INTRODUCTION TO MICROCOMPUTERS SECOND MIDTERM EXAM

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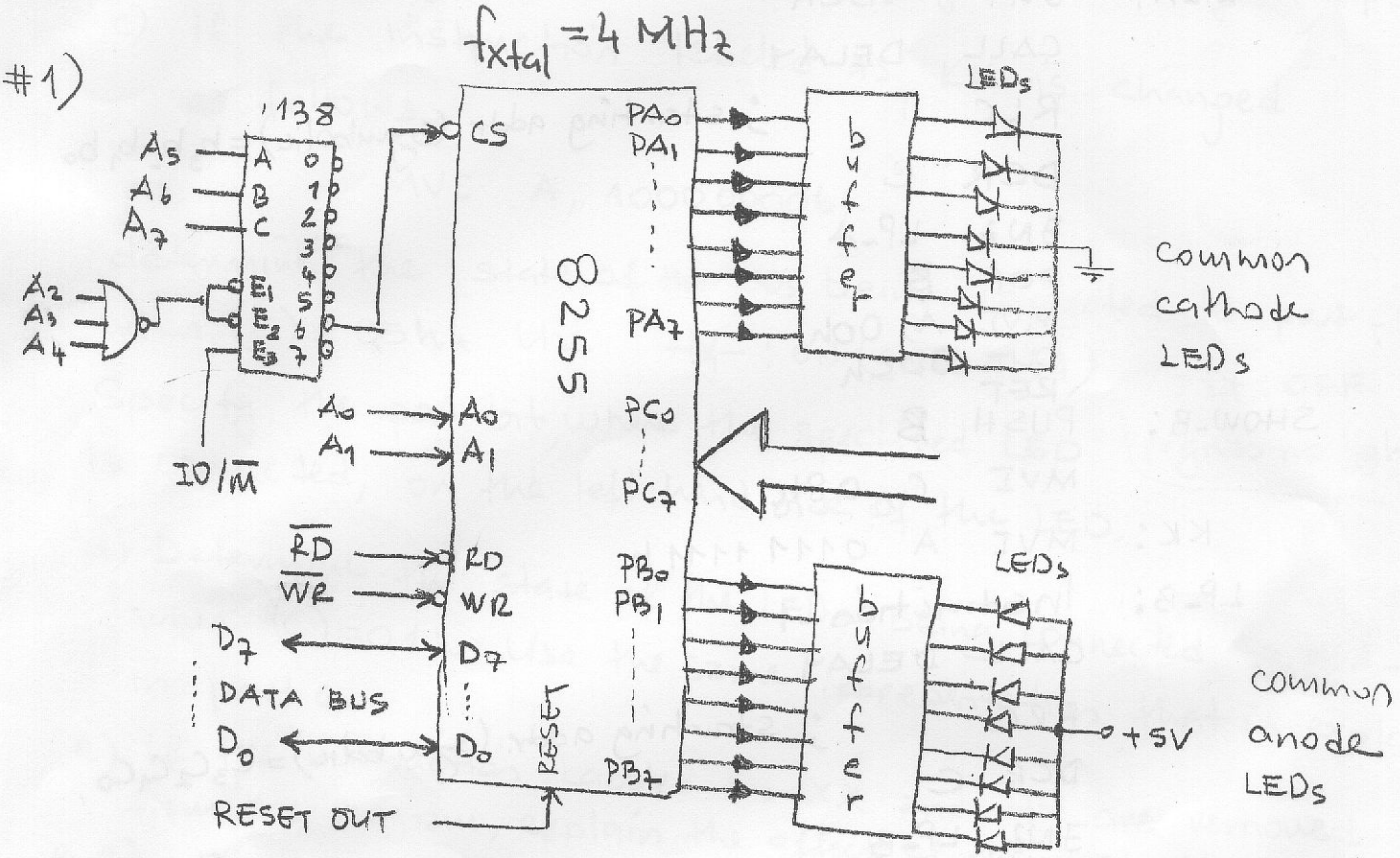
#1)



