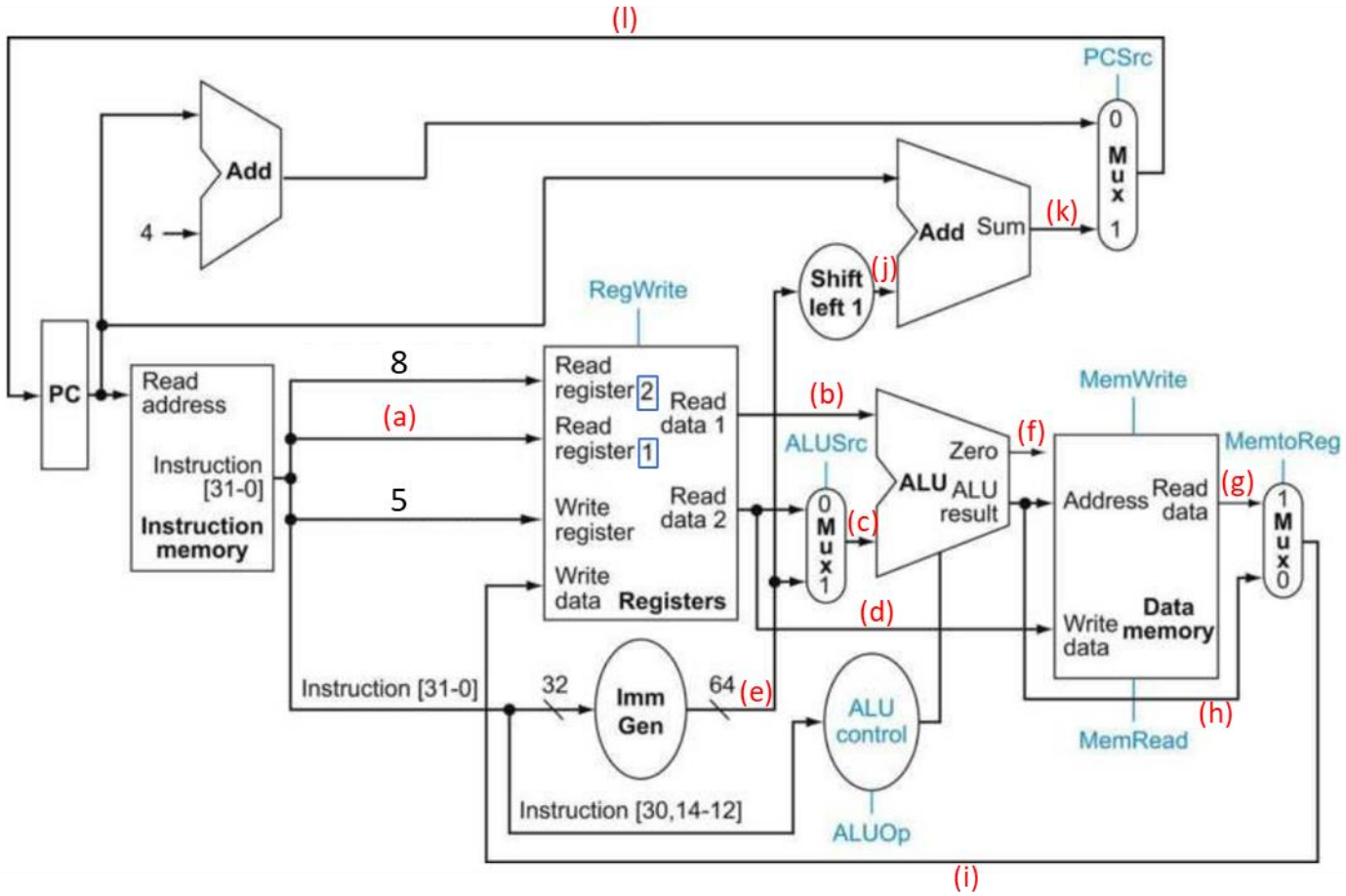
Question

Alex is a hard-working student. He wants to perform the following $addi$ instruction in a single-cycle machine:

$addi\ x5, x8, 16$

In order to achieve his goal, he designed a single-cycle machine by himself, **which is slightly different from the one on textbook**. The single-cycle datapath diagram below shows the execution of this machine:
(The framed numbers [1] and [2] are the only two differences.)



Please answer the following questions:

(1) Please set the control signals in the following table so that $addi$ can be executed properly.
Use "x" for don't care if necessary. (i.e., you should write "x" instead of "0" or "1" for don't care terms.)

RegWrite	ALUSrc	PCSrc	MemWrite	MemRead	MemtoReg

(2) Some values are already stated in the diagram. Please find the missing values for the 12 remaining signals (from (a) to (l)).
- Assume register x8 and program counter initially contain the value of 145 and 32 respectively.

- Please show the answer in decimal format.
- Please answer the “value”, not the “component”(ex: register) which stores the value.
  For example, if the register x8 stores the value 145, then you should answer “145” instead of “x8”.
- If a value cannot be determined, please mark it as “X”.

(a)	(b)	(c)	(d)	(e)	(f)
(g)	(h)	(i)	(j)	(k)	(l)

(3) How many kinds of instructions below can be executed correctly with this single-cycle machine?

add	*sub*	*ori*	*ld*	*sd*	*beq*

Answer

(1)

RegWrite	ALUSrc	PCSrc	MemWrite	MemRead	MemtoReg
1	1	0	0	x	0

Note that we still set ALUSrc to 1 because of the normal addi regulation.

(2)

(a)	(b)	(c)	(d)	(e)	(f)
16	X	16	145	16	X
(g)	(h)	(i)	(j)	(k)	(l)
X	X	X	32	64	36

Explanation:

(a) stores the last 5 digits of the immediate term.

(b) Reads the value of register x16, which is unknown.

(3) 2 (add, beq)