

Task 1

①

Program to Swap 2 Numbers

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	3A		LDA	2500	Load value at memory address
0001	00				2500 in register A
0002	25				
0003	47		MOV	B,A	Copy value at A to register B
0004	3A		LDA	2501	Load value at memory address
0005	01				2501 in register A
0006	25				
0007	32		STA	2500	Store value at A in memory address 2500
0008	00				
0009	25				
000A	78		MOV	A,B	Copy value at A to B
000B	32		STA	2501	Store value at A in 2501 memory address
000C	01				
000D	25				
000E	76		HLT		Stops Execution.

Observation:Input

Memory Address	Value
2500	56
2501	44

Output

Memory Address	Value
2500	44
2501	56

② Program to count no. of ones in binary representation of a given number

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	3E		MVI	A, 5F	Move Immediate Data i.e., given number 95 to A
0001	5F				
0002	47		MOV	B, A	Copy value at register A to B
0003	0E		MVI	C, 08	Move immediate data 08 to C
0004	08				C is remaining no. of bits to be read
0005	16		MVI	D, 00	Move 00 to D. D stores count of ones
0006	00				
0007	0F	LOC	RRC		Rotate bits to the right
0008	D2		JNC	LOC2	If carry flag is one, increment D, otherwise skip to LOC2
0009	0C				
000A	00				
000B	14		INR	D	increment D
000C	0D	LOC2	DCR	C	decrement C
000D	C2		JNZ	LOC	jump to LOC if zero there is no zero flag
000E	07				
000F	00				
0010	7A		MOV	A, D	Copy value in D to A
0011	32		STA	2050	Store value in A at memory address 2050.
0012	50				
0013	20				
0014	76		HLT		Stop Execution.

Test Case	<u>Input</u>		<u>Output</u>	
	Given Number		No. of Ones	
1	95		06	
2	01		01	
3	FF		08	
	Memory Address: Register A		Memory Address: 2050	

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③: Program to count number of even numbers in given 10 numbers.

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	21		LXI	H, 2050	Initialize HL pair with address that is just before address of first number i.e., 2051
0001	50				
0002	20				
0003	0E		MVI	C, 00	Register C stores count,
0004	00				Move immediate 00 to C
0005	16		MVI	D, 0A	Move immediate 0A to D,
0006	0A				Register D stores remaining no. of numbers
0007	23	LOOP	INX	H	Increment HL pair
0008	7E		MOV	A, M	Copy value at M to A
0009	E6		ANI	01	AND 01 with A and store result in A
000A	01				
000B	C2		JNZ	LOOP2	If zero flag is not zero, i.e., number is odd, go to LOOP2
000C	0F				
000D	00				
000E	0C		INR	C	If number is even, increment C
000F	15	LOOP2	DCR	D	Decrement D
0010	C2		JNZ	LOOP	If zero flag is ^{not} zero, go to LOOP
0011	07				
0012	00				
0013	79		MOV	A, C	Move value in C to A
0014	32		STA	3050	Store value in A at memory address 3050
0015	50				
0016	30				
0017	76		HLT		Stop Execution.

Input:

Memory Address	2051	2052	2053	2054	2055	2056	2057	2058
Value	13	14	15	16	17	16	15	14
Memory Address	2059 205A							
Value	13 01							

Output:

Memory Address	3050
Value	64

(4): Program to calculate sum of first N natural numbers

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	21		LXI	H,2050	Initialize HL HL pair with address of N i.e., 2050
0001	50				
0002	20				
0003	3E		MVI	A,00	A stores $N \times (N+1)$. Move immediate 00 to A
0004	00				
0005	4E		MOV	C,M	C counts no. of times N has to be added to A
0006	0C		INR	C	C was having N. Increment to N+1
0007	86	LOOP1	ADD	M	Add M to A
0008	0D		DCR	C	Decrement C
0009	C2		JNZ	LOOP1	Jump to LOOP1 if zero flag is not zero
000A	07				
000B	00				
000C	06		MVI	B,02	Move immediate 02 to B
000D	02				
000E	0E		MVI	C,00	C stores value of $N \times (N+1)/2$ by subtracting 2 repeatedly from A
000F	00				
0010	0C	LOOP2	INR	C	Increment C
0011	90		SUB	B	Subtract B i.e., 2 from A
0012	C2		JNZ	LOOP2	Jump to LOOP2 if zero flag is not zero
0013	10				
0014	00				
0015	79		MOV	A,C	Copy value in C to A
0016	32		STA	2051	Store value of A at memory address 2051
0017	51				
0018	20				
0009	76		HLT		Stop Execution.

TestCase	Input, N at 2050		Output, Sum at 2051
	1	2	
1	04	-	0A
2	05	-	0F
3	08	-	24
4	0A	-	37

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⑤: Program to find ASCII representation of a given BCD number.

