THE UNIVERSITY OF AUCKLAND

EXAMINATION FOR BSc GDipSci ETC 2000

COMPUTER SCIENCE

Data Communications Fundamentals

(Time allowed: **TWO** hours)

NOTES:

- Attempt ALL questions.
- Marks for each question are as shown.
- You may use a supplementary book for longer answers where necessary, but for each longer answer must clearly indicate in the answer space of this question/answer paper that the book is used for that answer.
- Ensure that your name, student ID, degree and similar details are completed in the space below, *and* on the cover of the answer book if one is used.
- Enter your name on every page of this question/answer paper.
- Calculators are NOT permitted.

Family Name .....

Given Names .....

Degree (BSc, GDipSci, etc) .....

Student Identification Number .....

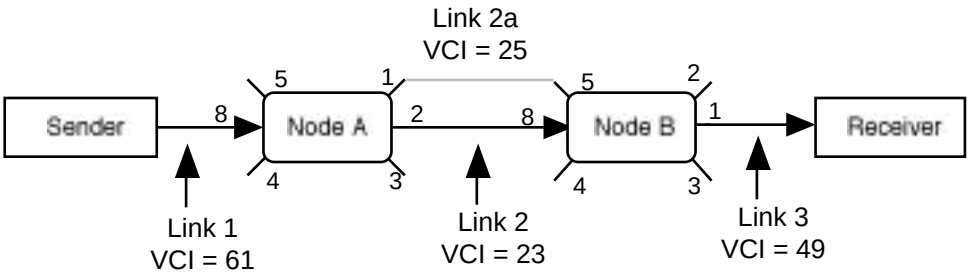
Departmental use only	
Exam total	

Family name .....

Given names .....

1. A student thinks that in a token ring it is best to receive the entire token and examine it before either forwarding it to the next station or seizing it to allow this station to send. Comment on this choice. **[3 marks]**

2. Two users communicate through a virtual circuit as shown. The ports of each node are numbered as in the figure (with the same values for both input and output). Although only a few physical links are shown, you should assume that all of the ports on the two nodes connect to other hosts or nodes.



(a) What routing table entries are needed in Nodes A and B to maintain the virtual circuit (sender to receiver) as shown by the *solid* lines in the figure? **[4 marks]**

	Input Line/Port	Input VCI	Output Line/Port	Output VCI
Node A				
Node B				

(b) The connection from node A to B is changed to that shown by the *dotted* line. What are the routing tables for the *reverse* circuit, from right to left? **[4 marks]**

	Input Line/Port	Input VCI	Output Line/Port	Output VCI
Node A				
Node B				

Family name .....

Given names .....

3. Explain how routing decisions for data messages differ in a network using datagrams, as compared with one using virtual circuits. **[4 marks]**

4. A token bus network is running with active stations whose addresses are A = 505, B = 623, C = 338 and D = 795.

A station E with address 484 enters the network in response to a message from one of the active stations. Complete the following table. **[5 marks]**

		Dest Addr	Source Addr	Message Type	Other Data
(i)	E responds to what message?				
(ii)	E responds with what message?				
(iii)	E receives the Token message			Token	

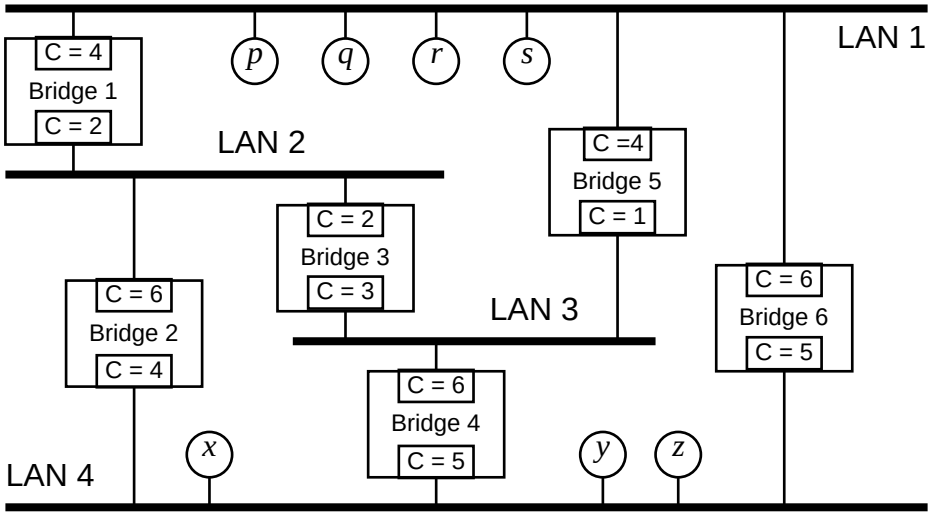
(iv) What changes would result if E had the address 103?. **[2 marks]**

5. How does a repeater differ from a bridge? **[2 marks]**

Family name .....

