1. Suppose a sender and receiver are communicating using the **Stop-and-Wait ARQ protocol**. The size of the data frame is **4000 bits**, the channel bandwidth is **1Mbps**, and the **propagation delay** between sender and receiver is **8 milliseconds**. Assume that acknowledgments are instantaneous and processing delays are negligible. What is the **channel utilization** in percentage?

[MCQ]

A 20%

B 25%

C 40%.

D 80%

2. Two nodes are connected via a point-to-point link using the **Stop-and-Wait protocol**. The frame size is **1000 bits**, the data rate of the channel is **50 kbps**, and the one-way propagation delay is **15 milliseconds**. Assume negligible processing time and negligible size for the acknowledgment frame. What is the **channel efficiency** (i.e., utilization) for the given setup?

[MCQ]

A 20%

B 25%

C 40%.

D 80%

3. **Two hosts use a Stop-and-Wait protocol over a point-to-point link. Which scenario leads to the highest utilization of the link?**

[MCQ]

- **A** Shorter link length and higher transmission rate
- **B** Longer link length and lower transmission rate
- **C** Longer link length and higher transmission rate
- **D** Shorter link length and lower transmission rate

4. **Which of the following statements about Stop-and-Wait protocol is true regarding its efficiency?**

[MCQ]

A. Efficiency increases with increasing propagation delay.

B. Efficiency increases with decreasing frame size.

C. Efficiency decreases when bandwidth-delay product increases.

D. Efficiency remains constant regardless of link length.

5. Consider a 50 Mbps link between a ground station (sender) and a drone (receiver) flying at an altitude of 600 km. The signal propagates at a speed of 3×10^8 m/s. The time taken (in milliseconds, rounded off to two decimal places) for the receiver to completely receive a packet of 2000 bytes transmitted by the sender is:

[NAT]

6. Consider a sliding window protocol between a sender and a receiver over a full-duplex, error-free link. Assume the following:

- The receiver processes data frames instantly.
- The sender processes acknowledgements instantly.
- The sender has an infinite number of frames ready to send.
- Each data frame is 1,500 bits and each acknowledgement frame is 40 bits.
- The link bandwidth is 2 Mbps (2×10^6 bits/sec).
- One-way propagation delay is 50 milliseconds.

What is the minimum sender window size (in number of frames), rounded to the nearest integer, required to achieve 80% link utilization?

[NAT]

7. A sliding window protocol is used over a full-duplex link with the following conditions:

- Data frame size: 1000 bits
- Acknowledgement frame size: 10 bits
- Link speed: 500 kbps (5×10^5 bits/sec)
- One-way propagation delay: 20 milliseconds
- Processing delays at receiver 5 milliseconds
- Queuing delay at receiver is 4 milliseconds
- Infinite data frames to send

What is the minimum window size (in frames), rounded to the nearest integer, required to achieve a utilization of 60%?

[NAT]

8. Station X uses 64-byte packets to send data to Station Y using a sliding window protocol. The round-trip delay between X and Y is 100 ms, and the bandwidth of the path is 256 kbps. What is the optimal window size (in packets) for maximum throughput?

[NAT]

9. A source node sends 128-byte packets to a destination node using a sliding window protocol. The one-way propagation delay is 30 ms, and the available bandwidth is 64 kbps. What is the optimal window size (in packets)?

[NAT]

10. Consider a 128×10^3 bits/second satellite communication link with one way propagation delay of 150 milliseconds. GoBack-N protocol is used on this link to send data with a frame size of 1 kilobyte. Neglect the transmission time of acknowledgement. The minimum number of bits required for the sequence number field to achieve 100% utilization is ________.

[NAT]