

Problem 1. The logic diagram in Figure 1 shows how you might use a 74HC373 octal latch (U2) and an 8k byte EPROM (U3) to expand an 8051 (U1) with an 8k external code memory space. Label AX is:

- (a) A11
- (b) A12
- (c) A13
- (d) A14
- (e) A15

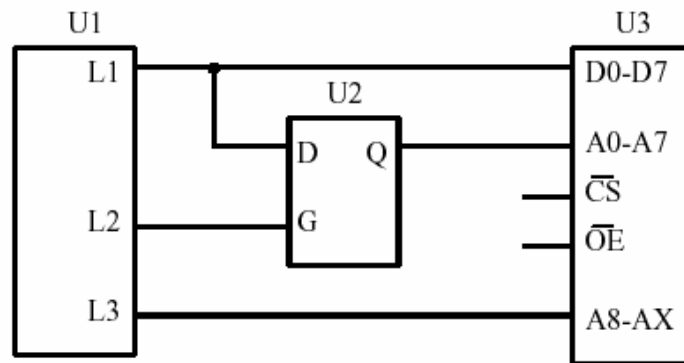


Figure 1: External code memory access.

Problem 2. For the configuration of Figure 1, assume that we are aiming to assign addresses in the range of A000 through BFFF to the locations in U3. We have used a 3-input NAND gate to create the address decoding logic connected to \overline{CS} . Which of the following bits will **NOT** be input to the NAND gate?

- (a) P2.7
- (b) P2.6
- (c) P2.5
- (d) P2.4
- (e) All of the above are input to the NAND gate.

Problem 3. 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 CJNE.
- (c) Version ii, as the resulting code utilizes CJNE.
- (d) Version i, as the resulting code utilizes DJNZ.
- (e) Version ii, as the resulting code utilizes DJNZ.

Problem 4. Given the register and memory contents given in Table 2, which bit(s) of PSW will change in value after the instruction `MOV A, @R0` is executed?

Hint: PSW.7=C, PSW.6=AC, PSW.5=General-purpose flag, PSW.4=RS1, PSW.3=RS0, PSW.2=OV, PSW.1=Not used, PSW.0=P.

- (a) PSW.0
- (b) PSW.2
- (c) PSW.3 and PSW.4
- (d) PSW.6
- (e) PSW.7

Register	Contents	Internal memory address	Contents
A	32H	35H	78H
PSW	81H	36H	80H
R0	35H	0AH	1AH

Figure 2: Register and memory contents.

Problem 5. 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) 129AH and 56BCH
- (b) 9A12H and BC56H
- (c) 1234H and 5678H
- (d) 9A34H and BC78H
- (e) 349AH and 78BCH

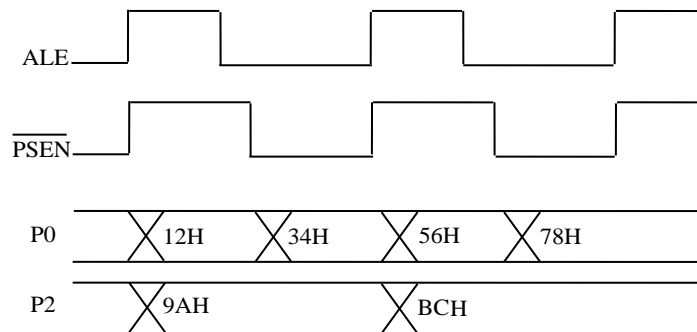


Figure 3: Timing diagram.

Problem 6. For the timing diagram of Figure 3, what is the second code byte fetched?

- (a) 9AH
- (b) 34H
- (c) 56H
- (d) BCH
- (e) 78H

Problem 7. For the code segment below, find the opcode for the “SJMP next” instruction. Assume that the SJMP instruction is stored in location 0000H.

```
        SJMP  next
        MOV   A,R0
next:    XRL   A,R0
```

- (a) 8001
- (b) 8010
- (c) 8011
- (d) 80FE
- (e) 80FD

Problem 8. What will the contents of A be after the three instructions above are executed for the first time?

