考生注意: 1. 依次序作答,只要標明題號,不必抄題。
2. 答案必須寫在答案卷上,否則不予計分,並限以藍黑色筆作答。
3. 試題隨卷繳回。(詳請詳閱試場規則)

The following problems may be answered in Chinese or English. You need to give all details in order to receive credit (point).

1. (**20 points**) We wish to compare the performance of two different machines: M1 and M2. The following measurements have been made on these machines:

Program	Time on M1	Time on M2
1	10 seconds	5 seconds
2	4 seconds	6 seconds

Program	Instructions executed on M1	Instructions executed on M2
1	200×10^6	160×10^6
2	100×10^6	120×10^6

   (a) (**6 points**) Which machine is faster for each program and by how much?
   (b) (**7 points**) Find the instruction execution rate (instructions per second) for each machine when running program 1 & 2.
   (c) (**7 points**) If the clock rate of machines M1 and M2 are 200 MHz and 500 MHz, respectively, find the clock cycles per instruction for program 1 & 2 on both machines using the data in Problem 3 and 4.

2. (**10 points**) Add $6.42_{ten}\times10^1$ to $9.51_{ten}\times10^2$, assuming that you have only three significant decimal digits. Round to the nearest decimal number, first with guard and round digits and then without them. Explain your work step by step.

3. (**15 points**) Assuming a 32-bit address, design
   (a) (**7 points**) a direct-mapped cache with 1024 blocks and a block size of 16 bytes (4 words).
   (b) (**8 points**) a two-way set-associative cache with 1024 blocks and a block size of 16 bytes.

4. (**5 points**) Use `add rd, rs, rt` (addition) and `addi rd, rs, imm` (addition immediate) instructions only to show the minimal sequence of MIPS instructions for the *C* statement *a* = *b**7-8; Assume that *a* corresponds to register $*s*0 and *b* corresponds to register $*s*1.

5. (**20 points**) Assume that process P_1 is running, P_2 and P_3 is ready. Now P_1 issues a read() system call. The CPU is transferred to kernel. After issuing the command to the controller, kernel has nothing to do. So it chooses the P_2 to run.
   (a) (**5 points**) What states are P_1, P_2, and P_3 now?
   While P_2 is running, clock interrupt happened. The CPU is transferred to kernel again.
   (b) (**5 points**) What states are P_1, P_2, and P_3 at this moment?
   After the handling of clock interrupt, the CPU now is transferred to P_3. While P_3 is running, an interrupt from i/o controller arrives. The kernel takes control and finds that the data for the read() of P_1 is ready. The kernel does something and the read() of P_1 is completed.
   (c) (**5 points**) What states are P_1, P_2, and P_3 at this moment?
   (d) (**5 points**) After the handling of i/o interrupt, can the CPU be transferred to P_1?
6. (**10 points**) Why does not the LRU algorithm exhibit Belady's anomaly?
7. (**20 points**) The disk space of a file can be allocated in linked list.
   (a) (**10 points**) What are the two problems with the linked list? (space/time)
   (b) (**10 points**) The FAT file system is actually implemented with linked list but with some efforts to alleviate these problems.
   Describe the approach of FAT.