FINAL EXAMINATION
COMPUTER NETWORKS : 03-60-367-01
UNIVERSITY OF WINDSOR
SCHOOL OF COMPUTER SCIENCE
Intersession 2008 - 2 Hours

Last Name: ....

First Name: ....

Student ID: ....

PLEASE READ CAREFULLY BEFORE YOU START

1. This is a CLOSED book test; no notes, textbooks, calculators or computer aids are allowed.
2. PRINT your name legibly and clearly with your Student ID in the space indicated above.
3. You will be asked to sign your name once at the beginning of the exam (sign-in, with photo ID available), and once before leaving the exam room (sign-out).
4. PLACE ANSWERS on the Scantron sheets provided – you must use a pencil (NO PENs). Fill in all areas required, including your name, course and section numbers. Sign and return this examination question paper. DO NOT REMOVE any pages or attach any papers to this test or you will void your test and receive a mark of zero. If you need more space for rough work you may use any additional space on the examination question paper. No part of this examination question paper will be marked.
5. You are not allowed to give or receive unauthorized help with your test. Any misconduct, as outlined by the Senate bylaw 31 article I, will be reported accordingly.
6. **You have 2 hours to complete this test.**
7. Final examination papers are not returned to students.

Good Luck!

I AGREE TO THE ABOVE TERMS AND WILL NEITHER RECEIVE NOR GIVE UNAUTHORIZED HELP ON THIS EXAM

```
TOTAL MARK:




                        /110
```

_____
SIGNATURE   DATE   ⟵ SIGN HERE

All questions are either Multiple Choice or True-False. For each Multiple Choice question, you are to choose <u>only one</u> response which best answers the question. For True-False questions you may <u>only</u> choose one option (True <u>or</u> False). Place all answers on the Scantron sheet provided. The examination will be marked using the campus computer.

If an error is made you must carefully and completely erase your mistake and then indicate your choice of answer. Completely and carefully fill the circle that indicates your answer to each question. Make sure you have selected the correct question number on the Scantron sheet corresponding to the question on the examination question paper.

WARNING !
Read and think carefully about each question before answering.
Questions have been scrambled by topic.

1.   Ethernet is considered to be both connectionless and reliable.
     A) True
     B) False

2.   Assume that three routers, U, V and W, have link costs: $c(U,V) = 4$, $c(U,W) = 50$ and $c(V,W) = 1$. Using the Bellman-Ford algorithm, the common routing table for all routers is:

```
          U   V   W
    U     1   4   5
    V     4   1   1
    W     5   1   1.
```
     A) True
     B) False

3.   With non-persistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
     A) True
     B) False

4.   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 application layer protocols besides HTTP are needed in this scenario?
     A) DNS and HTTP
     B) TCP for DNS; TCP for HTTP
     C) UDP for DNS; TCP for HTTP
     D) None of the above are correct responses.

5. 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 layer protocols besides HTTP are needed in this scenario?
    A) DNS and HTTP
    B) TCP for DNS; TCP for HTTP
    C) UDP for DNS; TCP for HTTP
    D) All of the above are correct responses.

6. In Ethernet networks, the Preamble consists of 7 bytes with pattern 10101010 followed by one byte with pattern _____ .
    A) 11101010
    B) 11111111
    C) 10101011
    D) None of the above responses are correct.

7. In Ethernet networks, the Preamble pattern is used to synchronize receiver and sender clock rates.
    A) True
    B) False

8. The term MAC refers to _____ .
    A) Machine Address Control
    B) Medium Access Control
    C) the first three characters of MAChine
    D) None of the above responses are correct.

