

Genetics of Viruses & Bacteria
Timed Practice

Name: _____ Class: _____

Multiple Choice Questions

1. A bacterium is infected with an experimentally constructed bacteriophage composed of the T2 phage protein coat and T4 phage DNA. The new phages produced would have _____.

A T2 protein and T4 DNA
B a mixture of the DNA and proteins of both phages
C T4 protein and T4 DNA
D T4 protein and T2 DNA

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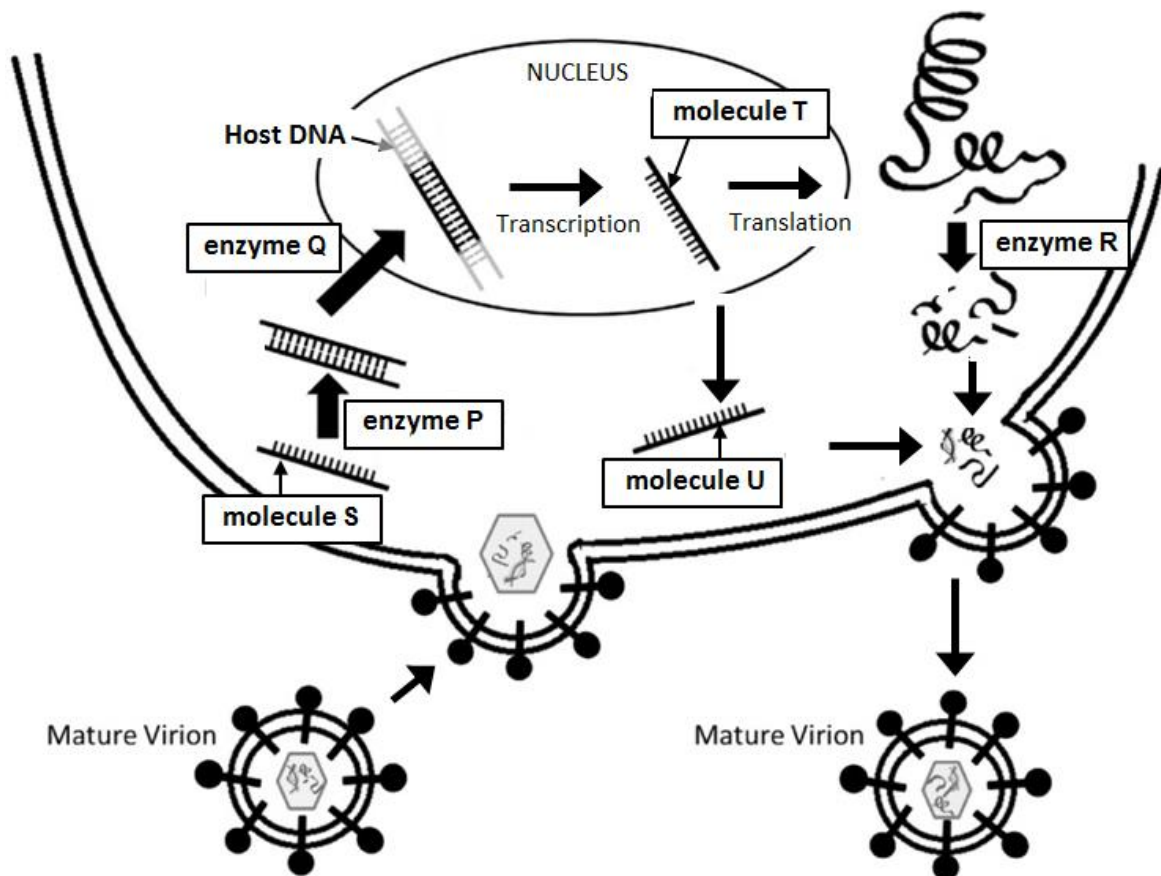
2. The use of antibiotics is currently the most common method of treating bacterial infections in humans. Phage therapy, which is the use of bacteriophages to treat bacterial infections, is being explored as a potential alternative. Which of the following statements about phage therapy are true?

- 1 Only a small dose of bacteriophage needs to be administered for the treatment to be effective.
- 2 One of the safety concerns in the use of phage therapy is that the bacteriophages can infect human cells.
- 3 Virulent bacteriophages are preferred over temperate bacteriophages.