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	21		LXI	H,2000	Load HL pair with address of the input number/given BCD number.
0001	00				
0002	20				
0003	7E		MOV	A,M	Move value in M to A
0004	46		MOV	B,M	Move value in M to B
0005	E6		ANI	OF	Bitwise AND OF and A, store result in A (Least Significant Byte)
0006	0F				
0007	C6		ADI	30	Add 30 to A. Store in A
0008	30				ASCII is obtained by adding 30
0009	32		STA	3000	Store value in A at memory address 3000
000A	00				
000B	30				
000C	78		MOV	A,B	Move value in B to A
000D	E6		ANI	F0	Bitwise AND F0 and A, store result in A (most significant byte)
000E	F0				
000F	07		RLC		Rotate Accumulator Left
0010	07		RLC		Rotate Accumulator Left
0011	07		RLC		Rotate Accumulator Left
0012	07		RLC		Rotate Accumulator Left
0013	C6		ADI	30	Add 30 to A. Store in A.
0014	30				
0015	32		STA	3001	Store value in A at memory address 3001
0016	01				
0017	30				
0018	76		HLT		Stop Execution.

Test Case	Input (Value at 2000H) address	Output (MSB at 3001 H) address	Output (MSB at 3000H) address
1	23	32	33
2	51	35	31
3	99	39	39
4	07	30	37

⑥: Program to find BCD representation of an 8-bit number 6

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	21		LXI	H,2050	Load HL pair with address of the input number
0001	50				
0002	20				
0003	3E		MVI	A,00	Clear Accumulator
0004	00				Move Immediate 00 to A
0005	16		MVI	D,00	Clear register D.
0006	00				D stores Most Significant Byte(MSB)
0007	4E		MOV	C,M	Load the input number into C
0008	C6	LOOP2	ADI	01	Add 01 to A
0009	01				A stores Least Significant Byte(LSB)
000A	27		DAA		Convert A to BCD format
000B	D2		JNC	LOOP1	Jump to LOOP1 if no carry
000C	0F				
000D	00				
000E	14		INR	D	Increment D
000F	0D	LOOP1	DCR	C	Decrement C
0010	C2		JNZ	LOOP2	Jump to LOOP2 if no zero flag
0011	08				
0012	00				
0013	32		STA	3050	Store value in A at memory address 3050
0014	50				
0015	30				
0016	7A		MOV	A,D	Move value in D to A
0017	32		STA	3051	Store value in A at memory address 3051
0018	51				
0019	30				
001A	76		HLT		Stop Execution.

Test Case	Input (Value at 2050H)	Output (MSB at 3051H)	Output (LSB at 3050H)
1	6F	11	01
2	51	00	81
3	FF	02	55
4	07	00	07

7: Program to find largest number among 5 given numbers

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	21		LXI	H,2050	Initialize HL Pair with address of first number i.e., 2050
0001	50				
0002	20				
0003	06		MVI	B,05	B stores no. of numbers yet to be read.
0004	05				Move immediate 05 to B
0005	05		DCR	B	Decrement B
0006	7E		MOV	A,M	Move first number i.e., M to A
0007	23	LOOP	INX	H	Increment HL pair, to next number
0008	BE		CMP	M	Compare M with A
0009	D2		JNC	LOOP2	If no carry, jump to LOOP2
000A	0D				
000B	00				
000C	7E		MOV	A,M	if M > A, move M to A i.e., carry flag = 1
000D	05	LOOP2	DCR	B	Decrement B
000E	C2		JNZ	LOOP	if no zero flag, jump to LOOP
000F	07				
0010	00				
0011	32		STA	3050	Store content of A at memory address 3050
0012	50				
0013	30				
0014	76		HLT		Stop Execution

Input

Memory Address	2050	2051	2052	2053	2054
Value	15	20	06	12	04

Output

Memory Address	3050
Value	20

⑧: Program to find sum of given N numbers

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ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	3A		LDA	4FFF	N is stored at memory address 4FFF. Copy N to A.
0001	FF				
0002	44				
0003	4F		MOV	C,A	Store N value in A to C
0004	21		LXI	H,4500	Initialize HL pair with address of first number
0005	00				
0006	45				
0007	3E		MVI	A,00	Store Sum in A. Move immediate 00 to A
0008	00				
0009	06		MVI	B,00	Store Carry in B. Move immediate 00 to B.
000A	00				
000B	86	LOOP	ADD	M	Add M to A
000C	D2		JNC	LOOP2	If no carry, jump to LOOP2
000D	10				
000E	00				
000F	D4		INR	B	If carry is 1, increment B
0010	23	LOOP2	INX	H	Increment HL pair
0011	0D		DCR	C	Decrement C
0012	C2		JNZ	LOOP	If no zero flag, jump to LOOP. i.e., if numbers are not finished
0013	0B				
0014	00				
0015	32		STA	4600	Store value of A, i.e., sum at memory address 4600.
0016	00				
0017	46				
0018	78		MOV	A,B	Store B i.e., carry in A.
0019	32		STA	4601	Store A i.e., carry at memory address 4601
001A	01				
001B	46				
001C	76		HLT		Stop Execution.

