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Viruses: Structure, Replication Cycles, and HIV

Exam — Microbiology

Pre-med/IB-style practice on virus structure, classification (DNA/RNA, enveloped/non-enveloped), replication strategies (lytic vs lysogenic), host range/tropism, and HIV as a key retrovirus example—focused on concept understanding and common traps.

40 items — Printable Exam

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Generated February 20, 2026

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1 A scientist isolates an infectious agent that contains nucleic acid and protein, but no ribosomes. It multiplies only inside living cells. Which statement BEST explains why this agent is an obligate intracellular parasite?

- A** It is too small to survive outside cells.
- B** It cannot synthesize proteins or generate enough resources independently, so it must use the host cell's machinery.
- C** It lacks a cell wall, so it cannot replicate.
- D** It cannot mutate unless it is inside a cell.
- E** It can reproduce only by mitosis, which requires a host.



2 Which option BEST defines a virion?

- A** A virus that is actively replicating inside a host cell
- B** A complete infectious virus particle outside a host cell, consisting of genome + protective structures
- C** The bacterial chromosome after a virus inserts into it
- D** A host cell with viral genes turned on
- E** A membrane-bound organelle that makes viral proteins



3 Which structure is found in ALL viruses (no exceptions among typical textbook viruses)?

- A** A lipid envelope
- B** A protein capsid
- C** Ribosomes
- D** A peptidoglycan cell wall





E Mitochondria

4 A disinfectant that dissolves lipids (like soap) is especially effective at inactivating which type of virus?



- A Non-enveloped viruses, because their capsids are made of lipid
- B Enveloped viruses, because their outer envelope is a lipid bilayer that can be disrupted
- C Only bacteriophages, because they have tails
- D Only RNA viruses, because RNA dissolves in soap
- E Only lysogenic viruses, because they hide in DNA

5 An enveloped virus leaves a host cell by budding. The virus obtains most of its envelope from:



- A New lipid synthesized by the viral capsid
- B The host cell membrane (or internal host membranes), which the virus buds through
- C The host cell wall
- D The bacterial nucleoid
- E The viral genome folding into a membrane

6 A single-stranded RNA virus enters a cell. Immediately after uncoating, host ribosomes begin translating the viral genome into protein without any viral enzymes being used first. Which genome type is MOST consistent with this?



- A Positive-sense (+) ssRNA





- B Negative-sense (–) ssRNA
- C Double-stranded RNA (dsRNA)
- D Double-stranded DNA (dsDNA)
- E Single-stranded DNA (ssDNA)

7 Which virus type **MUST** bring an RNA-dependent RNA polymerase inside the virion to start infection (basic rule)?



- A Positive-sense (+) ssRNA virus
- B Negative-sense (–) ssRNA virus
- C dsDNA virus
- D ssDNA virus
- E A temperate bacteriophage in lysogeny

8 Which sequence correctly represents the classic bacteriophage lytic cycle?



- A Attachment → DNA integration → cell division → induction → lysis
- B Attachment → genome entry → synthesis of viral parts → assembly → release (often by lysis)
- C Endocytosis → fusion → reverse transcription → integration → budding
- D Mitosis → cytokinesis → translation → transcription → budding
- E Spore formation → germination → replication → transformation → release





9 A bacterial culture infected by a bacteriophage suddenly becomes clear (turbidity drops sharply). Which event **MOST** directly causes the culture to clear?

- A** Viral attachment to bacterial receptors
- B** Assembly of virions inside the bacterium
- C** Lysis of many bacteria releasing new phage particles
- D** Integration of viral DNA into the bacterial chromosome
- E** Transcription of bacterial genes



10 A temperate bacteriophage infects a bacterium and integrates its DNA into the bacterial chromosome without immediately killing the cell. The integrated viral DNA is called a:

- A** Capsid
- B** Prophage
- C** Prion
- D** Plasmid
- E** Virion



11 A bacterium carrying a prophage is exposed to UV light. Soon after, many bacteria lyse and release phages. Which explanation **BEST** fits this observation?

