**Problem 1.**

Consider three different processors P1, P2, and P3, executing the same instruction set:

* 1) P1 has a 4.0 GHz clock rate and a CPI of 2.2,
* 2) P2 has a 3.0 GHz clock rate and a CPI of 1.5, and
* 3) P3 has a 2.5 GHz clock rate and has a CPI of 1.0.

1. Which processor has the highest performance expressed in instructions per second?

Processor 3

1. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions.

P1: # of cycles = 4\*10^10; # of instructions = 1.818\*10^10

P2: # of cycles = 3\*10^10; # of instructions = 2\*10^10

P3: # of cycles = 2.5\*10^10; # of instructions = 2.5\*10^10

**c)** We are trying to reduce the execution time by 30% but this leads to an increase of 20% in the CPI. What clock rate should we have to get this time reduction?

 P1: Clock Rate = 6.8 GHz

P2: Clock Rate = 5.1GHz

P3: Clock Rate = 4.2 GHz

**Problem 2.**

Compilers can have a profound impact on the performance of an application. Assume that for a program:

* 1) Compiler A results in a dynamic instruction count of 1.2E9 and has an execution time of 1.5 seconds,
* 2) Compiler B results in a dynamic instruction count of 1.0E9 and an execution time of 1.1 seconds.

1. Find the average CPI for each program given that the processor has a clock cycle time of 1 ns.

A: CPI = 1.1

B: CPI = 1.25

1. Assume the compiled programs run on two different processors. If the execution times on the two processors are the same, how much faster is the clock of the processor running compiler A's code versus the clock of the processor running compiler B's code?

A: 73.3% Faster

**c)** A new compiler is developed that uses only 6.0E8 instructions and has an average CPI of 1.1. What is the speedup of using this new compiler versus using compiler A or B on the original processor?

A:54.5% over A and 32% over B