9. Standard bus type Ethernet links are managed so that collisions are avoided.
    A) True
    B) False

10. The property that a network should provide services to several applications is called
    _____ .
    A) Scope
    B) Scalability
    C) Robustness
    D) Configurability

11. Most local area networks (LANs) use electrostatic network hardware.
    A) True
    B) False

12. Most fibre optic (photonic) networks are constructed based on the assumption that data transmission is completely reliable and also error free.
    A) True
    B) False

13. Amplitude modulation refers to rapid variations of signal strength to indicate bits or other tokens.
    A) True
    B) False

14. Suppose Client A initiates a Telnet session with Server S. At about the same time, Client B also initiates a Telnet session with Server S. If A and B are different hosts, it is possible that the source port number in the segments from A to S is the same as that from B to S.
    A) True
    B) False

15. Carrier signals are used to _____ .
    A) detect whether the network is currently in use by another host
    B) provide a stable reference above noise levels
    C) advise hosts that the network is active
    D) All of the above responses are correct.

16. A network's speed is expressed in terms of _____ .
    A) Routing protocol
    B) Round trip time
    C) Bit rate and latency
    D) I/O buffer response

17. Photonic networks utilize _____ switches.
    A) ABR
    B) IP
    C) CBR
    D) ATM

18. Transfer across TCP streams is full duplex.
    A) True
    B) False

19. Using TCP, three messages are exchanged before a connection exists.
     A) True
     B) False

20. In TCP, following a timeout, the server _____ .
     A) disconnects from the session
     B) retransmits the entire message
     C) retransmits the packet
     D) requests an acknowledgement from the client

21. Multiple TCP streams can distinguished on a given machine using _____ .
     A) Ports
     B) IP addresses
     C) network interface cards
     D) All of the above responses are correct.

22. A single program may have several open sockets at any time.
     A) True
     B) False

23. Both UDP and TCP require that the applications recognize their own data formats.
     A) True
     B) False

24. Which of the following is not a proper layer of the TCP stack?
     A) Link
     B) Network
     C) Transport
     D) All of the above responses are proper layers of the TCP stack.

25. All datagrams contain 2 ports.
     A) True
     B) False

26. Message encapsulation refers to _____ .
     A) designating message contents with descriptive data
     B) allowing for message content verification
     C) reliance upon IP for transmitting messages
     D) embedding payloads and protocol headers within logically layered packages

27. UDP and TCP are examples of _____ layer protocols.
    A) Application
    B) Link
    C) Transport
    D) Network

28. Closing a TCP socket requires _____ Acknowledgements.
    A) 0
    B) 1
    C) 2
    D) 3

29. The property that a network should operate efficiently when deployed on a small-scale as well as on a large-scale is called _____ .
    A) Migration
    B) Determinism
    C) Scalability
    D) Autoconfigurability

30. TCP abstracts data communication to appear as an apparent stream of flowing data.
    A) True
    B) False

31. The socket that represents a 'passive open' is a(n) _____ socket.
    A) Server
    B) Client
    C) TCP
    D) Application

32. In order to deal with the situation where, too many sources send too much data too fast for a network to handle, it is necessary to use a technique called _____ .
    A) Flow control
    B) Congestion control
    C) Routing control
    D) Dynamic packet management

33. The term ARP refers to _____ Protocol.
    A) Address Resolution
    B) Address Reservation
    C) Asynchronous Routing
    D) None of the above responses are correct.

34. Within LANs, link layer addressing is accomplished by using _____ .
    A) IP addresses
    B) MAC addresses
    C) IP and MAC addresses
    D) All of the above responses are correct.

35. HTTP is referred to as a stateless protocol because _____ .
    A) clients do not maintain historic information about transactions with servers
    B) servers and clients do not maintain open connections
    C) server maintains no information about past client requests
    D) All of the above responses are correct

36. Consider a packet of length 1024 bytes. Assuming the packet must travel over a link of distance 2500 kilometers with propagation speed 2.5×10^8 m/s and transmission rate 2 Mbps, what is the propagation delay?
    A) 1 msec
    B) 10 msec
    C) 21 msec
    D) 100 microsec

37. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 800 Kbps, R2 = 2 Mbps and R3 = 1 Mbps. Assuming no other traffic in the network, what is the throughput for the file transfer?
    A) 800 Kbps
    B) 2 Mbps
    C) 1 Mbps
    D) 3.5 Mbps

