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8085 PROGRAMMING

Q 1) **WAP to add the contents of locations 4000H and 4001H. Store the sum at 4002H and the carry at 4003H.**

Soln:

```
        MVI   B, 00H
        LXI   H, 4000H
        MOV   A, M
        INX   H
        ADD   M
        JNC   SKIP
        INC   B
SKIP:   INX   H
        MOV   M, A
        INX   H
        MOV   M, B
        RST1
```

Q 2) **WAP to add two BCD numbers stored in the locations 4000H and 4001H. Store the result at 4001H and 4002H.**

Soln:

```
        MVI   B, 00H
        LXI   H, 4000H
        MOV   A, M
        INX   H
        ADD   M
        DAA
        JNC   SKIP
        INC   B
SKIP:   INX   H
        MOV   M, A
        INX   H
        MOV   M, B
        RST1
```

Q 3) **WAP to add a series of 10 numbers stored from location 4000H. Store the result immediately after the series.**

Soln:

```
        SUB   A
        MOV   B, A
        LXI   H, 4000H
        MVI   C, 0AH

BACK:   ADD   M
        JNC   SKIP
        INC   B
SKIP:   INX   H
        DCR   C
        JNZ   BACK

        MOV   M, A
        INX   H
        MOV   M, B
        RST1
```

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Q 4) **WAP to find the largest in a given series of 10 numbers starting from location 4000H. Store the result immediately after the series.**

Soln:

```
      LXI   H, 4000H
      MVI   C, 0AH
      SUB   A
BACK: CMP   M
      JNC   SKIP
      MOV   A, M
SKIP: INX   H
      DCR   C
      JNZ   BACK
      INX   H
      RST1
```

Q 5) **WAP to find the number of +ve, -ve and zeros in a given series of 10 numbers. Store the result immediately after the series.**

Soln:

```
      SUB   A
      MOV   B, A        ; B = No of zeros
      MOV   C, A        ; C = No of +ves
      MOV   D, A        ; D = No of -ves
      LXI   H, 4000H
      MVI   E, 0AH

BACK: CPM   M           ; A - M i.e. 00H - Current number
      JZ    ZERO        ; Current number must be zero
      JC    POSV        ; Current number must be greater than zero
NEGV: INR   D           ; Current number must be less than zero
      JMP   NEXT
POSV: INR   C
      JMP   NEXT
ZERO: INR   B

NEXT: INX   H
      DCR   E
      JNZ   BACK
      RST1
```

Q 6) **SORT ACSENDING a series of 10 numbers starting from location 2100H.**

Soln:

```
      MVI   B, 09H
BCK2: LXI   H, 2100H
      MVI   C, 09H

BCK1: MOV   E, M        ; Current number in E
      INX   H
      MOV   A, M        ; Next number in A
      CMP   E           ; A - E
      JNC   SKIP        ; If next number is greater then don't bother
      MOV   M, E        ; else exchange the two numbers
      DCX   H
      MOV   M, A
      INX   H

SKIP: DCR   C
      JNZ   BCK1
      DCR   B
      JNZ   BCK2
      RST1
```

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BLOCK TRANSFER PROGRAMS:

Q 7) WAP to perform BLOCK TRANSFER of 10 bytes from location 2000H to location 3000H.

Soln:

```
      MVI   L, 09H
      LXI   B, 2000H
      LXI   D, 3000H

BACK: LDAX  B
      STAX  D
      INX   B
      INX   D
      DCR   L
      JNZ   BACK
      RST1
```

Q 8) WAP to perform OVERLAPPING BLOCK TRANSFER of 10 bytes from location 2000H to location 2004H.

Soln:

```
      MVI   L, 09H
      LXI   B, 2009H
      LXI   D, 200DH

BACK: LDAX  B
      STAX  D
      DCX   B
      DCX   D
      DCR   L
      JNZ   BACK
      RST1
```

Q 9) WAP to perform INVERTED BLOCK TRANSFER of 10 bytes from location 2000H to location 3000H.

Soln:

```
      MVI   L, 09H
      LXI   B, 2000H
      LXI   D, 3009H

BACK: LDAX  B
      STAX  D
      INX   B
      DCX   D
      DCR   L
      JNZ   BACK
      RST1
```

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Q 10) WAP to MULTIPLY two 8-bit numbers stored in location 2000H and 2001H. Store the result at 2002H and 2003H.