Consider the system given in the above. The following assembler program is written for the given digital circuit.

```
        ORG   0000h
        LXI   SP, 8000h
        MVI   A, S1
        OUT   S2
        MVI   A,00h        <- MVI B, 00h
        OUT   0DCh
        CMA
AGAIN:  OUT   0DDh
        IN    0DEh
        MOV   C,A
LP:     CALL  SHOW-A
        CALL  SHOW-B
        DCR   C
        JNZ   LP
        JMP   AGAIN
```

; starting addr. (symbolic) = $a_3 a_2 a_1 a_0$

; starting addr. (symbolic) = $d_3 d_2 d_1 d_0$

```
SHOW_A: PUSH  B
        IMVI  C, 08h
        MVI   A, 0000 0001
LP_A:   OUT   0DCh
        CALL  DELAY
        RLC                ; starting addr. (symbolic) = b3 b2 b1 b0
        DCR   C
        JNZ   LP_A
        POP   B
        MVI   A, 00h
        OUT   0DCh
        RET
SHOW_B: PUSH  B
        MVI   C, 08h
KK:     MVI   A 0111 1111 b
LP_B:   Instruction-1
        CALL  DELAY
        RRC                ; starting addr. (symbolic) = C3 C2 C1 C0
        DCR   C
        JNZ   LP_B
        POP   B
        MVI   A, 0FFh
        OUT   0DDh
        RET.
DELAY:  LXI   D, 54  ; This is 100 ms delay subroutine.
XX:     PUSH  PSW    ; PSW = AF Program Status Word
LOOP:   NOP
        NOP
        NOP
        NOP
        DCX   D
        MOV   A, D
ZZ:     ORA   E
        JNZ   LOOP
YY:     POP   PSW
        RET
```

a) Determine the values of S1, S2 and instruction-1

b) What does this program do, if the data read from port_C is 03h. Explain it shortly (not line by line pls.)

c) If the instruction labeled as KK is changed as follows

MVI A, 10000000b,

determine the state of the LEDs being connected to port-B when (C) = 05h. Use  : ON (gives light) : OFF (gives no light)
Specify the port bit, where the specified LED is connected, on the left hand side of the LED.

d) Determine the state of the LEDs being connected to port-A when (C) = 01h Use the same representation that is explained in part c.

e) If the instruction Labeled as XX and YY are removed from the program, explain the effect of them shortly.

#2) Reconsider the assembly program given in question-1.

a) Determine S4 value as a hex number. Note that the execution time for DELAY subroutine is 100ms.

b) Determine the active stack part and content of SP when the program reaches the point labeled as ZZ first time. Use symbolic address values, ishown in the program, if the corresponding starting addresses are necessary. Take (F) = XXh, f_{xtal} = 4 MHz

#3) Reconsider the digital circuit given in problem-1. Assume that the data at port C remain at value FFh. Consider the following assembly program for this digital circuit also. Assume also that all following events occur seperately after the power up reset of the 8085.

```
        ORG   0000h.
        LXI   SP, 8000h.
        MVI   A, 51
        OUT   52
        MVI   A, 00h
        OUT   0DCh
        CMA
        OUT   0DDh
        MVI   A, 08h
        SIM
LOOP:   NOP
 AA:    NOP
        NOP
 BB:    NOP
        NOP
 CC:    NOP
 DD:    NOP
        JMP   LOOP
        ORG   0024h   TRAP
        JMP   PRG1
        ORG   002Ch
        JMP   PRG2    RST 5.5
        ORG   0034h
        JMP   PRG3    RST 6.5
        ORG   003Ch
        JMP   PRG4    RST 7.5
        NOP
        NOP
PRG1:   IN    0DEh
        ANI   55h
        OUT   0DCh
        OUT   0DDh
        CALL  DELAY1
        EI
        RET
PRG2:   MVI   A, 0Fh
        OUT   0DCh
        OUT   0DDh
        CALL  DELAY1
        EI
        RET
PRG3:   IN    0DEh
        ANI   0AAh
        OUT   0DCh
        OUT   0DDh
        CALL  DELAY1
        EI
        RET
PRG4:   IN    0DEh
        ANI   33h
        OUT   0DCh
        OUT   0DDh
        CALL  DELAY1
        EI
        RET
DELAY-1: MVI  A, 0Ah
 TT:    CALL  DELAY
        DCR   A
        JNZ   TT
        RET
```

```
DELAY:  LXI   D, S4   ; This program is the same as it is
        PUSH  PSW     ; given in question-1.
        :
        :
        POP   PSW
        RET
```

