Problem 1. Assume the code segment below is executed. Which of the choices below correctly describes what happens as a result?

(a) The value 43H is written to Port 0.
(b) The two numbers on top of the stack are copied to memory locations 42H and 43H.
(c) The two numbers 52 and 80H are copied to the stack.
(d) The two numbers 42H and 43H are copied to the stack.
(e) Two bytes are pushed to the stack and two bytes are popped from the stack.

```
MOV 42H,#52
MOV 43H,#80H
PUSH 42H
PUSH 43H
```

Problem 2. CJNE is a 3-byte, 2-cycle instruction, while DJNZ is a 2-byte, 2-cycle instruction. Which version of the `for` loop below will be more efficient? Why?
i. `for (i=0; i<20; i++)`
ii. `for (i=20; i>0; i--)`

(a) They are equally efficient.
(b) Version i, as the resulting code utilizes DJNZ.
(c) Version ii, as the resulting code utilizes DJNZ.
(d) Version i, as the resulting code utilizes CJNE.
(e) Version ii, as the resulting code utilizes CJNE.

Problem 3. Assume the contents of memory begin with the values given in Figure 2. Let x be a one-byte variable located at memory address 3AH. What is the value of x after both instructions below are executed?

```
MOV R1, #27H
MOV x, @R1
```

(a) 13H
(b) 22H
(c) 27H
(d) 3AH
(e) 42H

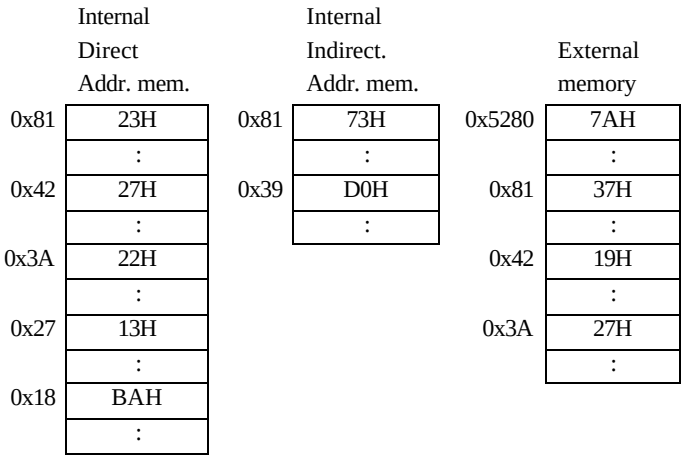

Figure 2: Contents of memory **before** instructions are executed.

Problem 4. Refer to Figure 2 for the original contents of memory. Assume the declaration `char idata y _at_ 0x81;` has been made at the top of the program. What is the value of A (the accumulator) after the instruction below is executed?

```
A = y + XBYTE[0x3A];
```

(a) AD
(b) 9AH
(c) 95H
(d) 8CH
(e) 4AH

Problem 5. Refer to Figure 2 for the original contents of memory. What is the value of x after the code segment below is executed?

(a) 13H
(b) 15H
(c) 7AH
(d) 7CH
(e) 7EH

```
DSEG  AT 27H
      x:  DS 1
CSEG  AT 00H
      MOV DPTR,#5280H
      MOVX A,@DPTR
      MOV x,A
      SETB 3AH
```

Problem 6. Assume that you are monitoring the water pressure in two separate pipes that eventually merge. Also assume that you can represent the water pressure for **each** pipe by a number between 0 and 255. You want an alarm to go off whenever the sum of the water pressure for the two pipes exceeds 400. Which precision would **most efficiently** represent the sum for the purposes of this application?

(a) char
(b) short int
(c) long int
(d) float
(e) double

Problem 7. Which of the following statements is the C equivalent of the ASM statement `MOV x, #y`? Assume that x and y are both characters and y is a location in internal memory.

(a) `x = *y;`
(b) `y = *x;`
(c) `x = y;`
(d) `x = &y;`
(e) `y = &x;`

Problem 8. Figure 3 depicts a timing diagram of the 8051 ALE, $\overline{\text{PSEN}}$, P0, and P2 signals during the fetch of two **external** code bytes. The numbers are the value of the data on the respective buses. Which are the two addresses accessed?

