Solutions for Performance slides

18) Our favorite program runs in 10 seconds on computer A, which has a 400 Mhz. clock. We are trying to help a computer designer build a new machine B, that will run this program in 6 seconds. The designer can use new (or perhaps more expensive) technology to substantially increase the clock rate, but has informed us that this increase will affect the rest of the CPU design, causing machine B to require 1.2 times as many clock cycles as machine A for the same program. What clock rate should we tell the designer to target?"

Assume the program takes X cycles and the desired rate is Y

(X/ 400/10^6) / (1.2X/ Y) = 10/6 therefore
Y = 800 Mhz

21) Machine A has a clock cycle time of 10 ns. and a CPI of 2.0
Machine B has a clock cycle time of 20 ns. and a CPI of 1.2

What machine is faster for this program, and by how much?

X*2*10 / x*1.2*20 = 20/24 machine A is faster

22) A compiler designer is trying to decide between two code sequences for a particular machine. Based on the hardware implementation, there are three different classes of instructions: Class A, Class B, and Class C, and they require one, two, and three cycles (respectively).

The first code sequence has 5 instructions: 2 of A, 1 of B, and 2 of C
The second sequence has 6 instructions: 4 of A, 1 of B, and 1 of C.

Which sequence will be faster? How much?
What is the CPI for each sequence?

A: 2*1+1*2+2*3 = 10 cpi(A) = 10/5 = 2
B: 4*1+1*2+1*3 = 9 cpi(B) = 9/6 = 1.5

23) Two different compilers are being tested for a 100 MHz. machine with three different classes of instructions: Class A, Class B, and Class C, which require one, two, and three cycles (respectively). Both compilers are used to produce code for a large piece of software.

The first compiler's code uses 5 million Class A instructions, 1 million Class B instructions, and 1 million Class C instructions.

The second compiler's code uses 10 million Class A instructions, 1 million Class B instructions, and 1 million Class C instructions.

Which sequence will be faster according to MIPS?
Which sequence will be faster according to execution time?

A: EXEC = (5+2+3)/100 = 10/100sec MIPS = 700/10 = 70
B: EXEC = (10+2+3)/100 = 15/100sec MIPS = 1200/15 = 80

28)
"Suppose a program runs in 100 seconds on a machine, with multiply responsible for 80 seconds of this time. How much do we have to improve the speed of multiplication if we want the program to run 4 times faster?"

How about making it 5 times faster?

Need to run for 100/4 = 25sec
Therefore 5*x = 80 x=16. Need a speedup of 16

Cannot run 5 times faster!

29) Suppose we enhance a machine making all floating-point instructions run five times faster. If the execution time of some benchmark before the floating-point enhancement is 10 seconds, what ?will the speedup be if half of the 10 seconds is spent executing floating-point instructions

We are looking for a benchmark to show off the new floating-point unit described above, and want the overall benchmark to show a speedup of 3. One benchmark we are considering runs for 100 seconds with the old floating-point hardware. How much of the execution time would floating-point instructions have to account for in this program in order to yield our desired speedup on this benchmark?

$100-x + x/5 = 100/3$ therefore $x \sim 83.3\%$