

THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2013
Campus: City

COMPUTER SCIENCE

Modern Data Communications

(Time allowed: TWO hours)

NOTE:

- Enter your name and student ID into the Teleform sheet **FIRST**.
- **THEN:** Attempt *all* questions!
- All questions have **ONE** correct answer.
- **DO NOT** tick two answers as correct for the same question.
- If you believe that there is an error in a question (multiple correct answers or no correct answer), select the answer you believe was intended as the correct one and contact the exam room supervisor after the exam.
- Keep your question book. Writing on the question book will not be marked.
- Use of calculators is **NOT** permitted.
- Good luck!

1. Which of the following SNR values could you describe as marginal in 256QAM?

- A. 24 dB
- B. 16 dB
- C. 48 dB
- D. 33 dB
- E. 256 dB

2. Which of the following HTTP/1.1 status codes indicates that a request could not be fulfilled because of bad syntax?

- A. 206
- B. 505
- C. 301
- D. 400
- E. 200

3. BGP4 is the routing protocol used in the global Internet. Which statement about BGP4 in the list below is FALSE?

- A. An Autonomous System is a set of networks with a administered by a single organisation, for example an Internet Service Provider (ISP).
- B. BGP4 is a Distance Vector routing protocol, using AS Path length as its routing metric.
- C. An Autonomous System must support only a single network prefix, e.g. 130.216.0.0/16.
- D. BGP4 supports routing *policies*, e.g. “traffic from network *X* must not be sent through Autonomous System *Y*.”
- E. An AS Path is a list of AS numbers leading to a given destination network.

4. Consider the following lines from a Web server log (in NCSA common access log format):

```
local - - [24/Oct/2013:13:46:45 -0600] "GET 2.gif HTTP/1.1" 200 2555
local - - [24/Oct/2013:13:46:47 -0600] "GET 3.gif HTTP/1.1" 200 36403
local - - [24/Oct/2013:13:46:50 -0600] "GET 4.gif HTTP/1.1" 200 441
```

Which of the following statements is FALSE?

- A. The requests were made in the year 2013.
- B. HTTP version 1.1 is being used.
- C. The total size of the objects transferred by the server is 30 kbytes.
- D. The objects were successfully served to the client.
- E. The requests were made by clients who were within the same network as the server.

5. Which of the following best describes Flow Control?

- A. Flow Control allows both sender and receiver respond to network congestion.
- B. Flow Control allows a sender to transmit big files.
- C. Flow Control makes sure that a receiver can keep up with data from a sender.
- D. Flow Control decides when a sender may begin sending data packets.
- E. Flow Control enables a sender to cope with lost data.

6. In the context of Web traffic, what is a flash crowd effect?

- A. A Web site gets more traffic from distant users than users in close proximity causing long propagation delays.
- B. A website catches the attention of a large number of users, and gets an unexpected and overloading surge of traffic.
- C. A Web site gets more traffic during the day than in the night.
- D. A Web site that gets more usage from young and flashy users than older users.
- E. An e-commerce Web site that is popular among users for buying expensive items.

7. Which of the follow statements about TCP is FALSE?

- A. TCP's sending window controls the number of packets that it may send back-to-back.
- B. A TCP receiver may acknowledge any received packet that falls within its current sliding window at any time.
- C. The TCP three-way handshake allows sender and receiver to know the other's initial sequence number.
- D. The window field in a TCP header tells a receiver how much space there is in the sender's receive buffer.
- E. TCP may acknowledge bytes from several packets with a single ACK packet.

8. Which of the following is the proper definition of a signal's bandwidth?

- A. The number of bits that the signal communicates per second.
- B. The width of the white space between constellation points.
- C. The difference between the highest and the lowest frequency component in the signal.
- D. The time it takes for the signal to reach the receiver.
- E. The maximum distance between two constellation points.

9. You need to bridge a distance of 50 km between two laboratory sites across a flat, treeless desert plain with a data link. Data rate or cost are not important, but latency is. Which of the following setups would you choose?

- A. A satellite link
- B. A twisted pair cable
- C. A direct radio link
- D. A coaxial cable
- E. A fibre-optic cable

10. A BitTorrent peer uses a technique called rarest first when deciding which chunks to request from a torrent swarm. How does this technique work?

- A. The peer downloads the oldest chunks from its neighbours with the highest data transfer rates.
- B. The torrent tracker maintains a list of rare chunks. Those chunks are requested by the peers.
- C. The peer downloads the smallest size chunk available from its neighbours.
- D. The peer downloads any chunk larger than 256 bytes.
- E. Among the chunks it does not have, the peer determines those that are the rarest among its neighbours and then requests those chunks.