(a) 04H and 42H
(b) A9H and 83H
(c) A920H and 8305H
(d) 2004H and 0542H
(e) 20A9H and 0583H

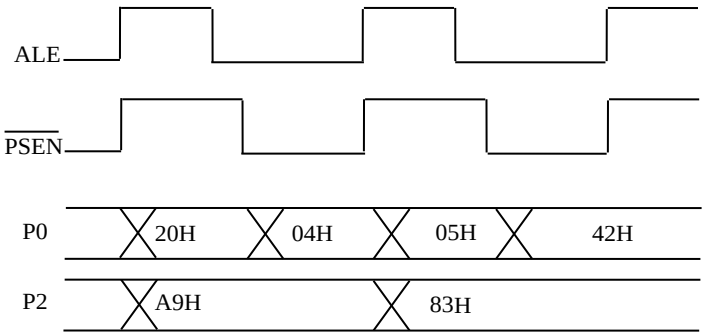

Figure 3: Timing diagram.

Problem 9. What kind of variable will x be if it is declared as: "`char data x _at_ 0x21;`"?

(a) global variable
(b) local variable
(c) array variable
(d) initialized variable
(e) can't tell

Problem 10. We would like to write a 1 to bit 3 of port 1 without changing any other bits. Which of the following segments of code accomplishes this task?

(a) `P1 = 0x08;`
(b) `P1 = P1 | 0x08;`
(c) `P1 = P1 & 0x08;`
(d) `sbit mybit = 0x94; mybit=1;`
(e) `P1^2 = 1;`

Problem 11. In which of the cases below would C code be preferable to ASM code?

(a) Safety is critical, so the program should be easy to understand and debug.
(b) A hardware driver with very precise timing requirements - on the order of microseconds
(c) One particular function is executed 90% of the time; but is a a few milliseconds too slow.
(d) The code will be phased out quickly, so maintenance of the code is not a concern.
(e) ASM is preferable in all of the above cases.

Problem 12. Which of the following is **NOT** a typical advantage of modular programming?

(a) ease of reuse
(b) speed of execution
(c) ease of debugging
(d) facilitation of team programming
(e) ease of maintenance of code

Problem 13. Which of the following instructions declares a relocatable code segment? Assume that the instruction listed is the only instruction executed for declaring the segment.

(a) `DSEG AT 300H`
(b) `CSEG AT 300H`
(c) `MYCODE SEGMENT CODE`
(d) `RSEG MYCODE`
(e) none of the above.

Problem 14. Figure 4 depicts the connection of bit 2 of Port 1 (P1.2) to two external devices. **Assume we write a "1" to P1.2 and transistor B is OFF and transistor C is ON.** If we perform a `MOV C, P1.2` instruction, which of the answers below correctly provides and justifies the resulting value of **C**?

(a) C=0, because transistor B is off.
(b) C=1, because transistor B is off.
(c) C=0, because transistor C is on.
(d) C=1, because transistor C is on.
(e) C=1, because we wrote a 1 to P1.2.