Given names .....

6. The diagram shows a system of several LANs interconnected with transparent bridges. The bridges have names such as "Bridge 4", which are used as the unique identifiers for the spanning tree algorithm. Each bridge port has an associated cost as shown, for example "C = 5". Two of the LANs are shown with connected stations or nodes (such as "*p*" and "*x*").



(a) Assuming for this part that *only Bridge 6 is operating*, explain what messages are on what LANs in response to each of the messages in the following sequence.
In each case state what, if anything, the bridge learns about the network (the answer may be "nothing"). The bridge has no initial knowledge. Information learned from one message may be used in handling later messages. **[6 marks]**

source → *dest*	*message is on LAN(s)*	*information learned by "Bridge 6"*
p → *r*		
x → *q*		
r → *s*		
r → *p*		
x → *p*		
z → *x*		

CONTINUED

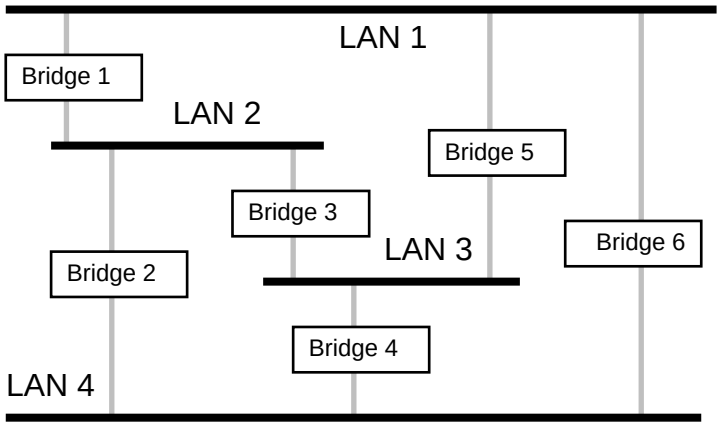
Family name .....

Given names .....

(b) Assuming that a network spanning tree has been built, which bridge will become the root bridge of the full network, and why? **[2 marks]**

(c) The diagram shows the network with only the LANs, bridges and possible connections. Mark the connections which are enabled to form the spanning tree.

(*Or you may mark the connections which are disabled, as long as the result is clear.*) **[4 marks]**



7. In a token ring the station which raises the priority of a token is responsible for lowering the token priority. Why must the priority be lowered, rather than just leaving it at the higher value? **[2 marks]**

8. What are the two principal categories of error control used to overcome transmission errors? **[2 marks]**

Family name .....

Given names .....

9. A CSMA/CD network such as IEEE 802.3 or Ethernet employs a technique called "truncated binary exponential backoff".

Why is binary exponential backoff used and how does it achieve its result?

You do not have to explain its operation in great detail. **[3 marks]**

10. A (7,4) Hamming code uses *odd* parity for each of its parity groups. The received codeword is 0000000.

(i) Correct the error (if any) in the received word and extract the corrected data bits (deleting the parity bits). You must state the bit order. **[4 marks]**

(ii) As in this example, odd parity is sometimes preferred to even parity for a Hamming code. Suggest a reason for this preference. **[1 mark]**

Family name .....

Given names .....

11. (a) Give *three* reasons why it may take more than 8 seconds to send a 100 megabyte file over a 100 megabit (10^8) per second link. **[3 marks]**

(i)
(ii)
(iii)

(b) Give some way of reducing each reason, if possible. **[3 marks]**

(i)
(ii)
(iii)

12. You read that "*Ethernet is a very inefficient network because so much data is lost from data collisions*". Argue against this statement. **[3 marks]**

Family name .....

Given names .....

