

Circle the answer that is most correct.

Questions (i)-(iv) refer to a communications system operating at 8 GHz in horizontal polarization. This system is used to receive signals at the Earth's surface transmitted from a spacecraft in orbit around Mars. Assume that all system components are polarization and impedance matched, and that a direct line of sight exists between the transmitter and receiver. The distance between the two is 100 million km, and the communications system operates in a 1 MHz bandwidth. The spacecraft is capable of transmitting 100 W of power, and has an antenna gain of 40 dBi. The Earth station receiver has an antenna gain of 65 dBi, a noise figure of 1.2, and operates in a 290 K external noise environment.

(i) What is the received power at the Earth station in decibels relative to one watt (dB_W) neglecting attenuation due to rain and atmospheric gases?

- (a) -83.6 (b) -98.7 (c) -105.2 (d) -145.5 (e) -167.3

(ii) Consider a case where the power at the receiver input is $S_i = -115 \text{ dB}_W$. What is the signal to noise ratio at the receiver output?

- (a) -17.8 dB (b) 5.1 dB (c) 28.2 dB (d) 65.7 dB (e) 83.3 dB

(iii) Estimate the rain rate required to produce a specific attenuation of 2 dB/km for this system.

- (a) 4.52 mm/hr (b) 10.19 mm/hr (c) 46.28 mm/hr (d) 98.3 mm/hr (e) 131.51 mm/hr

(iv) Find the minimum possible time delay between signal transmission from the spacecraft and signal reception at the receiver on Earth.

- (a) 15 usec (b) 6.23 msec (c) 333 msec (d) 2.61 sec (e) 7.77 sec

Error in problem ! Correct answer is 333 sec: Everyone will be marked correct on this question.