1. Why does circuit switching waste bandwidth if the traffic is bursty? Under what traffic conditions is circuit switching optimal?

2. You may have noticed that at busy events (e.g., concerts, sporting events, etc.) the Internet connection on your mobile device can become unstable. Describe what could be happening to cause the degradation in performance.

3. ARPANET was the predecssor to the modern Internet. In the original ARPANET design, the hosts offloaded many communication tasks to a separate device called the "Interface Message Processor" (IMP), essentially a small, lower-powered computer. The IMP was responsible for breaking down long streams of messages into packets up to 128 bytes in size, sending and receiving data from the actual wires forming the network, making sure messages were correctly received, and tracking the state of network links to determine where to forward packets. An application running on a host simply needed to write out the destination address where they wanted the data to go to the IMP and then write out the data to the IMP (simple, right?).

   This initial design stifled the number and variety of applications that could take advantage of ARPANET. Give potential reasons this happened by comparing the IMP-based design to the layered design of the Internet today.

4. An office has an Internet link rated at 100 Mbps full-duplex. Each user requires 10 Mbps when transmitting and each user is active 10% of the time.

   (a) Initially a static allocation of bandwidth is made for each user. How many users can the access link support?

   (b) The office actually has 25 people who need to use the Internet. As a result, they decide that the static allocation is not particularly efficient and decides to use a packet-switched approach instead. What is the probability that *exactly* 10 users are transmitting at any given moment?

   (c) What is the probability that more than 10 users are transmitting at any given moment?

5. Give two examples of multiplexing in a real-world system not related to computing: one that behaves more like a circuit-switched network and that behaves more like a packet-switched network. In each example, describe the characteristics that make it more packet/circuit-like, explain what the access policy is to the lower-layer channel (i.e, concurrency-control), and how overloading of the lower-layer channel manifests itself.