1. a. Suppose the information content of a packet is the bit pattern 1110 01101001 1101 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? Your answer should be such that a minimum-length checksum field is used.

   The minimum length checksum is a 4 by 4 matrix, right next to it is a 2-dimensional parities. The last column is for vertical parities are parity bits. The last row is for vertical parities are parity bytes.

1	1	1	0	1
0	1	1	0	0
1	0	0	1	0
1	1	0	1	1
1	1	0	0	0

   The transmitted bits: 11101 01100 10010 11011 11000

   b. For a cyclic redundancy check, consider the 5-bit generator G = 10011, and suppose that D has the value 1010101010. What is the value of R?

   r=|G|-1=4, so keep dividing 10101010100000 by 10011 and stop once it completes then we get our R is the remainder of D divides by G which is 0100.

2. Consider two nodes, A and B , that use the slotted ALOHA protocol to contend for a channel. Suppose node A has more data to transmit than node B , and node A 's retransmission probability p_A is greater than node B 's retransmission probability p_B

   a. Provide a formula for node A 's average throughput.

   Average throughput of A = $p_A(1\text{-}p_B)$

   b. What is the total efficiency of the protocol with these two nodes?

   Total efficiency of the protocol with these two nodes = $p_A(1\text{-}p_B) + p_B(1 - p_A)$

3. Assume that it's after the fifth collision with CSMA/CD

   a. What is the probability that a node chooses K = 4?

      2^5=32, so 1/32*100%=3.125%

   b. The result K = 4 corresponds to a delay of how many seconds on a 10 Mbps Ethernet?

   K*512 bit times = 2048 bit times

   2048 bit times/10Mbps= 204.8 microseconds

   204.8 microseconds /1,000,000 micros = 0.0002048 seconds

4. MAC addresses. Note that the address space size is the total number of possible addresses.

   a. How is it possible that no two network adapters have the same MAC address?

      It is possible. However, mostly due to error. MAC address identifies the manufacturer that is responsible for making sure no two network adapters has shared MAC address. MAC addresses are supposed to be worldwide unique. In most cases, both computers will connect to that network and think they are working fine, however, there will be random failures as they shared the same MAC address.

   b. How large is the MAC address space?

      Uses 48-bit address, 2^48 addresses

   c. How large is the IPv4 address space?

      Uses 32-bit address, 2^32 addresses

   d. How large is the IPv6 address space?

      Uses 128-bit address, 2^128 addresses

5. Address resolution protocol (ARP).

   a. Why is an ARP query sent within a broadcast frame?

      It has to send ARP query to get MAC address associated with that IP address. ARP query is sent within a broadcast frame is also because the querying host does not know has the LAN address for its corresponding destination IP address.

   b. Why is an ARP response sent within a frame with a specific destination MAC address?

      The response is sent with a specific MAC address, because it knows which adapter(s) sent the query. When receiver sends an ARP response, it signals that the LAN address of the sender via the packet it received.

   c. Suppose a router with two different interfaces connected to two different LANs. This router will have two ARP modules (one for each interface). Each ARP module will have its own ARP table. Is it possible that the same MAC address appears in both ARP tables? Why or why not?

      No, it is not possible. Because each of the ARP modules will different MAC addresses and each LAN has specific set of adapters and each adapter has unique LAN address.