1. (25 points) Consider the following program. Write the contents of the destination operand after each instruction is executed. Also explain what the program is doing at appropriate steps. What is the output of this program.

```assembly
.stack 100h
.code
main proc
    mov ax,@data
    mov ds,ax
    mov cx,outer_count
outer:
    mov ah,2
    mov dl,'X'
    int 21h
    mov outer_count,cx
    mov cx,inner_count
inner:
    mov ah,2
    mov dl,'Y'
    int 21h
    loop inner
    mov cx,outer_count
    loop outer

    mov ax,4C00h
    int 21h
main endp
.data
inner_count dw 2
outer_count dw 3
end main
```
2. (25 points) Consider the following program. Write the contents of the destination operand after each instruction is executed. Also explain what the program is doing at appropriate steps. What are the final values of value1 and value2 and their relationships to the given array?

```
.stack 100h
.code
main proc
    mov ax,@data
    mov ds, ax

    mov di, offset array
    mov ax, [di]
    mov value1, ax
    mov value2, ax
    mov cx, 6

A1:mov ax,[di]
    cmp ax, value2
    jge A2
    mov value2, ax

A2:cmp ax, value1
    jle A3
    mov value1, ax

A3:add di, 2
    loop A1

    mov ax, 4c00h
    int 21h
main endp
.data
array dw -1, 2000, -4000, 32767, 500, 0
value1 dw ?
value2 dw ?
end main
```
3. (25 points) What will be the hexadecimal value of the given operand after each of the following moves? (If any instruction is illegal write the word ILLEGAL as the answer.) Here var1 and var2 are 16 bit operands.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>mov ax, 5</td>
<td>AX = 0</td>
<td>AX =</td>
</tr>
<tr>
<td>mov ax, -5</td>
<td>AX = 0</td>
<td>AX</td>
</tr>
<tr>
<td>mov var1, var2</td>
<td>var1 = 0200h, var2 = 0100h</td>
<td>var1 =</td>
</tr>
<tr>
<td>div dl</td>
<td>DL = 02h, AX = 0083h</td>
<td>AX =</td>
</tr>
<tr>
<td>mul dl</td>
<td>DL = 02h, AX = 0083h</td>
<td>AX</td>
</tr>
<tr>
<td>mov al, bx</td>
<td>AL = 12, BX = 0015</td>
<td>AX</td>
</tr>
</tbody>
</table>
4. (25 points) Consider the following program. Explain the tasks of the code segments a1, a2, and a3 of this program.

```
.stack 100h
.data
    string db 'An error has occurred'
.code
main proc
    mov ax, @data
    mov es, ax
a1:
    mov bp, offset string
    mov ah, 13h
    mov al, 00
    mov bh, 00h
    mov bl, 87h
    mov dx, 173ah
    mov cx, 15h
    int 10h
a2:
    mov ah, 8h
    int 21h
a3:
    mov ah, 06h
    mov al, 01h
    mov bh, 07h
    mov ch, 17h
    mov cl, 3ah
    mov dh, 17h
    mov dl, 8fh
    int 10h
exit:
    mov ax, 4c00h
    int 21h
main endp
end main
```