Score:_____   Name:_____
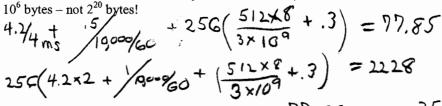
ECE 3055 Quiz 9 - March 31, 2010

1. What is the average, maximum, and minimum time to read a 128KB block of file data on a new Western Digital VelociRaptor disk drive that has an average seek time of 4.2 ms. The drive rotates at 10,000 RPM, has a SATA 3.0 transfer rate of 3Gb/s per second, and 512 byte sectors (i.e. Lower case "b" is bits). Assume the disk is idle and there is a .3 ms controller overhead per sector. Adjust average seek time **with** the book's ¼ suggested correction factor for measured or observed seek time for the average time. Assume the quoted average seek time is ½ the maximum seek time. Do not consider the internal disk controller's cache in your calculations. (*Note*: In I/O device transfer rates, MB is always 10^6 bytes – not 2^{20} bytes!

$$4.2/4 \, ms + \frac{.5}{10,000/60} + 256\left(\frac{512 \times 8}{3 \times 10^9} + .3\right) = 77.85$$

$$256\left(4.2 \times 2 + \frac{1}{10,000/60} + \left(\frac{512 \times 8}{3 \times 10^9} + .3\right)\right) = 2228$$

$$256\left(\frac{512 \times 8}{3 \times 10^9} + .3\right) = 76.8$$

Part 1: (Measured or Observed) Average time = __77.85__ **ms**

Part 1: (worst case) Maximum time = __2228__ **ms**

Part 1: (best case) Minimum time = __76.8__ **ms**

2. The original IBM PC XT from the mid 1980s used an ISA bus. The ISA bus ran using a 4.7 MHz bus clock and required 6 bus clock cycles to transfer a single data byte while performing memory writes. Compute the maximum I/O bandwidth of the bus for writes in megabytes per second. This bus became too slow as processors and memory became faster (with more smaller faster transistors, pipelining, and cache) and it was eventually replaced by the faster PCI bus.

$$\frac{4.7 \times 10^6}{6}$$

Maximum I/O bandwidth for PC-XT ISA bus = __.783__ **(in megabytes per second)**

3. An application is being ported to a multicore computer system with 12 processor cores. Assuming 85% of the sequential execution time is numerical computations that can be evenly divided among 12 processors and the remaining 15% is I/O that must be performed sequentially on one processor, what is the maximum speedup that could be obtained on the computer using all 12 cores? To obtain this speedup on the PC, the application must be rewritten to use 12 threads and the OS can assign and run one thread per core.

$$\frac{1}{\left(\frac{.85}{12} + .15\right)}$$

Maximum Speedup = __4.53__

4. Which I/O hardware transfer technique typically makes the most sense for a disk drive? *Explain fully*

DMA – DMA works in parallel with the CPU and is Faster Devices like disks that transfer blocks of data work best with DMA. See page 592