ECE3710 Exam 2. Name _____

Spring 2013. 5 pages. 102 points, but scored out of 100. You may use any non-living resource to complete this exam. Any hint of cheating will result in a 0.

Part 1 – Short Answer

1. (2 pts) An original 8051 uses a 5.5296 MHz crystal. How long (in μs) is a machine cycle?

   _____

2. (2 pts) If an external clock is used, which pin of the 8051 should it be connected to?

   _____

3. (3 pts) The following line appears in an Intel HEX file: **`:020304001516CC`**

   (a) is the checksum valid? _____

   (b) what address(es) will be affected? _____

   (c) how many bytes of data does this line provide? _____

4. (2 pts) Write one line (in C or assembly) that configures timer 0 as a 16-bit counter and timer 1 as an 8-bit auto-reload timer (e.g. for baud rate generation).

   _____

5. (2 pts) If an 8051 has a 22.1184MHz crystal, and timer 1 has been configured in mode 2, what value should be loaded to TH1 to obtain a 12.8kHz overflow frequency?

   _____

6. (2 pts) If TMOD is set to 09H, what two conditions are required for timer 0 to run?

   (a) _____

   (b) _____

7. (1 pt) (true/false) Timer 2 (8052) can be configured as a 16-bit auto-reload timer.

8. (2 pts) The 8051 supports a 9-bit serial format. Why? (circle all that apply)
   (a) to support the "8-bit data with parity, one stop bit" format.
   (b) to support the "8-bit data, no parity, two stop bits" format..
   (c) to support the "7-bit data with parity, two stop bits" format."
   (d) to enable a multi-processor communication feature.

9. (2 pts) Write one line (in C or assembly) that configures the serial port for 8-bit data, 1-bit parity and one stop bit.

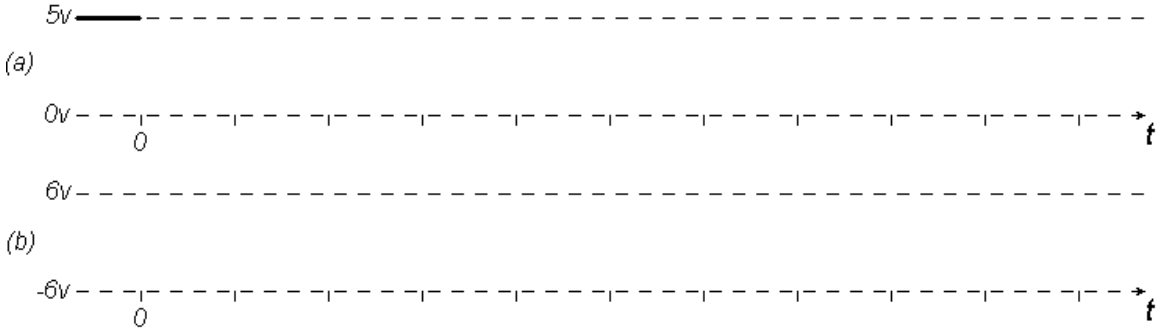
   _____

10. (3 pts) Can an 8051 with a 5.5296 MHz crystal send and receive serial data at 9600 baud? If so, list the relevant SFRs and what they must be written to. If not, explain why not.

    _____

    _____

11. (3 pts) The right parenthesis, ')' has an ASCII encoding of 29H. Show the waveform on the transmit line when this character is sent (a) out of the 8051 and (b) over RS232. Assume the start bit begins at t = 0.



12. (3 pts) Name the 5 interrupt sources on the original 8051 and their interrupt vectors (do not include reset)

Interrupt: _____	Vector = _____
Interrupt: _____	Vector = _____
Interrupt: _____	Vector = _____
Interrupt: _____	Vector = _____
Interrupt: _____	Vector = _____

13. (1 pt) (true/false) If bit IT1 = 1, then IE1 is cleared when the ISR (interrupt service routine) for external interrupt 1 returns.

14. (3 pts) The 8051 automatically clears TF0 and TF1 when their associated ISRs are called. Why doesn't it clear TF2 in the same way?

_____

_____

15. (2 pts) Write one line (in C or assembly) that configures the timer 2 interrupt, the serial interrupt and external interrupt 0 to be high priority.

_____

16. (2 pts) Suppose that timer 0 and external interrupt 1 are both low priority and become pending while a high priority interrupt is being serviced. Assuming no other high priority interrupts are pending, which interrupt (timer 0 or external interrupt 1) will be serviced when the high priority interrupt returns?

_____

17. (3 pts) Describe what happens if an interrupt service routine returns using the RET instruction instead of the RETI instruction.

