# AP® Biology
# 2002 Sample Student Responses
# Form B

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# BIOLOGY

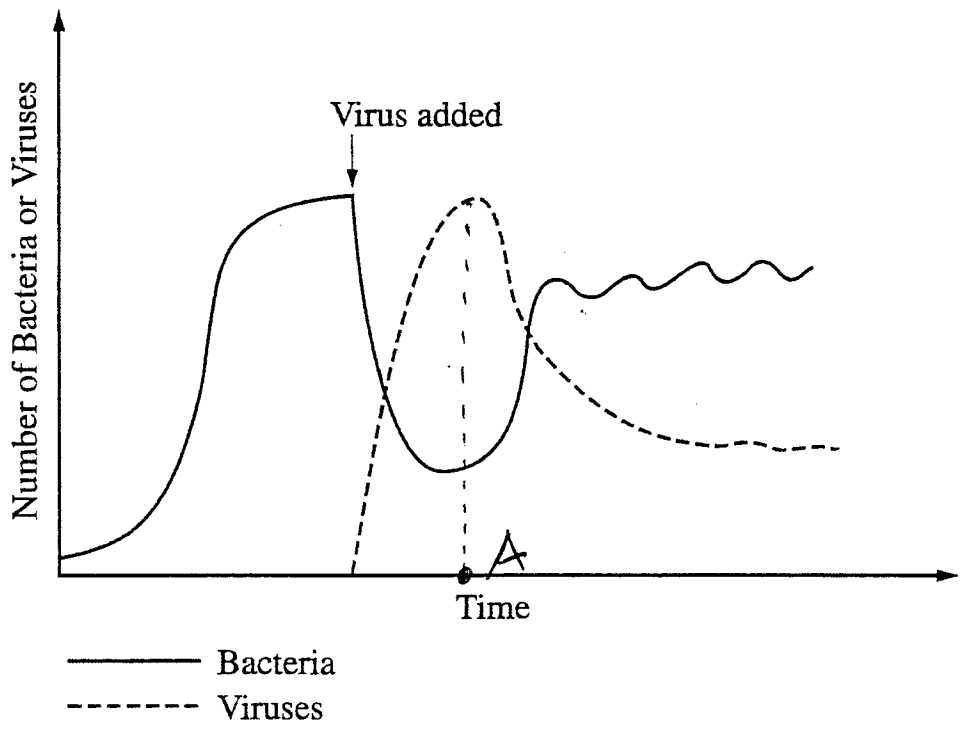
## SECTION II

**Time—1 hour and 30 minutes**

**Directions:** Answer all questions.

Answers must be in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write. Write all your answers on the pages following the questions in this booklet.

1. Bacteria were cultured in a system that allowed for the continual addition of fresh nutrients and the removal of waste products. Bacteriophage (virus) were added at the time shown and the following population changes were observed.




(a) **Describe** and explain the observed results.

(b) **Discuss** the infection cycle of a DNA virus from attachment to lysis.

(c) **Describe** how the genome of a retrovirus like HIV (Human Immunodeficiency Virus) becomes incorporated into the genome of the host cell.

(a) when the virus is added to the culture of bacteria, the number of bacteria falls rapidly and the number of viruses increases rapidly until the number of viruses reaches a peak and the number of bacteria reaches a trough. (see point A

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on graph above.) This happens because when viruses are added, they start infecting the bacteria. Viruses inject their genome into the host cell (bacteria) and cause the host to replicate its own genes. Many phage progeny are made inside the bacteria until the bacteria burst, performing lysis, releasing many new viruses. This increases virus count and decreases bacteria count, which is shown up to point A on the graph. However, after point A, number of bacteria rise again and number of viruses fall until they both reach an apparent equilibrium. This may be due to bacteria developing resistance to the virus. A mutation may cause bacteria to make a protein on its surface that does not let the virus attach. This would result in more bacteria surviving and viruses dying since they have no host cell.

