NAME _____

ID for the course _____

1. For each of the following files, write the output from m4.

(file a)
```
define(A, 1) A define(`A', 2) A define(A, 3) A
```

(file b)
```
define(A, B) define(A, C) A B AB
```

(file c)
```
define(A, 1)
define(B, A $1 define(`A', eval(A+2)))
A B A B(1) A B(2)
```

(file d)
```
define(A, 1)
define(B, `A $1 define(`A', eval(A+2))')
A B A B(1) A B(2)
```

(file e)
```
define(A, 1)
define(B, ``define($1, eval(A))'define(`A', eval(A+1))')
B(C) A B(D) A
```

(4x3)

2. Consider bit-wise operations. You are allowed to use only 'and', 'andn', 'or', 'orn', 'xor', and 'xnor' as instructions.

a	|	0	0	1	1
b	|	0	1	0	1
f1	|	1	1	1	1
orn	|				
xnor	|				

first argument
second argument

(a) Fill in the values for 'orn' and 'xnor'.

(b) Implement the following.

```
f1  %a_r, %b_r, %c_r
```

(c) Implement the instruction which negates the four least significant bits of %l0 with remaining bits unchanged.

(d) Implement the instruction which sets bit1, bit2, bit4 of %l0 to zero with remaining bits unchanged.

(5x2)

3.

(a) What binary number does this hexadecimal number represent: 37fedcba ?

(b) What octal number does this hexadecimal number represent: 37fedcba ?

(c) Write the 8-bit two's complement representation of a negative number that has no corresponding positive number.

(d) Write the range of the signed numbers that can be represented by a 4-digit hexadecimal number. You may use the exponential notation.

(e) Write the 4-digit 16's complement representation of -m where m is the following hexadecimal number: 30fb .

(5x3)

4. We run gdb on the executable file of a program containing the following code.

```
        mov    -17, %l0
        subcc  %l0, 8, %l1              ! break point 1 at this address
        add    %l0, 51, %l2
        bl     A
        add    %l0, 2, %l0
        sub    %l1, 20, %l1
        .global A
A:      add    %l2, 7, %l2              ! break point 2 at this address
```

(a) What is the output at break point 1 for p/t $l0?

(b) What is the output at break point 1 for p/x $l0?

(c) What is the output at break point 2 for p/x $l0?

(d) What is the output at break point 2 for p/x $l1?

(e) What is the output at break point 2 for p/x $l2?

(5)

5. In the following, acronyms are not accepted.

(a) Write the classical von Neumann cycle.

(b) Write the von Nuemann cycle for a RISC architecture with one less number of components.

(6)

6. Consider the following expression:

$$a \cdot x^4 + b \cdot x^3 + c \cdot x + d$$

Using Horner's algorithm, write simple SPARC assembly code to put in %l0 the value of the expression for x = e. a, b, c. d, and e are in %a_r, %b_r, %c_r, %d_r, %e_r. Fill all delay slots with useful instructions.

(5)

7. Assume that you have a macro *pred* to return the predecessor of a given natural number. Define a macro *diff* which returns a-b if a>b otherwise 0 when given as *diff*(a,b) with natural numbers a and b.