11. Which of the following is NOT true of the peer-to-peer architecture?

- A. Peers are intermittently connected and change IP addresses, which requires complex management.
- B. Arbitrary end systems communicate with each other.
- C. New peers bring new service capacity and new service demands.
- D. Example applications using peer-to-peer architecture are Xunlei, Skype, and Kankan.
- E. A peer-to-peer architecture uses data centres for scaling.

12. Which of the following sequences could be Manchester-coded (where H stands for “high level” and L for “low level”)? You may assume that the sequence starts at the beginning of a bit.

- A. LHHLLHLLHL
- B. HLLHHLHLHL
- C. LLHLLHLHHL
- D. HLLHLHHHLH
- E. HLHLHLHHHL

13. A 16QAM constellation diagram whose constellation points are in a quadratic 4x4 array arrangement (as shown in the lecture slides) has:

- A. 16 possible amplitudes
- B. 3 amplitude levels and 12 possible phase angles
- C. 4 amplitude levels and 4 frequencies
- D. 4 power levels and 4 phase levels
- E. 4 amplitude levels and 4 possible phase angles

14. Which of the following application-layer protocols is used by electronic email?

- A. SIP
- B. FTP
- C. RTP
- D. SMTP
- E. HTTP

15. Consider power ratio P_1/P_2 of 26 dB. If we double P_1 , then the corresponding voltage ratio is...?

A. 23 dB
B. 58 dB
C. 29 dB
D. 20 dB
E. 32 dB

16. Approximately how much data can be in transit between the two ground stations of a geostationary satellite link at any one time if the link has a data transfer rate of 60 million bits per second?

A. 15 million bits
B. 200 bits
C. 20 million bits
D. 10 million bits
E. 18,000,000,000,000,000 bits

17. The text below shows the reply sent from the server in response to an HTTP GET message (Note `<cr>` is carriage return and `<lf>` is line feed).

```
HTTP/1.1 200 OK<cr><lf>Date: Tue, 07 Oct 2013
12:39:45GMT..Server: Apache/2.0.52 (Fedora)
<cr><lf>Last-Modified: Tue, 10 Sep 2013 18:27:46
GMT<cr><lf>ETag: "526c3-f22-a88a4c80"<cr><lf>Accept-
Ranges: bytes<cr><lf>Content-Length: 3874<cr><lf>Keep-
Alive: timeout=max=100<cr><lf>Connection: Keep-
Alive<cr><lf>Content-Type: text/html; charset=ISO-8859-
1<cr><lf><cr><lf><!doctype html public "-//w3c//dtd html
4.0 transitional//en"><lf><html><lf><head><lf> <meta
http-equiv="Content-Type" content="text/html;
charset="iso-8859-1"><lf> <meta name="GENERATOR"
content="Mozilla/4.79 [en] (Windows NT 5.0; U)[Netscape]">
<lf><title>COMPSCI 314 homepage</title><lf></head><lf>
<much more document text following here (not shown)>
```

How many bytes are there in the document being returned?

A. 3874 bytes
B. 8859 bytes
C. 1827 bytes
D. 3874 kbytes
E. 3874 Mbytes

18. Which of the following was needed for 100 Mb/s (100BaseTX) Ethernet?

- A. 4B/5B encoding.
- B. Use four twisted pairs rather than one.
- C. Manchester encoding.
- D. 4B/5B encoding and MLT-3 signalling.
- E. MLT-3 signalling.

19. Suppose the page your browser wants to download is 100k bits long, and contains 10 embedded images (with file names img01.jpg, img02.jpg, ... img10.jpg), each of which is also 100k bits long. The page and the 10 images are stored on the same server, which has a 300 ms round-trip time (RTT) from your browser. We will abstract the network path between your browser and the Web server as a 100 Mb/s link. You can assume that the time it takes to transmit a GET message into the link is zero, but you should account for the time it takes to transmit the base file and the embedded objects into the link. This means that the server-to-client link has both a 150 ms one-way propagation delay, as well as a transmission delay associated with it. Assuming non-persistent HTTP (and assuming no parallel connections are open between the browser and the server), how long is the response time, i.e. the time from when the user requests the URL to the time when the page and its embedded images are displayed?