Input

Memory Address	44 FF (N)	4500	4501	4502	4503	4504	4505	4506	4507	4508
Value	09	20	EA	D8	A3	99	80	B7	3C	6D

Output

Memory Address	4600 (Sum)	4601 (Carry)
Value	FE	04

⑨: Program to find gray code of an 8-bit number

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ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	3A		LDA	2050	Load value at address 2050 in Accumulator
0001	50				
0002	20				
0003	47		MOV	B,A	Copy value in A to B
0004	37		STC		Set carry flag to 1.
0005	3F		CMC		Complement the Carry Flag, to reset it.
0006	1F		RAR		Rotate accumulator right with carry
0007	A8		XRA	B	Bitwise XOR A,B. Store result in A
0008	32		STA	3050	Store value in A at memory address 3050
0009	50				
000A	30				
000B	76		HLT		Stop Execution.

TestCase	Input (at 2050) address	Output (at 3050) address
	45	67
1	FF	80
2	60	50
3	09	0D
4		

10: Program to find 8-bit number from its gray code.

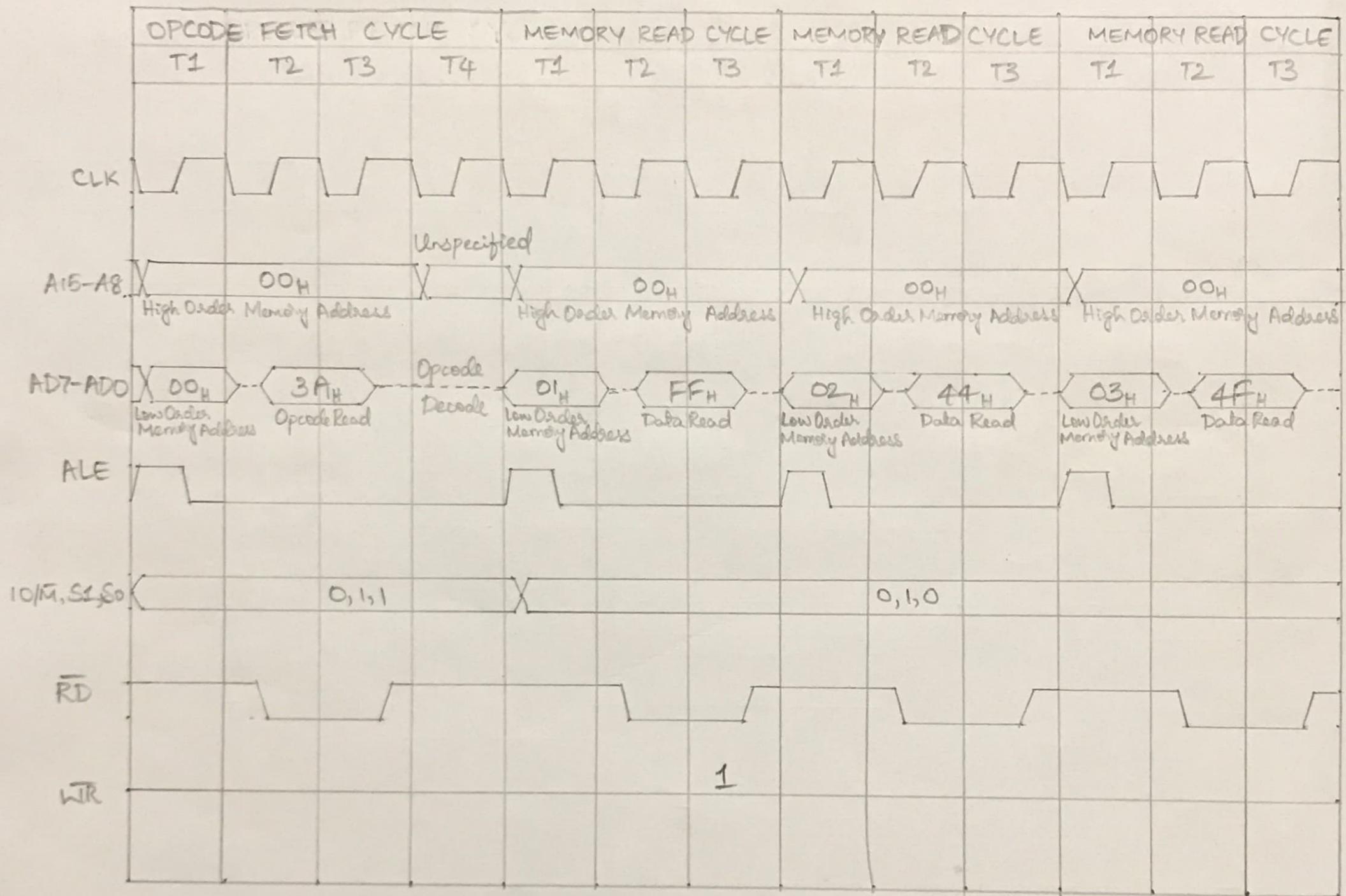
10

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
0000	3A		LDA	2050	Copy given number input into accumulator
0001	50				
0002	20				
0003	0E		MVI	C,07	Move 07 to C Immediate
0004	07				
0005	47		MOV	B,A	Copy value in A into B
0006	E6		ANI	80	Find most significant bit of value stored in A.
0007	80				
0008	0F	LOOP	RRC		Rotate accumulator value to right, no carry
0009	E6		ANI	7F	AN Bitwise AND of A and 7F
000A	7F				
000B	A8		XRA	B	Bitwise XOR of A and B
000C	0D		DCR	C	Decrement C
000D	C2		JNZ	LOOP	Jump to LOOP if zero flag is not zero
000E	08				
000F	00				
0010	32		STA	3050	Store value of A at memory address 3050
0011	50				
0012	80				
0013	76		HLT		Stop Execution.

