

1. (25 pts) _____

Name: _____

2. (30 pts) _____

This examination has five problems, each with approximate points indicated. The maximum possible total is 150 points.

3. (40 pts) _____

Show all your work. You may use the ECE 390 Laboratory Notes, one page of your own notes, and an unnecessary calculator.

4. (30 pts) _____

5. (25 pts) _____

Problem 1. (25 pts) Write short sequences of instructions to accomplish each task. You may use registers AX, BX, CX, DX without saving their contents. No comments are necessary.

(a) Memory bytes labeled P and Q contain integers p and q , respectively, in two's complement representation. Place the larger of p and q into the memory byte labeled R.

(b) Register BX holds the offset of the first character of a data record. If the byte in CL matches both the second and the third characters of this record, then set the memory byte labeled F to 1. Otherwise, set byte F to 0. Assume F is already declared with RESB.

Problem 3. (40 pts) You are using Turbo Debugger. The last two instructions executed were a three-byte `call Subr` at `cs:0129` and the `pusha` at `cs:0437`.

```
#exam1#Subr
cs:0437 60          pusha                ax 1776
cs:0438►BD0000     mov      si,0000     bx 0003
#exam1#.loop
cs:043B 8AA49401    mov      ah,[si+0194] cx 1406
cs:043F 00DC       add      ah,bl       si 1492
cs:0441 88A49901    mov      [si+0199],ah di 1867
cs:0445 46         inc      si          bp 0329
cs:0446 FECB       dec      bl          sp 01D2
cs:0448 80FB00     cmp      bl,00       ds 0FA7
cs:044B 75EE       jne     #exam1#.loop es 0F05
cs:044D BA9801     mov      dx,0198     ss 0F25
cs:0450 E83650     call    dspmsg       cs 0FA7
cs:0453 61         popa                ip 0438
cs:0454 C3         ret
```

```
ds:0190 4F 52 45 49 4C 4C 59 21 OREILLY!
ds:0198 52 45 44 42 4F 4F 4B 24 REDBOOK$
```

(a) Express each answer in hexadecimal. If there is insufficient information, write “Unknown.”

(i) The 20-bit linear address of the next instruction to be executed: _____

(ii) The value of the word at `ds:0197` at this time: _____

(iii) The value of the word at `ss:01D4` at this time: _____

(iv) The value of the word at `ss:01E2` at this time: _____

(b) Now suppose the execution of `Subr` continues from this point.

(i) How many times is `cmp bl,00` executed before the `ret` is executed? _____

(ii) State the values of the flag bits immediately after the last execution of `cmp bl,00`:

SF = _____ CF = _____ ZF = _____ OF = _____

(iii) What is printed out with the call to `dspmsg`? _____

(c) What would have happened if you had changed the value in the byte at `cs:044C` from `EE` to `FE` (hex) before you resumed execution at `cs:0438`? Why?

Problem 4. (30 pts) The subroutine `CheckSlashes` below should determine whether there is exactly one occurrence of the character `/` in a string starting at the offset in `BX`. The string has fewer than 200 bytes, and it ends with a zero-valued byte. This subroutine is called several times.

Input: `(BX)` = offset of first character in string

Output: `(CL)` = 1 if exactly one `'/'` in string, 0 otherwise

This subroutine has six mistakes. Identify these mistakes; for each, explain the mistake and specify a correction, using the line numbers.

```

1  scout    DB    0            ; Counts '/' in string
2  CheckSlashes
3      PUSH  BX
4  .loop:
5      CMP   BYTE [BX], '0'    ; Check for end of string
6      JE   .done
7      CMP   BYTE [BX], '/'    ; If character is slash
8      JE   .nextbx
9      INC   BYTE [scout]      ; then increment scout
10 .nextbx:
11     INC   BX
12     JMP   .loop
13     MOV   CL, scout         ; Copy value at scout to CL
14     CMP   CL, 1             ; If (CL) > 1
15     JLE   .done
16     MOV   CL, 0             ; then replace by 0
17 .done:
18     POP   BX
19     RET

```

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Problem 5. (25 pts) Write your answers in clear English.

(a) When testing `mp1.exe`, a student enters “S//” for the pattern string, and the program responds with “No records found”. Identify two possible causes for the incorrect output.

1. _____

2. _____

(b) In the `Encryp` subroutine in `mp2.asm`, suppose $f(c)$ is in `AL`, and `37` is in `CH`. The code at the right calculates $(f(c) * k1 + k2) \bmod 37$.

```
MUL BYTE[k1]
ADD AX,WORD[k2]
DIV CH
```

Suppose the word labeled `k2` represents a negative number in 16-bit two’s complement representation. How could executing `DIV CH` result in an overflow? Explain why.

(c) Let c be an integer such that $0 < c < 37$. Show that if $c x \equiv c y \pmod{37}$, then $x \equiv y \pmod{37}$. You may use any facts established in the homework or in class.
