

5. (3) Suppose the following code is executed:

```
LDA#   $C0
OUTB   $00
INB    $00
HLT
```

What does the Accumulator contain after the HLT instruction, assuming no characters have been entered?

6. (10) Given the following code sequence:

```
        .EQU    @,$000
V1:     .WORD   $8
V2:     .WORD   $16
V3:     .WORD   $FEDCBA
START:  LDX#    V2
        LDC     START
        STC     START+3
        LDX     V1
        STC     V3
        HLT
        .END
```

What memory locations and registers are **altered** by the execution of this program? Show the values of the registers and memory locations that have **changed** when the program terminates. Assume the program begins execution at "START".

ACC = XR = PC = SP =
MEM[] = MEM[] = MEM[] = MEM[] =

9. (18) The following is an interrupt-driven print string program. This program will not work as shown - there are at least 6 lines missing that are necessary in order to make the program function correctly. Your task is to fill in the missing lines.

```

                .EQU          @,$000
                .EQU          PRT_CNTL, $010
                .EQU          PRT_DATA, $011
MAIN:          LDA#           $80
                OUTB          PRT_CNTL           ; Enable interrupts
CHECK:         INB            PRT_CNTL           ; get status of printer
                JGE            CHECK             ; check to see if it is ready
                LDC            STRING
                OUTB          PRT_DATA           ; send character to printer
                STX            INDEX            ; update index
                INC            INDEX            ; add 1 to index
                LDS#           $E00
DOWORK:        NOP
                JMP            DOWORK
ISR:           PSHA           ; save registers
                PSHX
                LDX            INDEX            ; Pick up string char.
                CMX            LENGTH           ; Check to see if we are done
                JEQ            DONE
                LDC            STRING           ; output not complete -
                OUTB          PRT_DATA           ; print character
                STX            INDEX            ; store updated index
                JMP            EXIT
DONE:          LDA#           $C0              ; output complete -
                OUTB          PRT_CNTL           ; clear interrupt pending bit
EXIT:          POPX           ; restore regs
                IRTN
INDEX:         .WORD
STRING:        .CHAR          'Print this!',LENGTH

```

ASCII Table (MSD = Most Significant Digit)																
MSD (Hex)	Least Significant Digit (Hex)															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2	space	!	"	#	\$	%	&	,	()	*	+	'	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
6	'	a	b	c	d	e	f	g	h	i	h	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{		}		del

Instructions:

Instruction	Opcode (in Hex)
LDA	00
LDX	01
LDS	02
LDF	03
STA	04
STX	05
STS	06
STF	07
ADA	10
ADX	11
ADS	12
ADF	13
SBA	14
SBX	15
SBS	16
SBF	17
CMA	20
CMX	21
CMS	22
CMF	23
HLT	FFFFFF

Addressing Modes:

Mode	Opcode
Immediate	0
Frame Immediate	1
Direct	2
Frame Direct	3
Indexed	4
Frame Indexed	5
Indirect	6
Indirect Indexed	8

I/O Port Information:

I/O Port	Register
\$000	Keyboard Control
\$000	Keyboard Status
\$010	Printer Control
\$010	Printer Status
\$020	Tape Drive Control
\$020	Tape Drive Status
\$030	Timer Control
\$030	Timer Status
\$316	CRT Control

Keyboard		
Register	Bit Number 7654 3210	Interpretation
Control	x--- ---- -x-- ---- --xx xxxx	1 = enable interrupts, 0 = disable interrupts 1 = flush buffer, 0 = no operation unused (no affect)
Status	x--- ---- -x-- ---- --xx xxxx	1 = ready (data available) 1 = interrupt enabled unused (always zero)
Interrupt Addr		\$FF8

Tape Drive		
Register	Bit Number 7654 3210	Interpretation
Control	x--- ---- -x-- ---- --xx ---- ---- xxxx	1 = enable interrupts, 0 = disable interrupts 1 = clear interrupt request, 0 = no operation 00 = no operation 01 = read record 10 = write record 11 = rewind tape unused (no affect)
Status	x--- ---- -x-- ---- --x- ---- ---x ---- ---- 1--- ---- -xxx	1 = ready (to begin new operation) 1 = interrupt enabled 1 = tape mounted 1 = interrupt pending 1 = end of tape encountered on read unused (always zero)
Interrupt Addr		\$FFA

Printer		
Register	Bit Number 7654 3210	Interpretation
Control	x--- ---- -x-- ---- --xx xxxx	1 = enable interrupts, 0 = disable interrupts 1 = clear interrupt request, 0 = no operation unused (no affect)
Status	x--- ---- -x-- ---- --x- ---- ---x ---- ---- xxxx	1 = ready (to receive character) 1 = interrupt enabled 1 = printer on-line 1 = interrupt pending unused (always zero)
Interrupt Addr		\$FF9

Timer		
Register	Bit Number 7654 3210	Interpretation
Control	x--- ---- -x-- ---- --xx ---- ---- xxxx	1 = enable interrupts, 0 = disable interrupts 1 = clear ready bit, 0 = no operation 00 = no operation 01 = start timer (after loading counter) 10 = stop timer 11 = start timer (without loading counter) unused (no affect)
Status	x--- ---- -x-- ---- --xx xxxx	1 = ready (count complete) 1 = interrupt enabled unused (always zero)
Interrupt Addr		\$FFB