1. 8.8 The following operations are performed on a stack:

```
PUSH A
PUSH B
POP
PUSH C
PUSH D
POP
PUSH E
POP
POP
PUSH F
```

a. What does the stack contain after the PUSH F?

b. At which point does the stack contain the most elements? Without removing the elements left on the stack from the previous operations, we perform:

```
PUSH G
PUSH H
PUSH I
PUSH J
POP
PUSH K
POP
POP
POP
PUSH L
POP
POP
PUSH M
```

c. What does the stack contain now? (after PUSH M)

简答题 (3 分) 3 分

a. A F
b. the stack contains the most elements are " PUSH J" and " PUSH K "
c. A F M (M is the top of stacks)

2. 8.11 The following program needs to be assembled and stored in LC-3 memory.

```
        .ORIG   x4000
        AND R0, R0, #0
        ADD R1, R0, #0
        ADD R0, R0, #4
        LD  R2, B
    A   LDR R3, R2, #0
        ADD R1, R1, R3
        ADD R2, R2, #1
        ADD R0, R0, #-1
        BRnp    A
        JSR SHIFTR
        ADD R1, R4, #0
        JSR SHIFTR
        ST  R4, C
        TRAP    x25
    B   .BLKW   #1
    C   .BLKW   #1
        .END
```

a. How many memory locations are required to store the assembled program?

b. What is the address of the location labeled C?

c. Before the program can execute, the location labeled B must be loaded by some external means. You can assume that happens before this program starts executing. You can also assume that the subroutine starting at location SHIFTR is available for this program to use. SHIFTR takes the value in R1, shifts it right one bit, and stores the result in R4. After the program executes, what is in location C?

简答题 (3 分)　3 分

a. 16 locations
b. Address of C is x400f
c. C contains the average of the four consecutive values starting at memory location specified in B.

3. 8.14 As you know, the LC-3 ADD instruction adds 16-bit 2's complement integers. If we wanted to add 32-bit 2's complement integers, we could do that with the program shown next. Note that the program requires calling subroutine X, which stores into R0 the carry that results from adding R1 and R2.

   Fill in the missing pieces of both the program and the subroutine X, as identified by the empty boxes. Each empty box corresponds to one instruction or the operands of one instruction.

   Note that a 32-bit operand requires two 16-bit memory locations. A 32-bit operand Y has Y[15:0] stored in address A, and Y[31:16] stored in address A+1.

```
 1        .ORIG   x3000
 2        LEA R3, NUM1
 3        LEA R4, NUM2
 4        LEA R5, RESULT
 5        LDR R1, R3, #0
 6        LDR R2, R4, #0
 7        ADD R0, R1, R2
 8        STR R0, R5, #0
 9        ---------------- (a)
10        LDR -------- (b)
11        LDR -------- (c)
12        ADD R0, R1, R2
13        ---------------- (d)
14        TRAP    x25
15
16     X  ST  R4, SAVER4
17        AND R0, R0, #0
18        AND R4, R1, R2
19        BRn -------- (e)
20        ADD R1, R1, #0
21        BRn -------- (f)
22        ADD -------- (g)
23        BRn ADDING
24        BRnzp   EXIT
25     ADDING  ADD R4, R1, R2
```

简答题 (7 分) 7 分

a. JSR X
b. LDR R1,R3,#1
c. LDR R2,R4,#1
d. JSR X
e. BRn EXIT
f. BRn LABEL
g. ADD R5,R4,R1

教师评语:
本题后来改了一个版本，是9分的，但是这里系统限制没法给你打上9分了。手动帮你改了本次作业的总分，如果发现总分核算里仍然有问题，请在要求“核对平时成绩”时联系助教手动修改。