38. By using Web caching _____ .
    A) it is possible to reduce response time for client request
    B) it is possible to reduce traffic on an institution's access link
    C) the cache acts as both client and server
    D) All of the above responses is correct

39. TCP congestion control uses a congestion window to implement _____.
    A) Timeout acknowledgment
    B) Congestion avoidance
    C) Message traffic scheduling
    D) None of the above responses is correct

40. Applications require which of the following transport services.
     A) Data loss and Security
     B) Timing
     C) Throughput
     D) All of the above responses are correct

41. Delivery and storage of email messages to a server is achieved using _____ .
     A) Post Office Protocol (POP)
     B) Internet Mail Access Protocol (IMAP)
     C) Simple Mail Transfer Protocol (SMTP)
     D) Hypertext Transfer Protocol (HTTP)

42. General Peer-to-Peer systems must not use "always on" servers.
     A) True
     B) False

43. Peer-to-Peer networks are used _____ .
     A) for content sharing
     B) for Instant Messaging
     C) for IP based telephony
     D) All of the above responses are correct.

44. Host A is sending Host B a large file over a TCP connection. Assume Host B has no
     data to send Host A. Host B will not send acknowledgments to host A, because Host B
     cannot piggyback the acknowledgments on data.
     A) True
     B) False

45. The size of the TCP receive window (**RcvWindow**) may change throughout the
     duration of the connection.
     A) True
     B) False

46. Suppose Host A is sending Host B a large file over a TCP connection. The number of
     unacknowledged bytes that A sends cannot exceed the size of the receive buffer.
     A) True
     B) False

47. Routers provide feedback to end systems to assist _____ .
    A) network-assisted congestion control
    B) network-assisted flow control
    C) end-end congestion control
    D) end-end flow control

48. In pipelining protocols, the selective repeat approach requires _____ .
    A) Receiver only sends cumulative **acks**
    B) Sender maintains timer for cumulative **unacked** packets
    C) Receiver **acks** individual packets
    D) Both B and C responses are correct

49. Assume that three routers, U, V and W, have link costs: $c(U,V) = 4$, $c(U,W) = 50$ and $c(V,W) = 1$. Using the Bellman-Ford algorithm, the common routing table for all routers is:

    ```
            U   V   W
    U   0   4  50
    V   4   0   1
    W  50   1   0.
    ```
    A) True
    B) False

50. When the link cost increases suddenly between two routers in a network, poisoned reverse is used to _____ .
    A) accelerate the convergence to a stable routing table
    B) replace all update link costs initially to infinity for all routes through the affected routers
    C) guarantee unique routing solutions in the final routing tables
    D) Both A and B responses are correct.

51. Which layer has the responsibility of transferring datagrams from one node to adjacent node(s) over a link?
    A) Application layer
    B) Transport layer
    C) Link layer
    D) Network layer

52. The property that it should be possible to add new features to a network without disruption of network service is called _____ .
    A) Migration
    B) Safety
    C) Robustness
    D) Self-Stabilization

53. Transport services and protocols provide logical communication between hosts.
    A) True
    B) False

54. Round-trip time (RTT) is estimated based on _____ .
    A) a weighted average RTT that is fixed after several samples
    B) a weighted average RTT that is continuously updated
    C) sampling of routes to determine minimum cost paths
    D) None of these responses is correct.

55. Routing algorithms may be classified based on _____ .
    A) availability of global information
    B) availability of local information
    C) rate of change of network paths
    D) All of the above responses are correct.

56. A subnet may be defined as any interconnected set of computers and routers (or switches) that can operate in isolation from other subnets, or in cooperation with other subnets.
    A) True
    B) False

57. The need for IP tunneling depends primarily on the type of routers along the message path.
    A) True
    B) False

58. Network Address Translation is used because it expands the available device address space through use of port numbers and thereby satisfies the end-end argument at the network layer.
    A) True
    B) False

59. Network layer protocols must be defined in every host and router.
   A) True
   B) False

60. TCP flow control is provided by _____ .
   A) including value of the receiver buffer available size in acknowledgements
   B) keeping out-of-order segments in the receiver buffer
   C) keeping the send rate always less than the receive rate
   D) All of these responses are correct.

