Q1: True or False?

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

b. A user requests a web page that consists of some text and two images. For this page, the client will send one request message and receive 3 response messages.

c. Two distinct web pages (e.g. www.mit.edu/research.html and www.mit.edu/students.html) can be sent over the same persistent connection.

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

Q2: Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

Q3: Consider the figure. There is an institutional network connected to the internet. Suppose that the average object size is 900,000 bits and that the average request rate from the institution's browsers to the origin servers is 15 requests per second. Also suppose that the amount of time it takes from when the router on the internet side of the access link forwards an HTTP request until it receives the response is two seconds on average. Model the total average response time as the sum of the average access delay (that is delay from internet router to institution router) and the average internet delay. For the average access delay, use $\Delta/(1 - \beta \Delta)$, where $\Delta$ is the average time required to send an object over the access link and $\beta$ is the arrival rate of objects to the access link.
a. Find the total average response time.

b. Now suppose that a cache is installed in the institutional LAN. Suppose the hit rate is 0.4. Find the total response time.

Q4: (KR P4) The text below shows the reply sent from the server in response to a http GET message. Answer the following questions, indicating where in the message below you find the answer.

a. Was the server able to successfully find the document or not? What time was the document reply provided?

b. How many bytes are there in the document being returned?

c. What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

d. When was the document last modified?

HTTP/1.1 200 OK
Date: Tue, 07 Mar 2006 12:39:45 GMT
Server: Apache/2.0.52 (Fedora)
Last-Modified: Sat, 10 Dec 2005 18:27:46
ETag: 1526e3-f22-a88a4c80
Accept-Ranges: bytes
Content-Length: 3874
Keep-Alive: timeout=max=100
Connection: Keep-Alive
Content-Type: text/html; charset = ISO-8859-1
<!doctype html public ";//w3c//dtd html 4.0 transitional//en">
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"> <meta name="GENERATOR" content="Mozilla/4.79 [en] (Windows NT 5.0; U) Netscape")
<title>CMPSCI 453 / 591 NTU-ST550A Spring 2005 homepage</title>
<much more document text following here (not shown)>
Q5: (KR P5) Consider the following string of ASCII characters that were captured by Ethereal when the browser sent an HTTP GET message (i.e., this-is the - actual content of an HTTP GET message). The characters `<cr>` are carriage return and line-feed characters (that is, the italicized character string~ `<cr>` in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

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

b. What is the URL of the document requested by the browser?

c. What version of HTTP is the browser running?

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

```
GET /cs453/index.html HTTP/1.1<cr><lf>Host: gaia.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax) <cr><lf>Accept:ext/xml, application/xml, application/xhtml+xml, text/html; q=0.9), text/plain;q=0.8,image/png, */*; q=0.5 <cr><lf> Accept-Language: en-us, en;q=0.5 <cr><lf>Accept-Encoding: zip, deflate<cr><lf>Accept-Charset: ISO 8859-1, utf-8; q=0.7<cr><lf> Keep-Alive: 300<cr><lf> Connection: keep-alive<cr><lf>```