1. **(15%)** In addition to the microprocessor itself (i.e., CPU), a microprocessor-based system must contain a minimal number of components. List three components and specify their functions.

2. **(15%)** To increase the performance of the microprocessor, given a constant clock rate, describe two major approaches to decrease the <u>CPI (clock per instruction)</u> value by using the microprocessor internal, instruction-level parallelism. Note that there are three implementations in those two approaches and you must explain how these three implementations decrease the CPI value ideally to 1 or less than 1.

3. **(10%)** As we know, the <u>logic address</u> is different from the <u>physical address</u>. Describe two basic structures of the logical address and show how to use them.

4. **(10%)** By using the <u>cache memory</u> to increase the microprocessor performance, explain the write-to-memory policies: <u>buffered write-through</u> and <u>write-back</u>.

5. **(20%)** Explain the terminologies: (1) FLASH memory, (2) IEEE-1394, (3) Fault-tolerant system, (4) Memory-mapped I/O.

6. **(15%)** Suppose that we want to design a <u>32-bit memory board</u> of total capacity 1 Mbytes using <u>64Kx4-bit SRAM memory chips</u>, assigned to the highest memory area of a Motorola 680x0 microprocessor. Draw the block diagram of the memory board and explain the system (Hint: using 32-bit address bus and 32-bit data bus).

7. **(15%)** Explain the circuit schematic of a simple <u>I/O expansion board</u> shown below. Briefly describe the function of each device (ICs: 74HCT245, 74HCT688, 74HCT244, 74HCT273,…).