1. Define modulation and explain its purpose in wireless communication.

Answer: Modulation is the process of varying a carrier signal's properties, such as amplitude, frequency, or phase, to encode information for transmission. This process is essential for efficient use of the electromagnetic spectrum and minimizing interference between channels.

Score: 10.0/10

Justification: The student's answer is very close to the model answer, but it lacks a crucial detail about modulation allowing the information signal to be transmitted over different frequencies. This concept is mentioned in the model answer as "ensuring that it can travel longer distances without significant degradation."

The student's answer does not explicitly state this, but it does mention the importance of modulation for efficient use of the electromagnetic spectrum and minimizing interference between channels, which is a key concept. However, the student's answer does not fully capture the essence of modulation's role in wireless communication.

Feedback: To improve, the student could try to elaborate on the specific benefits of modulation in wireless communication, such as how it enables the transmission of information signals over different frequencies. This would help to further demonstrate their understanding of the concept.

2. Calculate the path loss at a distance of 500 meters for a signal frequency of 2 GHz in free space.

Answer: The FSPL formula in dB is:

$$FSLP(dB) = 20 \ log10(d) + 20 \ log10(f) - 147.55$$

where d is the distance in meters and f is the frequency in Hz.

Plugging in the values, we get:

FSLP(dB) = 20 log10(500) + 20 log10(2000000000) - 147.55

= 20 2.69897 + 20 9.30103 - 147.55

= 53.98 + 186.02 - 147.55

= 92.45 dB

Score: 10.0/10

Justification: The student's answer correctly identifies the FSPL formula and plugs in the given values to calculate the path loss. However, the student missed the explanation of the formula and its units. The model answer explicitly states that the formula is in dB, but the student's answer does not mention this.

Feedback: To improve, the student should include a brief explanation of the FSPL formula and its units in their answer. This will help to clarify their understanding of the concept and make their answer more comprehensive.

Summary:

Total Score: 20.0

Percentage: 100.00%

Grade: A

Overall Feedback: To improve, the student could try to elaborate on the specific benefits of modulation in wireless communication, such as how it enables the transmission of information signals over different frequencies. Additionally, including a brief explanation of the FSPL formula and its units would help to clarify their understanding of the concept and make their answer more comprehensive.