First Name :…… Last Name: …… G:…….

A digital transmission system is used to send video over an **ideal noiseless channel**. A source generates images of **500 × 500 pixels**, encoded using **8 bits per pixel**. The system transmits **20 images per second**.

The transmission channel has the following characteristics:

- Bandwidth: **2 MHz** , **Noiseless channel** , Propagation speed: **2.5×10^8 m/s**

1. **Determine the number of possible intensity levels. ?**

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2. **Determine the total number of bits required to transmit a single image**

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3. **Calculate the amount of data generated in one second (in Mbits).**

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4. **Determine the maximum data rate supported by the channel.**

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5. **Compare the source data rate with the channel capacity and conclude.**

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Correction

Image size: 500 × 500 pixels
Encoding: 8 bits/pixel
Frame rate: 20 images/s
Bandwidth: 2 MHz
Channel: Noiseless
Propagation speed: 2.5×10^8 m/s

1. Determine the number of possible intensity levels. [1 pt]

Number of levels = $2^8 = 256$ levels

Answer: 256 intensity levels

2. Determine the total number of bits required to transmit one image. [2 pts]

Pixels per image = 500 × 500 = 250,000 pixels
Bits per image = 250,000 × 8 = 2,000,000 bits

Answer: 2,000,000 bits (2 Mb)

3. Calculate the amount of data generated in one second (in Mbits). [2 pts]

Data per second = 2,000,000 × 20 = 40,000,000 bits

Answer: 40 Mbits/s

4. Determine the maximum data rate supported by the channel. [1 pt]

For a noiseless channel (Nyquist):
$C = 2B \log_2(M)$
Assuming binary signaling (M = 2):
$C = 2 \times 2\ \text{MHz} \times \log_2(2)$
C = 4 Mbps

Answer: 4 Mbps

5. Compare the source data rate with the channel capacity and conclude. [1 pt]

Source rate = 40 Mbps
Channel capacity = 4 Mbps

Since 40 Mbps > 4 Mbps, the channel cannot transmit the data without loss.

Answer: Transmission not possible