- A** UV causes the virus to lose its capsid
- B** UV induces the prophage to excise and enter the lytic cycle (induction)
- C** UV converts the prophage into a plasmid that cannot replicate
- D** UV makes bacteria divide faster, so more viruses appear
- E** UV blocks translation, so viruses are released





12 A harmless bacterial strain becomes toxin-producing after infection by a temperate phage that carries a toxin gene. This is an example of:



- A** Binary fission
- B** Lysogenic conversion
- C** Fermentation
- D** Translation coupling
- E** Osmosis

13 A bacteriophage accidentally packages bacterial DNA and transfers it to a new bacterium. The recipient gains a new gene. This mechanism of horizontal gene transfer is called:



- A** Conjugation
- B** Transformation
- C** Transduction
- D** Translation
- E** Meiosis

14 Which type of transduction can potentially transfer ANY bacterial gene because it results from random packaging errors during the lytic cycle?



- A** Specialized transduction
- B** Generalized transduction
- C** Conjugation





- D Transformation
- E Lysogenic conversion

15 A phage integrates into a specific site in the bacterial genome. Later, it excises incorrectly and carries nearby bacterial genes into new hosts. This is MOST consistent with:



- A Generalized transduction
- B Specialized transduction
- C Transformation
- D Conjugation
- E Mitosis

16 Why don't antibiotics that inhibit peptidoglycan synthesis (bacterial cell wall) directly stop viruses from replicating?



- A Viruses have a thicker peptidoglycan wall than bacteria.
- B Viruses do not build peptidoglycan cell walls; they use capsids/envelopes instead.
- C Viruses are made of cellulose, not peptidoglycan.
- D Viruses synthesize their own ribosomes, so antibiotics cannot bind.
- E Antibiotics only work on RNA, not on DNA.





17 Two strains of the same virus differ only in a surface protein. Strain 1 infects human respiratory cells; strain 2 cannot. The MOST direct explanation is that the surface protein determines:

- A The virus's ability to perform glycolysis
- B Which host cell receptor the virus can bind (tropism/host range)
- C Whether the virus uses mitosis or meiosis
- D Whether the host cell has mitochondria
- E How many ribosomes the virus contains



18 Plant viruses are often transmitted by insects or through mechanical damage. Why is this especially important for plant viruses compared with many animal viruses?

- A Plant cells lack genetic material, so viruses must be injected.
- B Plant cell walls act as a physical barrier that prevents easy membrane fusion/endocytosis-based entry.
- C Plant viruses are always enveloped and dissolve in water.
- D Plants do not have ribosomes, so viruses need insects to supply them.
- E Plant viruses replicate only in chloroplasts, which insects deliver.



19 A typical bacteriophage infects a bacterium. Which statement BEST describes how it delivers its genome?

- A The entire virion enters the bacterium by endocytosis.
- B The phage injects its nucleic acid through its tail; the capsid usually remains outside.
- C The bacterium actively imports the genome through nuclear pores.
- D The phage fuses with the bacterial mitochondrion.





- E** The bacterium translates the capsid first, then builds the genome.

20 Which statement **BEST** describes how viruses increase in number (compared with cellular reproduction)?



- A** They grow larger and then split by binary fission.
- B** They are assembled from newly made parts (genomes + proteins) inside a host cell.
- C** They replicate by mitosis.
- D** They replicate by meiosis to make gametes.
- E** They reproduce only by conjugation.

21 Which pairing of virus “shape class” with example is **MOST** accurate at a basic level?



- A** Icosahedral — head-tail bacteriophage
- B** Helical — rod-like plant virus nucleocapsid (classic example)
- C** Complex — spherical influenza virion because it is round
- D** Helical — always naked (non-enveloped) viruses only
- E** Icosahedral — requires a lipid envelope by definition

22 Many DNA viruses replicate in the nucleus of eukaryotic cells. The **BEST** basic reason is that they often rely on:



- A** Host ribosomes, which are found only in the nucleus





- B** Host DNA/RNA-processing machinery that is concentrated in the nucleus (general rule)
- C** Chloroplast enzymes that copy DNA
- D** Peptidoglycan synthesis enzymes located in the nucleus
- E** The bacterial nucleoid inside eukaryotic cells

23 Why do many RNA viruses evolve rapidly (show high genetic variability) compared with many DNA viruses?



- A** RNA viruses always replicate more slowly, increasing errors.
- B** RNA-dependent RNA polymerases often lack strong proofreading, so mutations occur more frequently.
- C** RNA viruses are protected by peptidoglycan, which causes mutation.
- D** RNA viruses do not have genomes, so they must constantly change.
- E** Mutations happen only in RNA, never in DNA.

