Name: _____

Directions: **Work only on this sheet** (on both sides, if needed). MAKE SURE TO COPY YOUR ANSWERS TO A SEPARATE SHEET FOR SENDING ME AN ELECTRONIC COPY LATER.

In all Test problems, assume 32-bit words unless stated otherwise.

1. (20) Fill in the blanks: During the execution of the jump instruction in line 24, p.94, the jump will be done if the _____ Flag and the _____ Flag bits satisfy certain conditions.

2. Consider the following code, which multiples each element in an array of 4 words by 28. It is assumed that **x** is a label in the **.data** segment (not shown), that all elements of **x** are considered unsigned, and that no product will need more than 32-bits.

```
.text
.globl _start
_start:
    blank (a) (entire line)
    movl $28, %ebx
    movl $4, %ecx
top:
    movl x(%edi), %eax
    imul blank (b)
    movl %eax, x(%edi)
    decl %ecx
    jz done
    blank (c) (entire line)
    blank (d) (entire line)
done:   movl $0, %edi
```

(a) (10) State what goes in blank (a).

(b) (10) State what goes in blank (b).

(c) (10) State what goes in blank (c).

(d) (10) State what goes in blank (d).

(e) (15) Suppose that the initial values in **x** are 2, 5, 1 and 8, and that we had used EDX instead of EDI in the above code. State the final values in **x**.

3. (25) List all lines in the letter-counting code, Section 3.14, that access memory during the execution (not fetch) cycle.

Solutions:

1. Sign, Overflow

2.a-d

```
.text
.globl _start
_start:
    movl $0, %edx
    movl $0, %edi
    movl $28, %ebx
    movl $4, %ecx
top:
    movl x(%edi), %eax
    imul %ebx
```

```
    movl %eax, x(%edi)
    decl %ecx
    jz done
    addl $4, %edi
    jmp top
done:   movl $0, %edi
```

2.e Even though we know the product is unsigned and will fit in EAX, IMUL won't know that, and will sign-extend in EDX. That will wipe out our value of expressions like x(%edx). So, only the first element of **x** will be changed, and the final values in that array will be 140, 5, 1, 8.

3. 16, 30

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