a) An RST7.5 hardware interrupt request signal arrives to the 8085 at point AA, What are the state of LEDs, which are connected to port-A and port-B, as explained in question-1, part C, at point BB.

b) A TRAP hardware interrupt request signal arrives to the 8085 at point AA, what are the state of LEDs, being connected to port-A and port B at point CC.

c) An RST7.5 hardware interrupt request signal arrives to the 8085 at point AA, after that a TRAP hardware request arrives at point BB. What are the state of LEDs, being connected to port-A and port-B at point CC.

d) A TRAP interrupt signal arrives at point AA, then a RST6.5 arrives at point BB, Later that a RST5.5 arrives at point CC, What are the state of LEDs, being connected to port-A and port-B at point DD.

e) In part-d, if we look at LEDs, connected to port-A and port-B, what do we see? Explain shortly.

INTRODUCTION TO MICROCOMPUTERS SECOND MIDTERM EXAM SOLUTION MANUAL

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#1) 8255 has a isolated I/O decoder since $E_3 = 1$ for

a) $IO/\overline{M} = 1$

A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	1	0	1	1	1	0	0	= DCh	Addr. of port A
						0	1	= DDh	" " port B
						1	0	= DEh	" " port C
						1	1	= DFh	" " control register

Control word

7	6	5	4	3	2	1	0	
1	0	0	0	1	0	0	1	= 89h

- 1 → I/O mode
- 00 → Mode 0
- 0 → port A output
- 1 → PCH input
- 0 → Mode-0
- 0 → port B output
- 1 → PCL input