24 Two different strains of a segmented RNA virus infect the same cell. Some new virions contain a mixture of genome segments from both strains. This process is called:



- A** Reassortment
- B** Binary fission
- C** Transformation
- D** Translation
- E** Mendelian segregation





25 HIV is classified as a retrovirus. Which statement BEST matches what makes a retrovirus “retro” in information flow?



- A** It converts protein into RNA.
- B** It uses reverse transcription: RNA is copied into DNA.
- C** It converts DNA into protein directly without RNA.
- D** It replicates only in bacteria.
- E** It is a bacteriophage that inserts into a plasmid.

26 Which enzyme allows HIV to convert its RNA genome into DNA inside the host cell?



- A** DNA polymerase I
- B** Reverse transcriptase
- C** RNA polymerase II
- D** Ligase
- E** Pepsin

27 After HIV makes a DNA copy of its genome, which viral enzyme MOST directly inserts that DNA into the host chromosome?



- A** Protease
- B** Integrase
- C** Helicase
- D** Catalase
- E** Trypsin





28 HIV produces large polyproteins that must be cut into functional proteins to form mature infectious virions. Which viral enzyme performs this cutting step?



- A Reverse transcriptase
- B Integrase
- C Protease
- D Ribosome
- E ATP synthase

29 Entry of HIV into many immune cells requires binding to CD4 and also to a co-receptor. Which co-receptor is commonly involved (basic concept)?



- A Aquaporin
- B CCR5 (or in some cases CXCR4)
- C Insulin receptor
- D SGLT1
- E Na⁺/K⁺ ATPase

30 In HIV, which statement about envelope proteins is MOST accurate at a basic level?



- A gp120 is mainly responsible for binding CD4/co-receptor; gp41 helps fuse viral and host membranes.
- B gp120 is the viral genome; gp41 is the viral capsid.
- C gp120 is a bacterial cell wall protein.
- D gp41 binds DNA inside the nucleus.





- E gp120 and gp41 are only present in non-enveloped viruses.

31 Which statement **BEST** explains why HIV can persist for years in a host even when immune responses reduce active virus levels?



- A HIV can survive by photosynthesis in the blood.
- B HIV can integrate into host DNA as a provirus and remain latent in infected cells.
- C HIV is protected by a peptidoglycan cell wall.
- D HIV forms bacterial endospores.
- E HIV replicates only outside cells where antibodies cannot reach it.

32 A virus is released from a living cell without immediately bursting it. Which type of virus is **MOST** consistent with this release strategy?



- A A non-enveloped virus that must exit by cell lysis
- B An enveloped virus that buds from the host membrane
- C A prion, which buds from membranes
- D A bacterial endospore
- E A plasmid

33 Which is **NOT** a typical function of a viral capsid?



- A Protect the viral genome from damage
- B Help attach to host cells (directly or indirectly via spikes)





- C Deliver the genome into the host cell during infection
- D Generate ATP to power viral replication
- E Package the viral genome into a stable particle

34 HIV mutates rapidly partly because its reverse transcriptase:



- A Has very strong proofreading and corrects most errors
- B Lacks effective proofreading, so copying errors are common
- C Is a ribosome that translates RNA into DNA
- D Works only in the lysosome, which causes mutation
- E Does not copy nucleic acids at all

35 Which sequence BEST represents the information flow for a retrovirus from entry to producing viral proteins?



- A DNA → RNA → DNA → protein
- B RNA → DNA → RNA → protein
- C Protein → RNA → DNA → protein
- D RNA → protein → DNA → RNA
- E DNA → protein (no RNA step)

36 In eukaryotic cells, integrated retroviral DNA is called a:





- A Prophage
- B Provirus
- C Capsomer
- D Viroid
- E Ribosome

37 Which statement about viral genomes is correct?



- A All viruses use DNA as their genetic material.
- B Viruses may use DNA or RNA (single- or double-stranded), depending on the virus.
- C Viruses store genetic information only as proteins.
- D Viruses have no genomes because they are not alive.
- E All viruses have both DNA and RNA genomes simultaneously.

