EE 308

Exam 2

March 25, 2002

Name: _____

You may use any of the Motorola data books, and the overheads posted on the Internet. Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

For all the problems in this exam, assume you are using an HC12 with a 16 MHz crystal, resulting in a 8 MHz processor clock.

Also, assume that `hc12b32.h` has been included, so you can refer any register in the HC12 by name rather than by its address in any C code you write.

1. The following questions concern writing C code.

    (a) Write some C code which will read the 16-bit signed integer at addresses `0x0500` and `0x0501`, and will store that number into memory locations `0x0910` and `0x0911`.

    (b) Write some C code which will set bits 3 and 4 of the byte at address `0x0400`, and leave all the other bits of that byte unchanged.

    (c) Write some C code which will do the following: If bits 3, 2, 1 and 0 of PORTB have the value 1001 (binary), write a `0xff` to PORTA. Otherwise, write a `0x00` to PORTA. (Assume that all bits of PORTA have been set up for output, and all bits of PORTB have been set up for input.)

2. Below are the contents of the memory of an HC12:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
09D0	10	23	3B	7C	10	04	86	80	B7	10	25	3B	FC	10	18	F3
09E0	12	50	FD	10	18	86	40	B7	10	23	3B	FC	10	12	DD	02
09F0	86	02	B7	10	23	3B	7C	10	03	86	40	B7	10	25	3B	86
FFC0	CC	05	9F	CD	99	03	84	9C	01	9B	CC	90	66	FC	93	30
FFD0	7E	E3	4B	7E	E5	38	21	54	05	83	09	34	2A	38	3C	03
FFE0	41	38	66	F2	7C	13	37	0C	25	F2	0C	38	5F	1B	42	1A
FFF0	7A	26	21	13	6A	AA	20	1F	4B	38	33	38	45	38	C0	10

The HC12 registers have the following values when an unmasked Timer Overflow Interrupt occurs:

Reg	–	–
CCR	S X H I N Z V C	1 1 1 0 0 1 0 1
A:B	AA	BB
X	C1A5	
Y	FFFF	
SP	09A0	
PC	0856	

(a) What is the address of the first instruction the HC12 will execute when coming out of reset?

(b) What is the address of the first instruction of the Timer Overflow interrupt service routine?

(c) Show what will be in the HC12 registers when it starts executing the first instruction of the interrupt service routine.

Reg	–	–
CCR	S X H I N Z V C	
A:B		
X		
Y		
SP		
PC		

3. Below are the contents of the memory of an HC12:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
09D0	10	23	3B	7C	10	04	86	12	B7	10	25	3B	FC	10	18	F3
09E0	C9	50	FD	10	18	86	40	B7	10	23	3B	FC	10	12	DD	02
09F0	86	02	B7	10	23	3B	7C	10	03	86	40	B7	10	25	3B	86

For the questions below, include a brief explanation of your reasoning. (Otherwise I cannot give partial credit if the answers are not completely correct.)

(a) The HC12 just received a Timer Overflow Interrupt, and is starting to execute the Timer Overflow interrupt service routine. The stack pointer at this time has a value of 0x09E0 .

     i. What is the return address — i.e., what is the address of the instruction the HC12 will return to when it exits the ISR with the RTI instruction?

     ii. What value was in the HC12 X register when it received the interrupt?

     iii. What value was in the HC12 condition code register when it received the interrupt?

(b) Using the same data in memory as above, assume that the HC12 is in a subroutine which was called from the main program. What is the return address to the main program? Again, assume that the stack pointer has a value of 0x09E0 when it first gets into the subroutine.

4. You are doing an experiment where you need to measure the the speed of an object. You do this by measuring the time it takes an object to travel between two points. When the object passes the first point it breaks a light beam which creates a pulse on a signal connected to Port T1. When it passes the second point it creates a pulse on a signal connected to Port T2. You know before the experiment that the time difference will be between 100 ms and 200 ms.
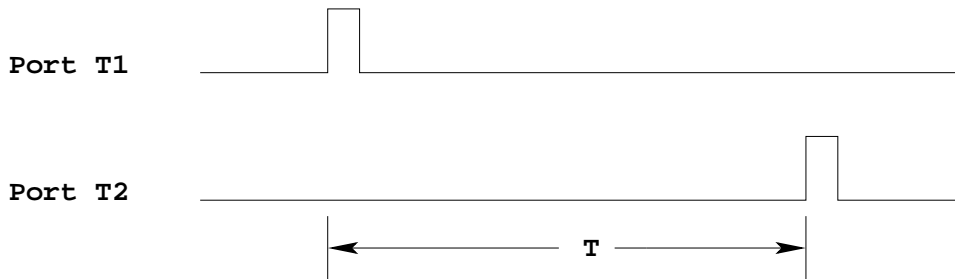
(a) What value should you write to the timer prescaler? Write some C code to do this.

(b) How do you set up the HC12 to capture the times of the rising edges of the two signals? Write some C code to do this.

(c) Write some C code which will wait until the object passes the second point.

(d) Write some C code which will clear the flag for Timer Channel 2.

(e) After both edges have been captured, the following is in the HC12 timer registers:

TC0	TC1	TC2	TC3	TC4	TC5	TC6	TC7
681C	C25F	1B25	A29C	F49A	F902	18AC	0059

How long (in seconds) did it take for the object to traverse the distance?

5. An HC12 has the following in its PWM registers:

PWCLK	PWPOL	PWEN	PWSCAL0	PWSCAL1	PWPER0	PWDTY0	PWCTL
34	5F	0F	10	80	C7	27	00

(a) What is the period (in seconds) of the PWM signal of Channel 0?

(b) What is the duty cycle (in percent) of the PWM signal on Channel 0?