(b) A virus has "legs" that can anchor itself to ~~[illegible] [illegible]~~ cell walls of its host cell. Once it anchors, it releases its genome into the host cell. The protein capsid remains outside as a "ghost" phage. The genome enters the host cell and replicates, using the host cell's energy and organic materials like ~~[illegible]~~ nucleotides. The genome codes for whole viruses – including its protein capsid. Viruses assemble themselves →

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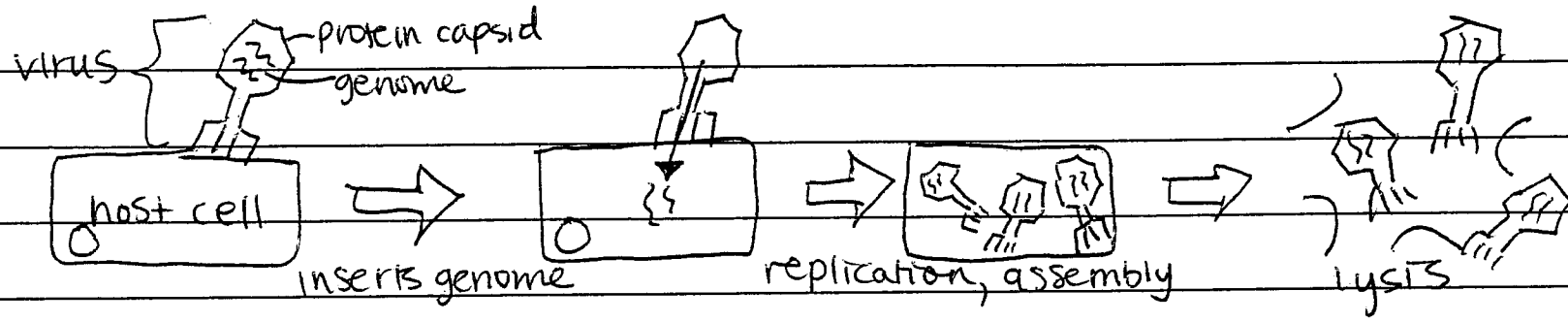
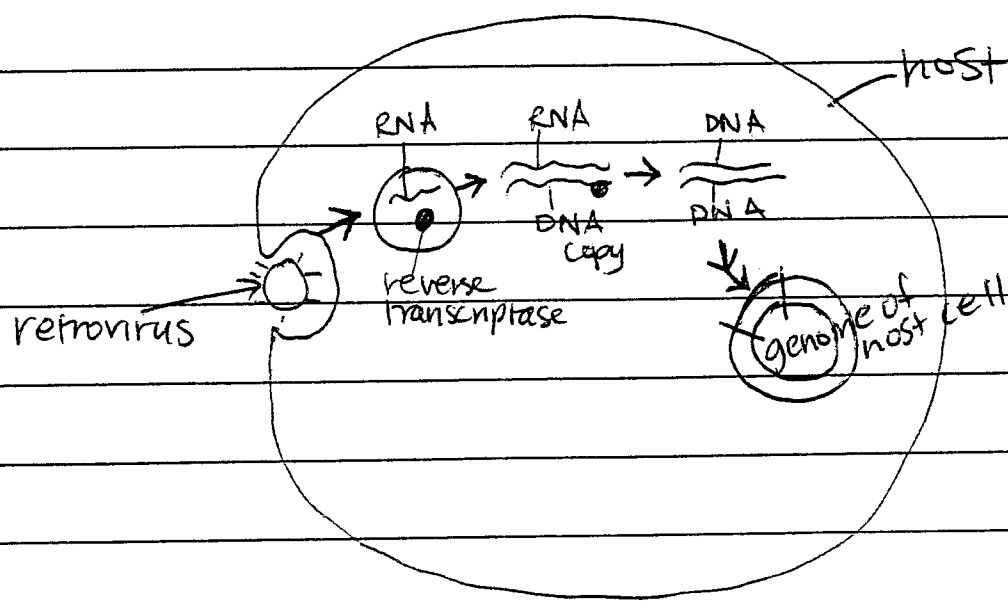
inside the host cell. These progeny accumulate inside the host cell and cause lysis. The cell bursts open and releases the progeny, allowing further reproduction of the virus. (See diagram below)




(C) A retrovirus inserts its genome into the host cell, which is made of RNA. It also inserts its unique enzyme reverse transcriptase with it. This enzyme uses the RNA genome as a template and makes a DNA strand that's complementary to the RNA by joining deoxyribonucleic acids. Then the DNA replicates to make itself double stranded like the host cell's genome, before it inserts inself into one of the host cell's actual chromosomes. (See diagram below)