61. Channel partitioning MAC protocols are inefficient at low network loads because active nodes cannot utilize un-owned allocated channels.
   A) True
   B) False

62. In "ring" networks, using the "taking turns" MAC protocol, a _____ is passed from one node to the next node sequentially.
   A) link allocation schedule
   B) "network ready" polling signal
   C) network synchronization signal
   D) control token

63. Connectionless demultiplexing may be performed using _____ .
   A) TCP
   B) UDP
   C) ICMP
   D) All of the above are correct responses.

64. Internet transport-layer protocols provide delay and bandwidth guarantees.
   A) True
   B) False

65. The TCP "Slow Start" approach to congestion control _____ .
   A) doubles the size of the message bundle until failure occurs
   B) increases the size of the message bundle linearly until failure occurs
   C) sends a message and waits to obtain the receiver buffer size before increasing the number of messages sent as a bundle
   D) None of the above responses is correct

66. The action of a sender involving the gathering of data from multiple sockets and enveloping the data with a header is called _____ .
    A) Multiplexing
    B) Packet creation
    C) Data integration
    D) Demultiplexing

67. Transport services and protocols _____ .
    A) provide communication between system processes running on different hosts
    B) are provided in hosts and routers
    C) make more than one transport protocol available to applications
    D) All of the above responses are correct

68. In TCP, flow control is maintained by _____ .
    A) Having senders keep a message buffer with varying size
    B) Having receivers return the speed of clearing their buffers
    C) Having senders modify their propagation speed
    D) Both A and B responses above are correct

69. Network services and protocols provide logical communication between hosts.
    A) True
    B) False

70. A datagram contains the payload bit pattern $<1100111, \; xxxx>$ where the first (left) field is the 7-bit data payload D and the second (right) field is the 4-bit Cyclic Redundancy Check code R. The receiver knows that the CRC generator G is the 5-bit pattern 01101. In order that the receiver determine that the datagram passes the CRC test as correct, the value of R received must be equal to _____ .
    A) 1010
    B) 1100
    C) 0101
    D) None of the above responses are correct.

71. One role of a NIC is to accept a datagram from the next higher layer and encapsulate the datagram into a frame, along with frame header and trailer bit fields, such as rdt and CRC.
    A) True
    B) False

72. Reverse Path Forwarding relies on a router's knowledge of the unicast based shortest path from it to the sender.
    A) True
    B) False

73. Demultiplexing _____ .
    A) involves gathering data from multiple sockets
    B) involves enveloping data with header
    C) involves delivering received segments to correct socket
    D) Both A and B are correct responses.

74. In TCP based demultiplexing, TCP sockets are identified by _____ .
    A) both sender and receiver port numbers
    B) sender IP address and port numbers
    C) receiver IP address and port number
    D) both sender and receiver IP addresses and port numbers

75. In pipelining protocols, the Go-back-N approach requires _____ .
    A) Sender can have up to N **unacked** packets in pipeline
    B) Receiver **acks** individual packets
    C) If sender timer expires, retransmit all N packets
    D) Sender has timer for each **unacked** packet

76. In order to establish a virtual connection (also called a virtual circuit) that permits datagrams to flow between communicating end hosts, it is necessary to _____ .
    A) involve both the end hosts and all intervening routers
    B) initiate the connection using specialized datagrams that carry historical information about the end-end route
    C) complete the connection using receiver and sender acknowledgements
    D) All of these responses are correct.

77. The motivation(s) for utilizing Network Address Translation include(s) _____ .
    A) making available a range of unique IP addresses for all devices in every subnet
    B) ability to change addresses of devices in local network without notifying outside world
    C) ability to change ISP without changing addresses of devices in global network
    D) establishing direct addressability to local devices inside subnet

78.   IP datagrams may be fragmented into several smaller IP datagrams _____ .
      A)   that are reassembled at the next router link
      B)   in order to adapt to the largest link layer frame
      C)   that are reassembled only at the final destination
      D)   Both B and C are correct responses.