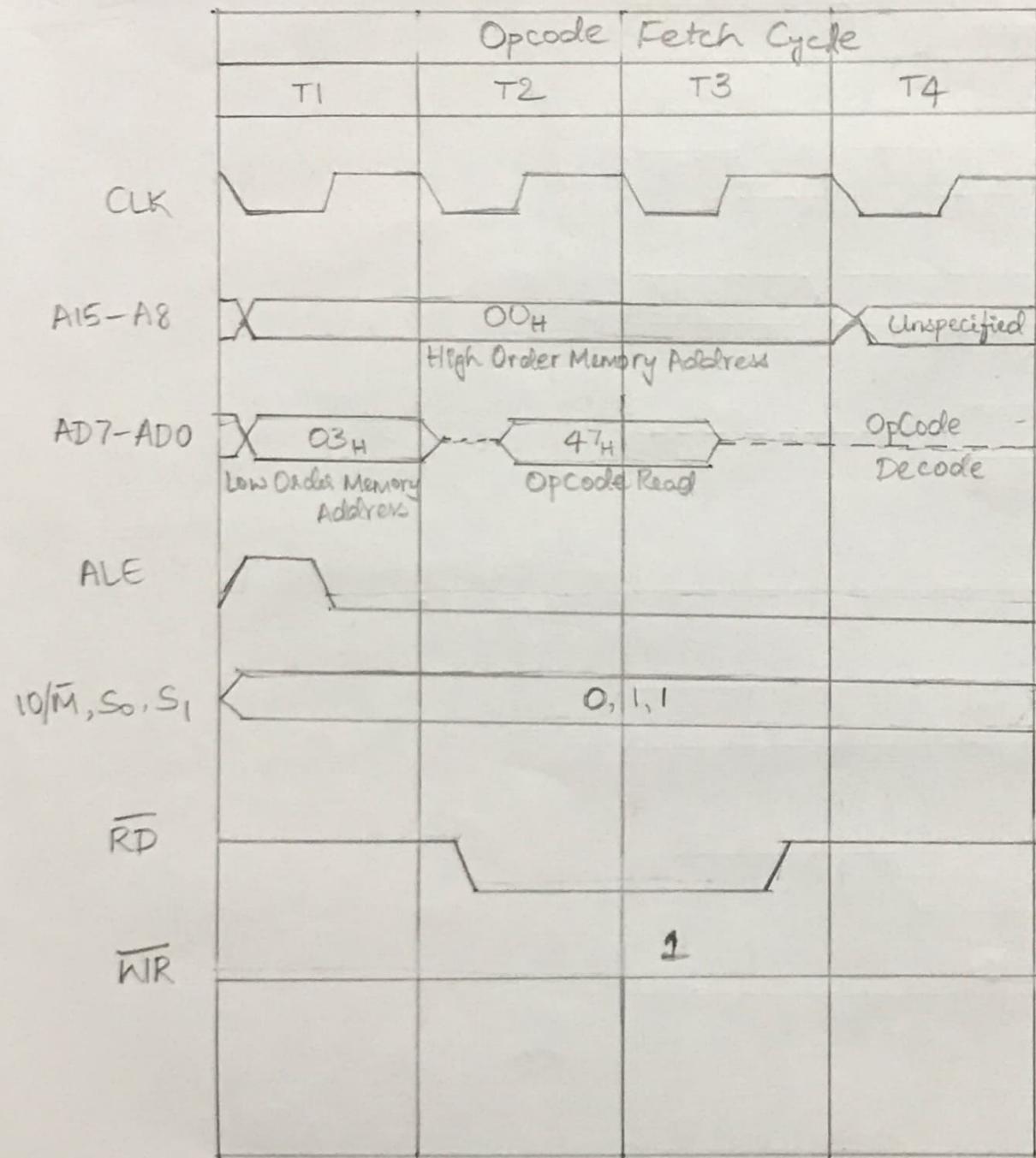
Test Case 1	Input (at 2050)	Output (at 3050)
1	50	60
2	0D	09
3	67	45
4	80	FF

Task 2:

