Problem 1: [24 Points] Answer the following questions as concisely as possible.

1a) When would you use the bind() call in building networking software? What does it do?

1b) Why does the Data Link layer have to do framing? Why can’t Data Link layer entities just send streams of bits?

1c) The Transport layer offers both reliable and unreliable services to applications. It seems like anything worth sending is worth sending reliably. Why would you ever choose an unreliable service?
Problem 2: You’ve been hired by Bradco, a soon-to-be-famous software outfit, to help them implement a networked version of the old 20 questions game. They’ve hired some big names in AI, and now have a server that can answer questions like “is it bigger than a breadbox?” etc. All that’s left is to formalize TQTP (the 20 questions transfer protocol) — that’s where you come in.

The TQTP application-level protocol should allow clients to transmit questions in English to the server, and receive responses. (It’ll run atop a reliable transport-layer protocol, so there are no concerns about data loss.) Bradco anticipates that expert players will become bored after months of continual play, but market research has shown that players will stay hooked if they are allowed to play shorter games (e.g. they’re only allowed 15 questions, etc). Thus, TQTP should allow a player to specify the desired limit when starting a game.

2a) [15 Points]: Describe the message types that your TQTP protocol will support.

2b) [15 Points]: Describe your design for a TQTP packet, including all relevant header details.

2c) [10 Points]: Is your TQTP protocol stateless? Explain.
Problem 3:

Your boss at Bradeo was so impressed with your TQTP protocol design, she asked you to help them design a line of, shall we say, “non-standard” Ethernet cards. The design team is trying to finalize their designs, and has asked for your input.

3a) [18 Points]: Their first design expands its contention window *linearly* when collisions occur. Does a host using this card get more or less than its fair share of the bandwidth if it shares a network with hosts using standard Ethernet cards? Explain.

3b) [18 Points]: The second design uses the standard Ethernet backoff mechanism, but maintains its contention window value even after a successful transmission. That is, after expanding the window on successive collisions, it stores the window size once it “wins” and uses that stored window size as a starting point again on the next transmission attempt. Does a host using your card get more or less than its fair share of the bandwidth when competing with standard Ethernet cards? Explain.