

Microbiology & Medical Virology

Practice Questions

Interactive Review • 10 High-Yield MCQs with Detailed Answer Key

[Bacteriology - Cell Wall Deficiency]

Q1. A culture of Gram-negative rods is subjected to prolonged low-dose lysozyme treatment in an isotonic medium. Microscopic examination reveals spherical bacterial forms that retain fragments of their outer membrane. Which term best describes these structures, and why are they naturally immune to beta-lactam antibiotics?

- A)** Protoplasts; because beta-lactams cannot penetrate through their inner plasma membrane.
- B)** Spheroplasts; because beta-lactams target peptidoglycan cell wall synthesis, which is partially or fully degraded in these forms.
- C)** L-forms; because their membrane contains high levels of sterols that directly neutralize penicillin.
- D)** Endospores; because their thick protein coat prevents antibiotics from entering the core.

[Bacteriology - Capsule & Quellung Reaction]

Q2. A sputum specimen from a patient with severe lobar pneumonia is mixed with specific diagnostic antiserum. Under microscopic observation, the capsules of the diplococci appear dramatically swollen and refractile. What is the immunological basis of this Quellung reaction?

- A)** Complement activation leads to lytic pore formation within the bacterial cell wall.
- B)** Binding of specific antibodies to the capsular polysaccharide alters its refractive index and causes visible swelling.
- C)** Bacteriophages absorb into the capsule, triggering rapid viral assembly and capsule expansion.
- D)** Phagocytic uptake by macrophages induces exocytosis of additional capsular fibrils.

[Bacteriology - Flagella & Taxis]

Q3. A mutant strain of *Salmonella typhi* is created with a defect in its flagellar basal body structure, reducing its motor rings from 4 to 2. How will this structural change most likely impact its motility compared to a wild-type strain?

- A)** It will increase motility because 2-ring motors require less ATP energy.
- B)** It will exhibit typical Gram-positive levels of lower flagellar rotation force, as Gram-negative cells normally require 4 basal body rings.
- C)** It will transform its motility from peritrichous swimming into internal axial filament wave motion.
- D)** It will switch from negative chemotaxis to positive phototaxis automatically.

[Bacteriology - Pili & Genetics]

Q4. In a laboratory experiment, an F⁺ donor *Escherichia coli* strain transfers a plasmid carrying tetracycline resistance genes to an F⁻ recipient cell. Which bacterial appendage directly establishes the physical bridge required for this horizontal gene transfer?

- A)** Short ordinary pili with adhesive tip receptors.
- B)** Long sex pilus composed of pilin subunits involved in conjugation.
- C)** Endoflagella winding around the periplasmic axial filament.
- D)** An exosporium layer formed during vegetative binary fission.

[Bacteriology - Spore Formation & Resistance]

Q5. Which sequence correctly traces the structural layers of a fully formed bacterial endospore from its innermost nucleoid-containing center to its outermost external surface layer?

- A)** Exosporium → Spore Coat → Cortex → Core
- B)** Core → Germ Cell Wall → Cortex → Spore Coat → Exosporium
- C)** Cortex → Spore Coat → Exosporium → Core
- D)** Spore Coat → Exosporium → Core → Cortex

[Virology - Replication & Baltimore Classification]

Q6. An unknown virus isolated from a patient is determined to have a negative-sense single-stranded RNA (-ssRNA) genome. If the purified genomic RNA alone is artificially introduced into a host cell's cytoplasm, why does IT FAIL to initiate viral replication?

- A)** Negative-sense RNA is directly toxic to host cell 80S ribosomes.
- B)** Host cells lack native RNA-dependent RNA polymerases necessary to transcribe negative-sense RNA into complementary mRNA (+RNA).
- C)** The genome must first enter the host cell nucleus to recruit host DNA polymerase III.
- D)** Negative-sense RNA must be reverse-transcribed into double-stranded DNA by host integrase.

[Virology - Capsid Symmetry & Resistance]

Q7. In clinical settings, why are naked (non-enveloped) icosahedral viruses like Poliovirus significantly more resistant to hand sanitizers (alcohol-based) and stomach acid than enveloped viruses like Influenza?

- A)** Naked viruses possess an outer layer composed of dipicolinic acid and calcium.
- B)** The lipid envelope of enveloped viruses is easily dissolved by lipid solvents/alcohols, causing loss of viral attachment proteins; whereas protein capsids are structurally resilient.
- C)** Enveloped viruses lack capsomeres, relying solely on host cell membranes for osmotic stability.
- D)** Naked viruses replicate exclusively via binary fission outside living host cells.

[Virology - Viral Tropism]

Q8. Influenza virus binds specifically to sialic acid residues on respiratory epithelial cells causing lung infections, but does not infect human brain tissue. This preference for a specific organ or tissue type is defined as:

- A)** Cellular Tropism

- B) Tissue Tropism**
- C) Host Tropism**
- D) Ambisense Expression**

[Virology - Ambisense RNA Strategy]

Q9. Analysis of an Arenavirus segment demonstrates that one portion of its single-stranded RNA genome is translated directly (+sense) upon entry, while another portion on the same strand must first be transcribed (-sense) by viral polymerase. What is this genomic strategy called?

- A) Retroviral Reverse Transcription**
- B) Ambisense RNA Expression**
- C) Icosahedral Splicing**
- D) Lysogenic Conversion**

[Virology - DNA Virus Characteristics]

Q10. Most double-stranded DNA (dsDNA) human viruses (such as Herpesviridae and Adenoviridae) replicate inside the host cell nucleus and exhibit high genetic stability. What primary mechanism accounts for this lower mutation rate compared to RNA viruses?

- A) RNA viruses utilize host ribozymes that purposefully introduce point mutations.**
- B) Nuclear DNA replication utilizes DNA polymerases with intrinsic 3' to 5' exonuclease proofreading activity.**
- C) dsDNA genomes are enclosed within a thick exosporium layer in cytoplasm.**
- D) dsDNA viruses undergo continuous antigenic shift via reassortment of segments.**

Answer Key & Explanations

Q#	Answer	Topic / Key Scientific Rationale
Q1	B	Spheroplasts retain partial outer membrane; beta-lactams target cell wall synthesis which is absent.
Q2	B	Antibody binding to capsular polysaccharide alters refractive index, causing apparent swelling.
Q3	B	Gram-negative bacteria require 4 basal rings (L, P, MS, C); loss of 2 rings reduces rotational mechanics.
Q4	B	F pilus (sex pilus) forms the conjugation bridge for horizontal plasmid transfer.
Q5	B	Endospore structure from inside out: Core -> Germ Cell Wall -> Cortex -> Spore Coat -> Exosporium.
Q6	B	-ssRNA is not recognized as mRNA and host lacks RNA-dependent RNA polymerase to copy it.
Q7	B	Lipid envelopes are disrupted by detergents/alcohols; naked protein capsids are chemically resilient.
Q8	B	Tissue Tropism refers to specificity for a particular tissue/organ (e.g., respiratory epithelium).
Q9	B	Ambisense RNA contains both positive-sense and negative-sense coding regions on one strand.
Q10	B	Host/viral nuclear DNA polymerases possess 3' to 5' exonuclease proofreading activity.

Summary Answer String: Q1: B | Q2: B | Q3: B | Q4: B | Q5: B | Q6: B | Q7: B | Q8: B | Q9: B | Q10: B