**P1**. True or false?

**a**. A user requests a Web page that consists of some text and three images. For this page, the client will send one request message and receive four response messages.

**FALSE**

**b**. Two distinct Web pages (for example, www.mit.edu/research.html and www.mit.edu/students.html ) can be sent over the same persistent connection.

**TRUE**

**c**. With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.

**FALSE**

**d**. The Date: header in the HTTP response message indicates when the object in the response was last modified.

**FALSE**

**e**. HTTP response messages never have an empty message body.

**FALSE**

**P2**. SMS, iMessage, and WhatsApp are all smartphone real-time messaging systems. After doing some research on the Internet, for each of these systems write one paragraph about the protocols they use. Then write a paragraph explaining how they differ.

**IMessage is the instant messaging application developed by Apple Inc. used to send texts, documents, photos, videos, contact information, and group messages over the Internet to other iOS or macOS users. The iMessage protocol is based off the Apple Push Notification service or APNs, which enables developers to send notification data to applications installed on Apple devices. Similarly both protocols are binary protocols, which are used in communication between two parties and is fast with sending and receiving data.**

**Whatsapp is a cross-platform messaging app owned by Facebook Inc. with text, voice and video communication capabilities. Capable of running on a variety of mobile devices it is also able to run as a desktop app if given a phone number and internet connection. Whatsapp uses a custom version of Extensible Messaging and Presence Protocol or XMPP, a communication protocol for message-oriented middleware. It enables near-real-time exchange of data between two or more network entities, and is an open standard, which means it is publicly available and allows for customization and implementation.**

**SMS is the text messaging service of most telephone, internet, and mobile devices. It utilizes standardized communication protocols to enable the exchange of text messages. Early on communication between short message service centers and handsets using Signaling System No. 7, a set of protocols developed in 1975. However nowadays most providers use a TCP/IP protocol such as short message peer-to-peer protocol (SMPP) or External Machine Interface (EMI). SMS message delivery is not guaranteed as they are treated as low-priority traffic compared to voice messages, however does not require internet connection.**

**In comparison, the major differences are split between the dedicated applications made initially for text based messaging, Whatsapp and iMessage, and SMS which is simply a component of telephones. SMS can only send text messages, while Whatsapp and iMessage are able to send pictures, videos as well as text messages. Also because SMS is a component of telephones it has no need for internet connection as it uses the phones network, while Whatsapp and iMessage work primarily with internet connection.**

**P4.**

**a**. What is the URL of the document requested by the browser?

**http://gaia.cs.umass.edu/cs453/index.html**

**GET /cs453/index.html , Host: gaia.cs.umass.edu<cr>**

**b**. What version of HTTP is the browser running?

**HTTP/1.1**

**c**. Does the browser request a non-persistent or a persistent connection?

**A persistent connection**

**Keep-Alive:**

**d**. What is the IP address of the host on which the browser is running?

**e**. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

**Mozilla/5.0, means Mozilla version 5.0**

**P8**. Referring to Problem P7, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with

**a.** Non-persistent HTTP with no parallel TCP connections?

**Time taken for client to receive HTML file =**

**8 objects received by the client means, since we must send each object and establish a connection each time. =**

**So for 8 objects with non-persistent connection with no parallel TCP connections =**

**b**. Non-persistent HTTP with the browser configured for 5 parallel connections?

**Time taken for client to receive HTML file =**

**With 5 parallel connections the 8 objects will be received by the client within 2 trips, so for 8 objects they will each take time to reach the client, which = 2(trips)**

**=**

**=**

**c**. Persistent HTTP?

**Time taken for client to receive HTML file =**

**With a persistent connection there will be no need to re-establish the connection, so all 8 objects may just travel across the same connection in time for the duration of the transfer.**

**P10**. Consider a short, 10-meter link, over which a sender can transmit at a rate of 150 bits/sec in both directions. Suppose that packets containing data are 100,000 bits long, and packets containing only control (e.g., ACK or handshaking) are 200 bits long. Assume that N parallel connections each get 1/N of the link bandwidth. Now consider the HTTP protocol, and suppose that each downloaded object is 100 Kbits long, and that the initial downloaded object contains 10 referenced objects from the same sender. **Would parallel downloads via parallel instances of non-persistent HTTP make sense in this case?** **Now consider persistent HTTP. Do you expect significant gains over the non-persistent case?** **Justify and explain your answer.**

**Part 1) Parallel downloads via parallel instances of non-persistent HTTP:**

**Non-persistent so the connection will be terminated after the first object has completely traveled between client and server, but 10 connections will be created in parallel for each of the 10 objects to be sent.**

**bits/s for 10 objects for parallel downloads, so total time for all objects would be :**

**=**

**=**

**=**

**=**

**Seconds**

**Part 2) now consider persistent HTTP. Do you expect significant gains over the non-persistent case?**

**Persistent HTTP will mean the connection the first object was transferred on will keep alive, and the 10 objects will travel from the very same connection.**

**bits/s for 10 objects for parallel downloads, so total time for all objects would be :**

**, 10 objects being transferred across the same connection.**

**=**

**=**

**=**

**=**

**=**

**=**

**seconds**