

QUESTION 1. [11 MARKS]

Consider two local networks, each connecting twelve machines. Network A uses the ethernet protocol to connect its twelve machines, whereas network B uses the token ring protocol to connect its twelve machines.

PART (A) [3 MARKS]

Explain how messages are passed between machines on network A.

SOLUTION: Each machine listens for messages addressed to it. When a machine needs to communicate with another machine on the same ethernet bus, it broadcasts a message with the other machine's address. If a machine detects a collision (another machine trying to broadcast at the same time) it stops broadcasting for a random time interval and re-broadcasts.

PART (B) [3 MARKS]

Explain how messages are passed between machines on network B.

SOLUTION: Each machine as a designated receiver for its messages, and a designated sender of messages to it, and they are thus connected in a ring. A bit pattern, called a token, is passed from machine to machine, and a machine wishing to send a message to another machine retains the token, sends the message with the address of the recipient machine, and waits until the message it is sending travels around the entire ring and it can confirm that it was sent. Then the token is passed to the next machine.

PART (C) [3 MARKS]

Explain how a message could be passed from a machine on network A to a machine on network B.

SOLUTION: One machine is connected to both networks. It examines all the intended recipients of messages sent on network A, and when it notices an address on network B, it sends the message on that network.

PART (D) [2 MARKS]

Give an example of a disadvantage for each network, A and B.

SOLUTION: If a single machine on network B fails, none of the machines on that network can exchange messages. If the message volume on network A is high, there will be many collisions, and hence re-sent messages.

QUESTION 2. [7 MARKS]

Describe how an HTTP server and an HTML browser cooperate to allow you to access content from a remote site on your machine. What potential danger is there in allowing a browser to run a program contained in an HTML page?

SOLUTION: The browser sends a request for an HTML file indicated by a URL (Uniform Resource Locator). The HTTP server on the machine where that resource is located sends the file back to the machine where the browser is running. The HTML browser interprets the HTML file according to protocols established by th W3 consortium. A browser may run a program that inadvertently or maliciously changes or reveals information on the browser's computer.

QUESTION 3. [27 MARKS]

Explain as much as you can of what's going on in the following Scheme expressions.

PART (A) [4 MARKS]

```
(/ (* (+ 3 2) (- 3 2)) 5)
```

SOLUTION: $3 + 2$ and $3 - 2$ are multiplied, yielding 5. This is then divided by 5, yielding 1.

PART (B) [4 MARKS]

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(if (> (* 3 2) (+ 3 2)) "I thought so!" "Whatever!")
```

SOLUTION: 3×2 and $3 + 2$ are compared. If 3×2 is greater than $3 + 2$ (which it is), then "I thought so!" is returned. Otherwise, "Whatever!" would have been returned.

PART (C) [4 MARKS]

```
(first (rest (reverse (rest '(3 5 7 9))))))
```

SOLUTION: The rest of '(3 5 7 9) is '(5 7 9). The reverse of that is '(9 7 5), and the rest of that is '(7 5). Finally, the first of this expression is 7.

PART (D) [5 MARKS]

```
(define (getMax list1 list2)
  (if (> (length list1) (length list2)) list1 list2))
```

SOLUTION: A procedure called *getMax* is defined, with parameters *list1* and *list2*. The lengths of *list1* and *list2* are compared, and if *list1* is longer, it is returned, otherwise *list2* is returned.

PART (E) [10 MARKS]

```
(define (make-pal myList)
  (if (< (length myList) 1) myList
      (append (list (first myList))
              (make-pal (rest myList))
              (list (first myList)))))
```

SOLUTION: A procedure called *make-pal* is defined that takes a parameter called *myList*. If *myList* has length 0, it is returned. Otherwise a list containing the first element of *myList* is appended to the result of *make-pal* on the remainder of *myList* appended to a list containing the first element of *myList*. The result is a palindrome of the elements of *myList*, first backwards, then forwards.

QUESTION 4. [5 MARKS]

If you divide a page into regions by drawing 11 straight lines, what is the minimum number of colours you require to ensure that two regions that border each other along a line segment do not have the same colour? Explain why.

SOLUTION: Suppose you draw the lines in order. After you draw the first line, you can colour the resulting two regions with two colours, but not one. For each subsequent line, designate part of the page as “above” and part of the page as “below” the line you are adding, and reverse the colour of any region above the line, while keeping the colours below the line the same. Any two regions that border along the new line will thus have different colours, and any regions that do not meet along the new line will inherit a colouring that worked from before the new line was added. Thus two colours is enough, and is the minimum required.

Total Marks = 50