- A. 10.91 seconds
- B. 3.91 seconds
- C. 1.91 seconds
- D. 20.91 seconds
- E. 6.61 seconds

20. Consider a client-server architecture. We denote the distribution time for this architecture by D . Let the size of the file to be distributed (in bits) be F . The server transmits one copy of file to each of its N clients. Let the upload rate of the server be u . Let d be the download rate of the client with the lowest download rate. What is the distribution time to get a copy of a file to all N clients?

- A. $D \geq F/d * 100$
- B. $D \geq \max\{NF/u, F/d\}$
- C. $D \geq \min\{NF/u, F/d\}$
- D. $D \geq \{F/d\}$
- E. $D \geq \max\{NF/u, uF/d\}$

21. Suppose a Web cache makes the following request to an origin server:

```
GET /1.gif HTTP/1.1
Host: www.abc.com
If-modified-since: Wed, 7 Oct 2013 09:23:24
```

The server responds with the following response:

```
HTTP/1.1 304 Not Modified
Date: Sat, 8 Oct 2013 15:39:29
Server: Apache/1.3.0 (Unix)
```

(empty entity body)

What is happening here?

- A. The cache is making a conditional get request to fetch a fresh copy of 1.gif if that object has been modified since 7 Oct 2013. The server responds indicating that the object has not been modified.
- B. The cache is making a standard get request to fetch a fresh copy of 1.gif. The server responds by serving the object to the client.
- C. The cache is making a standard get request to fetch a fresh copy of 1.gif. The server responds by serving the object to the cache.
- D. The cache makes a request for 1.gif from the server. The server responds by saying that the request is invalid.
- E. The cache is making a request to delete 1.gif from the server. The server responds that the object has been deleted.

22. Assume that a fibre from Auckland to New Plymouth is 360 km long, and is used to provide a 10 Mb/s link. Approximately how long does it take for a 1,000-byte frame to be sent out and acknowledged? (Hints: light travels at 2×10^8 m/s in optical fibre; you may ignore the time needed to transmit the short ACK frame).

- A. 3.6 ms
- B. 1.8 ms
- C. 5.2 ms
- D. 1.6 ms
- E. 4.4 ms

23. Which of the following Internet applications is loss-tolerant?

- A. Interactive games
- B. Web documents
- C. Instant messaging
- D. File transfer
- E. E-mail

24. Which of the following Web browsers first popularized the World Wide Web during its infancy?

- A. Internet Explorer
- B. Mozilla
- C. Mosaic
- D. Opera
- E. Netscape

25. Suppose a client wants to visit a Web site with a hostname `cnn.com`. If the client types the hostname `cnn.com` into the address bar of the browser, which of the following application-layer protocols does the browser use to facilitate a connection to the host?

- A. POP3
- B. ICMP
- C. DNS
- D. ARP
- E. IMAP

26. Consider the following statements about sliding window and rate control in TCP. Which of these statements is FALSE?

- A. Sliding window works well for all network transmission rates.
- B. Sliding window provides a simple way to handle retransmissions.
- C. Sliding window tells a sender how much space remains in the receiver's buffer.
- D. Rate control is more difficult to implement.
- E. Rate control does not work well when many sessions must share a network link.

27. Consider a sliding window system that uses w frames as its window size. If s is the sequence number of the first frame in the window, when can the system move the window on to frame $s + 1$?

- A. When it receives a NAK for frame s .
- B. When it receives an ACK for frame s from the receiver.
- C. When it receives an ACK for a frame with sequence number greater than s .
- D. When it has sent all of the w frames currently in the window.
- E. When the receiver has space available to receive more frames.

28. When does an 802.11 wireless network need to use 802.11's CTS/RTS protocol?

- A. When there are several different wireless networks active in the same place.
- B. When the network is required to support mobile devices that may move in from a different wireless network.
- C. When some of the devices near a wireless access point cannot hear each other directly.
- D. When interference makes direct communication between devices unreliable.
- E. When the network has no access point, i.e. its devices are operating in "infrastructure" mode.

29. Which part of 0111011000111010010100111110 has been parsed in LZ78 after the 4th parsing step has been completed?

- A. The first 6 bits
- B. The first 13 bits
- C. The first 7 bits
- D. The first 10 bits
- E. The first 8 bits

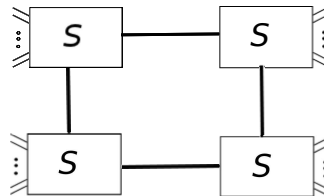
30. Which of the following statements about client-side Web measurement is FALSE?

