1.)

a.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
lw r2, 0(r1)	IF	ID	EXE	MEM	WB									
label 11: beq r2, r0, label 12		IF	ID	X	EXE	MEM	WB							
lw r3, 0(r2)					IF	ID	EXE	MEM	WB					
beq r3, r0 , label 11						IF	ID	X	EXE	MEM	WB			
label 11: beq r2, r0, label 12							IF	ID	X	EXE	MEM	WB		
sw r1, 0(r2)										IF	ID	EXE	MEM	WB

b.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
lw r2, 0(r1)	IF	ID	EXE	MEM	WB									
label 11: beq r2, r0, label 12		IF	ID	X	EXE	MEM	WB							
lw r3, 0(r2)			IF	X	ID	EXE	MEM	WB						
beq r3, r0 , label 11						IF	ID	EXE	MEM	WB				
add r1, r3, r1							IF	ID	EXE	MEM	WB			
label 11: beq r2, r0, label 12								IF	ID	EXE	MEM	WB		
lw r3, 0(r2)									IF	ID	EXE	MEM	WB	

sw r1, 0(r2)										IF	ID	EXE	MEM	WB

c.)

lw r2, 0(r1)
label 11: bez r2, label 12
lw r3, 0(r2)
bez r3, label 11
add r1, r3, r1
label 11: bez r2, label 12
sw r1, 0(r2)

d.)

If there is a load before the branch section
If there is a load before another instruction
If there is an instruction that is dependent on the branched register

2.)

a.)

In order to find the extra amount of CPI the equation will be:
Extra CPI = # stall cycles due to miss-predicted branches * (1 - Always-Taken Predictor) * BEQ
Extra CPI = 3 * 0.55 * 0.25 = 0.4125

b.)

In order to find the extra amount of CPI the equation will be:
Extra CPI = # stall cycles due to miss-predicted branches * (1 - Always-Not-Taken Predictor) * BEQ
Extra CPI = 3 * 0.45 * 0.25 = 0.3375

c.)

In order to find the extra amount of CPI the equation will be:
Extra CPI = # stall cycles due to miss-predicted branches * (1 - 2-bit predictor) * BEQ
Extra CPI = 3 * 0.15 * 0.25 = 0.1125

d.)

In order to find the speed up from conversion we need to use the equation:
Speed up from conversion = $\frac{CPI\ without\ conversion}{CPI\ with\ conversion}$
In order to find the CPI we need to use the equation:
CPI without conversion = Base CPI + # stall cycles due to miss-predicted branches * (1 - 2-bit predictor) * BEQ

CPI without conversion = 1 + 3 * (0.15) * 0.25 = 1.1125
CPI with conversion = Base CPI + # stall cycles due to miss-predicted branches * (1 - 2-bit predictor) * BEQ * 1/2
CPI with conversion = 1 + 3 * (0.15) * 0.25 * 0.5 = 1.05625
Speed up from conversion = $\frac{1.1125}{1.05625}$ = 1.05325

e.)

In order to find the speed up from conversion we need to use the equation:
Speed up from conversion = $\frac{CPI\ without\ conversion}{CPI\ with\ conversion}$
In order to find the CPI we need to use the equation:
CPI without conversion = Base CPI + # stall cycles due to miss-predicted branches * (1 - 2-bit predictor) * BEQ
CPI without conversion = 1 + 3 * (0.15) * 0.25 = 1.1125
2ALU instructions = Base CPI + ((Base CPI + # stall cycles due to miss-predicted branches * (1 - 2-bit predictor)) * BEQ * ½)
CPI with conversion = 1 + ((1 + 3 * (0.15)) * 0.25 * 0.5) = 1.18125
Speed up from conversion = $\frac{1.1125}{1.18125}$ = 0.9418