highly active antiretroviral therapies (HAART) have become the treatment method of choice in treating human HIV infections. What is required for a treatment to be classified as HAART, and why have these treatments proven so effective in the treatment of HIV infections?
Section: 1.2
Skill: Synthesis/Evaluation

30) If an individual is infected with HIV that goes undetected and untreated, the infection follows a standard clinical course of progression. Explain the three sequential phases of untreated HIV infection, the approximate times over which these phases occur, and the corresponding levels of both HIV RNA and CD4 T cells circulating in the host bloodstream.

Section: 1.1
Skill: Knowledge/Comprehension