A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

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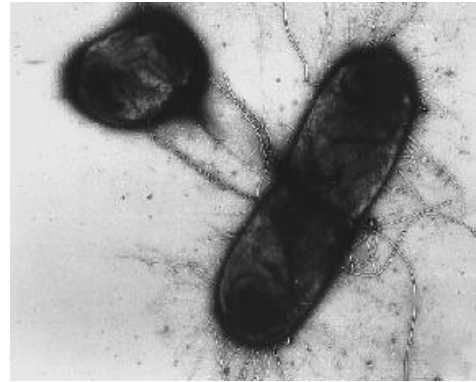
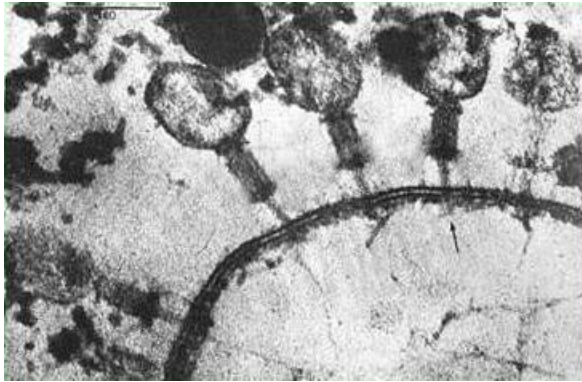
3. The diagram shows the life cycle of the HIV. Enzymes P to R are involved in specific processes, indicated by the three bold arrows, occurring during the life cycle of the virus. Which of the following are the correct identities of enzymes P to R and molecules S to U?



	enzyme P	enzyme Q	enzyme R	molecule S	molecule T	molecule U
A	RNA-dependent RNA Polymerase	Integrase	Protease	Positive-sense RNA	Negative-sense RNA	Positive-sense RNA
B	Reverse Transcriptase	Integrase	Protease	Positive-sense RNA	Positive-sense RNA	Positive-sense RNA
C	RNA-dependent RNA Polymerase	Nuclease	Lysozyme	Negative-sense RNA	Negative-sense RNA	Negative-sense RNA
D	Reverse Transcriptase	Nuclease	Lysozyme	Negative-sense RNA	Positive-sense RNA	Negative-sense RNA

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4. The photomicrographs show two different processes of genetic transfer in bacteria.

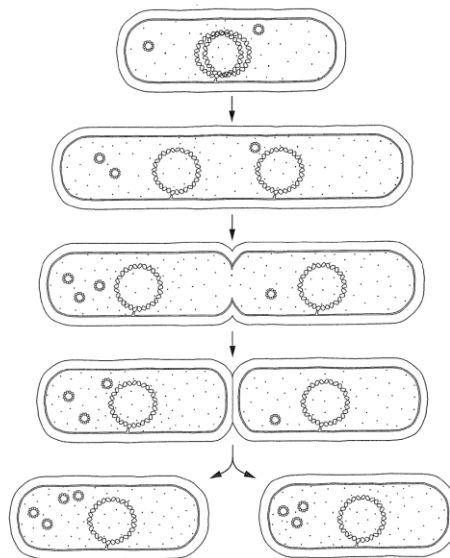


Which statement is true for both processes?

- A There is physical contact between the donor and recipient.
- B Specific genes in the donor are required for genetic transfer to occur.
- C Any gene in the bacterial genome can be transferred.
- D None of the above.

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5. The diagram is a schematic representation of reproduction occurring in bacteria.



Based on the diagram, which observation is **not** valid?

- A Formation of the cell wall is responsible for the separation of two daughter cells.
- B The small chromosomal structures are not replicated along with the main chromosome.
- C The number of the main chromosome is conserved in daughter cell.
- D The quantity of genetic material in daughter cells will always be similar to the parental cell.

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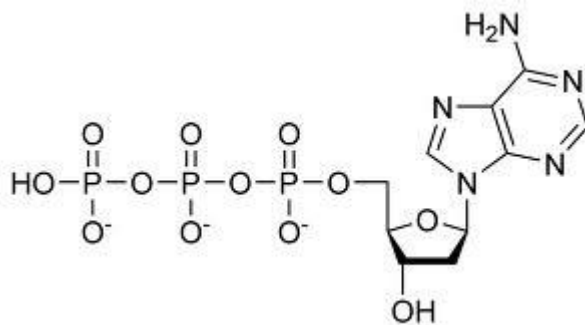
Structured Questions

1. The Human Immunodeficiency Virus (HIV) is a retrovirus which specifically infects CD4⁺ T-cells in humans. The levels of CD4⁺ T-cells become severely depleted in patients with acquired immunodeficiency syndrome (AIDS).

