1. A 56-kbps pure ALOHA channel is to be shared among a number of stations, each sending a 1k bit frame, on average one frame every 10 seconds. (Assume the sender can buffer frames to handle variations in successful sending vs. this generation rate). What is the maximum number of stations this network can support?

2. Repeat problem 1. for
   a. a slotted ALOHA channel.
   b. a 1-persistent CSMA channel.

3. Suppose measurements made on a slotted ALOHA channel for a very large number of users shows that on average 10% of the slots are idle.
   a. What is the channel load $G$?
   b. What is the throughput of the channel?
   c. Is this channel overloaded or under loaded (vs. optimal use)?

4. If a LAN uses the basic bit-map protocol, how long does a station have to wait, in the worst case if there are $N$ stations on the LAN?

5. Using the wireless MACAW protocol, with multiple stations active, under what conditions can simultaneous transmissions take place successfully?

6. A LAN using Manchester encoding runs at 200 megabaud. What is its bit rate?

7. Sketch the encoded bit stream for 1101111001
   a. using Manchester encoding
   b. using differential Manchester (assume the line is initially in the “low” state.)

8. A CSMA/CD LAN is 1 km in length, and has a bandwidth of 50 Mbps. There are no repeaters. Data frames are 512 bits long, including 32 bits used for header, CRC etc. The first bit slot following a successful data transmission is reserved for use by the receiver to send back a 32 bit acknowledgment frame. What is the maximum effective data rate this channel can achieve, assuming no collisions? (Assume a transmission speed of 200 m/µsec.)

9. Why does the clock for a 1000-Base-SX Ethernet run at 1250 MHz?

10. If a 50 byte IP packet (including all headers, etc.) is to be transmitted by Ethernet, how much padding of this is needed when put into an Ethernet frame?

11. (Extra credit) Suppose a 54 Mbps 802.11g LAN transmits 64 byte frames and the radio channel has a bit error rate of $10^{-x}$ (meaning that an error occurs in one bit per $10^{x}$). On average, what percentage of the frames will arrive undamaged (as a function of $x$)? How many frames per second get damaged for $x = 7, 8, 9$?