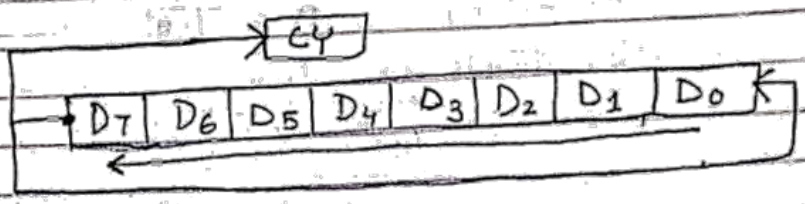
10. RLC : Rotate Accumulator Left.

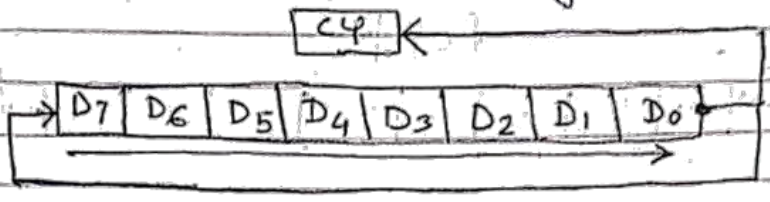
M/C ⇒ 1 (OF)
T ⇒ 4T



Flag: ONLY CARRY FLAG MODIFIED
&
Other flags not altered.

11. RRC - Rotate accumulator right.

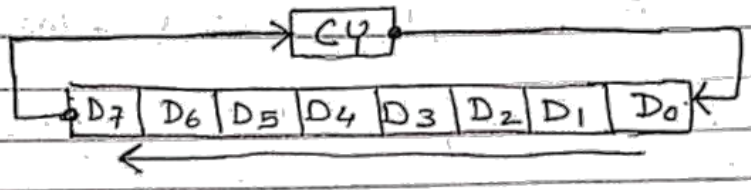
M/C = 1 (OF)
T = 4T.



Flag: only CY flag is modified. others not.

12. RAL - Rotate Accumulator left through carry.

M/C = 1 (OF)
T = 4T.



Flag: Only CY is modified not other flags.

Ex: WAP to shift 16 bit data, 1 bit right. Assume data is in B-C register pair.

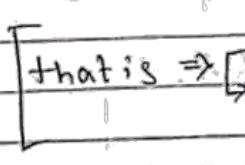
Ans.

3A	25
B	C

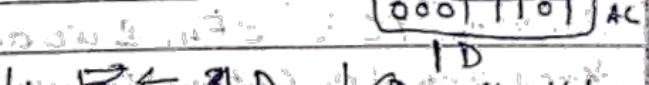
MOV A, B - AC ← 3A

ORA A - Setting CY = 0

RAR - Rotate Ac Right. Put D0 to CY & CY to D7.



After RAR execute



MOV B, A. → B ← 1D

in CY D8 is saved

MOV A, C

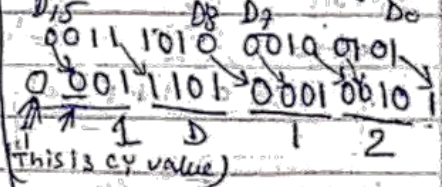
RAR - Rotate Ac Right

MOV C, A.

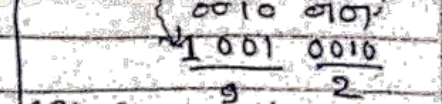
1D	12
B	C

Ans

(*) We should keep D8 safely at CY and move it to D7 for LSB right shifting.



Normal right shift RRC of 25 will give wrong result

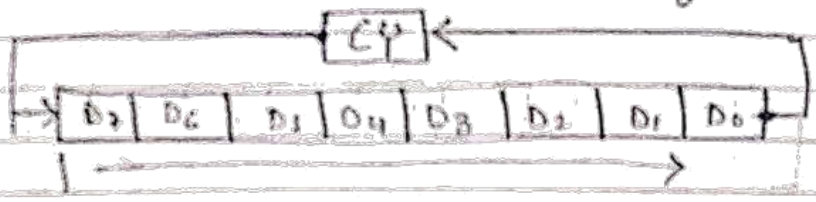


Verification process ⇒ (For why this prog. is important):-

* Step 1: Take B-C 3A-25.
* Step 2: Convert it to binary.
* Step 3: Shift 1 bit right, see result (1D-12)
* Step 4: Now take only LSB 25 & shift right by RRC. 2 see result ⇒ (92) That is wrong result. Hence verified.

13. RAR - Rotate Accumulator right through carry.

M/C → 1 (OF)
T → 4T



Flag : Only CY flag will be modified.

14. CMC - Complement Carry flag.

M/C → 1 (OF)
T → 4T

Flag : only CY will be modified & other not changed

15. STC - Set Carry flag.

M/C → 1 (OF)
T → 4T

Flag : Only Carry (CY) flag will chang & no other flag will be changed / effected.

