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

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1.1

Riktig True / Galt False			
1.1.1... ☐ ..... ☒	1.1.6... ☐ ..... ☒	1.1.11 ☐ ..... ☒	1.1.16. ☐ ..... ☒
1.1.2... ☒ ..... ☐	1.1.7... ☒ ..... ☐	1.1.12 ☒ ..... ☐	1.1.17. ☐ ..... ☒
1.1.3... ☐ ..... ☒	1.1.8... ☐ ..... ☒	1.1.13 ☒ ..... ☐	1.1.18. ☒ ..... ☐
1.1.4... ☐ ..... ☒	1.1.9... ☐ ..... ☒	1.1.14 ☐ ..... ☒	1.1.19. ☐ ..... ☒
1.1.5... ☐ ..... ☒	1.1.10. ☐ ..... ☒	1.1.15 ☐ ..... ☒	1.1.20. ☐ ..... ☒

1.2

Riktig True / Galt False			
1.2.1... ☐ ..... ☒	1.2.5... ☐ ..... ☒	1.2.9 .. ☒ ..... ☐	1.2.13. ☒ ..... ☐
1.2.2... ☒ ..... ☐	1.2.6... ☒ ..... ☐	1.2.10 ☒ ..... ☐	1.2.14. ☒ ..... ☐
1.2.3... ☒ ..... ☐	1.2.7... ☒ ..... ☐	1.2.11 ☒ ..... ☐	1.2.15. ☒ ..... ☐
1.2.4... ☐ ..... ☒	1.2.8... ☒ ..... ☐	1.2.12 ☐ ..... ☒	1.2.16. ☐ ..... ☒

1.3

Riktig True / Galt False			
1.3.1... ☒ ..... ☐	1.3.6... ☒ ..... ☐	1.3.11 ☐ ..... ☒	1.3.16. ☐ ..... ☒
1.3.2... ☒ ..... ☐	1.3.7... ☐ ..... ☒	1.3.12 ☐ ..... ☒	1.3.17. ☐ ..... ☒
1.3.3... ☐ ..... ☒	1.3.8... ☐ ..... ☒	1.3.13 ☒ ..... ☐	1.3.18. ☒ ..... ☐
1.3.4... ☒ ..... ☐	1.3.9... ☐ ..... ☒	1.3.14 ☐ ..... ☒	1.3.19. ☐ ..... ☒
1.3.5... ☐ ..... ☒	1.3.10. ☒ ..... ☐	1.3.15 ☐ ..... ☒	1.3.20. ☒ ..... ☐

Kontroller:	Eksamensvaktens signature / Invigilator's signature
• Studentnr. på alle sider • Samme studentnr. over alt	

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1.4

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.4.1... ☒	☐	1.4.5... ☒	☐	1.4.9 .. ☒	☐	1.4.13. ☐	☒
1.4.2... ☒	☐	1.4.6... ☐	☒	1.4.10 ☐	☒	1.4.14. ☒	☐
1.4.3... ☐	☒	1.4.7... ☒	☐	1.4.11 ☒	☐	1.4.15. ☐	☒
1.4.4... ☐	☒	1.4.8... ☒	☐	1.4.12 ☒	☐	1.4.16. ☒	☐

1.5

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.5.1... ☐	☒	1.5.5... ☒	☐	1.5.9 .. ☒	☒	1.5.13. ☒	☐
1.5.2... ☐	☒	1.5.6... ☐	☒	1.5.10 ☒	☐	1.5.14. ☒	☐
1.5.3... ☐	☒	1.5.7... ☒	☐	1.5.11 ☒	☐	1.5.15. ☐	☒
1.5.4... ☐	☒	1.5.8... ☒	☐	1.5.12 ☐	☒	1.5.16. ☒	☐

1.6

Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False	Riktig True	Galt False
1.6.1... ☐	☒	1.6.6... ☐	☒	1.6.11 ☒	☐	1.6.16. ☒	☐
1.6.2... ☐	☒	1.6.7... ☒	☐	1.6.12 ☐	☒	1.6.17. ☒	☐
1.6.3... ☐	☒	1.6.8... ☐	☒	1.6.13 ☒	☐	1.6.18. ☒	☒
1.6.4... ☒	☐	1.6.9... ☐	☒	1.6.14 ☒	☐	1.6.19. ☐	☒
1.6.5... ☒	☒	1.6.10. ☒	☒	1.6.15 ☒	☒	1.6.20. ☒	☐

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2.1. Flow control is the receiver controls the data flow (sending rate) from the sender.

