C 0 1 1 1 1 DC

(1) a) 93_{10} $0101\ 1101_2$ $5D_H$

$+122_{10}$ $+\ 0111\ 1010_2$ $+\ 7A_H$

215_{10} $1101\ 0111$ $D7_H$

N

OV = 1 Z = 0

b) No Carry ⇒ Branch to SAVE ⇒ SUM = D7

c) STATUS = N OV Z DC C = 1 1 0 1 0 = $1A_H$

(2) WREG = $C7_H$ = 11000111_2

RESULT = $C7_H$ = 11000111_2

↑ BCF

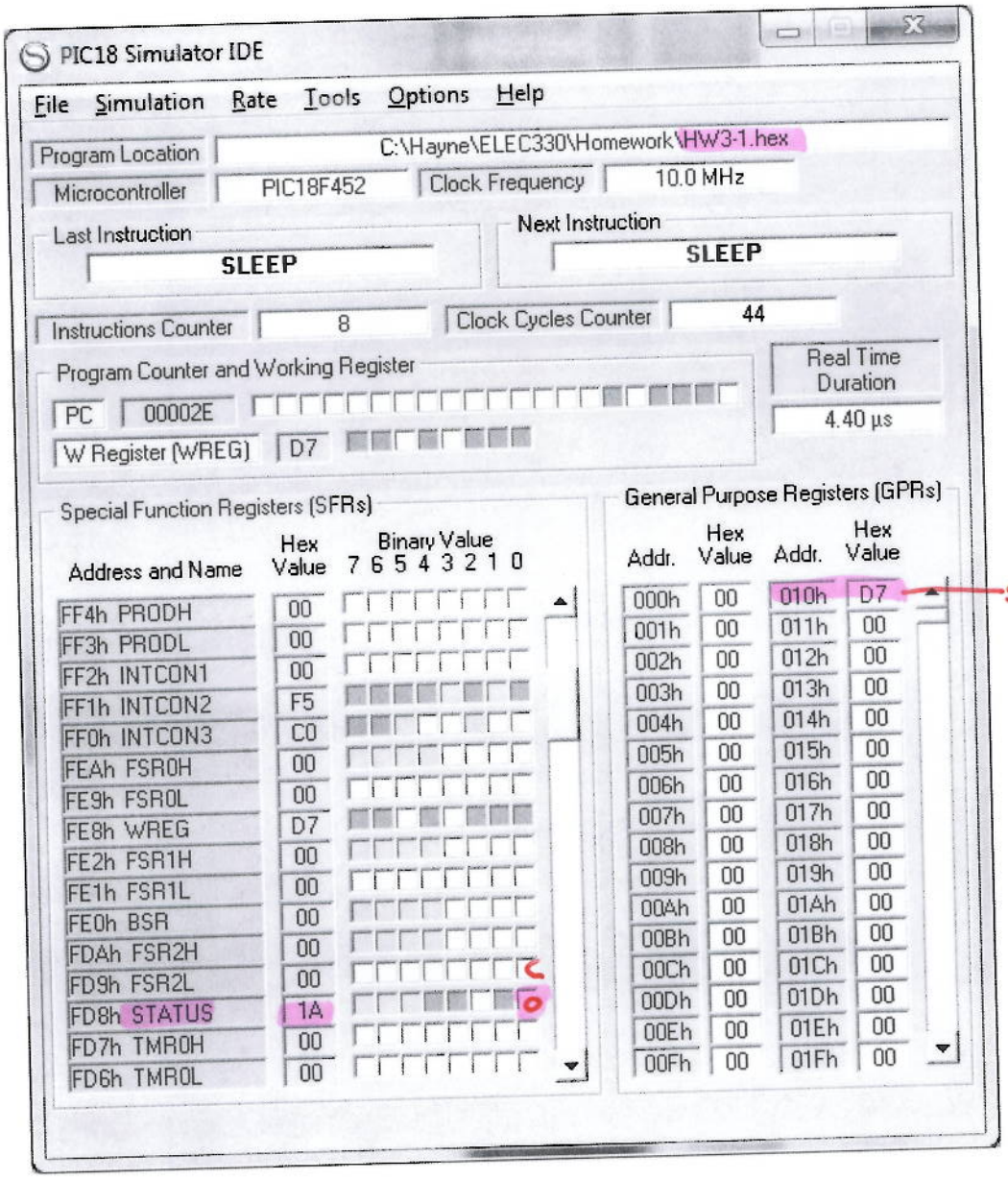
RESULT = 47_H = 01000111_2

b) No Flags affected ⇒ STATUS = N OV Z DC C = 00000 = 00_H

BN N=0 ⇒ No Branch

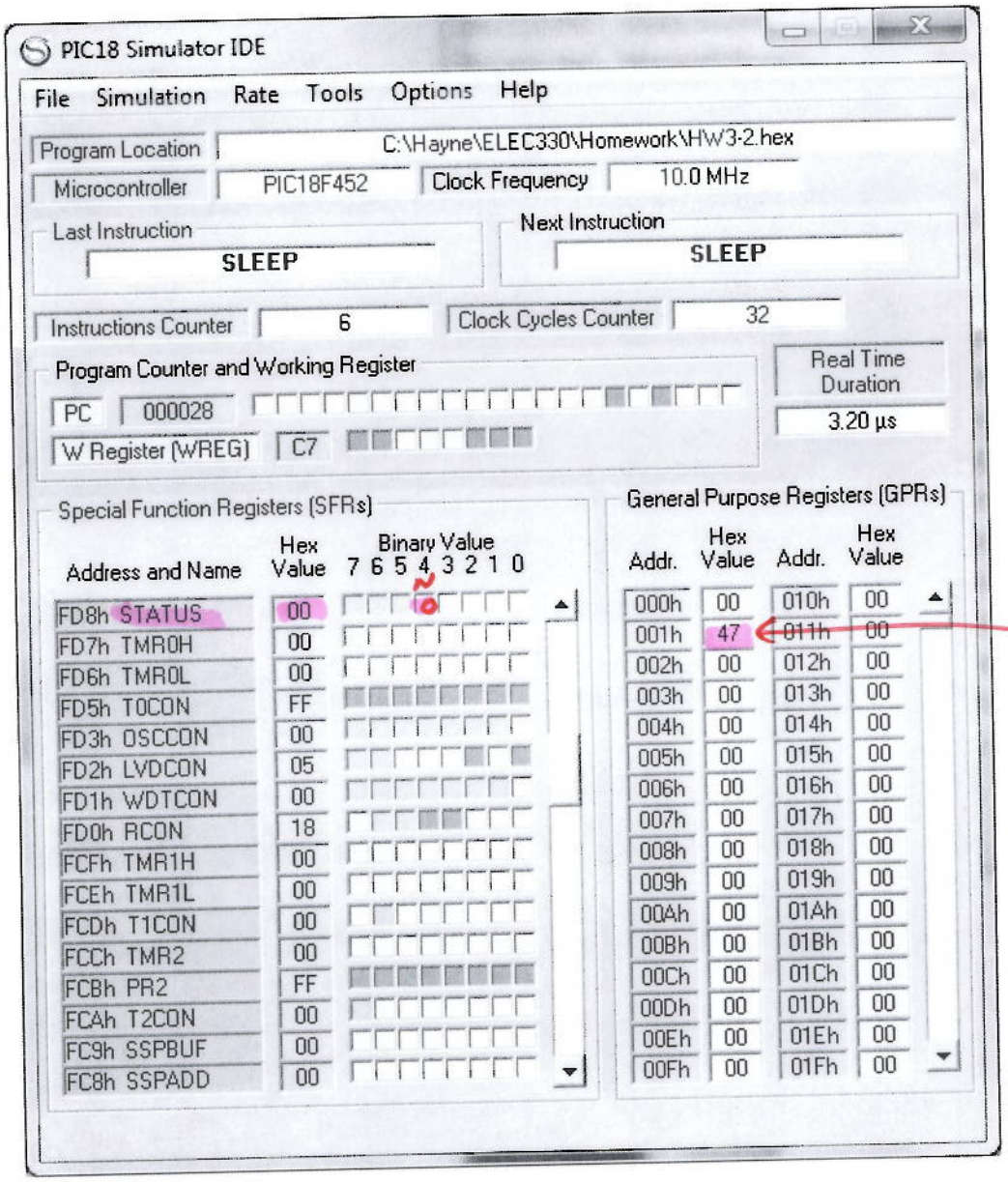
a) Final RESULT = 47_H

```
'IC ASSEMBLER LISTING
Line    Address Opcode  Instruction
-----------------------------------------
0001    000000          ;Line removed by MPASMWIN preprocessor:         #include <p18F452.inc>
0002    000000          SUM     EQU     0x10
0003    000000                  ORG     0x00
0004    000000  EF10            GOTO    START
0004    000002  F000
0005    000004                  ORG     0x20
0006    000020  0E5D    START:  MOVLW   D'93'
0007    000022  6E10            MOVWF   SUM
0008    000024  0E7A            MOVLW   D'122'
0009    000026  2410            ADDWF   SUM,W
0010    000028  E301            BNC     SAVE
0011    00002A  68E8            SETF    WREG
0012    00002C  6E10    SAVE:   MOVWF   SUM
0013    00002E  0003            SLEEP
0014    000030                  END
-----------------------------------------
Number of errors = 0
```