S1 = Control word = 89h

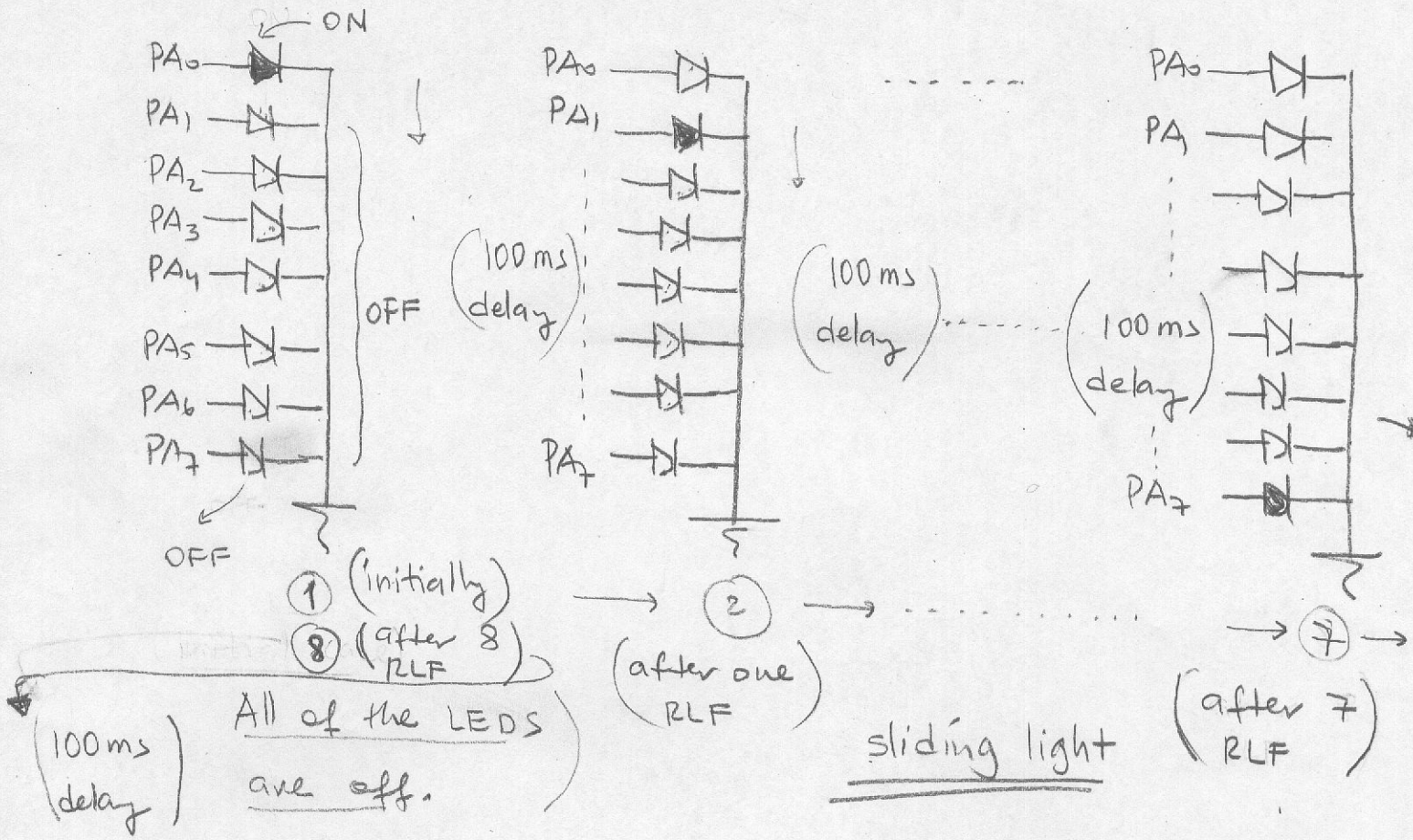
Instruction-1 = OUT ODDh

S2 = Addr. of control register = ODFh

b) The function of the program is explained as follows

* Initially 8255 is programmed as it is shown in the figure
* LEDs, connected to port-A (common cathode) and port-B (common anode) are made off

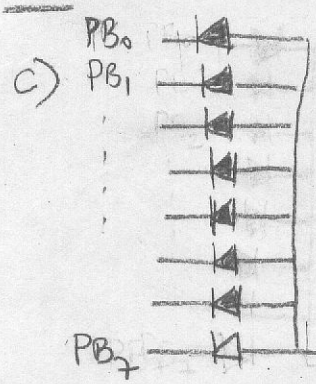
* A data is read port-C
* SHOW_A, later on SHOW_B are called. This job is done the number, of which is read from port-C, times.
* In SHOW_A subroutine:



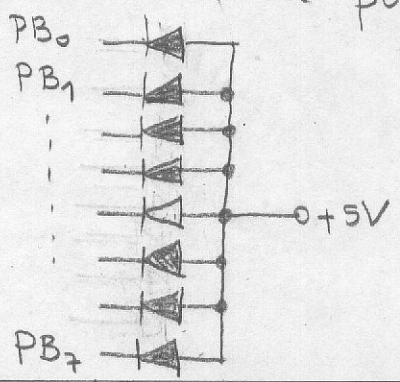
* In SHOW_B subroutine:

The opposite job that is explained above is done in port-B. First, the LED being connected to PB_7, is on, the others off. 100 ms later, the LED being connected to PB_6, is on, the others are off and so on. (Light goes from PB_7 to PB_0)