2.2. Flow control is commonly used in **Transport Layer** and **Data Link Layer**. It may also be used in **Application Layer**.

The reason of having flow control in these layers is that, due to limited processing capacity, limited storage space and/or other reasons, the receiver may not be able to handle the incoming data as they arrive and will lose them, if the sender sends the data too fast. This scenario can happen in Transport Layer, Data Link Layer and Application Layer.

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2.3. In stop-and-wait flow control, the sender sends one packet and then waits for an acknowledgment from the receiver before proceeding to send the next packet.

In particular, after sending a packet, the sender keeps waiting and checking if there is an acknowledgement for this packet. If a pre-defined **timeout** time has passed for the waiting, the sender re-sends the packet. If the acknowledgement is received, the sender sends the next packet. At the receiver side, it sends back to the sender an acknowledgement for the packet it receives correctly

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2.4. One problem/disadvantage is that the stop-and-wait flow control is inefficient in utilizing the communication channel between the sender and the receiver:

The following equation can be found from the channel utilization slide of stop-and-wait flow control:

$U = (X/C)/[(X/C)+2\tau]$

Where U denotes the maximum channel utilization: X packet size; C the channel capacity; τ one way propagation delay. This equation implies that, if the propagation cannot be ignored, the stop-and-wait flow control can never fully utilize the channel capacity.

Another problem is that duplicate packets may be sent and received. If packets are not associated with some sequence number, the receiver side will not notice such duplication, and this will cause problem.

2.5. Under stop-and-wait flow control, it takes at least one round-trip time to send one data packet. This round trip time, in this question, is at least twice the one way propagation delay. In other words, at most one packet is sent every 2ms.

Suppose the maximum size of the packet is X. Then, the maximum data rate is X/(2ms) .

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3.1. In the Internet, textual domain names are used. However, the Internet protocol is based on numerical IP addresses. Hence, DNS is needed to map textual domain names and e-mail destinations/addresses to numerical IP-addresses.

WWW and E-mail are two sample Internet applications that use DNS.

3.2. DNS is generally unchanged over short time. So, operations can be repeated without harm. When a process makes a DNS request, it typically starts a timer. If the timer expires, it just makes the request again. So, no harm is done.

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3.3. Normally, each zone has a primary DNS name server and one or several secondary DNS name servers. Secondary name servers are used to increase the reliability of the system in cases where some name server(s) are down.

4.1. MAC sub-layer is needed for a network with multi-access channels. It is used to determine who goes next on a multi-access channel.

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4.2. In CSMA/CD, the time is divided into slots. The algorithm works as follows:

Before a node wants to send a data frame, it senses the channel:

- If the channel is idle, the node starts to transmit the frame. At the same time, it senses the channel for collision. If there is collision, the node stops transmitting and wait for some random time before taking another try of transmitting. If no collision is detected, the node finishes the transmission.
- If the channel is busy, the node keeps sensing the channel until the channel becomes idle. Then, the above step is repeated.

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5. The router will route the packets as follows:

Packet (a) to Interface 1
Packet (b) to Interface 0
Packet (c) to Router 2
Packet (d) to Router 1
Packet (e) to Router 2

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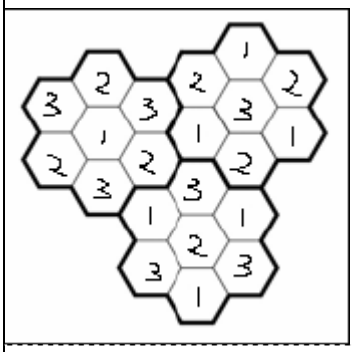
6.1. Frequencies are re-used in different cells to increase the system capacity, or to increase the number of users that can be supported at the same time in the system.