PIC18 Simulator IDE
File Simulation Rate Tools Options Help
Program Location
C:\Hayne\ELEC330\Homework\HW3-1.hex
Microcontroller
PIC18F452
Clock Frequency
10.0 MHz
Last Instruction
SLEEP
Next Instruction
SLEEP
Instructions Counter
8
Clock Cycles Counter
44
Program Counter and Working Register
PC
00002E
W Register (WREG)
D7
Real Time Duration
4.40 µs
Special Function Registers (SFRs)
Address and Name
Hex Value
Binary Value 7 6 5 4 3 2 1 0
FF4h PRODH 00
FF3h PRODL 00
FF2h INTCON1 00
FF1h INTCON2 F5
FF0h INTCON3 C0
FEAh FSR0H 00
FE9h FSR0L 00
FE8h WREG D7
FE2h FSR1H 00
FE1h FSR1L 00
FE0h BSR 00
FDAh FSR2H 00
FD9h FSR2L 00
FD8h STATUS 1A
FD7h TMR0H 00
FD6h TMR0L 00
General Purpose Registers (GPRs)
Addr. Hex Value Addr. Hex Value
000h 00 010h D7
001h 00 011h 00
002h 00 012h 00
003h 00 013h 00
004h 00 014h 00
005h 00 015h 00
006h 00 016h 00
007h 00 017h 00
008h 00 018h 00
009h 00 019h 00
00Ah 00 01Ah 00
00Bh 00 01Bh 00
00Ch 00 01Ch 00
00Dh 00 01Dh 00
00Eh 00 01Eh 00
00Fh 00 01Fh 00
SUM

HW3-2.lst

```
'IC ASSEMBLER LISTING
Line    Address Opcode  Instruction
--------------------------------------------
0001    000000          ;Line removed by MPASMWIN preprocessor:          #include <p18F452.inc>
0002    000000          BYTE    EQU     0xC7
0003    000000          RESULT  EQU     0x01
0004    000000                  ORG     0x00
0005    000000  EF10            GOTO    START
0005    000002  F000
0006    000004                  ORG     0x20
0007    000020  0EC7    START:  MOVLW   BYTE
0008    000022  6E01            MOVWF   RESULT
0009    000024  E601            BN      NEXT
0010    000026  9E01            BCF     RESULT,7
0011    000028  0003    NEXT:   SLEEP
0012    00002A                  END
--------------------------------------------
Number of errors = 0
```


PIC18 Simulator IDE
File Simulation Rate Tools Options Help
Program Location
C:\Hayne\ELEC330\Homework\HW3-2.hex
Microcontroller
PIC18F452
Clock Frequency
10.0 MHz
Last Instruction
SLEEP
Next Instruction
SLEEP
Instructions Counter
6
Clock Cycles Counter
32
Program Counter and Working Register
PC
000028
W Register (WREG)
C7
Real Time Duration
3.20 µs
Special Function Registers (SFRs)
Address and Name
Hex Value
Binary Value 7 6 5 4 3 2 1 0
FD8h STATUS 00
FD7h TMR0H 00
FD6h TMR0L 00
FD5h T0CON FF
FD3h OSCCON 00
FD2h LVDCON 05
FD1h WDTCON 00
FD0h RCON 18
FCFh TMR1H 00
FCEh TMR1L 00
FCDh T1CON 00
FCCh TMR2 00
FCBh PR2 FF
FCAh T2CON 00
FC9h SSPBUF 00
FC8h SSPADD 00
General Purpose Registers (GPRs)
Addr. Hex Value Addr. Hex Value
000h 00 010h 00
001h 47 011h 00
002h 00 012h 00
003h 00 013h 00
004h 00 014h 00
005h 00 015h 00
006h 00 016h 00
007h 00 017h 00
008h 00 018h 00
009h 00 019h 00
00Ah 00 01Ah 00
00Bh 00 01Bh 00
00Ch 00 01Ch 00
00Dh 00 01Dh 00
00Eh 00 01Eh 00
00Fh 00 01Fh 00
RESULT

Assemble and run the following programs using the PIC18 Simulator IDE. Your solution should include the theoretical results, the assembler listing and an annotated screen capture of the simulator showing the correct register values.

1.

```
            #include <p18F452.inc>
SUM         EQU     0x10
            ORG     0x00
            GOTO    START
            ORG     0x20
START:      MOVLW   D'93'
            MOVWF   SUM
            MOVLW   D'122'
            ADDWF   SUM,W
            BNC     SAVE
            SETF    WREG
SAVE:       MOVWF   SUM
            SLEEP
            END
```

a) Specify the results of the ADD operation.
b) Specify the answer stored in SUM.
c) Specify the final contents of the STATUS register.

2.

```
            #include <p18F452.inc>
BYTE        EQU     0xC7
RESULT      EQU     0x01
            ORG     0x00
            GOTO    START
            ORG     0x20
START:      MOVLW   BYTE
            MOVWF   RESULT
            BN      NEXT
            BCF     RESULT,7
NEXT:       SLEEP
            END
```

a) Specify the answer stored in RESULT.
b) Specify the final contents of the STATUS register.