_____

_____

18. (2 pts) What command should be sent to a character-oriented LCD controller to set the cursor to the forth character of line 2?

_____

19. (1 pt) (true/false) It is best to check the busy flag before writing to an LCD.

20. (4 pts) When <u>data</u> are written to an LCD controller, what is the state of the following four signals? (Answer H or L.)
    CS = _____ RD = _____ WR =_____ RS (A_0) =_____

21. (2 pts) Name 3 different types of A/D converter we discussed in class:
    _____
    _____
    _____

22. (4 pts) A 14-bit A/D converter uses a 1.5v positive reference and a 0.1v negative reference.
    (a) What is its step size? _____
    (b) What is the output of the A/D if its input is 0.85v? _____

23. (3 pts) A certain 12-bit A/D converter uses sample and hold circuit and an analog multiplexer to select one of several input channels. The sampling capacitance is 20pF and the resistance through the MUX is 3.4kΩ. If the desired sample accuracy is ½ of an LSB and the source resistance is 12.5kΩ, how long must the input channel be selected before the conversion can begin?

    _____

24. (2 pts) Which of the following quantities are commonly used to characterize a <u>DAC</u> (circle all that apply):
    (a) resolution
    (b) conversion time
    (c) step size
    (d) capacity

25. (4 pts) An 8-bit DAC has V_{ref}^{+} = 10.0V and V_{ref}^{-} = 0V.
    (a) What is its step size? _____
    (b) What voltage will it output if its input is 70H? _____

Part 2 - Problems

26. (5 pts) Fill in the missing entries for the semiconductor memories shown below:

Type	Organization	Capacity	Address Pins	Data Pins
SRAM		256K	16	
DRAM	4M x 1			
EPROM		512K		8
	256Kx8		10	

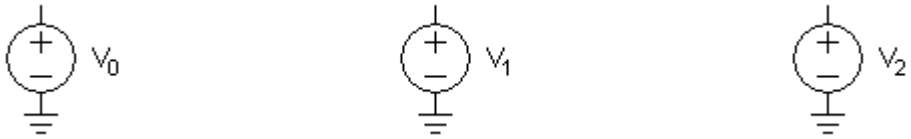
27. (6 pts) A certain type of oxygen sensor generates 13 mV per percent O_2. The offset voltage (the output of the sensor at 0% O_2) is 0.15V. If the A/D converter in problem 22 is used with this sensor, find an equation to convert the output of the A/D to oxygen level (in percent) using the form:

$$PO_2 = \frac{m(AtoD - k)}{2^{16}}$$

Find *k* and *m* (round to the nearest integer).

k = _____ *m* = _____

28. (3 pts) Draw an R/2R Resistor network for a 3-bit DAC.



29. (4 pts) Write an interrupt service routine in assembly for timer 0 that toggles P2.0 once every 72 interrupts.

```
    org 0BH
    jmp timer0_int          ; timer 0 interrupt

timer0_int:
```

30. (12 pts) A Caesar (or shift) cipher encodes a character by shifting its position in the alphabet by a fixed amount. For example, if the shift is 3, A→D, B→E, … W→Z, X→A, Y→B and Z→C. Write a program to run on the C8051F020 that receives characters over the serial port, performs a Caesar cipher (shift 3) on the upper-case alphabetic characters (A-Z), and sends the encrypted characters back through the serial port. (All other characters are echoed without encryption.) Your code may assume the 22.1184MHz crystal is running, but it must initialize the timer(s), serial port and interrupts. Once the configuration is complete, all work must be done inside the interrupt service routine(s). You may write this code in assembly or C. It is recommended that since this is a take-home exam, you should test your code in Lab 418, print off a copy and staple it to this exam. Otherwise, if you are feeling lucky, write your code on the back of this page and call it good.

31. (12 pts) You are designing a system using the C8051F020 to replace an obsolete system that uses an old 8051. In order to minimize the impact in software, you must use the same memory map as the original system, which is shown below. You will use a 32Kx8 Static RAM, an 8Kx8 ROM, and a 256x8 NVRAM with RD, WR and CS all active low. The LCD module is the same as the one we used in our class project. Show a schematic of the system including the external bus (address, data and control), address decoder, memories, LCD module, decoding circuitry and address latch, if necessary. Make sure to label the ports on the C8051F020. Draw busses with a single line and name their bits (e.g. A_7-A_0). Finally, State the value that must be stored in EMI0CF for your schematic to work. (Note: it is OK if something happens to be mapped into the "Not Used" regions since the old software never accesses those locations anyway.)

0000 7FFF	Static RAM
8000 807F	NV RAM
8080 9FFF	Not Used
A000 A001	LCD Module
A002 DFFF	Not Used
E000 FFFF	ROM