13. Two stations on a 10BASE5 IEEE802.3 LAN are exchanging messages (requests and responses), with negligible separation between a request and its response and between one response and the next request. There is negligible other traffic. A "request" has 80 information bytes. (*Assume that an 802.3 message has an overhead of 40 octets in inter-record gap, preamble, addresses, FCS, etc and that there are negligible other delays.*) The term "rate" means the number of bytes transferred per second, or possibly transferred per second.

(a) What sized *data block* should be transferred in the response message to ensure that user information (the data within the response) is transferred at $^2/_3$ the network rate.

[4 marks]

(b) Show that the maximum possible user data rate is about $^{15}/_{16}$ of the network rate. (You may leave the answer as an unsimplified fraction.) **[4 marks]**

14. Give two reasons why local area networks usually discard failing messages while wide-area networks often retry them. **[2 marks]**

Family name .....

Given names .....

15. Networks are sometimes subject to “deadlock”.

(a) What are the two types of deadlock? **[2 marks]**

(b) Give one way of preventing deadlock. **[2 marks]**

(c) If a deadlock does occur, give one way by which it may be broken. **[2 marks]**

16. Headers in TCP and IP contain various fields, some of which are in the following table. Mark each field as being part of its appropriate header and briefly indicate its function.

[8 marks]

Field	IP	TCP	Function
Time to live			
checksum			
fragment offset			
version			
source address			
destination port			
sequence number			
urgent pointer			

Family name .....

Given names .....

17. (a) Describe a “two-way” handshake. **[3 marks]**

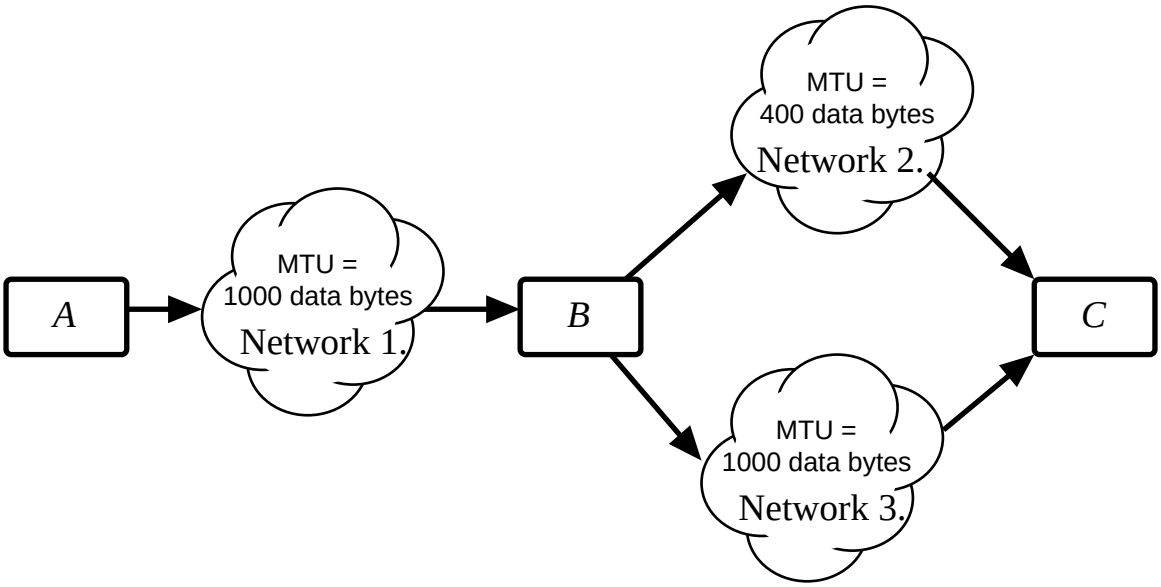
(b) Describe a “three-way” handshake. **[6 marks]**

(c) What is the problem of a two-way handshake which is solved by a three-way handshake?. **[2 marks]**

Family name .....

Given names .....

18. Suppose a router at *A* in the figure receives an IP packet with 4000 data bytes, fragments the packet and routes the fragments to *B* via network 1.
B in turn routes all fragments except the second one to *C* via network 3, but sends the second fragment to *C* via Network 2.



Show the fragments that *C* receives and give relevant values in the fragment headers.

- *You must place your own appropriate headings on the columns.*
- *The table may have more rows than you need for all of the fragments.*
- *The precise fragment order at C does not matter, but packets sent over a path must remain in the order of sending.*

Fragment				
1				
2				
3				
4				
5				
6				
7				
8				
9				

[8 marks]