* Later on a new data is read from port-C

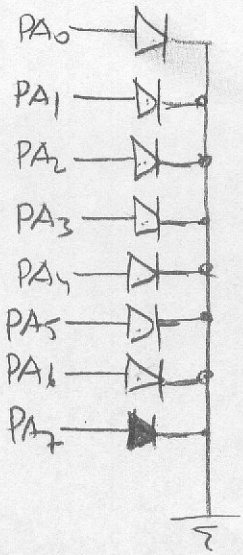


c) (A) = 1000 0000b
(C) = 08h
initial case



(C) = 05
three times
RRC
(7)

d)



when (C) = 01 Seven times RLC

e) Since accumulator is used in SHOW_A, SHOW_B and DELAY subroutines, PUSH PSW and POP PSW instructions are used in DELAY subroutine to keep original values of accumulator in SHOW_A and SHOW_B subroutines. If the instructions labeled as XX and YY are removed from the DELAY subroutine, from return of DELAY, we have always (A) = 00h. Because of it, except initial case, all LEDs connected to port A will be off (No sliding light). In SHOW_B subroutine, except initial case, all LEDs will be on (No sliding off LED) this time.

#2)

a)

			# of T-states
DELAY:	LXI	D, 54	10
	PUSH	PSW	12
LOOP:	NOP		4
	NOP		4
	NOP		4
	NOP		4
	DCX	D	6
	MOV	A, D	4
	ORA	E	4
	JNZ	LOOP	10/7
	POP	PSW	10
	RET		10

$$10+12+\overbrace{(4+4+4+4+6+4+4+10)}^{40}(S4-1)+37+20=\frac{100\,10^{-3}}{\left(\frac{1}{2\,10^{+6}}\right)}$$