79.   The IPv6 datagram header has length 40 bytes.
      A)   True
      B)   False

80.   RIP, OSPF and BGP are examples of _____ .
      A)   application layer routing protocols
      B)   transport layer routing protocols
      C)   network layer routing protocols
      D)   Both B and C responses are correct.

81.   In TCP "slow start", after establishing the connection, the message flow rate is
      _____ .
      A)   increased linearly until first loss event
      B)   increased linearly after the first loss event
      C)   increased exponentially until first loss event
      D)   Both B and C are correct responses.

82.   Forwarding refers to _____ .
      A)   the manner by which datagrams are routed from source to destination ports of end
           hosts
      B)   the manner by which datagrams are routed from input to output ports of individual
           routers
      C)   the set of algorithms required to ensure near-optimal path selection of datagrams
      D)   the manner by which datagrams are routed from source to destination between
           adjacent routers

83.   The main goal of Bellman-Ford's algorithm is to ensure that all network nodes have the
      same information to provide shortest path service for message routing.
      A)   True
      B)   False

84.   Internet Control Message Protocol (ICMP) is used by hosts and routers to communicate
      network-level information.
      A)   True
      B)   False

85. If a router malfunctions, the link state algorithm is affected because _____ .
    A) a node can advertise incorrect path cost
    B) a node can advertise incorrect link cost
    C) errors are contained locally within the network
    D) each node recomputes its table and forwards it to other nodes

86. ICMP (Internet Control Message Protocol) messages are carried in IP datagrams.
    A) True
    B) False

87. Assuming that W is the maximum window size established by TCP "slow start", and the round-trip time is RTT, what is the average throughout of TCP as a function of W and RTT?
    A) W/RTT
    B) 0.5 x W/RTT
    C) 1.25 x W/RTT
    D) None of the above responses is correct.

88. Datagram networks do not require call setup at the network layer.
    A) True
    B) False

89. Router buffer sizes should be selected based on _____ .
    A) message round-trip time (eg. as determined by acknowledgements)
    B) link capacity
    C) tolerance for data loss due to overflow
    D) All of these responses are correct.

90. The first item in an IP datagram is the _____ .
    A) header length (in bytes)
    B) total datagram length (in bytes)
    C) protocol version number
    D) type of service

91. In datagram networks _____ .
    A) routers maintain state about end-to-end connections
    B) packets are forwarded using destination host address and virtual circuit number
    C) packets between same source-destination pair may take different paths
    D) None of these responses is correct.

92. The purpose of a network interface card is to implement the link and physical layer interface.
     A) True
     B) False

93. Link layer services provide _____ .
     A) Framing and flow control
     B) Reliable delivery between adjacent nodes
     C) Error detection and correction
     D) All of the above responses are correct.

94. The MAC address is _____ .
     A) Burned into the NIC ROM
     B) Set locally on the host using software
     C) Both A and B are correct responses
     D) None of these responses are correct.

95. In order to provide multiple access to networks it is necessary to _____ .
     A) use a reserved channel to obtain communication information about channel sharing
     B) specify a distributed algorithm that determines how nodes share channel
     C) use only devices for which collisions do not occur
     D) Both A and B responses are correct.

