EGC442 Problem Set 3 Dr. Izadi

First Name:_____ Last Name: _____

1. A particular processor has a clock rate of 1 GHz. The clock thus ticks one billion times per second.

- True
- False

2. A clock rate of 1 GHz corresponds to a period of 1 nanosecond, which is $1x10^9$ seconds.

- True
- False

3. Computer C's performance is 4 times as fast as the performance of computer B, which runs a given application in 28 seconds. How long will computer C take to run that application?

4. Our favorite program runs in 10 seconds on computer A, which has a 2 GHz clock. We are trying to help a computer designer build a computer, B, which will run this program in 6 seconds. The designer has determined that a substantial increase in the clock rate is possible, but this increase will affect the rest of the CPU design, causing computer B to require 1.2 times as many clock cycles as computer A for this program.

   a. What is the CPU clock cycles for computer A?
      - $2\times10^9 \frac{\text{cycles}}{\text{sec}}$
      - 20 x 10^9 cycles
      - 10 sec

   b. Computer B's performance is improved by reducing the _____.
      - number of clock cycles required to execute the program
      - length of a clock cycle

5. Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 250 ps and a CPI of 2.0 for some program, and computer B has a clock cycle time of 500 ps and a CPI of 1.2 for the same program.

a. How does one know that each computer executes the same number of instructions for the program?

- All computers use the same number of instructions for a given program.
- Both computers use the same instruction set architecture.
- Both computers use the same implementation.

b. Which computer has a faster clock?

- Computer A
- Computer B

c. Which computer requires fewer clock cycles to execute a single instruction?

- Computer A
- Computer B

d. If Computer A executes 1000 instructions for the program, what is the program's CPU time on Computer A?

- 1000 instr * 2.0 cycle/instr * 250 ps/cycle = 500,000 ps.
- 1000 instr * 1.2 cycle/instr * 500 ps/cycle = 600,000 ps.

e. If Computer A executes 1000 instructions for the program, how many instructions does Computer B execute for the program?

- 1000
- 1000 * 1.2 = 1200
- 1000 * 2.0 = 2000

f. For a particular program, Computers A and B execute 2000 instructions. A's CPU time is 2000 * 2.0 * 250 = 1,000,000 ps. B's is 2000 * 1.2 * 500 = 1,200,000 ps. How much faster is Computer A than B?

- 1.2
- 200,000

g. Computer A is better than Computer B.

- Yes
- Unclear

6. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts:

	CPI for each instruction class		
	A	B	C
CPI	1	2	3

For a particular high-level language statement, the compiler writer is considering two code sequences that require the following instruction counts:

Code sequence	Instruction counts for each instruction class		
	A	B	C
1	2	1	2
2	4	1	1

a. Instruction class ____ requires the largest number of cycles per instruction.

b. Code sequence 2 executes _____ instructions.

c. Code sequence 2 requires _____ CPU clock cycles.

d. Assume a new code sequence 3 contains the following instruction counts for each instruction class. What is code sequence 3's CPU clock cycles?

Code sequence	Instruction counts for each instruction class		
	A	B	C
3	10	4	6

e. Assume a new code sequence 3 contains the following instruction counts for each instruction class. What is code sequence 3's CPI?

7. Assume CPI and clock cycle time remain constant. Reducing the instruction count will reduce the program's execution time.
   - True
   - False

8. For a given number of instructions, assume CPI is increased by 20%, and clock cycle time is decreased by 10%. The program execution time decreases.
   - True
   - False