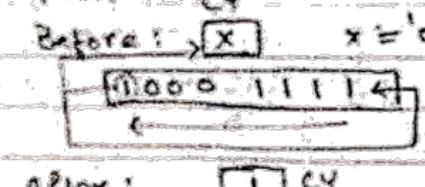
Difference between RLC RAL

RLC

Suppose, AC is 8FH. & we don't know content of CY flag. Now we execute following instruction!

MVI A, 8FH.
RLC.

Result →

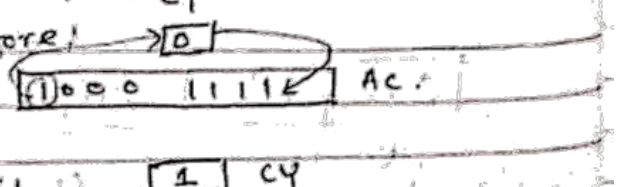


RAL

Suppose, AC is 8FH. ~~& we set CY=0~~ then execute following instruction.

MVI A, 8FH
ORA A + Setting CY = 0.
RAL.

Result →



Diff: Between —

(b)

ORA A.	ANA A.
1. OR (logic) operation accumulator content with accumulator content. Result : store in accumulator	1. AND (logic) operation accumulator with accumulator. Result : store in accumulator.
2. Flag : S, Z, P - change according result CY = reset & AC will be reset also	2. Flag : S, Z, P - change according to result. Here CY and AC will be CY reset & AC set.
3. Register addressing mode.	3. Register addressing mod.
4. M/C = 0.F T = 4T	4. M/C = 0F T = 4T

(c)

CMA	CMC.
1. This is complement the accumulator. (Ac) Result: Store in Ac.	1. Complement the CY flag only.
2. No flags are effected.	2. Only CY flag is effected.
3. M/C - 0.F T ⇒ 4T Implicit Add. mode	3. M/C - 0F, T = 4T Implicit Add. mode

(d)

CMP B	CMP M.
1. Compare Ac content with Content of register 'B.'	1: Compare Ac with memory Content pointed by M(H-L pair)
2. M/c - 0F. T = 4T	2. Mk = 0F+MR T = 7T
3. Register Add. mode.	3. Register Indirect add. mode

EX1: WAP TO SHIFT 16 BIT DATA RIGHT BY ONE BIT.

B-C = 3B 24 =

$D_{15}D_{14}$ D_8 D_7 D_0

0 0 1 1 1 0 1 1 0010 0100

0 0 0 1 1 1 0 1 **1**<-CARRYFLAG

INITIAL CARRY FLAG VALUE

$D_{15}D_{14}$ D_8 D_7 D_0

0 0 1 1 1 0 1 1 0010 0100

0 0 0 1 1 1 0 1 **100 1** **0010**

Correct Result :1 D 9 2

From following combinations

RAR-RRC ---- 1D 12

RAR-RAR ---- 1D 92

RRC-RRC---- 9D 12

RRC-RAR ---- 9D 92

We can conclude RAR-RAR is the correct option.

EX2: WAP TO SHIFT 16 BIT DATA LEFT BY ONE BIT. YOUR 16 BIT DATA IS STORED INTO 8000-8001 MEMORY LOCATIONS.

8000	8001
3B	24

ANS:

SIMULATOR:

STARTING ADDRESS:2000

USER DATA GRID

MEMORY LOCATION	DATA
8000	3B
8001	24
9000	?
9001	?

Memory Address	Label	Mnemonic	Opcode	Operand	Hex Code	Comments
2000		**LXI H 8001**	LXI	H 80 01_H	21	
2001					01	
2002					80	H-L<-8001
2003		**ORA A**	ORA	A		CY<-0
2004		**MOVAM**	MOV	A M		AC<-24
2005		**RAL**	RAL			AC<-48 , CY=D_7
2006		**STA 9001**	STA	9001	32	
2007					01	
2008					90	
2009		**DCX H**	DCX	H		H-L<-8000
200A		**MOVAM**	MOV	A M		AC<-3B
200B		**RAL**	RAL			AC<- 76

200C		**STA 9000**	STA	9000	32	
200D					00	
200E					90	
200F		**HLT**			76	

LOWER 8 BIT DATA:

CY=0

0010 0100

RAL: 0100 1000 CY=D_7= 0

UPPER 8 BIT DATA:

CY=D_7 =0

0011 1011

RAL: 0111 0110 CY=D_{15}= 0

EX7: WAP TO SHIFT 8 BIT DATA LEFT BY ONE BIT. YOUR 8 BIT DATA IS STORED INTO 8000 MEMORY LOCATIONS AND STORE THE RESULT INTO 9000.

THEORY:

USER DATA GRID :

MEMROY LOCATION	DATA
8000	3B
9000	?

Memory Address	Label	Mnemonic	Opcode	Operand	Hex Code	Comments
2000		LXI H 8000	LXI	H 80 00H	21	
2001					00	
2002					80	H-L<-8000
2003		ORA A	ORA	A		CY<-0
2004		MOVA M	MOV	A M		AC<-3B
2005		RAL	RAL			AC<-76
2006		STA 9000	STA	9000	32	
2007					00	
2008					90	
2009		HLT			76	

EX4: WAP TO SHIFT 8 BIT DATA LEFT BY ‘n’ BITS so that you get original data back. YOUR 8 BIT DATA IS STORED INTO 8000 MEMORY LOCATIONS AND STORE THE RESULT INTO 9000.