38 A newly discovered virus has an RNA genome that cannot be directly translated by host ribosomes. Early viral protein production occurs only if the infecting particle provides a polymerase. Which genome type is MOST consistent with this clue?



- A Positive-sense (+) ssRNA
- B Negative-sense (–) ssRNA
- C A host mRNA molecule
- D A bacterial plasmid
- E A protein-only infectious particle





39 A double-stranded RNA (dsRNA) virus enters a cell. What **MUST** happen before host ribosomes can make viral proteins?

- A** The dsRNA must be reverse-transcribed into DNA and integrated.
- B** The dsRNA must be transcribed into single-stranded mRNA using a viral RNA-dependent RNA polymerase.
- C** The dsRNA must be converted into peptidoglycan.
- D** The dsRNA must be imported into the nucleus through nuclear pores as intact dsRNA and directly translated.
- E** The dsRNA must be copied by host ribosomes into DNA.



40 Which comparison between viruses and bacteria is **MOST** accurate?

- A** Viruses and bacteria both have ribosomes and reproduce by binary fission.
- B** Bacteria are cells with metabolism and ribosomes; viruses are acellular and are assembled using host machinery.
- C** Viruses are always larger than bacteria and have mitochondria.
- D** Bacteria need host cells to reproduce, but viruses do not.
- E** Viruses have peptidoglycan cell walls; bacteria have capsids.







#	Ans	Answer Text
1	B	It cannot synthesize proteins or generate enough resources independently...
2	B	A complete infectious virus particle outside a host cell, consisting of ...
3	B	A protein capsid
4	B	Enveloped viruses, because their outer envelope is a lipid bilayer that ...
5	B	The host cell membrane (or internal host membranes), which the virus bud...
6	A	Positive-sense (+) ssRNA
7	B	Negative-sense (−) ssRNA virus
8	B	Attachment → genome entry → synthesis of viral parts → assembly → releas...
9	C	Lysis of many bacteria releasing new phage particles
10	B	Prophage
11	B	UV induces the prophage to excise and enter the lytic cycle (induction)
12	B	Lysogenic conversion
13	C	Transduction
14	B	Generalized transduction
15	B	Specialized transduction
16	B	Viruses do not build peptidoglycan cell walls; they use capsids/envelope...
17	B	Which host cell receptor the virus can bind (tropism/host range)
18	B	Plant cell walls act as a physical barrier that prevents easy membrane f...
19	B	The phage injects its nucleic acid through its tail; the capsid usually ...
20	B	They are assembled from newly made parts (genomes + proteins) inside a h...
21	B	Helical — rod-like plant virus nucleocapsid (classic example)
22	B	Host DNA/RNA-processing machinery that is concentrated in the nucleus (g...
23	B	RNA-dependent RNA polymerases often lack strong proofreading, so mutatio...
24	A	Reassortment
25	B	It uses reverse transcription: RNA is copied into DNA.
26	B	Reverse transcriptase
27	B	Integrase
28	C	Protease
29	B	CCR5 (or in some cases CXCR4)
30	A	gp120 is mainly responsible for binding CD4/co-receptor; gp41 helps fuse...
31	B	HIV can integrate into host DNA as a provirus and remain latent in infec...
32	B	An enveloped virus that buds from the host membrane
33	D	Generate ATP to power viral replication
34	B	Lacks effective proofreading, so copying errors are common
35	B	RNA → DNA → RNA → protein
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38	B	Negative-sense (−) ssRNA



