

1. a: 1
b: 0
c: x
d: 0
e: 0
f: 0
g: 0
h: 1

2. f.

3. b.

4. $400 + 180 + 150 + 320 + 180 + 80 = 1310 \text{ ps}$

$$\frac{1}{1310 \times 10^{-12}} = 7.63 \times 10^8 \text{ Hz}$$

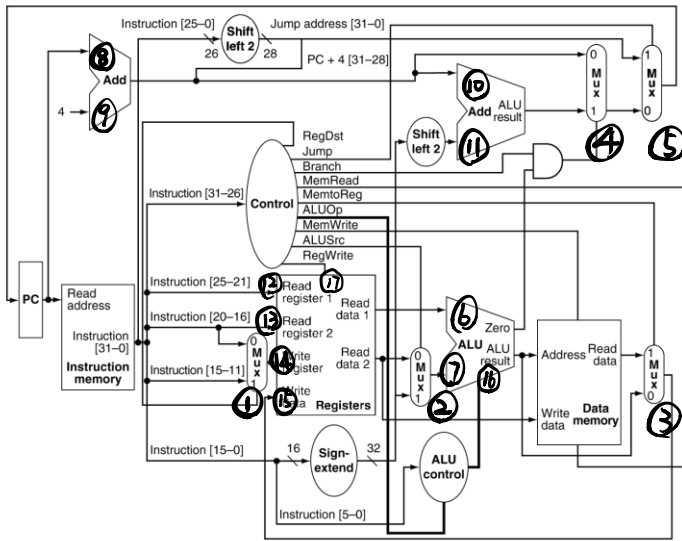
5. Let the value in \$a2, \$s6, \$s2 be 0, the value in \$s1 be 1. Then,

\downarrow \downarrow
 00110 10110

add \$s6, \$s2, \$s1

We check that if the value in \$a2 becomes 1, then there is a stuck-at-0 fault on bit 16 of output of the Instruction memory.

b. SW \$2, 20(\$3)



For ALU: Input ⑥: 4.

Input ⑦:

(00000000000010100)₂

Input ⑪: (0010)₂

For adder: Input ⑧: PC

Input ⑨: 4

Input ⑩: PC + 4

Input ⑫: 80

For MUX ① output: X

For MUX ② output: (00000000000010100)₂

For MUX ③ output: X

For MUX ④ output: PC + 4

For MUX ⑤ output: PC + 4

For 'Register': Input ⑬: (00011)₂

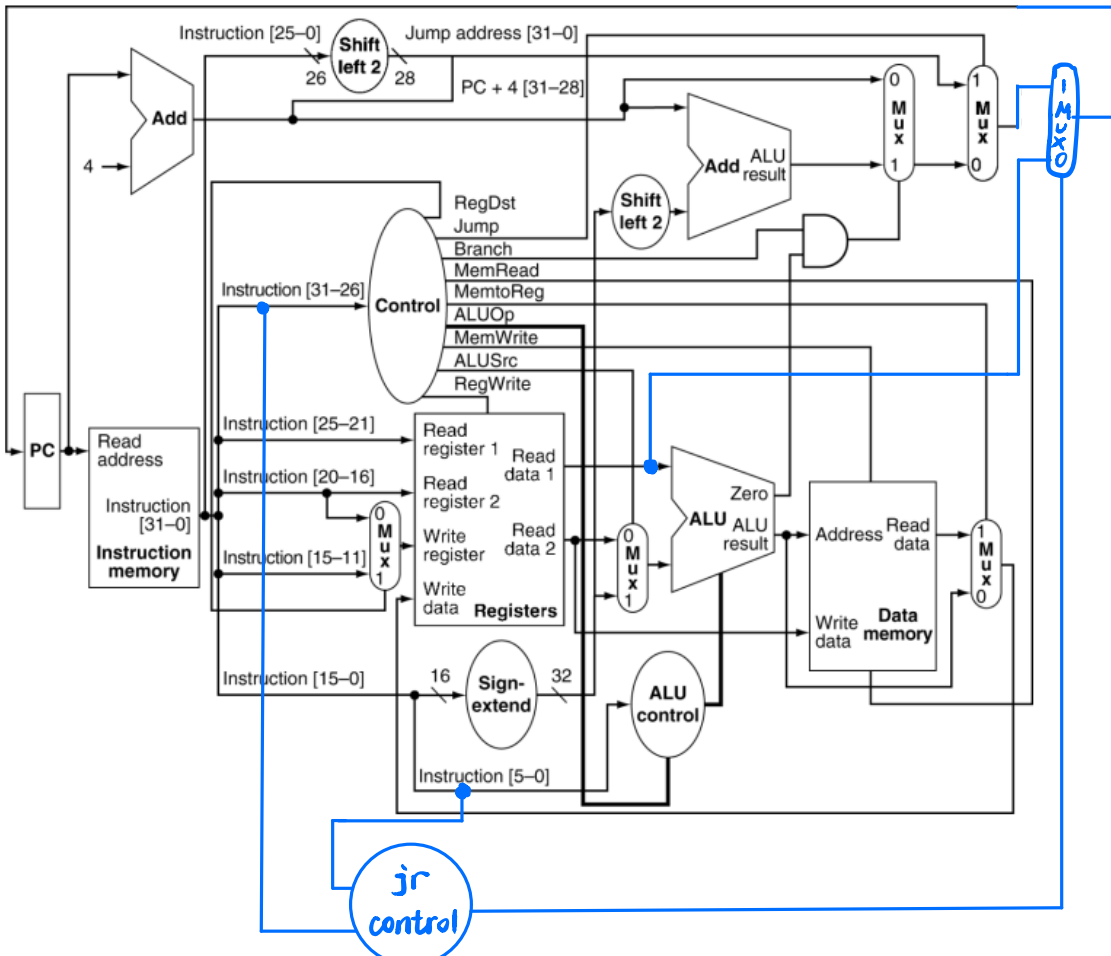
Input ⑭: (00010)₂

Input ⑮: X

Input ⑯: X

Input ⑰: 0

7.



8. (1). $100 + 120 + 300 + 30 + 100 = 650$ ps

(2). ALUOp

$$100 - 50 = 50 \text{ ps}$$

9. (1). 360 ps

(2). $360 \times 5 = 1800$ ps

(3). $(2000 + 4) \times 360 = 721440$ ps

$$CPI = \frac{2000 + 4}{2000} = 1.002$$