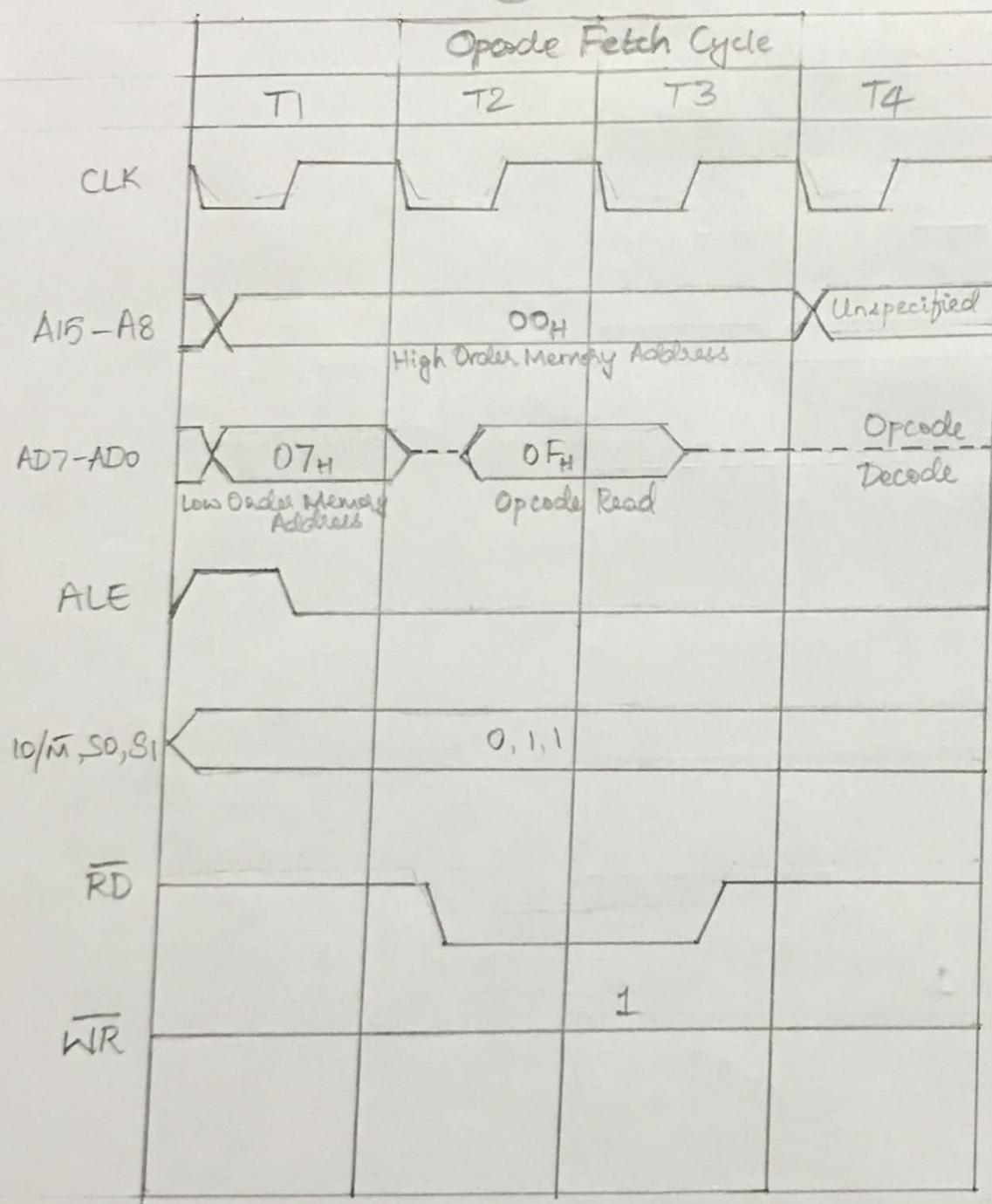
① LDA 44FF



② MOV B,A



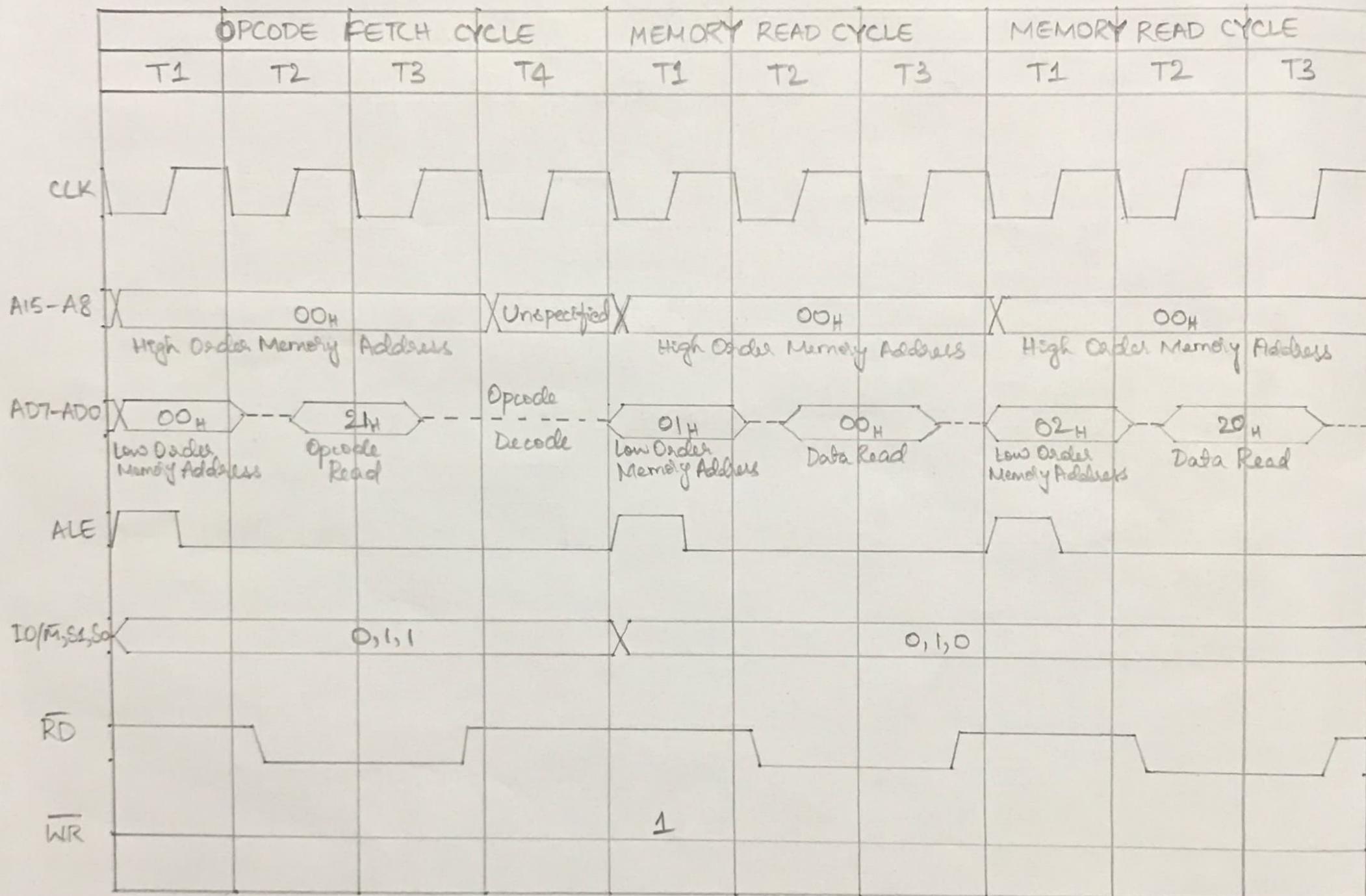
(3) RRC



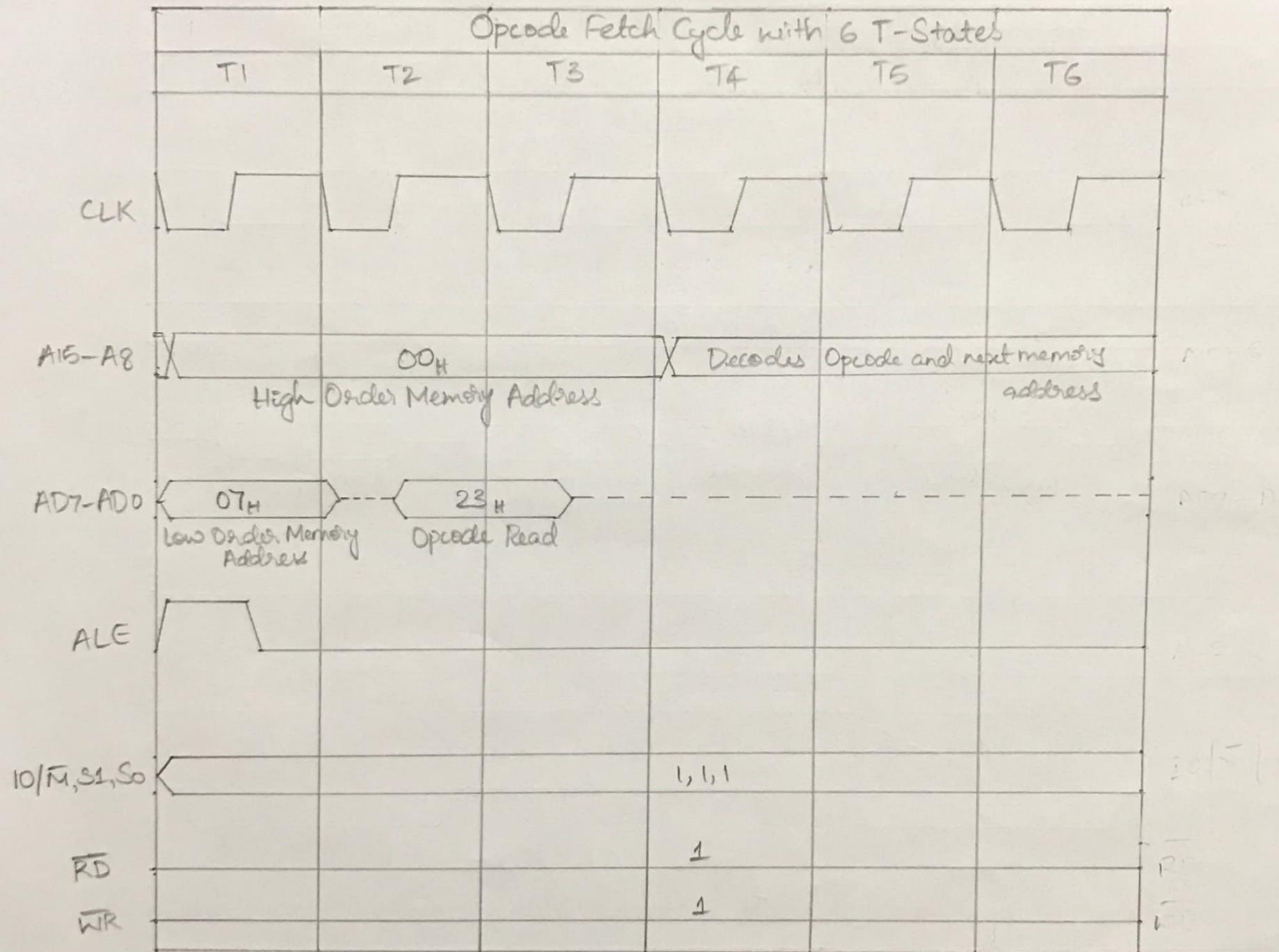
④ JNC 000F

OPCODE FETCH CYCLE				MEMORY READ CYCLE			MEMORY READ CYCLE		
T1	T2	T3	T4	T1	T2	T3	T1	T2	T3
CLK									
A15-A8	X	00H	X	Unspecified	X	00H	X	00H	X
		High Order Memory Address				High Order Memory Address			High Order Memory Address
AD7-AD0	OB _H	D2 _H	Opcode Decode	OC _H	OF _H	Data Read	OD _H	OO _H	Data Read
	Low Order Memory Address	Opcode Read		Low Order Memory Address		Data Read	Low Order Memory Address		Data Read
ALE									
IO/M,S1,S0		0,1,1		X			0,1,0		
RD									
WR				1					

