

Victoria University of Wellington
DEGREE EXAMINATIONS — 1999

COMP203 COMPUTER ORGANISATION

END OF TRIMESTER 2/3

Time Allowed: 3 hours.

Instructions:

- There are a total of 45 marks.
- Attempt all questions.
- Paper and electronic foreign language dictionaries are allowed.
- Calculators and reference materials are not allowed.

Question 1.

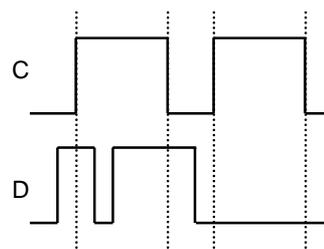
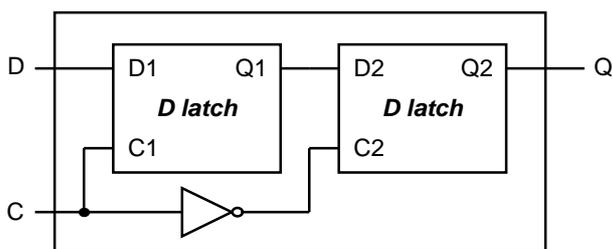
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here:   beq $1, $t2, there
        . . .
there:  add $t1, $t2, $t1
    
```

Consider the code sequence above in which the ellipses (‘. . .’) indicate some number of instructions that are not shown.

- (a) Given your understanding of PC-relative addressing, explain why an assembler might have problems implementing directly the branch instruction at the top of the code sequence. [3 marks]
- (b) Suggest how the assembler might rewrite the code sequence to solve these problems. [2 marks]

Question 2.



Consider the D flip-flop with falling-edge trigger shown above left and the timing diagram for the inputs shown above right.

- (a) Copy the timing diagram into your answer book and then add timing diagrams for the outputs Q1 and Q2. You need to show how the values of Q1 and Q2 depend on C and D, so draw it carefully, making clear which edges are aligned and which edges are not aligned. You may assume that Q1 is at logic 0 initially. [3 marks]
- (b) Why are D flip-flops not used for DRAM? [1 mark]
- (c) Sketch a DRAM cell and label the parts. [2 marks]
- (d) Explain why DRAM cells need to be refreshed. [1 mark]

Question 3.

- (a) Give four advantages of virtual memory. [2 marks]
- (b) Give two disadvantages of virtual memory. [1 mark]
- (c) Explain in detail the structure of page table entries and how page tables are used in virtual memory systems. [5 marks]

Question 4.

I have been given a second-hand hard disk drive to fit into a 80486 computer used by my daughter's kindergarten. The kids are curious about the insides of the drive.

- (a) Draw a diagram depicting the internal organisation of a simplified hard disk drive with 4 platters, 4 tracks per platter, and 8 sectors per track. Show on your diagram where the platters, tracks, and sectors are and make your diagram clear enough for a 4-year-old (and the exam marker) to understand. [3 marks]

There is a full specification for my disk on Seagate's Web site:

CFA340A

Spec Sheet

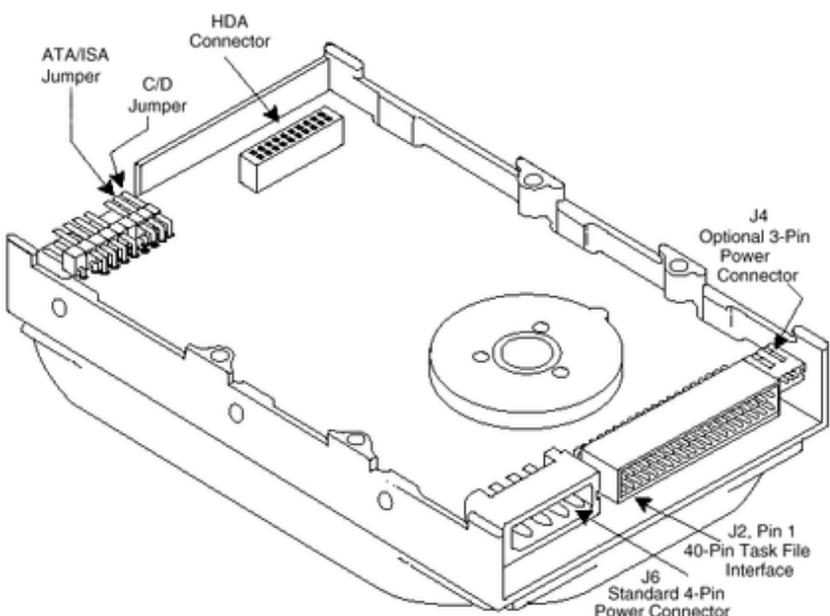
File Pro Advantage Family

[Cylinders:](#) 665