- (a) Depends on the original value of A only
- (b) Depends on the original value of R0 only
- (c) Depends on the original values of both R0 and A
- (d) 00H
- (e) FFH

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

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

Problem 10. Assume that you are monitoring the current drawn by two different electrical devices. For each device, you are using an A/D converter to represent the current of the device by a number between 0 and 128. You want a fuse to blow whenever the sum of the current drawn by the two devices exceeds 255. 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 11. 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 12. 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 13. 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 14. In which of the cases below would C code be preferable to ASM code?

- (a) A hardware driver with very precise timing requirements - on the order of microseconds
- (b) Safety is critical, so the program should be easy to understand and debug.
- (c) One particular function is executed 90% of the time; but is 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 15. Assume that an 8051 is connected to a keyboard with four keys, as in Figure 4. If the code below is executed on this 8051, and a value of 7E is returned, which of the following can be concluded using only this information?

```
P3= 0x7F;
```

```
x= P3;
```

- (a) A is open
- (b) A is closed
- (c) B is open
- (d) B is closed
- (e) none of the above.

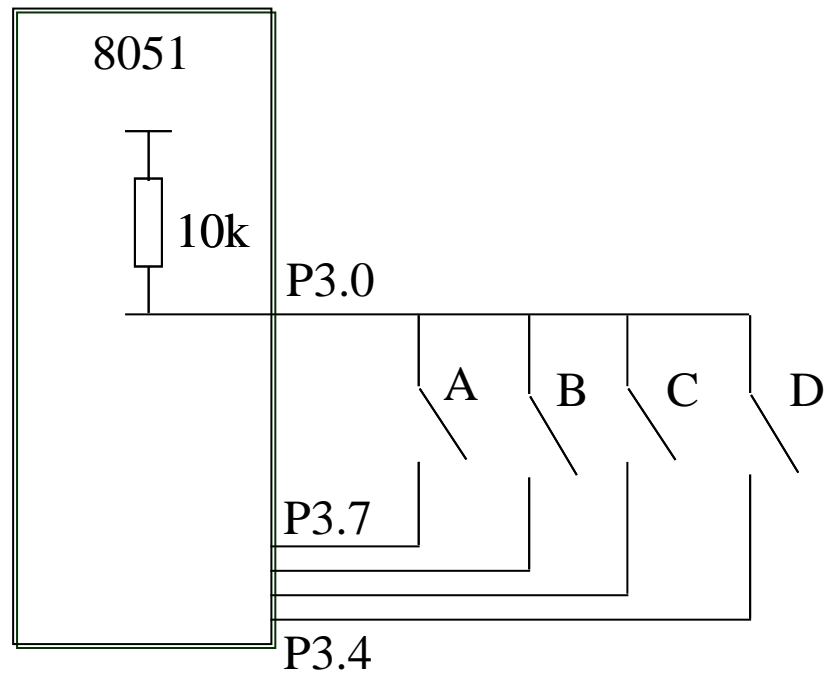


Figure 4: 4-key circuit.

Problem 16. Which of the 8051's interrupt sources is non-maskable?

- (a) EX0
- (b) EX1
- (c) TF0
- (d) TF1
- (e) none of the above.

Problem 17. Which of the following C programming keywords is most useful in facilitating context switching for the 8051?

- (a) void
- (b) for
- (c) using
- (d) return
- (e) sbit

Problem 18. Assume we execute the following instruction:

`MOV IE,#96H`. Which interrupts are **NOT** enabled after the instruction executes?

(Hint: IE.7 = EA, IE.5 = ET2, IE.4 = ES, IE.3 = ET1, IE.2 = EX1, IE.1 = ET0, IE.0 = EX0)

(Hint: Polling Sequence = External 0, then Timer 0, then External 1, then Timer 1, then Serial.)