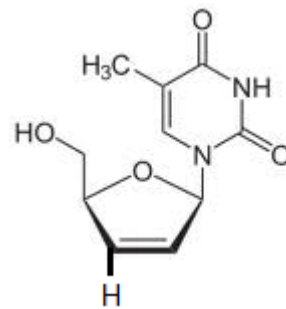
(a) Suggest how HIV reduces the levels of CD4⁺ T cells. [2]

1. Viral infected T cells are triggered to undergo **apoptosis** (by other white blood cells);
2. Lysis of infected T cells eventually occur due to the **budding** of many new virions and host cell surface membrane is depleted;

A drug known as Zerit may be used to treat patients with HIV. Zerit belongs to a class of drugs called analogue reverse transcription inhibitors. These nucleotide analogues have similar structures to deoxyribonucleotides except that the 3' OH group is replaced with a 3' H atom.



Deoxyribonucleotide



Zerit

(b) Suggest how this drug may be effective in delaying the replication of HIV in the body. [3]

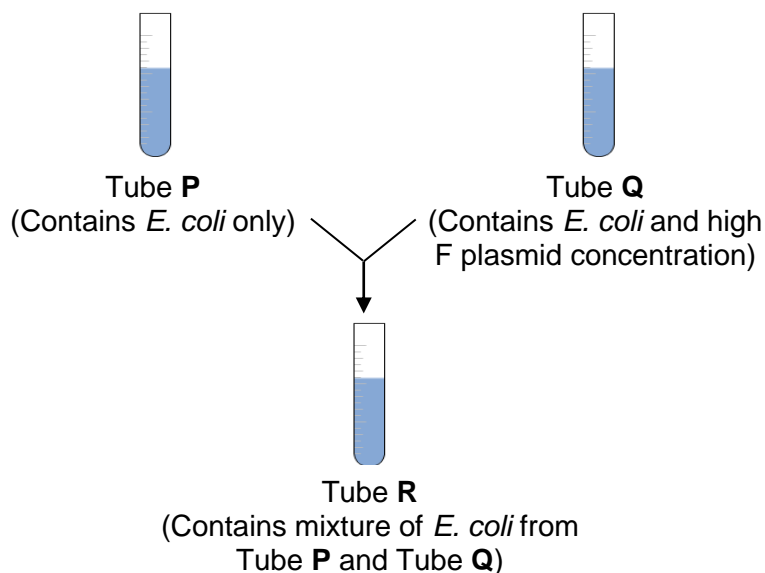
1. Zerit is **structurally similar** to a deoxyribonucleotide;
2. Hence acts as a **competitive inhibitor** which binds to the **active site** of reverse transcriptase;
3. After incorporation into an elongating strand of DNA, it prevents the next deoxyribonucleotide from being added due to the **lack of a free 3'OH group**;
4. HIV is **unable to form double-stranded DNA for integration** into the host genome as a provirus;

(Any 3 out of 4 points)

2. A researcher studied the growth of *Escherichia coli* bacteria under various conditions. A strain of *E. coli* which has a mutated *lacZ* gene was used for the experiment. This strain was grown in a liquid medium, and was labelled Tube **P**.

Next, the researcher synthesized an artificial F plasmid containing a functional copy of the *lacZ* gene. The presence of a functional *lacZ* gene in bacteria allows cells to utilize lactose as a source of energy. This F plasmid was added in high concentrations in a separate tube containing the same *E. coli* strain, and was labelled Tube **Q**.

Both tubes were incubated under appropriate conditions for five days. The researcher then isolated bacteria from Tube **P** and Tube **Q** and cultivated them in a separate tube, labelled as Tube **R**.



- (a) The researcher spread a sample of each bacterial culture from Tube **P** and Tube **Q** on each of the three types of plates below:

Plate **A**: Glucose medium Plate **B**: Lactose medium Plate **C**: Lactose medium with penicillin antibiotic

- (i) In the table below, indicate if there is growth (✓) or no growth (✗) of bacteria from Tube **P** and Tube **Q** on the respective plates. [1]

	Plate A	Plate B	Plate C
Tube P	✓	✗	✗
Tube Q	✓	✓	✗

- (ii) The researcher discovered that all the *E. coli* cells contained a functional *lacZ* gene in Tube **R**, including bacteria that did not originally have it in Tube **P**. With reference to the information given, explain this observation. [4]

- Competent cells have taken up the F plasmid containing a functional *lacZ* gene in Tube Q through transformation (with the expenditure of ATP);
- Conjugation between (donor) F⁺ cells from Tube Q and (recipient) F⁻ cells from Tube P has occurred in Tube R;
- Where F⁺ cells (from Tube Q) attach to F⁻ cells (from Tube P) via a sex pilus / formation of conjugation tube between F⁺ and F⁻ cells;
- F plasmid containing functional *lacZ* gene is transferred from F⁺ cells to F⁻ cells;