EE 308

Exam 2

March 29, 2005

Name: _____

You may use any of the Motorola data books and the notes from the web. 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 HCS12DP256 with a 4 MHz crystal and a 24 MHz bus clock.

Also, assume that `iodp256.h` has been included, so you can refer any register in the HCS12 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 set bits 2 and 3, and clear bits 0 and 7 of the byte at address 0x2400.

   (b) Write some C code which will write the 16 bit number 0x55aa to the word at address 0x2402.

   (c) Write some C code which will wait until bit 2 of the TFLG1 register becomes one.

2. Below are the contents of the memory of an HCS12:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10D0	10	23	3B	7C	10	04	86	80	B7	10	25	3B	FC	10	18	F3
10E0	12	50	FD	10	18	86	40	B7	10	23	3B	FC	10	12	DD	02
10F0	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	10	34	2A	38	3C	03
FFE0	41	38	66	F2	7C	13	37	1C	25	F2	1C	38	5F	1B	42	1A
FFF0	1A	26	21	13	6A	AA	20	1F	4B	38	33	38	45	38	10	20

(a) What is the address of the first instruction the HCS12 will execute when coming out of reset?

(b) What is the address of the first instruction of the Timer Channel 2 interrupt service routine?

3. Below are the contents of the memory of an HCS12:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10D0	10	23	3B	7C	10	04	86	80	B7	10	25	3B	FC	10	18	F3
10E0	12	50	FD	10	18	86	40	B7	10	23	3B	FC	10	12	DD	02
10F0	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	10	34	2A	38	3C	03
FFE0	41	38	66	F2	7C	13	37	1C	25	F2	1C	38	5F	1B	42	1A
FFF0	1A	26	21	13	6A	AA	20	1F	4B	38	33	38	45	38	10	20

The HCS12 registers have the following values when an unmasked Real Time Interrupt occurs:

Reg	–	–
	S X H I N Z V C	
CCR	1 1 1 0 1 0 0 1	
A:B	A3	92
X	A51C	
Y	2020	
SP	3BE5	
PC	1024	

(a) Explain in detail what happens when the HCS12 responds to the interrupt.

(b) Show what will be in the HCS12 registers when it starts executing the first instruction of the interrupt service routine.

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

(c) Also, show what has happened to the stack – fill in values for memory locations which have changed below.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
3BD0																
3BE0																
3BF0																

(d) List at least five things needed in your program when you use interrupts.

(e) The assembly language Real Time Interrupt interrupt service routine is the following:

```
rti_isr:
            inc PORTA
            rti
```

How much time (in bus cycles and in seconds) does it take for the HCS12 to respond to the Real Time Interrupt – i.e., from the time the HCS12 receives a Real Time Interrupt, how long does it take for the HCS12 to get into, execute, and exit from the interrupt service routine? Explain.

(f) What is wrong the the above interrupt service routine?

4. The following questions pertain the the HCS12 timer subsystem.

   (a) How do you enable the HCS12 timer subsystem? Write some C code to do this.

   (b) What is the basic frequency of the timer subsystem clock – i.e., the frequency before changing the prescaler?

   (c) How do you change the frequency of the timer subsystem clock? Write some C code to set the frequency to 3 MHz.

   (d) Write some C code to clear `C4F`, the flag for timer channel 4. Be sure your code does not clear any other timer flag which may be set.

   (e) Write some C to set up timer channel 4 to function as an input capture. Set it up to capture a falling edge. Be sure that you do not change the functionality of any other timer channel.

   (f) Write some C to set up timer channel 5 to function as an output compare. Set it up to set Channel 5 output high on a successful compare. Be sure that you do not change the functionality of any other timer channel.

5. The HCS12 is being used to control the intensity of a light. The light needs a PWM frequency of 2.5 kHz. Write some code which will enable PWM Channel 2 with a 2.5 kHz frequency and a duty cycle of 25%.