CS 330 - Homework 1-A

1. Consider three different processors that implement the same instruction set architecture. Call the implementations P_1, P_2, and P_3:

Processor	**Clock Rate**	**CPI**
P_1	3 GHz	1.5
P_2	2.5 GHz	1.0
P_3	4.0 GHz	2.2

   (a) Calculate the clock tick time for each processor. Give your answer in picoseconds, rounded to the closest picosecond.

   (b) Which processor has the highest performance, if we are interested only in clock cycles per second?

   (c) Suppose each processor executes a program for 10 seconds. Calculate the number of clock cycles used. Give your answer rounded to the closest whole number.

   (d) Calculate the average number of instructions executed per second for each processor. Which processor has the highest performance, if we are interested only in the average number of instructions executed per second?

   (e) If the processors each execute a particular program in 10 seconds, find the number of instructions used by each processor.

2. Consider two different implementations of an instruction set architecture: P_1 and P_2. The instructions in this ISA can be divided into four different categories: A, B, C, and D. The following table gives the clock rate of each processor, along with the CPIs of the instructions from each class.

	P_1	P_2
Clock Rate	2.5 GHz	3 GHz
CPI for class A instructions	1	2
CPI for class B instructions	2	2
CPI for class C instructions	3	2
CPI for class D instructions	4	2

   When we use the llvm compiler to compile the source code for a particular program, the compiler uses $2.5 \cdot 10^8$ instructions, drawn from the four classes as follows: 10% from A, 20% from B, 50% from C, and 20% from D.

   (a) Calculate the average CPI used during the compilation for both processors?

   (b) How many clock cycles does the compilation take on each processor?

(c) How much time does the compilation take on each processor?

(d) Which processor is faster on this task?

(e) Calculate the performance of each processor in terms of compilations per second.

(f) Use your answer from 2e to determine which processor has the better performance, and then calculate how much faster that processor is than the slower processor.