(1) [2] Which has been increasing faster, relative latency or bandwidth?

(2) (2) Is MOS technology current-based or charge-based?

(3) [2] What are the two main ways to define performance?

(4) [2] As technological advances allow us to make both transistors and wires smaller and smaller, what happens to the power density?

(5) [3] If a data item is word aligned (where a word is 32 bits), what does that mean? (What can be said about the address of the beginning of the data item?)

(6) [3] When we talk about the number of operands in an instruction (a 1-operand or a 2-operand, for example), what do we mean?

(7) [3] Which is a better metric for comparing processors, energy or power? Why?

(8) [3] Salesmen will often quote the peak performance of their machine. What is peak performance, and what other kind of performance should you want to know?

(9) [3] What is the "threshold voltage"?

(10) [3] Is it possible to design a flawless architecture? Explain your answer.

(11) [3] Why do most current chips feature multiple cores on the same die?

(12) [3] What is a benchmark program?

(13) [4] Is it true that as technology changes and chips use more and more transistors, benchmarks must change to adapt? Explain your answer.

(14) [4] What are the two primary goals of a compiler (in order)?

(15) [4] Over a stretch of 20 years, clock rates grew by a factor of 1000 while power consumed only grew by a factor of 30. How was this accomplished? Why is this technique no longer effective?

(16) [4] Why are there multiple dies per silicon wafer? Why not just fabricate one huge die per wafer?

(17) [5] It is difficult for the internal processing elements on a CMOS chip to cross the chip boundary and communicate with things that are on other chips. Explain why that is.

(18) [5] There are two different types of power consumption, static and dynamic. Which one contributed the most to overall power consumption 20 years ago? What is the situation now, and why has it changed?

(19) [6] Machines today use registers - often as many as they can. Give 2 advantages and 2 disadvantages to using registers.

(20) [6] A standard compiler optimization step is to do register allocation. However, there are times when register allocation is difficult to do while maintaining program correctness - explain why.

(21) [4] Processor A requires 400 instructions to execute a given program, uses 2 cycles per instruction, and has a cycle time of 3 ns. Processor B uses 6 cycles per instruction, and has a cycle time of 4 ns. How many instructions will Processor B need to execute in order to give the same CPU time as Processor A? (Show your work)

(22) [6] An important program spends 70% of its time doing Integer operations, and 30% of its time doing floating point arithmetic. By redesigning the hardware you can either make the Floating Point unit 90% faster (take 10% as long), or the integer unit 40% faster (take 60% as long). Which should you do, and why?

(23) [8] You are responsible for designing a new embedded processor, and you have been told you must use a fixed 18 bit instruction size. To make this work you have decided to use a 2-operand instruction format, 32 registers, and support 256 instructions. Your boss just came in and said things have changed, and you now can only use 12 bits - how would you change your instruction format? Be sure to explain why you are making the changes (what problem are you solving?)

(24) [12] Suppose we are considering two alternatives for our conditional branch instructions, as follows:

M1 - A condition code is set by a compare instruction and followed by a branch that tests the condition

M2 - A compare is included in the branch.

On both machines, the conditional branch instruction takes 2 cycles, and all other instructions take 1 cycle. On M1, 20% of all instructions executed are conditional branches. Because M2 has the compare included in the branch, the clock cycle is 1.10 times longer than M1.

Show how you would solve this problem. Which one would you choose to do, and why? (You should be able to do the various calculations involved, even without a calculator.)