Group: _____ Last name and first name (IN CAPITAL LETTERS): _____

Computer Systems Architecture: Midterm Test – 10% of the final grade
All additional sheets must be signed!

Exercise 1 **1.5p** *Write the amount of RAM allocated, both in* `bits` *and in* `Bytes`*, for each of the following variables declared in the* `.data` *section:*

Declaration in `.data`	***size in bits***	***size in Bytes***
`str1: .asciz "String of\n"`		
`str2: .ascii "characters\n"`		
`myWord: .long 242, 8, 35, 17`		
`myLong: .long 0x8fde2025`		
`myBytes: .byte 's', 't', 'r', '\0'`		

Write a `WRITE` system call (system call number 4) for the character string `str1`, so that its entire contents, excluding the terminating null byte, and nothing else are written to `standard output`.

Exercise 2 **1p** *Complete the following table with the correct values in bases 2 and 16.*

Base 2	***Base 16***
	04 00 00 02
1111 0101 1010 1100 0101 0011 1010 1010	

Exercise 3 **2p** *Consider the following program written in* `assembly` *(Intel x86 processor,* `AT&T` *syntax):*

```
.data
    x: .long 0x4000002
    z: .long 0x2000
    t: .long 0b1000000000000000
.text
.global main
main:
    movl x, %eax
    mull z
et1:
    divl t
    decl %eax
et_exit:
    movl $1, %eax
    xorl %ebx, %ebx
    int $0x80
```

We execute the following commands in the `debugger`*:*

```
b main; b et_exit; run; stepi; stepi; i r eax; i r edx; c; i r eax; i r edx;
```

The values obtained, in order, are:

EAX (1)	***EDX (1)***	***EAX (2)***	***EDX (2)***

Important! *Write all values exclusively in base 16.*

Exercise 4 **1.5p** *Consider the following instructions in* `main`*:*

```
movl $0x8000000, %eax
movl $0x200000, %ebx
mul %ebx
divl p
```

Describe what happens if $p = 2^{14}$. What happens if $p = 2^{20}$?

Exercise 5 **1p** *Consider the following program written in assembly (Intel x86 processor, AT&T syntax):*

```
.data
    x: .long 5
    y: .long 20
.text
.global main
main:
    movl x, %ebx
    movl y, %eax
    movl $15, %edx
    mul %ebx
    add %edx, %eax
    movl $2, %esi
    divl %esi
    movl %edx, %ecx
    addl $20, %ecx
et_loop:
    inc %ebx
    inc %edx
    dec %eax
    loop et_loop
    add %edx, %eax
et_exit:
    movl $1, %eax
    xorl %ebx, %ebx
    int $0x80
```

*Fill in the register values (**in base 10**) when program execution reaches the et_exit label (after running b et_exit; run; i r in the debugger):*

EAX	EBX	EDX

Exercise 6 **1p** *Consider the following program written in assembly (Intel x86 processor, AT&T syntax):*

```
.data
.text
.global main
main:
    movl $0xd8eb6d7f, %ecx
    sub %eax, %eax
    sub %ebx, %ebx
    movl $0, %edx
    movw %cx, %dx
    movb %dh, %al
    movb %dl, %bh
    addw %ax, %bx
    cmp %ebx, %edx
    jg et
et_loop:
    cmp $0, %eax
    je et_exit
    dec %ebx
    dec %eax
    jmp et_loop
et:
    cmp $0, %eax
    je et_exit
    inc %ebx
    dec %eax
    jmp et_loop
et_exit:
    movl $1, %eax
    xorl %ebx, %ebx
    int $0x80
```

The register values at the et_exit label (in base 16) are:

EAX	EBX	ECX	EDX

Exercise 7 **1p** *Write two **distinct** ways to access the third element of an array of .word values. (Assume that the third element exists; it has index 2, since indexing starts at 0.) The array is declared in the .data section and is named w.*

Exercise 8 **1p** *Write a code sequence in main that computes the product of the remainders obtained when the squares of the elements of an array are divided by 5 ($\prod_{i=0}^{n-1}((v[i])^2 \bmod 5)$). Assume that the array length is n and its name is v. This information is already provided in the .data section. Your solution must start at the main label.*