Soln:

```
        LXI   H, 0000H
        LXI   D, 0000H

        LDA   2000H       ; Take multiplicand in A
        ADI   00H         ; Check for zero
        JZ    EXIT        ; If zero, then simply exit
        MOV   E, A        ; Else take multiplicand into E

        LDA   2001H       ; take multiplier in A
        ADI   00H         ; Check for zero
        JZ    EXIT        ; If zero, then simply exit
        MOV   C, A        ; Else take multiplier in C as the count

BACK:   DAD   D           ; Add multiplicand to itself
        DCR   C           ; C number of times
        JNZ   BACK

EXIT:   SHLD  2002H       ; Store the result as required
        RST1
```

Q 11) WAP to divide two 8-bit numbers stored at 2000H and 2001H. Store the result at 2002H and 2003H.

Soln:

```
        LXI   H, 2000H
        MOV   B, M        ; Take dividend in B
        INX   H
        MOV   A, M        ; Take divisor in A
        ADI   00H         ; Check for zero
        JZ    EXIT        ; If zero, its an INVALID operand. Simply exit.

        MOV   A, B        ; A gets the dividend
        MOV   B, M        ; B gets the divisor
        MVI   C, 00H      ; C will be the quotient

BACK:   CMP   B           ; A - B
        JC    DONE        ; no further steps as A < B
        SUB   B           ; A ← A - B
        INR   C
        JMP   BACK

DONE:   STA   2002H       ; Store remainder
        MOV   A, C
        STA   2003H       ; Store quotient
EXIT:   RST1
```

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Q 12) WAP to generate a delay of 1 msec using 8085 working at 3 MHz.

Soln:

```
DLAY: MVI   B, XXH      ; 7 T-states … … … Count is calculated later
BACK: DCR   B           ; 4 T-states … … … Decrement Count
      JNZ   BACK        ; 10T (true) / 7T (false)
      RET               ; 10T-states
```

T_D = MT + [(Count)$_d$ x NT] – 3T

Here MT = Time outside the loop = 17T
NT = Time inside the loop = 14T

T_D = 17T + [(Count)$_d$ x 14T] – 3T

Required T_D = 1 msec = 10^{-3} sec
Given 1T = 0.333 µsec = 0.333 x 10^{-6} sec

Substituting the above values we get:

10^{-3} = 17x(0.333x10^{-6}) + [(Count)$_d$ x 14x(0.333x10^{-6})] – 3x(0.333x10^{-6})

Dividing by (0.333 x 10^{-6}) we get:

3003 = 17 + [(Count)$_d$ x 14] + 3

2983 = [(Count)$_d$ x 14]

213 = (Count)$_d$

Count = D5H

Similarly any other required delay can be achieved.
In this method, the max-delay achieved is 1.18 msec with count = FFH.
In the above calculations, the value of "1T" will change if operating frequency is anything other than 3 MHz.
If frequency is not given, then you can assume it to be 3 or 5 MHz.

Q 13) WAP to generate a delay of 0.5 msec using 8085 working at 3 MHz.

Soln: "Home-work"

Answer: Count = 6AH

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Q 14) WAP to generate a SQUARE-WAVE of 1 KHz using SOD pin of 8085.

Soln:

```
BACK: MVI   A, 40H      ; SIM Command = 0100  0000
      SIM
      CALL  DLAY
      MVI   A, C0H      ; SIM Command = 1100  0000
      SIM
      CALL  DLAY
      JMP   BACK
```

For a square wave of 1 KHz, the time period is 1 msec.
Hence the required delay is of 0.5 msec.
Assume 8085 is working at 3 MHZ

```
DLAY: MVI   B, XXH      ; 7 T-states … … … Count is calculated later
BACK: DCR   B           ; 4 T-states … … … Decrement Count
      JNZ   BACK        ; 10T (true) / 7T (false)
      RET               ; 10T-states
```

T_D = MT + [(Count)$_d$ x NT] – 3T
Here MT = Time outside the loop = 17T
NT = Time inside the loop = 14T
T_D = 17T + [(Count)$_d$ x 14T] – 3T
Required T_D = 0.5 msec = 0.5 x 10^{-3} sec
1T = 0.333 µsec = 0.333 x 10^{-6} sec
Substituting the above values we get:
$0.5x10^{-3} = 17x(0.333x10^{-6}) + [(Count)_d \times 14x(0.333x10^{-6})] - 3x(0.333x10^{-6})$
Count = 6AH

Q 15) WAP to transfer the value 35H serially with one start bit "0" and one stop bit "1".