- A. Client-side Web measurement requires placing a snippet of javascript code on every page of the Web site.
- B. Client-side Web measurement is not able to record the traffic volume generated by the Web server.
- C. Client-side Web measurement is able to record page errors.
- D. Client-side Web measurement is done by third-party analytics services such as Google Analytics.
- E. Client-side Web measurement can track users through the use of cookies.

31. An OSPF router maintains database of link states, each router in a large OSPF network will have a large database. OSPF uses Areas to subdivide a large OSPF network. Which of the following best describes why OSPF Areas are useful?

- A. OSPF is a Link State Internal Gateway Protocol, it scales better than RIP (which is a Distance Vector protocol).
- B. An OSPF AS Boundary router advertises (within an OSPF Autonomous System) routes learned from the outside world.
- C. OSPF Area 0 is the *backbone* Area, transit between other OSPF Areas is only allowed via the backbone Area.
- D. Internal routers for an area need only store topology information for links inside their Area.
- E. Areas make it easier for a Network Administrator to manage the network.

32. Consider the network of Ethernet switches shown in this diagram.



What would prevent packets from looping forever around the four switches?

- A. Ethernet's spanning tree protocol could be used to disable a link between two of the switches.
- B. Each switch knows the MAC address of devices connected to it, therefore a packet cannot loop around them.
- C. Switches keep tables of MAC addresses, they use these to recognise and discard packets they've seen more than once.
- D. The Ethernet packet contains a hop count which is decremented each time a packet is sent switch sends a packet; when the count reaches zero, the packet is discarded.
- E. Switches can't prevent looping, a network like this would not work.

33. Which of the following statements about Statistical Multiplexing for frames on a link is TRUE?

- A. Statistical Multiplexing can handle frames that have different lengths.
- B. Statistical Multiplexing uses a link more efficiently than Time-division Multiplexing.
- C. Statistical Multiplexing allocates the same amount of bandwidth to each data stream.
- D. Statistically multiplexed data streams can have different data rates.
- E. Statistical Multiplexing does not require fixed time slots.

34. In network-coded TCP based on random linear network coding, the encoded packets (blocks) sent by the transmitter are linear combinations of original data packets. The acknowledgment packets from the receiver to the transmitter ...

- A. are not actually required and are transmitted for peace of mind only.
- B. tell the transmitter which byte the receiver expects to see next.
- C. are encoded to identify the packets that have not been received.
- D. tell the transmitter which coefficients to use for encoding.
- E. tell the transmitter how many blocks have been seen by the receiver.

35. Which of the following request methods allows a client to see the HTTP message lines, but not receive the object itself when making a request to a server?

- A. POST
- B. HEAD
- C. GET
- D. PUT
- E. DELETE

36. When does it make most sense to use Virtual LANs?

- A. When one needs to support multicast traffic for many users.
- B. When one needs to improve data privacy for different groups of users.
- C. When one need to support different kinds of traffic in the same LAN.
- D. When one needs to support Voice over IP (VoIP) services in a LAN.
- E. When one needs to reduce the amount of equipment needed to support several different groups of users.

37. Which of the following pairs of parameters of a sinusoidal signal depend on each other, such that one cannot be changed without affecting the other?

- A. Frequency and amplitude
- B. Power and phase
- C. Amplitude and power
- D. Amplitude and phase
- E. Frequency and phase

38. Who is the creator of the World Wide Web?

- A. Tim Berners-Lee
- B. Larry Page
- C. Jim Kurose
- D. Marc Andreessen
- E. Bill Gates

39. Given an alphabet with letters A, B, C, D, and E and the probabilities $A=0.05$, $B=0.07$, $C=0.08$, $D=0.25$ and $E=0.55$, derive the associated Huffman code, assuming that we always assign the respective lower-weight child node or subtree to the 0 branch.

- A. $A=001$, $B=0001$, $C=0000$, $D=01$, $E=1$
- B. $A=0010$, $B=0011$, $C=000$, $D=01$, $E=1$
- C. $A=0010$, $B=0011$, $C=000$, $D=10$, $E=11$
- D. $A=001$, $B=0011$, $C=000$, $D=01$, $E=1$
- E. $A=0010$, $B=0100$, $C=0001$, $D=10$, $E=11$

40. The signal-to-noise ratio at the receiver of a digital radio link with bandwidth B Hz is 33 dB. What is the approximate theoretical channel capacity?

- A. $11B$ bits/s
- B. $33B$ bits/s
- C. $5B$ bits/s
- D. Potentially any of the above, depending on the noise power.
- E. 36 dB

Working page 1

Working page 2

Working page 3

