



Answers To Assembly Exercise On Page 158

1) The assembled programs are given in the box on the right.

Notice that the symbols BYTE1 and BYTE2 are used as both immediate symbolic data, and as symbolic addresses. When they are used as the latter, however, they need to be assembled in two-byte form.

2) The 'return from subroutine' instruction is missing from the end of both programs. In the 6502 version, the completed code would need to include the following line:

```
A00D      60          RTS
```

and the Z80 version needs this line:

```
A00D      C9          RET
```

3) The value \$45 is first loaded into the accumulator register as immediate data, and then \$45 is added on top of it, so that the accumulator contains the value \$8A. This accumulated total is then stored in RAM at address \$0045. The value \$38 is then added into the accumulator as immediate data, so that the accumulator now contains the value \$C2 (\$45 + \$45 + \$38). This total is finally stored in RAM at location \$0038.

4) 'Immediate data' is data that is actually stored in the instruction. In the instructions we gave in the exercise programs (such as LDA #S9C and LD A,SE4) the values S9C and SE4 are the data to be loaded into the accumulator. They are stored in the instructions of which they are operands, and comprise the contents of the byte immediately following the op-code. If data is not available, then it must be stored in some other part of memory, and be referred to by its address rather than its value.

5) The value of BYTE1 is given as \$45, which properly written gives memory location \$0045. Clearly, this address is on page zero of memory.

Exercise

We may wish to examine the contents of the processor status register (PSR), and it will be convenient to display this number as a binary rather than a hex byte. We include here the Spectrum version of a 'decimal-to-binary conversion subroutine'. This exercise asks you to patch this into the Monitor program on page 118.

```
7000 REM*****BINARY BYTE S/R*****
7001 REM*CONVERTS A NUMBER N (<256)*
7002 REM*TO AN 8-CHARACTER BINARY *
7003 REM*REPRESENTATION IN B# *
7010 B#=""
7020 FOR D=8 TO 1 STEP-1
7030 LET N1=INT(N/2)
7040 LET R=N-2*N1
7050 LET B#=STR$(R)+B#
7060 LET N=N1
7070 NEXT D
7080 RETURN
```

Basic Flavours

On the Commodore 64, change line 7050 in the subroutine to:

```
7050 BS=MIDS(STR$(R),2)+BS
```

Location Address	Machine Code	Assembly Language
6502		
0000		START EQU SA000
0000		BYTE1 EQU \$45
0000		BYTE2 EQU \$38
0000		ORG START
A000	A9 45	LDA #BYTE1
A002	18	CLC
A003	69 45	ADC #BYTE1
A005	8D 45 00	STA BYTE1
A008	69 38	ADC #BYTE2
A00A	8D 38 00	STA BYTE2
Z80		
0000		START EQU SA000
0000		BYTE1 EQU \$45
0000		BYTE2 EQU \$38
0000		ORG START
A000	3E 45	LD A,BYTE1
A002	A7	AND A
A003	CE 45	ADC A,BYTE1
A005	32 45 00	LD (BYTE1),A
A008	CE 38	ADC A,BYTE2
A00A	32 38 00	LD (BYTE2),A

Data Base