$$22+40(S4-1)+37+20=100\,10^{-3}.\,2\,10^{6}$$

$$79+40(S4-1)=200\,10^{3}$$

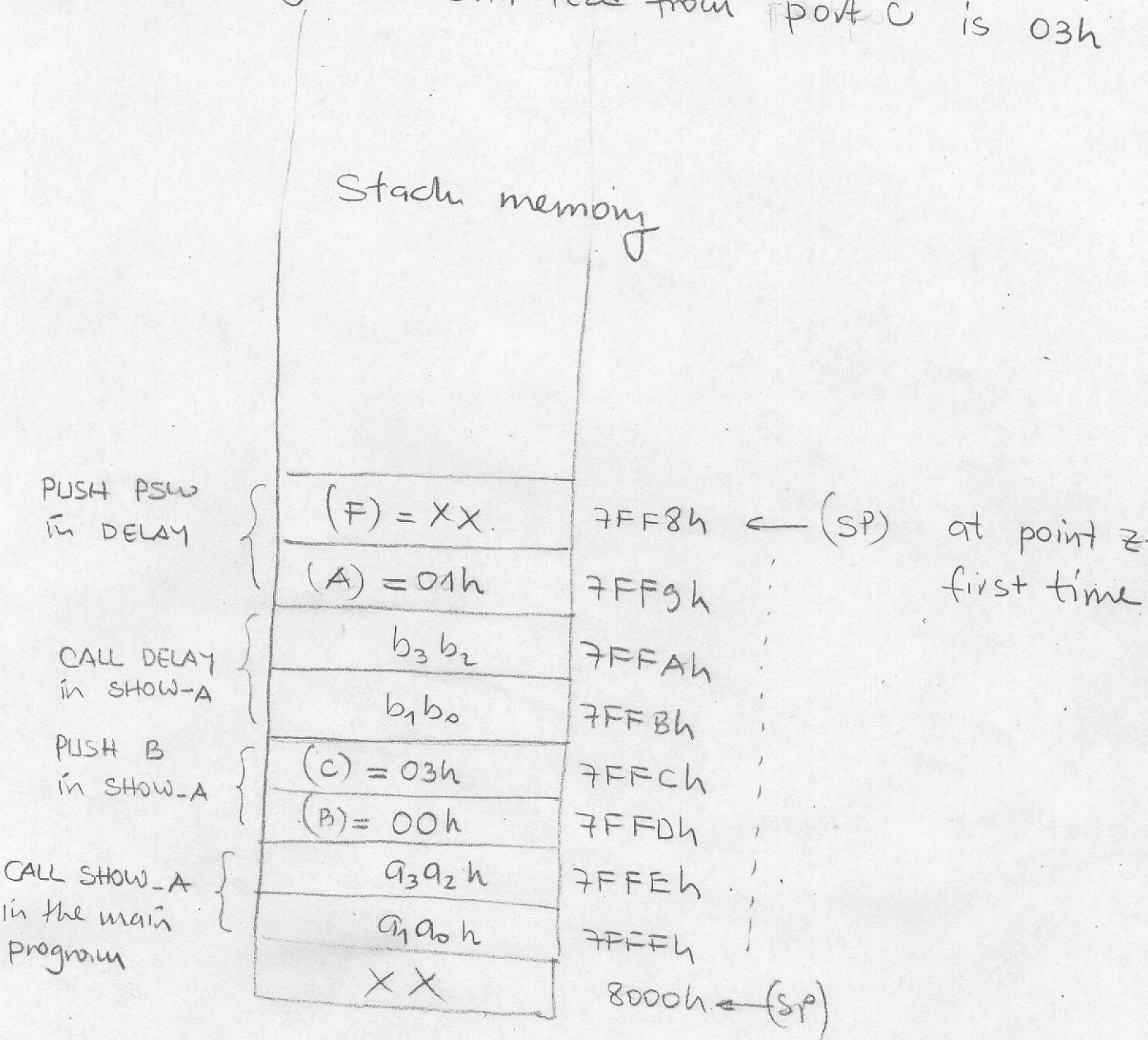
$$40(S4-1)=200\,000-79$$

$$S4=1+\frac{200\,000-79}{40}$$

$$S4=(4999)_{10}\rightarrow \boxed{S4=1387h}$$

$$\boxed{(DE)=1387h}$$

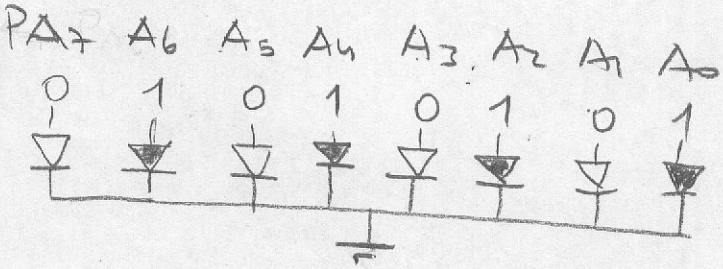
b) Assuming the data read from port C is 03h

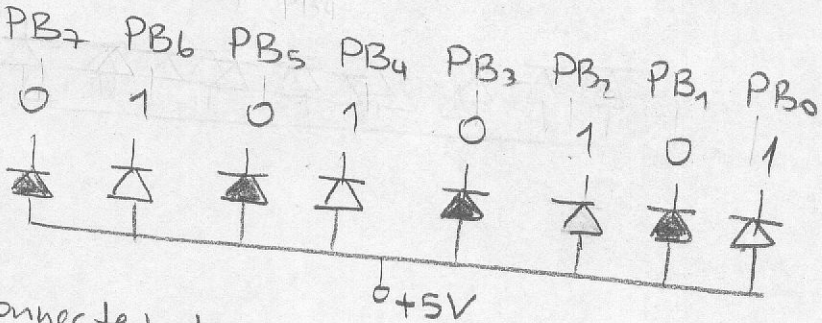


#3) Data port C remains at FFh.

