



LES REGLENE FØR DU STARTER!  
READ THE RULES BEFORE YOU START!

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## 1.1

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.1.1... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.1.2... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.1.3... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.1.4... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.1.5... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>
1.1.6... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.1.7... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.1.8... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.1.9... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.1.10 <input checked="" type="checkbox"/>	..... <input type="checkbox"/>

## 1.2

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.2.1... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.2.2... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.2.3... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.2.4... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.2.5... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>
1.2.6... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.2.7... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.2.8... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.2.9... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.2.10 <input type="checkbox"/>	..... <input checked="" type="checkbox"/>

## 1.3

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.3.1... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.3.2... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.3.3... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.3.4... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.3.5... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>
1.3.6... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.3.7... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.3.8... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.3.9... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.3.10 <input type="checkbox"/>	..... <input checked="" type="checkbox"/>

## 1.4

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.4.1... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.4.2... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.4.3... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.4.4... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.4.5... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>
1.4.6... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.4.7... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.4.8... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.4.9... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>	1.4.10 <input type="checkbox"/>	..... <input checked="" type="checkbox"/>

## 1.5

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.5.1... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.2... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.3... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.4... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.5... <input type="checkbox"/>	..... <input checked="" type="checkbox"/>
1.5.6... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.7... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.8... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.9... <input checked="" type="checkbox"/>	..... <input type="checkbox"/>	1.5.10 <input checked="" type="checkbox"/>	..... <input type="checkbox"/>

Kontroller:	Eksamensvaktens signature / Invigilator's signature
<ul style="list-style-type: none"> <li>• Kandidatenr. på alle sider</li> <li>• Samme kandidatenr. over alt</li> </ul>	



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2.	
<b>2.1:</b>	78.91.80.250
<b>2.2:</b>	<b>78.91.80.0/22</b>
<b>2.3:</b>	<b><math>2^{10} \approx 1000</math></b>
<b>2.4:</b>	<b>11</b>
<b>2.5:</b>	Varying queuing delay in routers on the round trip path between the source host and a router.
The round trip delay is determined by processing delay, propagation delay, transmission delay, and queuing delay at each node on the round trip path. While the first three delays may be considered unchanged in each experiment, the queuing delay may change dramatically between experiments. (Another small chance possibility is that the probing packet in each experiment goes through different round trip path.)	



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3.	
3.1:	Forward to "Interface 0".
3.2:	Forward to "Interface 1".
3.3:	Forward to "Router 2".
3.4:	Forward to "Router 1".
3.5:	Forward to "Router 2".



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4.

**4.1:** The (IP) address of the host is "**145.254.160.237**".  
The (IP) address of the server is "**65.208.228.223**".

**4.2:** There are **20 bytes** in the IP header.

**There are 28 bytes in the payload of the IP datagram.** The "Total Length" field tells the entire packet size, including header and data, in bytes, which is 48. The IP header length is 20. So, the payload of this IP datagram is  $48 - 20 = 28$  bytes.

**4.3:** The sequence number of the TCP SYN initiating the TCP connection is **0**.  
The Flag bits value "**0x002**" indicates that this segment is a SYN segment.

The TCP port number of the host used for the connection is: **3372**.

The TCP port number of the server used for the connection is: **80**.

**4.4:** The sequence number of the SYNACK segment sent by the server in reply to the SYN is **0**.



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**4.5:** (To establish a connection, TCP uses a three-way handshake. Before a client attempts to connect with a server, the server must first bind to a port to open it up for connections: this is called a passive open. In this question, the port number is 80 at the server side (corresponding to HTTP service). Once the passive open is established, a client may initiate an active open. )

To establish the connection, the three-way handshake works as follows:

1. **SYN:** The host sends **Packet 1**, which is a **SYN**, to the server, which performs the active open. The client sets the segment's sequence number to a random value A, which is **0** in this example.
2. **SYN-ACK:** In response, the server replies in **Packet 2** with a **SYN-ACK**. The acknowledgment number is set to one more than the received sequence number (A + 1), which is **1** in this example, and the sequence number that the server chooses for the packet is another random number B, which in this example is 0.
3. **ACK:** Finally, the host sends an **ACK** back to the server in **Packet 3**. The sequence number is set to the received acknowledgement value i.e. 1 in this case, and the acknowledgement number is set to one more than the received sequence number i.e. 1 in this case.

At this point, both the client and server have received an acknowledgment of the connection, and the connection is established.

**4.6: There are 1380 bytes of data carried by the TCP segment of Packet 6.**

**In TCP segment of Packet 5** (sent from the server to the host), **Seq=1**, telling that, for this TCP segment, the sequence number is 1.

**In TCP segment of Packet 7** (sent from the host to the server), **ACK=1381**, implying the host has received all data preceding the ACK sequence number 1381.

**So, ACK=1381 in TCP segment of Packet 7 implies that, data bytes corresponding to sequence numbers 1, 2, ..., 1380 have been received, which in total are 1380 bytes.**

**This means, there are total 1380 bytes of data are carried by TCP segments in Packet 5 and Packet 6.**

**Note that for Packet 5, the TCP segment payload "Len=0", i.e. there is no data carried by it.**

**Hence, the TCP segment of Packet 6 carries 1380 bytes of data.**



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5.

5.1:

1010 0

1010 0

1010 0

1011 1

**0001 1**

5.2: Suppose there is one bit error in row one and column four. Then the above becomes:

101**1** 0 x

1010 0

1010 0

1011 1

**0001 1**

x

With the two-dimensional parity check, the location is indicated by the two parity errors "x", telling its is bit at the 1<sup>st</sup> row and the 4<sup>th</sup> column, which is error. Changing this bit from "1" to the opposite "0" will correct the error.

The above applies to the parity checking bits as well.

5.3: Now, suppose there are two bit errors as indicated below:

101**1** 0 x

1010 0

101**1** 0 x

1011 1

**0001 1**

The above parity errors "x" imply that there are errors. However, in this example, it is not possible to locate these error bits.



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6.

**6.1.d**

**6.2.d**

**6.3.b**

**6.4.b**

**6.5.b**

Remark: In Q.6.5, the numbers are expressed the form of three significant figures.)







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COMMENTS


