Mid-term examination

Short answer questions (60 points)

1. What are the layers of the network stack? Briefly describe the function of each layer.

2. Please briefly compare the characteristics and differences between Circuit Switching and Packet Switching.

3. Describe the communication process in a TCP/IP network.

4. Describe the two types of HTTP connections: Non-persistent HTTP and Persistent HTTP. Highlight the key differences between them.

5. Describe the role of DNS in the internet and explain the basic process of how DNS resolves a domain name (e.g., www.amazon.com) to its corresponding IP address.

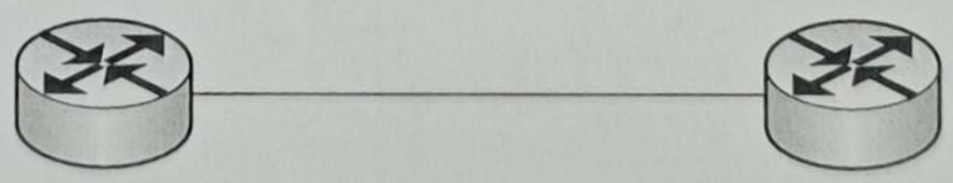
6. You accessed Amazon.com before. When you access Amazon.com again, the website lists the items that you browsed before and provide some recommendations to you. Explain how this happens.

Calculation problems (40 points)

1. Consider the figure below, in which a single router is transmitting packets over a single link to another router at the other end of the link. Suppose that the packet length is **L = 12,000 bits**, and that the link transmission rate along the link to the router on the right is **R = 600 Mbps**.

(a) What is the transmission delay for a single packet? Show your calculation.

(b) What is the maximum number of packets per second that can be transmitted by the link? Show your calculation.

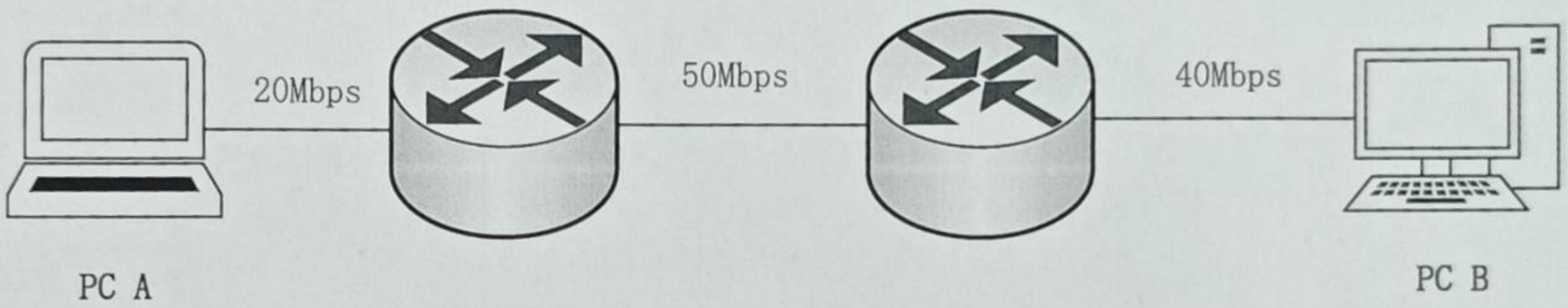


2. Consider that a user clicks on a link in a web browser to retrieve a web page. The web page contains the base HTML and all 15 objects. Let RTT represent the Round Trip Time between the local host and the server hosting the page with all the objects. Assume that transmission time is negligible. How long does it take before the host can receive all the objects?

a) Non-persistent HTTP is used.

b) Persistent HTTP is used.

3. Suppose that PC A has a file with size of 1 Gbits to send to PC B through the following path. How much time (in sec) will pass from the time when B receives the first bit of the file until B has received the whole file?



4. Suppose that a web browser wants to display a web page that contains references to 12 objects (including images, CSS, and JavaScript files). Assume that both the base HTML file and all objects are very small, so their transmission times can be ignored. For each of the scenarios (a–d) below, answer the following two questions:
How many HTTP request messages does the browser need to send in total to retrieve all objects?
How many RTTs are needed until the client has received all objects?

a) The web browser can open up to 4 parallel TCP connections to the server over which it can send/receive HTTP messages. Assume that **non-persistent HTTP** is used.

b) The web browser can open up to 4 parallel TCP connections to the server over which it can send/receive HTTP messages. Assume that **persistent HTTP** is used.

c) The web browser can create a single TCP connection to the server over which it can send/receive HTTP messages. Assume that **non-persistent HTTP** is used.

d) The web browser can create a single TCP connection to the server over which it can send/receive HTTP messages. Assume that **persistent HTTP** is used.