## Midterm Winter 2004 SYSC 2003 Computer Organization Section A Department of Systems and Computer Engineering

Name :		Total :	/ 40
Stı	udent Number :		
A s	summary of basic HC12 assembly instruction	as is provided on the back p	page.
Qι	uestion 1 [8 marks] Write brief answers.		
a)	[2 marks] What is a microcontroller?		
b)	[2 marks] Embedded systems generally suff specific example of an instruction or address optimized its instruction encoding for space	sing mode that shows how	
c)	[2 marks] How does a cross-assembler diffe	er from an assembler ?	
d)	[2 marks] Both of the following statements location \$1000, but at different times. Explorg \$1000  var DW \$0300 and	ain the difference.	

## Question 2 [20 marks]

a) [2 marks] Write a **single** assembly instruction that performs the same operation as this sequence: LDAA variable

ANDA #\$03 STAA variable

f) [8 marks] Complete the following assembly program that computes the volume of a sphere with an (unsigned) byte diameter. The volume is represented as a 32-bit unsigned number. The computation being performed is:

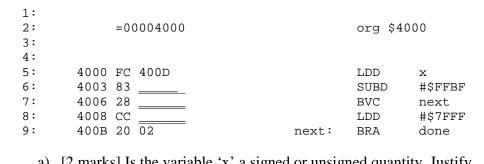
volume = PI \* diameter<sup>3</sup> / 6 where PI is approximated by 355/133. The program rearranges the equation in an attempt to minimize loss of precision by performing as many multiplications as possible before dividing.

Your solution must use the HC12 instructions properly. Use the comments as your guide.

org \$4000 bra compute db 255 diameter: volume: rmw \_\_\_\_\_ compute: ; Compute diameter<sup>2</sup> \_\_\_\_\_ diameter \_\_\_\_ diameter MUL ; Compute diameter<sup>3</sup> = diameter \* diameter<sup>2</sup> TFR D, \_\_\_\_ LDAB diameter CLRA **EMUL** ; Compute diameter $^3/(113*6)$ \_\_\_\_#113\*6 **EDIV** ; Compute (diameter $^{3}/(113*6)$ ) \* 335 **EMUL** \_\_\_\_\_ volume ; Store computed value in volume STD SWI ; Done.

c) [10 marks] Below is a short memory dump. Suppose that PC=\$4000, and <u>all</u> the instructions in the following listing are now executed. Answer the related questions. Show your work for partial marks.

## 4000: FC 40 0D 83 FF BF 28 03 FC 7F FF 20 02 8F 31 3F



- a) [2 marks] Is the variable 'x' a signed or unsigned quantity. Justify.
- b) [3 marks] Fill in all blanks (\_\_\_\_\_) in the listing above.
- c) [2 marks] What is the hexadecimal value in register D now?

d) [3 marks] What is the current PC after executing the sequence?

**Question 3** [12 marks] Write the assembly implementation of the following subroutine using the course policies for assembly subroutines. Pass parameters on the stack.

```
void convert( byte value, char &ascii[8] ) // Returns an array of 8 characters containing the ASCII representation of the // unsigned binary value.
```

Example: If the value is \$FC, the returned array =  $\{'1','1','1','1','1','0','0'\}$ .

Do not worry about a terminating character.

**Tip**: This question has two components: (1) subroutines and (2) ASCII conversion. If you don't know how to do the ASCII conversion, you can still write the outline for your subroutine to demonstrate your knowledge of parameters passing and thereby gaining part marks.