1. In a computer network, what is the difference between a node and a terminal. What are examples of nodes and examples of terminals?

2. The Internet is a network of networks. It is structured as a hierarchy.

   i. What was the main reason for structuring the Internet as a hierarchy?

   ii. Describe the different hierarchical levels of the Internet.

3. Circuit switching versus packet switching:

   i. In a circuit switching network, when Alice wants to communicate with Bob, a physical "circuit" is established between Alice and Bob before any data can be sent.
      a. Why do you think this is necessary?
      b. What is(are) the advantage(s)?
      c. What is(are) the disadvantage(s)?

   ii. In a packet switching network, when Alice wants to communicate with Bob, no circuit is established and Alice simply starts sending data to Bob.
      a. What is(are) the advantage(s)?
      b. What is(are) the disadvantage(s)?

4. In packet switching networks, resource sharing is done through "statistical multiplexing".
   i. Explain what statistical multiplexing is.
   ii. Suppose a scenario where Alice is sending data at 10Mbps and Bob is sending data at 1Mbps. Using your explanation of statistical multiplexing, do you expect to see more packets from Alice or more from Bob on the link they share? Explain.

   iii. On average, assuming the network has enough capacity, what would be the ratio between the number of packets from Alice and Bob.

5. In deep space communication scenarios, the network connection between 2 nodes in space has the following characteristics: it takes 1 minute for information to travel from A to BÍ¾ between the 2 hosts, there is one router whose queuing delay is 2.5 milliseconds and processing delay 1 millisecond. The link connecting A to B is 10Mbps.
   i. What is the total latency to send 2MBytes of information between A and B?

   ii. What is the dominating factor causing latency in this scenario?

6. In so-called "Big Data" applications, very large amounts of data are generated and will be transmitted over the network. Suppose you have 30 terabytes of data to transfer between a data center in Buffalo, New York and another one in Salt Lake City, Utah. You havea 150 Mbps dedicated link available for transferring the data. Is it more efficient to do the data transfer over the link or use an overnight postal delivery service?

7. Explain encapsulation and de-encapsulation in the context of the Internet's protocol stack. Do they contribute to the cost (or overhead) of transmitting and receiving information over the Internet? Explain and comment on the distinction between communication and processing overhead.