a) At the begining of the program, masks of all interrupts are removed. But the program enters the endless loop (dummy loop) without making interrupt enable! The state of all LEDs, being connected to port A and port B, will be off at point CC since all of them were made off at the begining of the program and the RST7.5 interrupt request will not be recognized by the microprocessor due to disable interrupt conditions.

b) Since TRAP is a NMI, the program will reach PRG1. Inside the PRG1



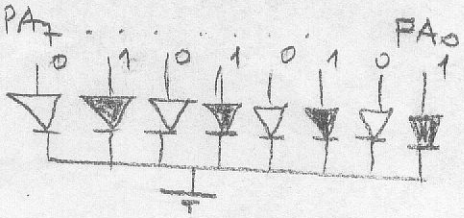


the LEDs connected to port A and port-B remains as shown in the above in 1 second (DELAY1 sub takes $10 \times 100 = 1000\ ms = 1\ s$) and the program returns the main program by making EI. So, the LEDs connected to port-A and port-B at states shown in the above at point CC.

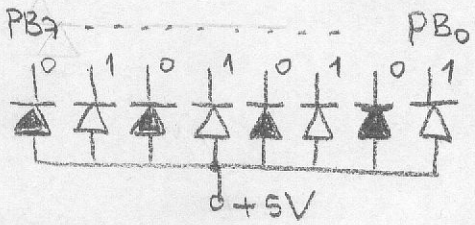
c) In the ligh of explanations given in part a and part b, the state of LEDs connected to port A and port B will be the one shown in the figure in part b. (7)

d)

STATE - (1)



(7)

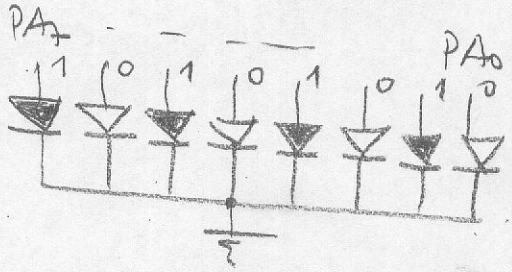


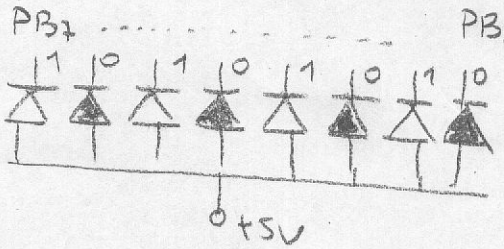
(1 sec delay)

In PRG1 (ISR of TPAP)

(also just after AA)

STATE - (2)



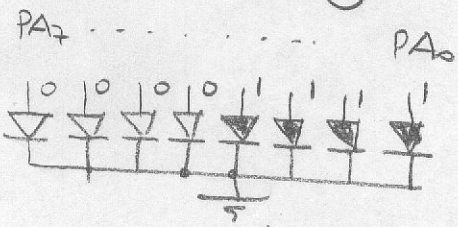


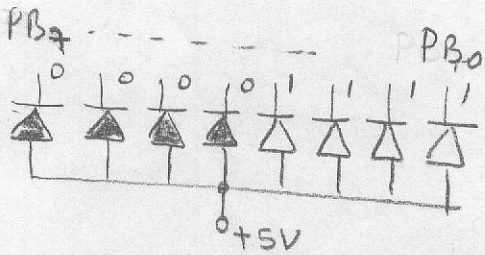
(1 sec delay)

In PRG3 (ISR of 6.5)

(also just after point BB)

STATE - (3)





State of the LEDs at point DD.

In PRG 2 (ISR of 5.5)

(also just after point CC)

(7)

e) Initially LEDs connected to port A and port B are off. After that, Sequence of events are as STATE - (1) 1 sec delay STATE - (2) 1 sec. delay STATE - (3) at point DD. Since return of PRG1, EI is done, RST 6.5 at BB and RST 5.5 at CC are recognized by the microprocessor!