CS455 - Introduction to Computer Networks
Homework 3

- **Question 1 (20 pts)**
  - What is the **bit pattern** sent by an **idle BISYNC** sender ?

```
```

  - A **BISYNC sender** wish to **transmit** the following **data**:

```
Header:    01111110 00010000
Message:   00000011 00010000 01111110
CRC code:  11111111 00010000
```

    Give the **BISYNC** **frame** **transmitted** using **character stuffing**: (I already wrote 2 **SYN** characters for you in the **answer**)

```
00010110 00010110
```

- **Question 2 (20 pts)**
  - An **HDLC sender** wants to **transmit** a **HDLC frame** containing the following **information**:

```
Destination address:       01111110
Send sequence number:      111
Receive sequence number:   000
Poll bit is not set
Data:                      11111111 11111111
FCS:                       01111111 01111111
```

    Show the **HDLC** ***information*** **frame** of the **sender** **before** using **bit stuffing** (I **already** put a **flag** code in the **answer** for you):

```
01111110
```

Show the **HDLC frame** of the **sender** **after** using **bit stuffing** - provide your **answer** as **follows**:

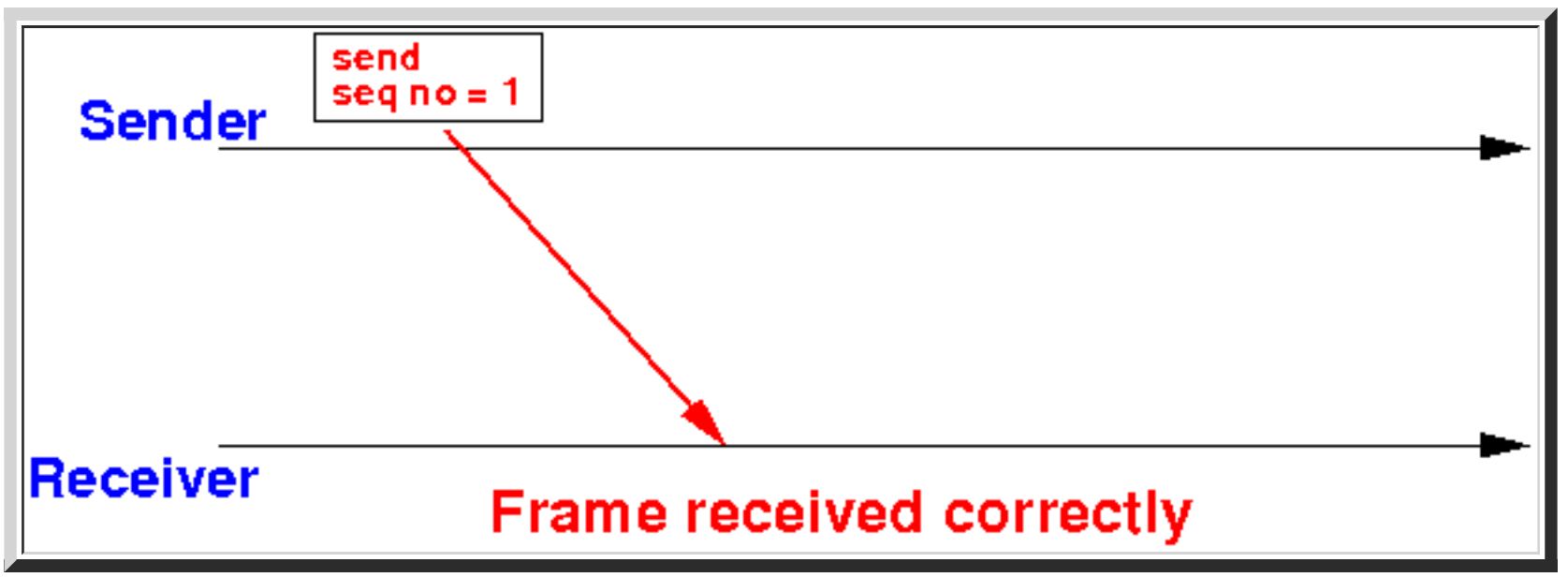
1. **Copy** the **frame** in the **above answer** into the **box below**
2. **Add** the **stuffed bits** by writing the **^** symbol **in the position** where you will **insert** a **0 bit** using the **bit stuffing** method

```
01111110
```

- **Question 3 (20 pts)**
  - A **sender** is using **Stop-and-Wait** to communicate with a **receiver**.