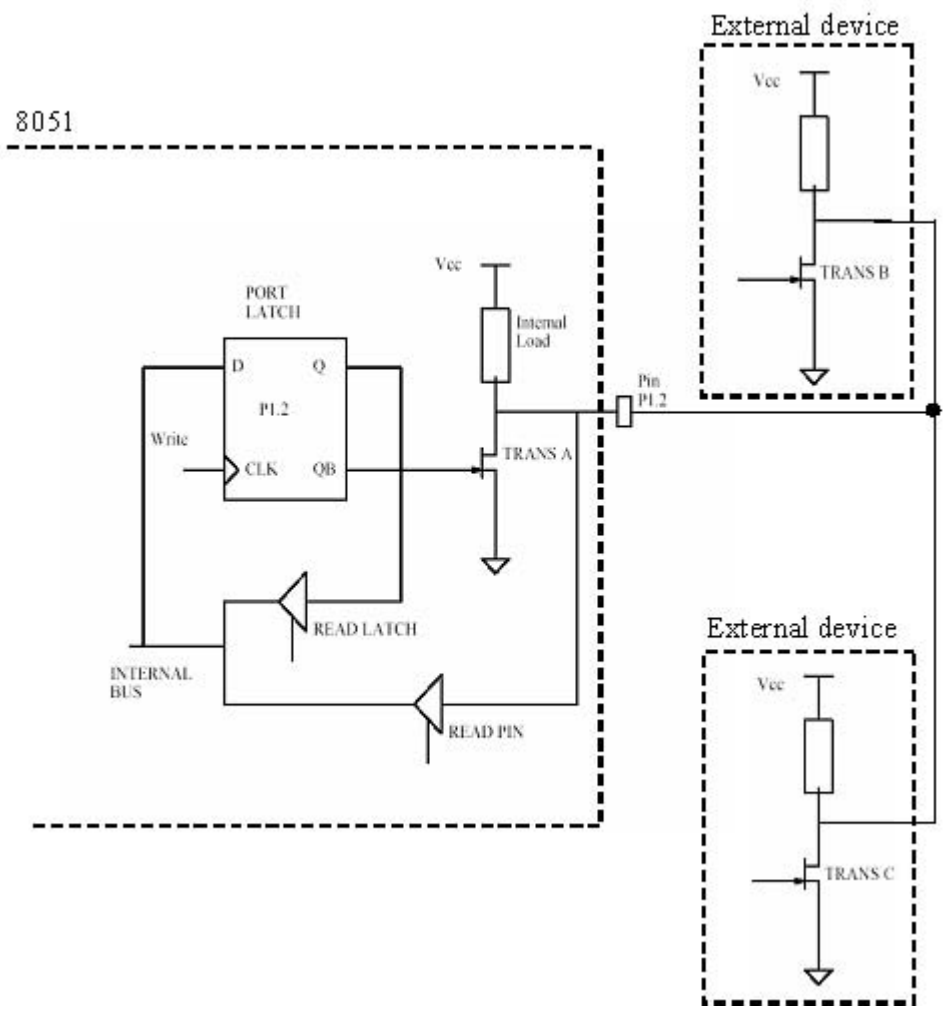

Figure 4: Bit 2 of Port 1.

Problem 15. Assume that the PC contains the address 4203H and A contains 02H before the command `MOVC A,@A+PC` is executed. The contents of a segment of external code memory are as shown in Figure 5. What will A contain after the instruction is executed?

(a) 02H
(b) 03H
(c) 04H
(d) 05H
(e) 06H

Address	Contents
4200H	00H
4201H	01H
4202H	02H
4203H	03H
4204H	04H
4205H	05H
4206H	06H
4207H	07H
4208H	08H

Figure 5: Contents of a segment of external memory.

Problem 16. Find the number of **machine cycles** needed to execute the entire delay subroutine below.
Recall that the NOP instruction takes one machine cycle to execute.

(a) 100
(b) 105
(c) 400
(d) 402
(e) 403

```
delay:  MOV R2, #100
here:   NOP
        NOP
        DJNZ R2, here
        RET
```

Problem 17. Consider the instruction "`here: CJNE A,#10H,here`." Which is the machine code for this instruction?

(a) `B4 10 FD`
(b) `B4 10 FE`
(c) `B4 FE 10`
(d) `B4 10 00`
(e) `B4 10 02`

Extra Credit Question
Extra Credit Question
Extra Credit Question

Correct answer adds 5 bonus points to your total score.

Problem 18. For the waveforms in Figure 6, which instruction is read from code memory **and** executed?

(a) `XRL A,@R1`
`(b) DEC R2`
`(c) INC A`
`(d) ORL 04H,A`
`(e) RLC A`

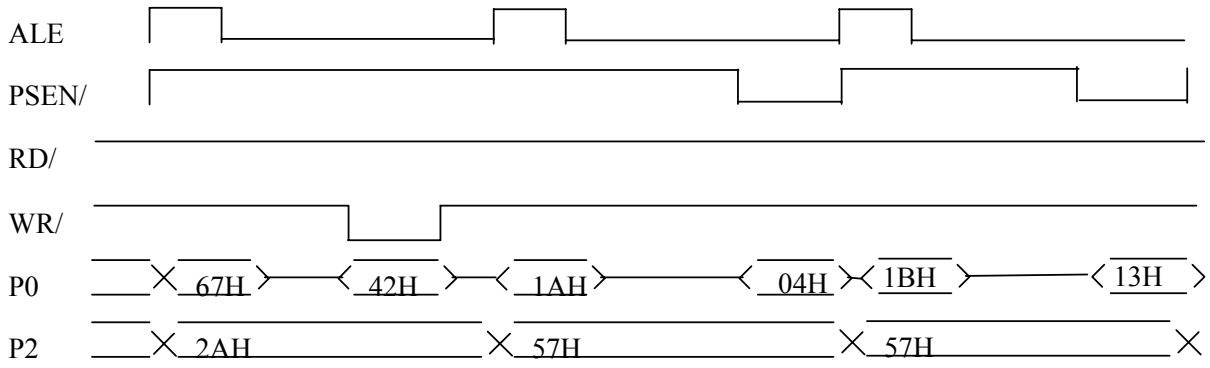

Figure 6: Timing diagram.