Soln: Serial communication happens bit by bit starting from the LSB.
As per the question, we need to send the start bit (0), then the data and finally the stop bit (1).
Hence a total of 10 bits will move out as follows:

```
  0              1 0 1 0 1 1 0 0           1
Start      8-data bits in reverse order    Stop
```

```
      MVI   A, 40H      ; start bit (0)
      SIM
      MVI   A, C0H      ; send a "1"
      SIM
      MVI   A, 40H      ; send a "0"
      SIM
      MVI   A, C0H      ; send a "1"
      SIM
      MVI   A, 40H      ; send a "0"
      SIM
      MVI   A, C0H
      SIM               ; send a "1"
      SIM               ; send a "1" again
      MVI   A, 40H      ; send a "0"
      SIM
      SIM               ; send a "0" again
      MVI   A, C0H      ; send a "1" as the stop bit
      SIM
      RST1
```

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Q 16) WAP to transfer the value 35H serially with one start bit (0) and one stop bit (1) at a Baud rate of 2400. Assume 8085 is working at 3 MHz.

Soln: Baud rate is the rate at which data is send.
BR = 2400 means 2400 bits have to be sent in 1 second.
Hence the delay between sending two bits is of (1/2400) seconds.
$T_D = 0.41667 \times 10^{-3}$ sec

```
DLAY: MVI   B, XXH      ; 7 T-states … … … Count is calculated later
BACK: DCR   B           ; 4 T-states … … … Decrement Count
      JNZ   BACK        ; 10T (true) / 7T (false)
      RET               ; 10T-states
```

$T_D = MT + [(Count)_d \times NT] - 3T$
Here MT = Time outside the loop = 17T
NT = Time inside the loop = 14T
$T_D = 17T + [(Count)_d \times 14T] - 3T$

Required $T_D = 0.41667$ msec $= 0.41667 \times 10^{-3}$ sec
$1T = 0.333$ µsec $= 0.333 \times 10^{-6}$ sec
Substituting the above values we get:
$0.41667 \times 10^{-3} = 17 \times (0.333 \times 10^{-6}) + [(Count)_d \times 14 \times (0.333 \times 10^{-6})] - 3 \times (0.333 \times 10^{-6})$
Count = 58H

A total of 10 bits will move out as follows:

```
  0              1 0 1 0 1 1 0 0           1
Start       8-data bits in reverse order   Stop
```

```
   MVI   A, 40H      ; start bit (0)
   SIM
   CALL  DLAY
   MVI   A, C0H      ; send a "1"
   SIM
   CALL  DLAY
   MVI   A, 40H      ; send a "0"
   SIM
   CALL  DLAY
   MVI   A, C0H      ; send a "1"
   SIM
   CALL  DLAY
   MVI   A, 40H      ; send a "0"
   SIM
   CALL  DLAY
   MVI   A, C0H
   SIM               ; send a "1"
   CALL  DLAY
   SIM               ; send a "1" again
   CALL  DLAY
   MVI   A, 40H      ; send a "0"
   SIM
   CALL  DLAY
   SIM               ; send a "0" again
   CALL  DLAY
   MVI   A, C0H      ; send a "1" as the stop bit
   SIM
   CALL  DLAY
   RST1
```

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Q 17) WAP to transfer a RANDOM NUMBER stored at location 2000H serially with a start bit (0) and a stop bit (1).

Soln:

```
        LDA   2000H       ; read number in A
        MOV   B, A        ; store number in B
        MVI   C, 08H      ; count

        MVI   A, 40H      ; send "zero" as the start bit
        SIM

BACK:   MOV   A, B        ; get the number
        RRC               ; get its LSB in Carry flag
        MOV   B, A        ; store rotated number in B for next iteration
        JC    ONE         ; if carry flag is "1" then go to send a "one"
        MVI   A, 40H      ; else send a "zero"
        SIM
        JMP NEXT
ONE:    MVI   A, COH      ; send a "one"
        SIM
NEXT:   DCR C
        JNZ BACK          ; repeat for all 8-bits

        MVI A, C0H        ; send a "one" as the stop bit
        SIM
        RST1
```