Question 2 (15 points):

In an important application 20% of the instructions are branches. When this application is running on a pipelined processor, 30% of the total cycles executed are wasted as stall cycles because of branch miss predictions. Currently this applications takes 10 minutes to execute on a processor running with a clock frequency of 4 GHz.

a. (**5 points**) How many cycles are wasted because of the stalls caused by branch miss predictions when this application executes?

b. (**5 points**) The compiler team got a better understanding of the pipelined architecture and of the branch prediction mechanism implemented by the hardware. They were able to eliminate 2/3 of the stalls due to the branch miss prediction. What percentage of the execution time is now wasted in stall cycles because of miss predictions?

c. (**5 points**) What is the speedup that results from this improvement to the code?