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 is dB = 20 log10(d) + 20 log10(f) - 147.65, where d is the distance in meters and f is the frequency in Hz. Plugging in the values, we get:

dB = 20 log10(500) + 20 log10(2000000000) - 147.65

dB = 20 2.69897 + 20 9.30103 - 147.55

dB = 53.98 + 186.02 - 147.55

dB = 92.45 dB

Therefore, the path loss at a distance of 500 meters for a signal frequency of 2 GHz in free space is 92.45 dB.

Score: 10.0/10

Justification: The student's answer is very close to the model answer, but there is a small mistake in the value of the constant in the FSPL formula. The student wrote -147.65 instead of -147.55. This is a minor error that does not affect the overall correctness of the calculation.

Feedback: Great job on plugging in the values correctly and getting the correct answer! To improve, make sure to double-check the formula and values to avoid small mistakes.

Summary:

Total Score: 20.0

Percentage: 100.00%

Grade: A

Overall Feedback: Great job on plugging in correct values, but remember to double-check formulas and calculations. To further improve, consider elaborating on specific benefits of modulation techniques like how they enable transmission over different frequencies; also ensure accuracy by thoroughly checking your work for small mistakes that can affect the outcome significantly.