Endsem

1.
    a. 501
       One for listening, rest 500 for client connection
    b. 1
       The ONLY server-sideport number in use at the server will be the single port number associated with the welcoming socket, e.g., port 80 on a web server).

2. Let d be the propagation delay and r be the transmission rate;
   One way delays are 5ms and 6ms.
   d + 512/r = 5 * 10^-3; d + 12000/r = 6 * 10^-3
   Solving for d and r gives, r = 11.5Mbps and d = 5ms
    a. 4.9-5
    b. 11.4-11.5

3. 1
   Over 2kms, the loss suffered if 20dB; 20 = 10 log_10 (100/R)
   10^2 = 100/R → R is 1mW
   (or Tx power is 20dBm; loss is 20dB, received power is 0dBm = 1mw)

4.
    a. 80
       4 bits result in 4 bits, so the efficiency is same as 4B/5B
    b. 4
       4 zeros in input results in 00001

5. TCP checksum: Can be a problem since the port is changed
   IP checksum: Can be a problem since the IP addresses are changed.
   Ethernet checksum: Not a problem since this calculation is done (afresh) below NAT at the link layer

6.
    - The adaptor was in promiscuous mode.
    - The destination MAC address was a multicast group to which A belonged.
    - The destination MAC address matched that of the adaptor
    - The destination MAC address was the broadcast address

7. (HTTP, IMAP)

8.

```
101011 | 1101101010000000
         101011
          111011
          101011
           100000
           101011
             101110
             101011
                101000
                101011
                    11000
```

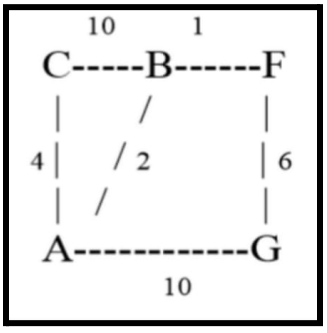
So it sends 1101101010011000.

9.

- The station can detect a collision at time T+7 micro seconds if there was no collision detected between time T and T+7
- The station can detect a collision at time T+16 micro seconds if there was no collision detected between time T and T+16

10.

a.



b. Yes. There is a possibility of looping. After A and B do the recomputation, the shortest A—B path is through C, but C still thinks that the shortest C—B path is through A. So the packet will be transiently stuck in an A—C—A... loop

11.

a. Department A: 130.56. 0000 0000. 0000 0000 /25 (supports 2^7 = 128)
Department B: 130.56. 0000 0000. 1000 0000 /25 (supports 2^7 = 128)
Department C: 130.56. 0000 0001. 0000 0000 /26 (supports 2^6 = 64)

Department D: 130.56. 0000 0001. 0100 0000 /26 (supports 2^6 = 64)
Department E: 130.56. 0000 0010. 0000 0000 /23 (supports 2^9 = 512)

b. Router F
Subnet: mask Next Hop
130.56.0.0 /24 C (traffic for A and B, aggregated)
130.56.1.0 /26 C (traffic for C)
130.56.1.64 /26 D (traffic for D)
130.36.2.0 /23 D (traffic for E)
default Interface0 (outside to Internet)

12.

Cwnd	RTT	Segments sent
1	0	1
2	1	2,3
4	2	4,5,6,7
8	3	8,9,10,11,12,13,14,15
14	4	16 to 27
14	5	-
1	6	14
2	7	28,29
4	8	30,31,32,33
7	9	34,35,36,37,38,39,40
8	10	41 to 48
9	11	48 to 56
10	12	57 to 66

13.

RTT	Cwnd	Segments-sent	Explanation
0	0	0	Slow start
1	2	1, 2	“
2	4	3, 4, 5, 6	“
3	8	7, 8, 9, 10, 11, 12, 13, 14	“
4	9	15, 16, 17, 18, 19, 20, 21, 22,11	Slow start then fast retransmission

5	6	23, 24, 25, 26, 27, 28	Fast recovery
6	6/7	29, 30, 31, 32, 33, 34, 35	Congestion avoidance

14.

a. 22
   Total Time is 2RTT + 10*2RTT = 22 RTT
b. 6
   2RTT for base html. 2 RTT for first 5 and 2 RTT for second 5.
c. 12
   Total time: 2RTT for base + 10 RTT for 10 images within same connection = 12RTT
d. 3
   2 RTT for the base file. Then you send all 10 requests in one TCP segment and get the responses back. This takes another RTT.

15.

a. 0.96 - 0.9695 - 97
   2 requests for the small object and 2 requests for the big object.
   In the downlink direction:
   (2 * 10^5 + 2 * 500 * 10^3)* 8 bits / 10* 10 ^6 = 0.96 fraction of the link.
b. 0.41 - 0.4241 - 42
   0.8 requests of small object served by cache (100 bytes downloaded on the access link for conditional GET response), 1.2 requests from outside web server (full file downloaded on access link), 1.2 requests of big object served by cache (100 bytes downloaded on the access link for conditional GET response), 0.8 requests from outside web server (full file downloaded on access link) per sec on average
   (0.8 * 100 + 1.2 * 10^5 + 1.2 * 100 + 0.8 * 500* 10^3) * 8 bits / 10 * 10^6 = 0.416 fraction of the link

16.

a. (foo.com, dns1.foo.com, NS)
   (dns1.foo.com, 14.12.30.40, A)
b. (web.foo.com, 14.12.30.50, A)
   (www.foo.com, web.foo.com, CNAME)
   (mail.foo.com, 14.12.30.60, A)
   (foo.com, mail.foo.com, MX)

17. C1 and S1 are using HTTP. R4 as part of BGP. S2 uses DNS, which is UDP. Similarly R1, R2 and R3 use OSPF that operates at the network layer itself.
    a. 6
    b. R1, R2, R3, R4
    c. R4
    d. C1, S1, S2, R1
    e. C1, S2
    f. C1, S1, R4