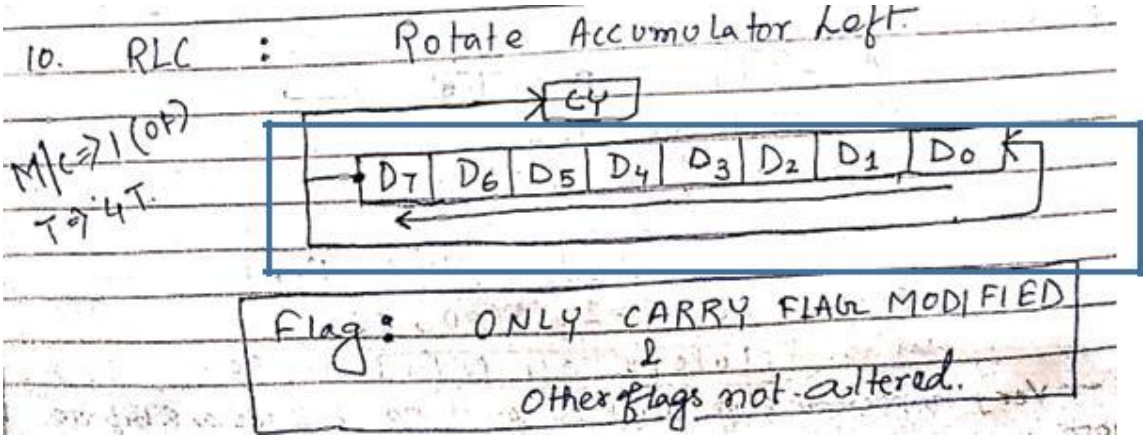
ANSWER:

USER DATA GRID :

MEMROY LOCATION	DATA
8000	3B
9000	?

We can use RLC or RAL.

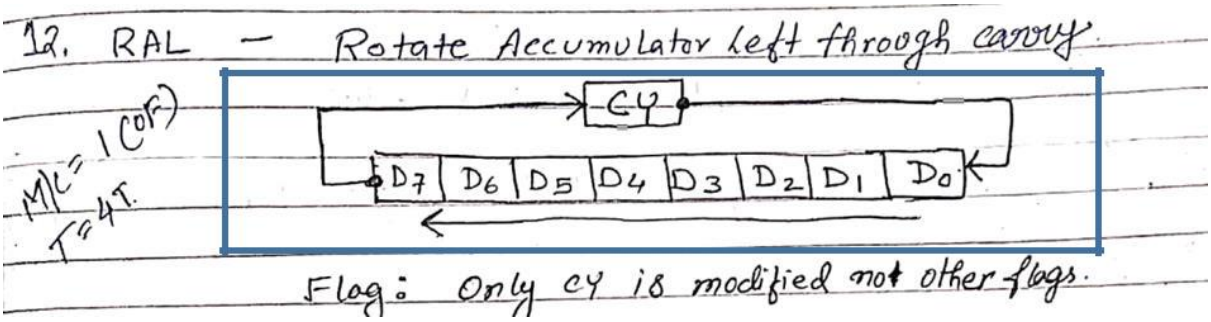
A. USING RLC:



Here data is moving in circular motion from D_0 –D_7-D_0. So we need to move the data left by 8 times to get the original data back.

Memory Address	Label	Mnemonic	Opcode	Operand	Hex Code	Comments
2000		**LXI H 8000**	LXI	H 80 00H	21	
2001					00	
2002					80	H-L<-8000
2003		**MVI C 08**	MVI	C 08		C<-08
2004					08	
2005		**ORA A**	ORA	A		CY<-0
2006		**MOVAM**	MOV	A M		AC<-3B
2007	L1:	**RLC**	RLC			LEFT MOVE 1BIT
2008		**DCR C**	DCR	C		C<-C-1
2009		**JNZ L1**	JNZ	2007 (L1)		
200A					07	
200B					20	
200C		**STA 9000**	STA	9000	32	9000<-3B
200D					00	
200E					90	
200F		**HLT**			76	

B. USING RAL:



Here data is moving in circular motion from D_0 –D_7-CY-D_0. So we need to move the data left by 9 times to get the original data back.

Memory Address	Label	Mnemonic	Opcode	Operand	Hex Code	Comments
2000		**LXI H 8000**	LXI	H 80 00H	21	
2001					00	
2002					80	H-L<-8000
2003		**MVI C 09**	MVI	C 09		C<-08
2004					09	
2005		**ORA A**	ORA	A		CY<-0
2006		**MOVAM**	MOV	A M		AC<-3B

2007	L1:	**RAL**	RAL			LEFT MOVE 1BIT
2008		**DCR C**	DCR	C		C<-C-1
2009		**JNZ L1**	JNZ	2007 (L1)		
200A					07	
200B					20	
200C		**STA 9000**	STA	9000	32	9000<-3B
200D					00	
200E					90	
200F		**HLT**			76	