

Chapter 4: 8, 16, 18, 26

Chapter 5: 19 a,c,e; 22 b; 24 a

Additional problems:

1. Explain the role of DDRx, PORTx, and PINx in I/O operations.
2. A switch is connected to pin PC4 and an LED to pin PC5. Write a program to get the status of the switch (SW) and send it to the LED. Assume that the LED is common anode (0 turns the LED on and 1 turns the LED off). When SW = 1, the LED should be on. When SW = 0, the LED should be off.
3. Work with your project team to create an Microchip Studio workspace for the ATmega32. Copy the code from your solution to Chapter 4: Problem 26. Single Step execute the program and use the Microchip Studio simulation for the I/O PINS to change the input pin values and observe the output PORT bit values. Submit a screen shot of your program simulation showing the PIN and PORT registers.
4. Which of the following are invalid uses of the single register/immediate addressing mode?
a) LDI R16, 0x32 b) STS 0x62, R17 c) STS 0x42, 0x01 d) OUT 0x15, R19
e) OUT PORTB, 0x35 f) OUT 0x18, 0x19
5. Identify the addressing mode for each of the following (single register/immediate; register, direct address, register indirect):
a) OUT PORTA, R19 b) STS 0x20, R19 c) SUB R18, R31 d) MOV R1, R2
e) STS Z, R19
6. For the following assembler directives, determine the contents for each ROM location:

 .ORG 0x100

 Data: .DB 0x10, 0x48, 48, 0b11110000, 0xAB, 0b10001110
7. Which of the following instructions are valid? If the instruction is valid, which bit is altered?
a) CBI PORTB, 5 b) CBR R16, 3 c) SBR R21, 0 d) BLD PORTA, 2
8. Write an assembly program that finds the number of 0s in an 8-bit data item.

SECTION 4.1: I/O PORT PROGRAMMING IN AVR

1. The ATmega32 has a DIP package of ____ pins.
 2. In ATmega32, how many pins are assigned to V_{CC} and GND?
 3. In the ATmega32, how many pins are designated as I/O port pins?
 4. How many pins are designated as PORTA in the 40-pin DIP package and what are their numbers?
 5. How many pins are designated as PORTB in the 40-pin DIP package and what are their numbers?
 6. How many pins are designated as PORTC in the 40-pin DIP package and what are their numbers?
 7. How many pins are designated as PORTD in the 40-pin DIP package and what are their numbers?
 8. Upon reset, all the bits of ports are configured as ____ (input, output).
 9. Explain the role of DDRx and PORTx in I/O operations.
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10. Write a program to get 8-bit data from PORTC and send it to PORTB and PORTD.
11. Write a program to get 8-bit data from PORTD and send it to PORTB and PORTC.
12. Which pins are for Rx/D and Tx/D?
13. Give data memory location assigned to DDR registers of Ports A–C for the ATmega32.
14. Write a program to toggle all the bits of PORTB and PORTC continuously
(a) using 0xAA and 0x55 (b) using the COM instruction.

SECTION 4.2: I/O BIT MANIPULATION PROGRAMMING

15. Which ports of the ATmega32 are bit-addressable?
16. What is the advantage of bit-addressability for AVR ports?
17. Is the instruction "COM PORTB" a valid instruction?
18. Write a program to toggle PB2 and PB5 continuously without disturbing the rest of the bits.
19. Write a program to toggle PD3, PD7, and PC5 continuously without disturbing the rest of the bits.
20. Write a program to monitor bit PC3. When it is HIGH, send 0x55 to PORTD.
21. Write a program to monitor the PB7 bit. When it is LOW, send \$55 and \$AA to PORTC continuously.
22. Write a program to monitor the PA0 bit. When it is HIGH, send \$99 to PORTB. If it is LOW, send \$66 to PORTB.
23. Write a program to monitor the PB5 bit. When it is HIGH, make a LOW-to-HIGH-to-LOW pulse on PB3.
24. Write a program to get the status of PC3 and put it on PC4.
25. Create a flowchart and write a program to get the statuses of PD6 and PD7 and put them on PC0 and PC7, respectively.
26. Write a program to monitor the PB5 and PB6 bits. When both of them are HIGH, send \$AA to PORTC; otherwise, send \$55 to PORTC.
27. Write a program to monitor the PB5 and PB6 bits. When either of them is HIGH, send \$AA to PORTC; otherwise, send \$55 to PORTC.
28. Referring to Figure 4-8 and Table 4-8, write the machine equivalent of "SBIS PINB,3".
29. Referring to Figure 4-6 and Table 4-8, write the machine equivalent of the "SBI PORTA,2" instruction.

SECTION 5.3: LOGIC AND COMPARE INSTRUCTIONS

19. Find the contents of register R20 after each of the following instructions:

- | | | | |
|-----|----------------|-----|---------------|
| (a) | LDI R20, 0x65 | (b) | LDI R20, 0x70 |
| | LDI R21, 0x76 | | LDI R21, 0x6B |
| | AND R20, R21 | | OR R20, R21 |
| (c) | LDI R20, 0x95 | (d) | LDI R20, 0x5D |
| | LDI R21, 0xAA | | LDI R21, 0x75 |
| | EOR R20, R21 | | AND R20, R21 |
| (e) | LDI R20, 0x0C5 | (f) | LDI R20, 0x6A |
| | LDI R21, 0x12 | | LDI R21, 0x6E |
| | OR R20, R21 | | EOR R20, R21 |
| (g) | LDI R20, 0x37 | | |
| | LDI R21, 0x26 | | |
| | OR R20, R21 | | |

20. Explain how the BRSH instruction works.

21. Does the compare instruction affect the flag bits of the status register?

22. Assume that R20 = 85H. Indicate whether the conditional branch is executed in each of the following cases:

- | | | | |
|-----|---------------|-----|---------------|
| (a) | LDI R21, 0x90 | (b) | LDI R21, 0x70 |
| | CP R20, R21 | | CP R20, R21 |
| | BRLO NEXT | | BRSH NEXT |
| | ... | | ... |

23. For Problem 22, indicate the value in R20 after execution of each program.

SECTION 5.4: ROTATE AND SHIFT INSTRUCTIONS AND DATA SERIALI- ZATION

24. Find the contents of R20 after each of the following is executed:

(a) LDI R20, 0x56
SWAP R20
CLC
ROR R20
ROR R20

(b) LDI R20, 0x39
SEC
ROL R20
ROL R0

(c) CLC
LDI R20, 0x4D
SWAP R20
ROL R20
ASR R20

(d) CP R20, R20
LDI R20, 0x7A
ROR R20

25. Show the code to replace the SWAP instruction:

- (a) using the ROL instruction
- (b) using the ROR instruction

26. Write a program that finds the number of zeros in an 8-bit data item.

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27. Write a program that finds the position of the first high in an 8-bit data item.
The data is scanned from D0 to D7. Give the result for 68H.
28. Write a program that finds the position of the first high in an 8-bit data item.
The data is scanned from D7 to D0. Give the result for 68H.