⑤ LXI H, 2000



⑥ INX H

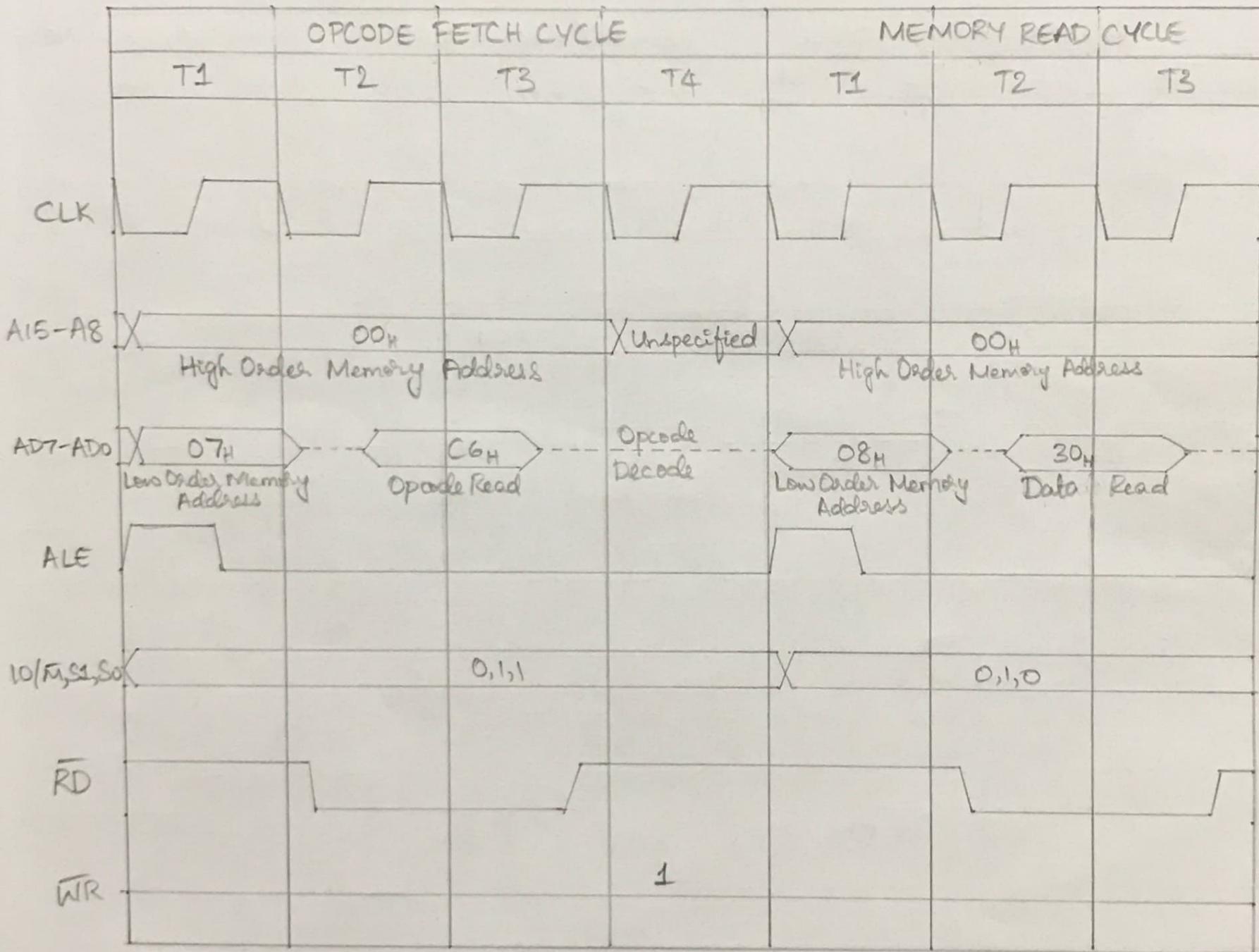


7 ADD M

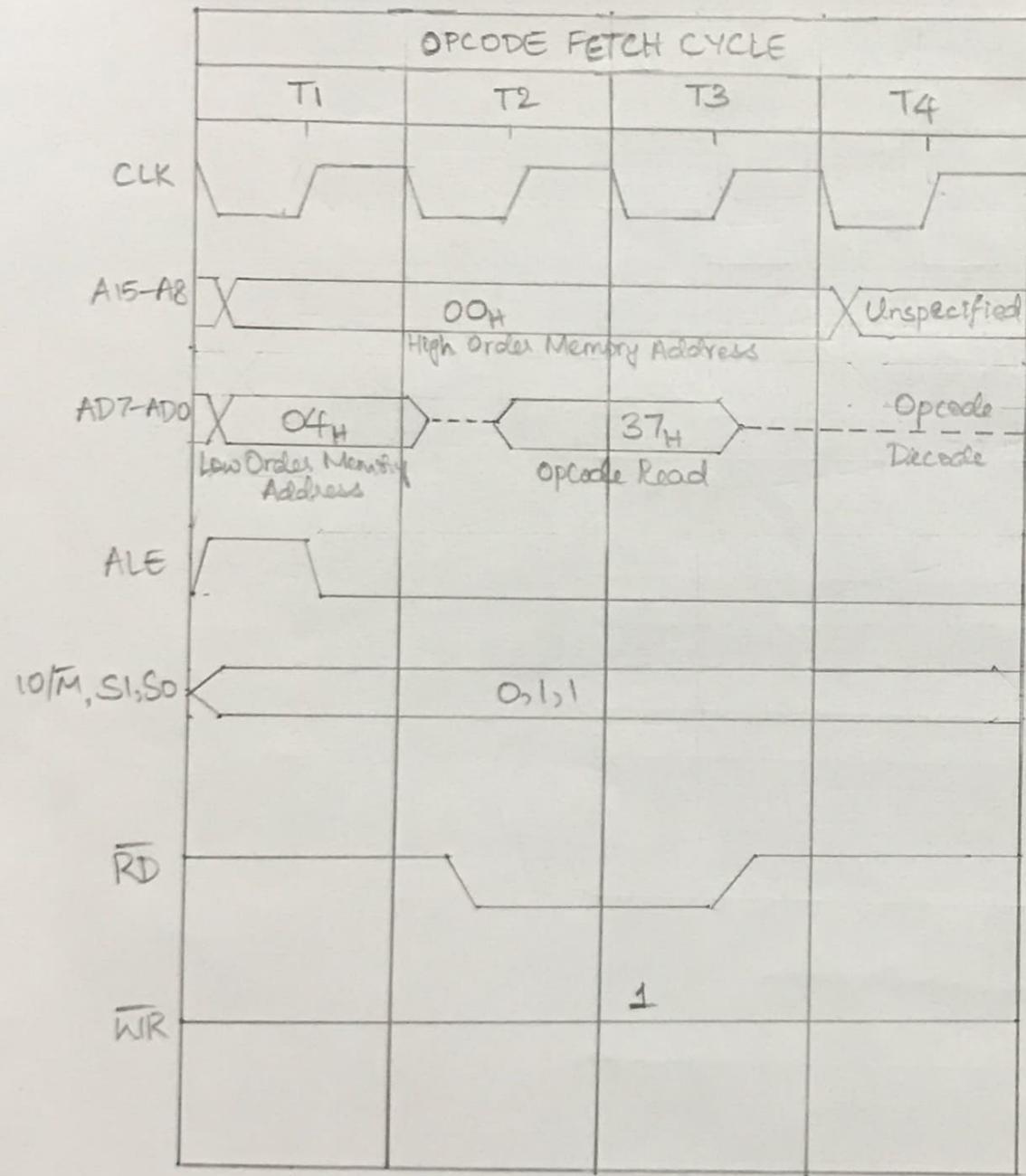
7

	Opcode Fetch Cycle				Memory Read Cycle		
	T1	T2	T3	T4	T1	T2	T3
CLK							
A15-A8	X	00H	Unspecified	X	00H		
	High Order Memory Address				High Order Memory Address		
AD7-AD0	07H	86H	08H	ODH			
	Low Order Memory Address		Opcode Read		Data Read		
ALE							
I0/R, S1, S0		0,1,1		X	0,1,0		
RD							
WR			1				

⑧ ADI 30



(9) STC



(10) HLT

HLT

