◙ LES REGLENE FØR DU STARTER!
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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	☒	☐	1.1.2	☒	☐	1.1.3	☒	☐	1.1.4	☒	☐	1.1.5	☒	☐
1.1.6	☐	☒	1.1.7	☐	☒	1.1.8	☐	☒	1.1.9	☒	☐	1.1.10	☐	☒

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	☒	☐	1.2.2	☐	☒	1.2.3	☒	☐	1.2.4	☐	☒	1.2.5	☒	☐
1.2.6	☒	☐	1.2.7	☐	☒	1.2.8	☒	☐	1.2.9	☐	☒	1.2.10	☒	☐

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	☒	☐	1.3.2	☐	☒	1.3.3	☒	☐	1.3.4	☒	☐	1.3.5	☒	☐
1.3.6	☒	☐	1.3.7	☐	☒	1.3.8	☐	☒	1.3.9	☐	☒	1.3.10	☐	☒

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	☐	☒	1.4.2	☒	☐	1.4.3	☐	☒	1.4.4	☒	☐	1.4.5	☒	☐
1.4.6	☐	☒	1.4.7	☒	☐	1.4.8	☒	☐	1.4.9	☒	☐	1.4.10	☐	☒

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	☒	☐	1.5.2	☒	☐	1.5.3	☐	☒	1.5.4	☐	☒	1.5.5	☒	☐
1.5.6	☒	☐	1.5.7	☒	☐	1.5.8	☒	☐	1.5.9	☒	☐	1.5.10	☐	☒

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2.

2.1:   **b) and c)**

2.2: **d)**

2.3: **d)**

Remark: 1279 packets' (parallel over link 1 and link 2) transmission time over 64kbpbs + 2 packets' transmission time (pkt 1 on link 1 and pkt 1280 on link 2 without parallel transmission on both links) + propagation delays of both links.

2.4: **c)**

Remark: 1 packet / two way delay (i.e. at least 2* propagation delay + 2* transmission delay) ≈ 1K Bytes / 20ms = 50K bytes/second = 400 Kbps

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3.

3.1: **a)**

3.2: **b)**

3.3: **d)**

3.4: **c)**

3.5: **d)**

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4.

4.1: d)

4.2: a)

4.3: c) and d)

5.

5.1: (1+5) x 601 = 3606 msec = 3.606 sec

Note, the transmission time of a 100 kbits file (e.g. the Web base file or an image file) over a 100 Mbps link is 1msec. For each object (including both the Web base file and the five image files): the delay is 2 RTT + transmission time = 601 msec.

The delays associated with each object are:

- 300 msec (RTT) to set up the TCP connection that will be used to request the object.
- 150 msec (one way) to send the GET message and have it propagate to the server; at the server, it takes 1 msec to transmit the object, which needs 150 msec to propagate back to the client. (301 msec in total)

Remark: After sending the object, the server tells to close the connection, but TCP does not actually terminate the connection until it knows the client has received the object. Such connection termination delay is not counted. In addition, we assume the delay between receiving an object and displaying it at the browser is negligible. The same are adopted for 5.2 and 5.3.

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5.2: 300 + 301 + 300 + 305 = 1206 msec = 1.206 sec

The delays associated with this scenario are:

- 300 msec (RTT) to set up the TCP connection that will be used to request the base file.
- 150 msec (one way delay) to send the GET message for the base file, and have the message propagate to the server, plus 1 msec to transmit the base file, plus 150 msec for the base file to propagate back to the client (for a total of 301 msec).
- The client now sets up 10 parallel TCP connections. 300 msec (RTT) is needed to set up the 5 TCP connections (since they are set up in parallel).
- 150 msec (one way delay) to send the 5 GET messages in parallel for img01.jpg through img5.jpg and have the GET messages propagate to the server. It will take the server 5 msec to transmit the 5 jpeg files, plus 150 msec for the last jpeg file to propagate back to the client (for a total of 305 msec).

5.3: 300+ 301 + 5 x 301 = 2106 msec = 2.106 sec

The delays associated with this scenario are:

- 300 msec (RTT) to set up the TCP connection that will be used to request the base file, and 5 images. (Subsequent HTTP messages are sent over one TPC connection.)
- 150 msec (one way delay) to send the GET message for the base file, and have the message propagate to the server, plus 1 msec to transmit the base file, plus 150 msec for the base file to propagate back to the client (for a total of 301 msec).
- 150 msec (one way delay) to send the GET message for img01.jpg and have it propagate to the server, plus 1 msec to transmit the img01.jpg file, plus 150 msec for the img01.jpg file to propagate back to the client (for a total of 301 msec).
- The last step above is repeated for the rest four image files.

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5.4: No, it is likely not a problem. Note that non-persistent HTTP is used. Thus, as long as the link layer association does not change while downloading a page, the changing link-layer association will not be visible to the web browser application.

5.5: Yes, likely this will cause problem. If your computer's link-layer association changes, it will need an IP address in the network associated with the new access point. Since this network is likely to be different from the network associated with the old access point, the IP address is likely to change. Hence, you will no longer be receiving datagrams sent to your old IP address. If a file transfer is in progress when your link-layer association changes, the file transfer will eventually abort because the underlying TCP sender will no longer receive ACKs from your computer, once it joins the new network and discards its old IP address.

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6.

6.1: No, a least-cost path is not necessarily a shortest path (that only counts the number of links). When the weights of all links are equal, then the least-cost path is also the shortest path.

6.2: For the specific network shown in Figure 2, the answer is Yes.

Remark: Generally, the answer is No. One reason is that between two nodes, there may be multiple paths that have the same least-cost value. As a result, a least-cost path from N1 to N2 may not be the reverse of a least-path from N2 to N1.

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6.3:

N	D(A),p(A)	D(B),p(B)	D(C),p(C)	D(E),p(E)	D(F),p(F)
D	4,D	infty	1,D	4,D	infty
DC	3,C	9,C		4,D	infty
DCA		5,A		4,D	infty
DCAE		5,A			6,E
DCAEB					6,E

D(x): current value of cost of path to destination x;
p(x): predecessor node along path from source to x.

The least-cost path from D to B is DCAB, and the cost of this path is 5.
The shortest path from D to B is DAB with cost 6, or DCB with cost 9, or DEB with cost 14.

6.4:

N	D(A),p(A)	D(B),p(B)	D(C),p(C)	D(D),p(D)	D(F),p(F)
E	infty	10,E	infty	4,E	2,E
EF	infty	6,F	infty	4,E	
EFD	8,D	6,F	5,D		
EFDC	7,C	6,F			
EFDCB	7C				

The least-cost path from E to B is EFB, and the cost of this path is 6.

The shortest path from E to B is EB with cost 10.

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