- (a) Serial
- (b) External 0
- (c) External 1
- (d) Timer 0
- (e) All of the above interrupts are enabled.

Problem 19. Assume that after reset, the interrupt priority is set by the instruction “`MOV IP,#00001100B`.” Assuming that all five interrupt sources are simultaneously triggered afterward, which interrupt is serviced last? Assume that the sources hold their interrupting signal active until their interrupt is handled.

(Hint: IP.5 = PT2, IP.4 = PS, IP.3 = PT1, IP.2 = PX1, IP.1 = PT0, IP.0 = PX0)

- (a) Serial
- (b) Timer 0
- (c) Timer 1
- (d) External 0
- (e) External 1

Problem 20. Which of the registers below does **NOT** affect how external interrupt 0 is detected/handled?

- (a) TCON
- (b) IE
- (c) IP
- (d) PCON
- (e) All of the above registers affect the detection/handling of EX0.

Problem 21. Which of the following is **NOT** a functionality provided by the timers/counters of the 8051?

- (a) Providing baud rates for serial communication.
- (b) Serialization/deserialization of bits for serial communication.
- (c) Calculating the time elapsed between events.
- (d) Counting the number of times a particular event occurs.
- (e) All of the above are functions provided by the timer/counters of the 8051.

Problem 22. Which of the pins or bits below affect the frequency of the pulse used as the clock for an 8051 timer/counter 1 in timer mode?

- (a) P3.4
- (b) P3.5
- (c) C/\overline{T} (bit 6 of TMOD)
- (d) M1 (bit 5 of TMOD)
- (e) none of the above.

Problem 23. How many bytes is the shortest instruction that can be used to modify TMOD?

- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) none of the above.

Problem 24. Which of the following bits allow you to start and stop the timers/counters through hardware?

- (a) bit 1 of TMOD
- (b) bit 3 of TMOD
- (c) bit 5 of TMOD
- (d) bit 5 of port 3
- (e) none of the above.

Problem 25. Which counter mode **CANNOT** be used to count an event that is expected to occur 7500 times before system reset?

- (a) mode 0
- (b) mode 1
- (c) mode 2
- (d) mode 3
- (e) Any of the above modes can be used.

Problem 26. Assume that the waveform in Figure 5 appears at the serial port input. Which value will end up in SBUF?

- (a) 06H
- (b) 14H
- (c) 41H
- (d) 60H
- (e) none of the above.

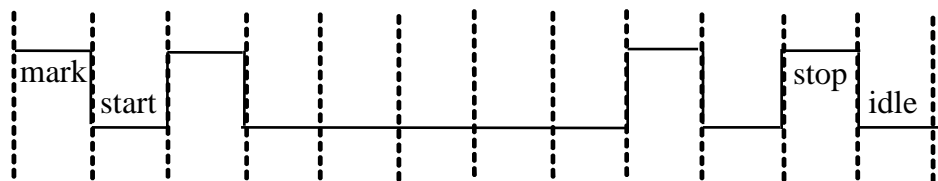


Figure 5: Waveform appearing at serial input.

Problem 27. Assume that we are programming the 8051 serial port to be in mode 1. Which of the registers below has **NO** effect on the serial communication?

- (a) SCON
- (b) PCON
- (c) TCON
- (d) TH1
- (e) IP

Problem 28. Consider the following 8051 serial port parameters: mode 1, clock frequency 12MHz, target baud rate 19200.

Determine the TH1 auto-reload value for SMOD =0. Round your numbers up to the nearest integer.

- (a) FCH
- (b) FDH
- (c) FEH
- (d) FFH
- (e) none of the above.

Problem 29. Which single bit could you change in the previous problem to generate a baud rate of 9600 instead?

- (a) TH1.4
- (b) TL1.4
- (c) SMOD
- (d) RxD
- (e) none of the above.

Problem 30. Which term is the best characterization of the 8051's serial port?

- (a) half-duplex
- (b) full-duplex
- (c) read-only
- (d) write-only
- (e) none of the above.