96. Suppose Client A initiates a Telnet session with Server S. At about the same time, Client B also initiates a Telnet session with Server S. If A and B are the same host, it is possible that the source port number in the segments from A to S is the same as that from B to S.
     A) True
     B) False

97. Assume that four (4) datagrams are received in sequence and are then checked for parity errors. The first datagram bit string contains the 7-bit pattern 1011010, followed by the second datagram pattern 0000111, third datagram pattern 1111110, and fourth datagram pattern 0110011. Each of the bit patterns consists of a leading (leftmost) 6-bit pattern that is the data payload followed by the rightmost parity bit (parity is defined as 0/1 if the number of 1-bits in the data payload is even/odd). The fourth datagram pattern bits are the parity values of the first three datagram bits in the corresponding positions. The error checking scheme is the two-dimensional parity bit check. Which of the following statements is most correct?
     A) All datagram data payloads are correct with highest probability
     B) It is impossible to be fully certain about the data correctness in this case
     C) There is certainly an error in the second datagram
     D) There is certainly an error in the third datagram

98. With half duplex at the link layer, nodes at both ends of the link can transmit, but not at same time.
    A) True
    B) False

99. Hosts A and B are directly connected with a 200 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send application data into the link at 100 Mbps, but Host B can read out of its TCP receive buffer at a maximum rate of 50 Mbps. The long term average rate at which Host A sends data is approximately _____ .
    A) 50 Mbps
    B) 75 Mbps
    C) 100 Mbps
    D) 200 Mbps

100. RIP advertisements typically announce the number of hops to various destinations. BGP updates, on the other hand, announce the _____ to the various destinations.
    A) link costs
    B) adjacent link nodes
    C) "I'm alive" message
    D) previous link path table

101. Consider a virtual-circuit network. Suppose the VC number is a 16-bit field. What is the maximum number of virtual-circuits that can be carried over a link?
    A) 2^{16}
    B) 2^{15}
    C) $2^{16} - 1$
    D) 2^{12}

102. BGP messages are exchanged using _____ .
    A) UDP
    B) TCP
    C) ICMP
    D) Proprietary Cisco protocols

103. The reasons for handling routing differently in Inter-AS and Intra-AS routing are based on _____ .
    A) differences in router capabilities
    B) distance vector versus link state information
    C) policy, scale and performance
    D) imposed standards for packaging messages

104. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching to determine whether message traffic is to be routed through one of only four forwarding ports. The range of addresses to be routed through Port 2 is

_____ .
 A) 00000000 through 00111111
 B) 00000000 through 11111100
 C) 10000000 through 10111111
 D) 01000000 through 10000000

105. Consider sending a 3000 byte datagram into a link that has a maximum transfer size (MTU) of 500 bytes. How many fragments are generated?
 A) 8
 B) 7
 C) 6
 D) 5

106. Banded frequency modulation permits _____ .
 A) multiple message signals to overlap on links
 B) standard oscillators to be deployed on network devices
 C) redundancy checking of messages
 D) Frequency banding is only used for FM radio.

107. If Bob and Alice are two peers and each is located behind a Network Address Translation (NAT) server across a wide-area network (WAN). In the absence of application-specific NAT configuration _____ .
 A) they can establish a reliable UDP connection
 B) they cannot establish a SMTP connection
 C) they can establish a TCP connection
 D) they cannot establish a TCP connection

108. At the network layer, a spanning tree is used to ensure that no redundant packets are received by any node.
 A) True
 B) False

Use the following Table for Questions **109 and 110**. The table contains the link costs (in arbitrary units) between routers S, T, U, V, W, X, Y and Z. A dash (hyphen) entry indicates that there is no connection between these pairs of routers.

	S	T	U	V	W	X	Y	Z
S	0	1	4	-	-	-	-	-
T	1	0	2	4	-	-	7	5
U	4	2	0	3	3	-	-	-
V	-	4	3	0	4	3	1	-
W	-	-	3	4	0	6	-	-
X	-	-	-	3	6	0	6	-
Y	-	7	-	1	-	6	0	12
Z	-	5	-	-	-	-	12	0

109. Based on the pairwise link costs in the Table above, and using Dijkstra's algorithm, determine the shortest path route from X to S.
    A) Infinity
    B) 10
    C) 8
    D) 9

110. Based on the pairwise link costs in the Table above, and using Dijkstra's algorithm, determine the shortest path route from X to Z.
    A) Infinity
    B) 12
    C) 16
    D) 18

You may use the space below and over the page for rough work. This work will not be marked.

Use this page for rough work.