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# BIOLOGY

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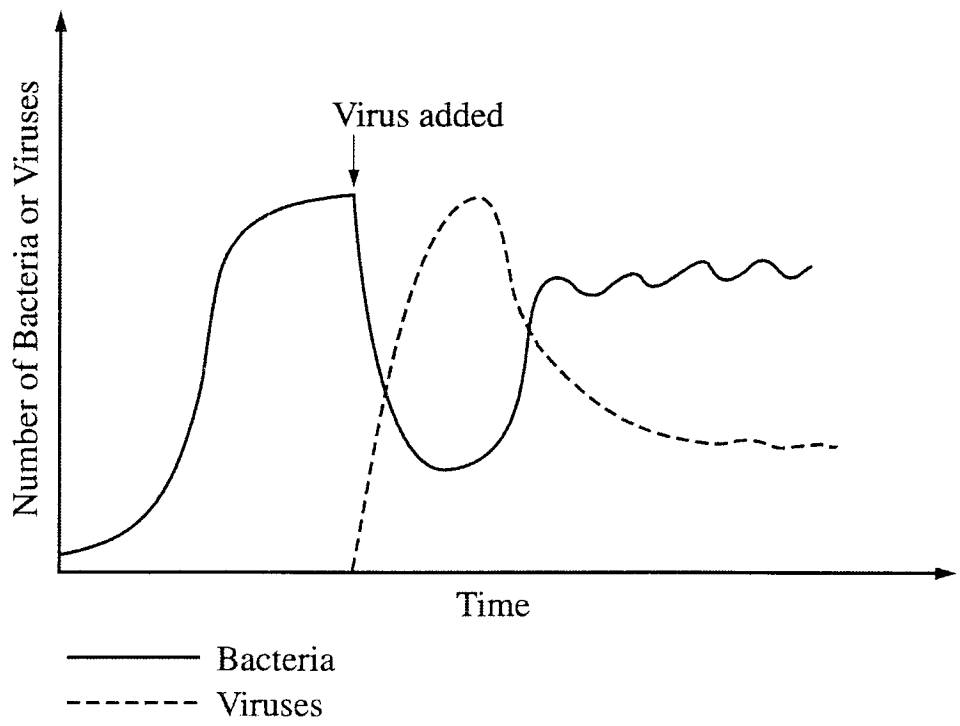


(a) **Describe** and explain the observed results.

(b) **Discuss** the infection cycle of a DNA virus from attachment to lysis.

(c) **Describe** how the genome of a retrovirus like HIV (Human Immunodeficiency Virus) becomes incorporated into the genome of the host cell.

To begin with the bacteria flourished because they had the nutrients and means for waste removal needed to survive and reproduce through mitosis. As the viruses were introduced to the culture of bacteria, they began to infect the bacteria by attaching to specific receptor sites on the bacteria, releasing their ~~DNA~~ genetic material into the bacterial cell and eventually causing the infected bacterial cells

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to lyse. This is why so many bacteria cells died upon the introduction of bacteriophage into the culture. The viruses were able to multiply themselves at the expense of the bacteria cells, explaining the large number of viruses compared to the very low number of bacterial cells present. The next part of the graph shows an ultimate increase in bacterial cells and an eventual decrease of viruses. This could be explained by an acquired immunity of the bacterial cells against the virus. Perhaps the bacteria acquired differed glycoproteins along its membrane, allowing the virus no longer to attach and infect ~~its harmful~~ the bacteria cell with its genetic material and destructive enzymes. Because of this more bacteria cells are able to live and reproduce. Eventually a dynamic equilibrium is reached. The viruses die out because without a host they can no longer reproduce, creating an equilibrium for the viruses aswell.

There are two different kinds of viruses, concerning the type of genetic material they carry. DNA viruses carry their genetic material in the form of DNA. They infect their host by, first, attaching to the membrane of the host cell by use of specific receptor proteins. They then inject their DNA into the host which causes the DNA of the host to break apart. At this point the host cell no longer has control of its functions. The viral DNA copies itself, using nucleotides from the broken-down host DNA, and instructs the cell, with the use of its ribosomes and other cell structure, to produce the proteins for the capsid shell of the virus. Once this is complete, the

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Viral DNA makes an enzyme which causes the cell membrane of the host to break down. Because the cell membrane is broken down, more water enters the cell from its surroundings and the cell bursts, or lyses.

Other viruses, such as the HIV Virus are retroviruses, and instead of causing the infected host to lyse, ~~they remain in the cell~~ the genetic material remains in the cell as part of the host genome. To begin with, a retrovirus is one ~~that~~, that instead of DNA, carries its genetic material in the form of ~~DNA~~ RNA. Inside the capsid of a retrovirus is the RNA and also an enzyme called reverse transcriptase. This enzyme, upon the injection of the viral ~~DNA~~ RNA into the host cell, transcribes (in reverse) the RNA into DNA. Once this has taken place the DNA ~~is copied and transcribed~~, instead of copying itself and causing the host DNA to break down, incorporates itself into the host genome. The viral DNA codes for a protein which allows it to do so. When the DNA incorporates itself into the host genome, the virus is said to be in the lysogenic cycle - a cycle in which the bacterial cell is not lysed. The viral DNA stays ~~there~~, in the host genome, until it enters the lytic cycle (explained in previous ~~Resp~~ paragraph).

