1. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?
   a. Application Layer
      i. Maintains network applications
      ii. Handles processes and protocols like HTTP, SMTP, and FTP
   b. Transport Layer
      i. Communication layer that sends messages from applications to their endpoints
      ii. TCP and UDP transport
   c. Network Layer
      i. The destination of the message sent through the transport layer
      ii. Provides the service of delivering the segment to the transport layer in the destination host
   d. Link Layer
      i. Provide reliable delivery, from transmitting node, over one link, to receiving node
      ii. Examples of link- layer protocols include Ethernet, WiFi, and the cable access network's DOCSIS protocol.
   e. Physical Layer
      i. Link dependent and further depend on the actual transmission medium of the link
      ii. The job of the physical layer is to move the *individual bits* within the frame from one node to the next
2. List six access technologies. Classify each one as residential access, company access, or mobile access.
   a. Dial-up – residential
   b. DSL – residential
   c. Cable – residential
   d. WLAN – mobile
   e. Ethernet – company
   f. WAP – mobile
3. Compare the delay in sending an x-bit message over a k-hop path in a circuit-switched network and a (lightly loaded) packet-switched network. The circuit setup time is s seconds, the propagation delay is d seconds per hop, the packet size is p bits, and the data rate is b bps. Under what conditions does the circuit-switched network have a shorter delay? [NOTE: you need to explain the reasoning process on how you come out the final answer.]
   a. If we start by calculating the delay of both the circuit-switched and packet-switched networks, then we can compare and determine the conditions that create a faster circuit-switched network. So, in a circuit-switched network, the delay is the sum of the setup time, the propagation delay, and the time it takes to send a packet; thus, delay = s + kd + p/b. Then, in a packet-switched network, the delay is the sum of the total propagation delay and the time to send a packet. Therefore, we can see that the differentiating factor is the setup time. As such, we can deduce

that while the startup time is less than (k-1)p/b, the circuit-switched network will have a lower total delay.

4. List the four broad classes of services that a transport protocol can provide. For each of the service classes, indicate if either UDP or TCP (or both) provides such a service.
   a. Email - TCP
   b. File Transfer - TCP
   c. Streaming multimedia – TCP or UDP
   d. Internet telephony - UDP