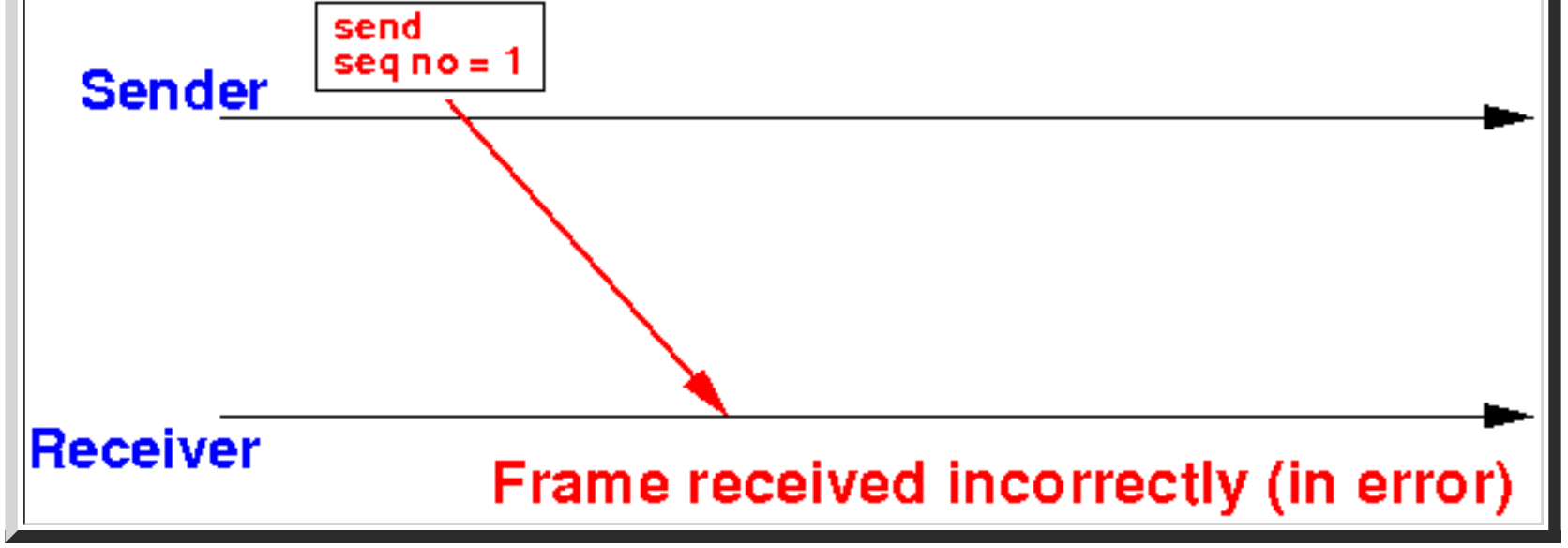
    Suppose a **frame** with **send sequence number = 1** is **received correctly**.

    Show the **response** of the **received** in the **figure**:



Suppose a **frame** with **send sequence number = 1** is **received** ***incorrectly***.

Show the **response** of the **received** in the **figure**:



- **Question 4 (20 pts)**
  - The **Stop-and-Wait** protocol was once very **popular**; but when the **bandwidth** of the network **increased** to **Mbps**, the **Stop-and-Wait** protocol was **abandoned**.

    This **question** will **explore** the **reason** why.

    Around **1980's**, we use **modems** to connect **home PC** to **Emory's workstations**

    The **transmission speed (= bandwidth)** of a **modem connection** is **64 kbps (= 64,000 bps)**

    The **one-way propagation delay** between my **house** and **Emory** is **5×10^{-5} sec** (I live about **15 km** away)

    Assume that there are **no transmission errors** (best possible case)

    Suppose each **data frame** consists of **1000 bytes (= 8000 bits)** and each **ACK frame** is **10 bytes (= 80 bits)**, compute the **effective bandwidth utilization** if the **sender** transmits **continuously** to the **receiver**

    > - The **effective bandwidth utilization** is the **fraction** of the **available bandwidth** that is **used** for **data transmission** (= transmitting **data frames**)

    I.e.:

    > - What **fraction/portion** of the **available 64 kbps bandwidth** is used to **transmit data frames**

    Answer:

- Around **1995**, the **telecom companies** introduce **high speed internet connections** of speeds of about **100 Mbps (= 100,000,000 bps)**

  Assume that there are **no transmission errors** (best possible case)

  Suppose each **data frame** consists of **1000 bytes (= 8000 bits)** and each **ACK frame** is **10 bytes (= 80 bits)**, compute the **effective bandwidth utilization** if the **sender** transmits **continuously** to the **receiver**

  In other words:

  - What **fraction/portion** of the **available 100 Mbps bandwidth** is used to **transmit data frames**

  Answer:

- **Question 5 (20 pts)**

A sender and a receiver is using the **Stop-and-Wait protocol**.

The **one-way propagation delay** between the **sender** and **receiver** is **1 msec**.
The **one-way propagation delay** from the **receiver** to the **sender** is the **same** as the **forward delay**

The transmission data rate on the link is 1 Gbps.

Each **data frame** consists of **10000 bits** and each **ACK frame** is **100 bits** long. The sender needs to transfer a **file** of **1,000,000 bytes**.

There are **no transmission errors**.

- How long will it take for the sender to completely transfer the file.

  Show your derivation to get full credit.