

### Quiz 3 Solution

#### CSE 112 Computer Organization

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**Q1:**

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1  mov r1 r2
2  mov r3 r2
3  mov r4 r3
4  breq r3 r4 label
5  mov r10 r1
6  add r14 r15 r6
7  sub r11 r5 r1
8  label: add r1 r4 r5
9  add r2 r1 r1

```

Instructions	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
mov r1 r2	F	D	X	M	W													
mov r3 r2		F	D	X	M	W												
mov r4 r3			F	D	D	D	X	M	W									
breq r3 r4 label				F	F	F	D	D	D	X	M	W						
mov r10 r1							F	F	F	D	nop	nop	nop					
add r14 r15 r6										F	nop	nop	nop	nop				
label: add r1 r4 r5											F	D	X	M	W			
add r2 r1 r1												F	D	D	D	X	M	W

**[8 marks, one for each correct instruction. In case a student's answer is partially correct, give marks in proportion to how many instructions are correct.]**

**[2 marks to show branch taken. No partial marking for this case.]**

RAW Dependencies:

1. On r1 between 1 and 5
2. On r1 between 1 and 7
3. On r1 between 1 and 9
4. On r3 between 2 and 3
5. On r3 between 2 and 4
6. On r4 between 3 and 4
7. On r4 between 3 and 8
8. On r1 between 8 and 9

WAR Dependencies:

1. On r2 between 9 and 2
2. On r2 between 9 and 1
3. On r1 between 8 and 7
4. On r1 between 8 and 5

WAW Dependencies:

1. On r1 between 8 and 1

**[13 marks, +1 for each correct dependency.**

0.25 for correct classification (WAR, RAW or WAW) + 0.25 for correct register + 0.5 for correct instruction number (both instruction number should be correct, else deduct 0.5 marks)= 1 mark per dependency. ]

[-0.5 for every incorrect dependency. The lowest marks possible for this part is 0. Don't give less than 0 for dependencies].

Cycles required to execute the program = 18

**Marking cases:**

Pipeline Diagram	Cycle Number	Marks
Correct	Correct	2
Incorrect	In accordance with the pipeline diagram	1 (Partial marks for counting)

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