Q1. Consider the following program snippet. Assume the offset of "data" label is 0x103. Fill in table of memory contents at the end of this code. All values should be in hex. Initial CF is zero. [8 marks]

```
jmp start

data: dw 0x364B, 0x17C3, 0xAE09, 0x8F7F

start:
  AND word [data+2], 0x5555
  XOR byte [data+4], 0xCC
  RCR word [data+6], 2
  SAR byte [data+1], 3
```

Group A

Group B

```
jmp start

data: dw 0x364B, 0x17C3, 0xAE09, 0x8F7F

start:
  OR word [data+4], 0x8866
  SAL byte [data+1], 3
  XOR byte [data], 0x35
  ROL word [data+6], 2
```

	0	1	2	3	4	5	6	7
DS:103								

RCR = rotate right though carry SAL = shift left arithmetic
SAR = shift right arithmetic ROL = rotate left

Group A

	0	1	2	3	4	5	6	7
DS:103	A3	0B	11	51	EA	8E	06	27

Group B

	0	1	2	3	4	5	6	7
DS:103	96	C0	B1	7B	66	8E	6A	70

1 mark for each correct byte

Q2. Consider the following 'thrice' subroutine. It takes in a number as parameter, and puts 3 times its value in [answer] variable.

```
1  thrice:
2    push bp
3    mov bp, sp
4
5    push ax
6    mov ax, [bp+4]
7    add ax, [bp+4]
8    add ax, [bp+4]
9    mov [answer], ax
10
11   pop ax
12   pop bp
13   ret 2
14
15 start:
16   push 9
17   call thrice
```

[3 + 3 marks]

Group A

i. If initial SP value (before program beginning) is 0xFFBC, give values of SP after line numbers 9 and 13 have finished.

ii. Support `ret 2` is not allowed, and only simple `ret` is available. How would you clear parameter space on stack. Give the instruction(s) and line number where to insert those.

Group B

i. If initial SP value (before program beginning) is 0xFF58, give values of SP after line numbers 6 and 17 have finished.

ii. Within the subroutine, create space for 2 local variables and discard it at the end. Give the instruction(s) and line number where to insert those.

Gr A

Line 9: SP–8 = FFB4

Line 13: SP+8 = FFBC

(1.5 marks each)

Add following after line 17

pop ax ; dummy pop to any reg

OR

add sp, 2

(1.5 mark for instruction, 1.5 for location)

Gr B

Line 6: SP–8 = FF50

Line 17: SP+8 = FF58

(1.5 marks each)

Add after line 3

sub sp, 4

Then add after line 11

add sp, 4 ; OR mov sp, bp

(1.5 mark for each instruction at correct location)