CPE 631 Advanced Computer Systems Architecture: Homework #1

Question #1 (15 points).
Your team has been considering two different architectural improvements A1 and A2 (both have roughly the same complexity). Your collaborator responsible for evaluation handed you the following table showing speedups relative to the base system for each improvement for a set of 5 benchmarks (B1-B5). Your task is to make decision which one A1 or A2 should be pursued further. Can you make a decision, and if yes, what is your choice? Show your analytical work.

Speedup	B1	B2	B3	B4	B5
A1	1.5	4	3	2	5
A2	3	1.5	4	4	3

Question #2 (10 points).
Four enhancements E1, E2, E3 and E4 with the following speedups are proposed for a new architecture:
Speedup1 = 10; Speedup2 = 20; Speedup3 = 5; Speedup4 = 50, respectively.
The enhancements are non-overlapping and orthogonal to each other. We are considering two approaches in maximizing performance (A1 and A2) where A2 requires slightly more complex hardware support.
A1: Enhancements E1 and E2 are in use; the distribution of enhancement usage is 30% (E1) and 40% (E2).
A2: Enhancements E3 and E4 are in use; the distribution of enhancement usage is 20% (E3) and 50% (E4).
Which of these 2 approaches (A1 or A2) is better?

Question #3 (10 points).
Consider a computer platform that should be enhanced. We make an enhancement that improves some mode of execution by a factor of 14. We know that the enhanced mode is used 50% of the time, measured as a percentage of the execution when the enhanced mode is used.
4.A (5 points) What percentage of the original execution time has been converted to the fast mode?
4.B (5 points) What is total speedup we have obtained from the fast mode?

Question #4 (15 points)
Consider two different implementations, M1 and M2, of the same instruction set. M1 has a clock rate of 400MHz, and M2 has a clock rate of 200MHz. The average number of clock cycles for each instruction class on M1 and M2 is given in the following table:

Instruction class	CPI (M1)	CPI (M2)	C1 usage	C2 usage	C3 usage
A	4	2	30%	30%	50%
B	6	4	50%	20%	30%
C	8	3	20%	50%	20%

The table also contains a summary of three different compilers using the instruction set.
C1 is a compiler produced by the makers of M1, C2 is a compiler produced by the makers of M2, and the other compiler C3 is a third-party product. Assume that each compiler uses the same number of instructions for a given program but that the instruction mix is as described in the table.
Answer the following questions:
4.A (3 points) Using C1 on both M1 and M2, how much faster can the makers of M1 claim that M1 is compared to M2?
4.B (3 points) Using C2 on both M2 and M1, how much faster can the makers of M2 claim that M2 is compared to M1?
4.C (3 points) If you purchase M1, which compiler would you use?
4.D (3 points) If you purchase M2, which compiler would you use?
4.E (3 points) Which machine would you purchase given the choice of compiler, if we assume that all other criteria are identical, including costs?