6.2. Each cell has six neighbors. If the central cell uses frequencies Group 1, its six neighbors can use Group 2, 3, 2, 3, 2, and 3 respectively, as illustrated in the figure below. Accordingly, only three unique cells are needed. So, each cell can have 280 frequencies.



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7.1. WRONG

The first and-clause is true. The second and-clause is false: this leg is called 'forwarding leg' and is charged to ZN. This leg goes from fixed to mobile in this case from fixed to fixed in other cases, it is and is called 'forwarding leg'. (>From this we also see that 'ZN pays nothing' is false.)

Conclusion: The combined statement is false (wrong).

Explanation:

The major billing principle from POTS is also used in GSM, and is as follows:

P1: A subscriber shall be charged for a call based on information available for him.
(Other good explanations are also acceptable as well. They may be quite short.)

For the calling party this principle P1 leads to:

Caller A shall be charged for a call based on information available for him, i.e. based on the dialed number, numbering plans and charging info related to these numbers

Additional info: This is in PSTN typically based on a numbering plan i.e. on the called number. Previous local fixed calls were cheaper than regional and national fixed calls, and the different international charging applied (to be looked up in the phonebook). Today we have separate number series for mobile calls, hence A knows is he places a mobile-to-mobile or a mobile-to-fixed call. We also still have separate international prefix

For B the same principle P1 applies as follows:

CFU service is known to B, (but may not be known to A, A does not know if CFU is active or not). Hence forwarding is charged to the subscriber of the forwarding service 'forwarding leg'. Since CFU in not known to A, A is not charged for this. Hence B is charged for this, (since the service is not for free).

In the case in the exam:
A = X1N is charged for the 'calling leg' (from mobile to fixed)
B = ZN is charged for the for the 'forwarding leg' from fixed to mobile

Note also that there is nothing called 'mobile leg', and this also makes the 2nd and-clause false: X2N is not charged, (only receiving a call without roaming).

There is something called 'roaming leg' but does not apply to this case since X2N is not roaming, while only utilizing regional mobility within OpM2N's network (as explained in the text in the exam)

Note: we said that the same person Ola is behind both the subscriptions X2N and ZN, hence the same person will get the bill, but the charging still goes to ZN and X2N as two different subscriptions. Tvilling etc. was excluded, such services also ties several numbers to a common bill.

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KOMMENTARER COMMENTS

1.1.16 False. This is because the connection set up packets may follow different routes from data packets. So, it is possible that the setup time is shorter even though there need several rounds of info. packet exchanging.

1.3.5 False. The maximum number of errors that can be corrected is 8.

1.4.4 False. The statement is too strong to hold. If "always converges" is changed to "may converge", then the statement is true.

1.5.9. True (based on the English version); False (based on the Norwegian version). Everyone will get the corresponding point from this statement due to the mismatch between the English version and the Norwegian version.

1.6.5 The statement is a bit ambiguous. For a new domain, permission is required from the domain where it will be included. However, for any subdomain, the permission is not required. (Book P.582)

Everyone will get the corresponding point from this statement.

1.6.6 False. The correct statement is: An e-mail system is made up of two subsystems that are user agents and message transfer agents.

1.6.10. The statement is a bit ambiguous. Even though, by default, POP3 removes messages from the mail server, it can be configured such that the messages can still be left on the mail server. Everyone gets the corresponding point for this statement.

1.6.15. The terms "Webmail" and "IMAP" have commonly been used in a way broader than what is seen from this textbook. As a consequence, this statement becomes a bit ambiguous.
Everyone gets the corresponding point from this statement.

1.6.18. Due to the ambiguous definition of an en IP "telephone", everyone gets the corresponding point for this statement.

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