[Heads:](#) 16
[Sectors:](#) 63

[Capacity:](#) 343.0 MB
[Speed:](#) 4000 rpm
[Seek time:](#) 13 ms avg
[SeaFAX#:](#) 2323402

Related information:

[Reference Manual For All Conner Models \(5.9 Mbytes\)](#)



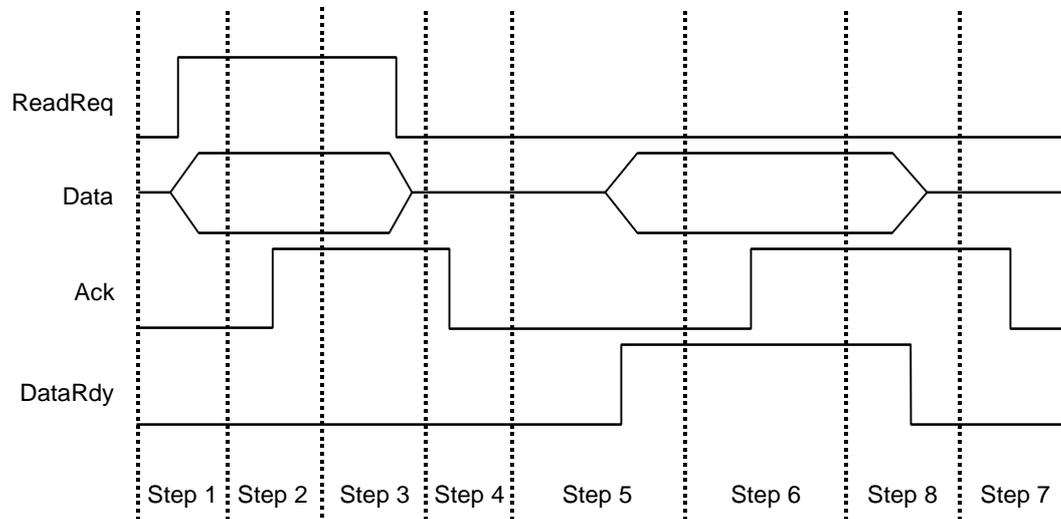
The diagram shows a top-down view of a hard disk drive. It features a central spindle with a circular platter. Various connectors and jumpers are labeled: ATA/ISA Jumper, C/D Jumper, HDA Connector, J4 Optional 3-Pin Power Connector, J2 Pin 1 40-Pin Task File Interface, and J6 Standard 4-Pin Power Connector.

The C/D jumper is used to determine whether the drive is a master (drive C) or a slave (drive D). The drive is configured as a master, when jumpered, and a slave when not jumpered. The ATA/ISA jumper is used when daisy-chaining two drives. This jumper may have to be removed when this drive is used together with older (Pre-ATA) drives.

- (b) What is the average time required for my disk to read a 512-byte sector if the disk has a transfer rate of 0.5 Mbytes/s and a controller overhead of 4 ms? You may assume that the disk is initially idle so that there is no waiting time. [3 marks]
- (c) The specification refers to daisy-chaining of drives. Explain what problem daisy-chaining solves. Draw a diagram demonstrating daisy-chaining three drives, show and label the control lines to the drives and between the drives. [3 marks]

Question 5.

The figure below shows an asynchronous, handshaking protocol used by an I/O



controller device to read a word from memory.

For each of the eight steps describe:

- Which of the two parties (the I/O device or the memory) is active, i.e. which party is changing its outputs.
- Which inputs the active party is responding to (if any).
- What operations the active party performs internally (if any).
- What changes the active party makes to its outputs. [4 marks]

Question 6.

- Define the term *exception*. [2 marks]
- List four different *causes* of exceptions. [2 marks]
- Describe in general terms the MIPS mechanism for dealing with exceptions. [3 marks]

Question 7.

You have been given 18 32K x 8-bit SRAMs to build an instruction cache for a processor with a 32-bit address. What is the largest size (i.e. the largest size of the data storage area in bytes) direct-mapped instruction cache that you can build with four-word blocks? Draw your cache design, showing the valid bits, the tags, the blocks, the tag comparison logic, and the breakdown of the address into its cache access components. [5 marks]