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# BIOLOGY
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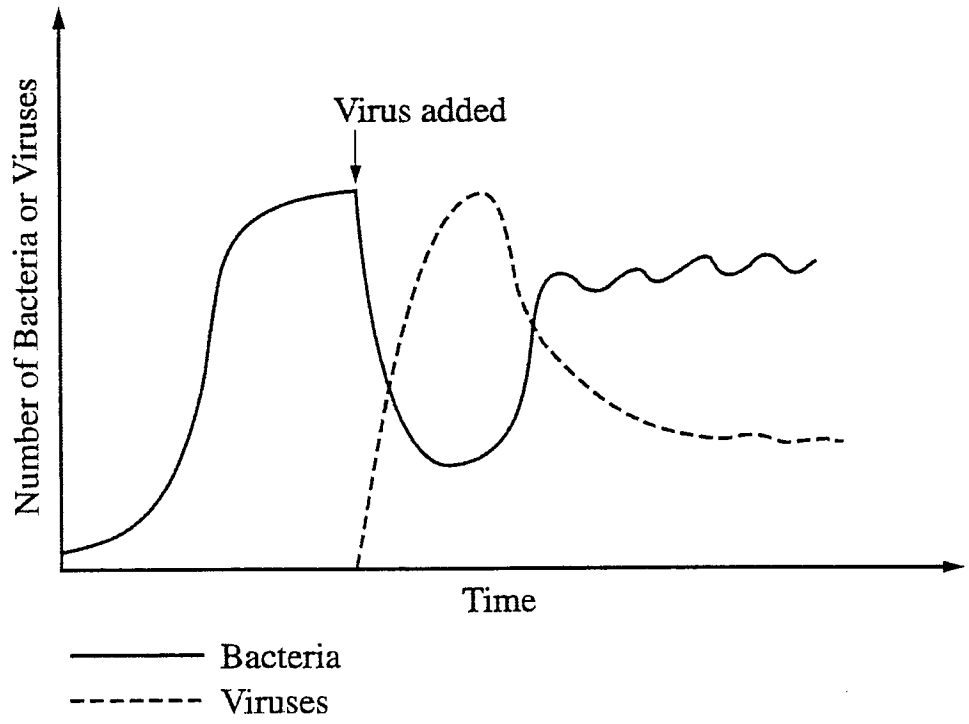


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(b) **Discuss** the infection cycle of a DNA virus from attachment to lysis.

(c) **Describe** how the genome of a retrovirus like HIV (Human Immunodeficiency Virus) becomes incorporated into the genome of the host cell.

Bacteria are cultured with ample nutrients and its population shows exponential growth. However when virus ~~were~~ are added. The population of bacteria ~~dropped~~ tremendously while that of virus ~~is~~ increase. After a while virus & bacteria both reach the carrying capacity and ~~their~~ Their population fluctuate ~~is~~ around the carrying capacity. When virus are first introduced, they infect bacteria ~~with~~ hence number of

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virus ~~increased~~ increase with very fast rate. After the population of virus reach the peak, limiting ~~factors~~ are taken ~~as~~ into account. There might be very high density of virus or not enough food. Thus ~~it~~ the number of virus ~~drop~~ fall till the equilibrium between bacteria and virus are ~~reached~~ reached

Virus ~~attaches~~ to a bacteria. It injects its DNAs into the bacteria cell. as ~~well~~ well as restriction enzymes. Restriction enzymes cut out parts of bacterial DNA making sticky ends. Virus DNA ~~are attached to the portion of DNA of bacteria~~ replace the lost portion of bacterial DNA. Now this infected DNA produces proteins for the virus. ~~and its comp~~. And ~~new~~ new viruses are ~~formed~~ formed inside the bacterial cell. As the number of virus ~~cell~~ reach certain level within a bacteria cell. ~~There is~~ the bacteria cell cannot accomodate any more viruses. The viruses lyse ~~at the same~~ the bacterial cell. Viruses from the bacteria move around to infect other cells and the cycle continues.

When retroviruses are attached to the host cell and its RNAs ~~are~~ invaded into the host cell, something happens which opposes the central dogma. DNA is formed from RNA of retro virus by the help of enzyme RNA repticase. This newly formed DNA, along with the original DNAs in the ~~host~~ hostcell connect each other and translated to RNA of the host cell, which contains ~~information~~ genetic information from the DNA produced from RNA of retrovirus.