PROBLEMA 5.1

a)
```
push D
push C
sub
push B
push A
sub
div
push C
sub
pop R
```

b)
```
load C
sub D
store R
load A
sub B
div R
store R
load C
sub R
store R
```

PROBLEMA 5.2

a) $10^9 \cdot 0'3 + 2(10^9 \cdot 0'1) = \underline{5 \cdot 10^8 \text{ accesos}}$

b) $2'5 = 10^9 \cdot 2'5 \cdot \frac{1}{f}$; $f = \underline{1\ GHz}$

c) $0'9 \cdot 10^9 + 2(0'1 \cdot 10^9) + 0'5 \cdot 10^8 + 0'3 \cdot 5 \cdot 10^8 +$
$+ 0'2 \cdot 0'7 \cdot 5 \cdot 10^8 + 0'15 \cdot 0'2 \cdot 10^9 =$ ~~1'85 · 10⁹ instr~~
$\underline{1'85 \cdot 10^9 \text{ instr}}$

d) $2'5 = 1'85 \cdot 10^9 \cdot 1'2 \cdot \frac{1}{f} \Rightarrow f = \underline{0'888\ GHz}$

e) CISC: $P_f = 10 \cdot 1 = 10\,W$ $P_c = 50 \cdot 10^{-9} \cdot 1^2 \cdot 1 \cdot 10^9 = 50\,W$
$P_T = 60\,W$ $E_T = 60\,W \cdot 2'5\,s = \underline{150\,J}$

RISC: $P_f = 8 \cdot 1 = 8\,W$ $P_c = 40 \cdot 10^{-9} \cdot 1^2 \cdot 0'888 \cdot 10^9 = 35'52\,W$
$P_T = 43'52\,W$ $E_T = 43'52\,W \cdot 2'5\,s = \underline{108'8\,J}$

f) Ganancia = $\frac{150}{108'8} = 1'379$

g) $2'5 = \frac{1'5 \cdot 10^{9} \cdot 1'3}{f}$; $f = 0'78$ GHz

h) $P_F = 8 \cdot 1 = 8$ W $\quad P_C = 40 \cdot 10^{-9} \cdot 1 \cdot 0'78 \cdot 10^{9} = 31'2$ W

$P_T = 39'2$ W $\quad E_T = 39'2 \cdot 2'5 = 98$ J

Ganancia = $\frac{150}{98} = 1'531$

PROBLEMA 5.3

a)

```
      movl %ecx <- $0
loop: cmpl %ecx, $1000000
      jge fin
      load %eax <- x
      load %r1 <- V[%ecx · 4]
      imull %eax <- %eax · %r1
      load %r2 <- suma
      addl %r2 <- %r2 + %eax
      store suma <- %r2
      addl %ecx <- %ecx + $1
      jmp loop
fin:
```

b) $7 \cdot 10^6 + 1 = 7\,000\,001$ inst

$10 \cdot 10^6 + 1 = 10\,000\,001$ uops

c) ~~1'3 Mops / ciclo~~ ~~1 ciclo / 1'3 Mops~~

c) $10000001 \text{ Mops} \cdot \frac{1 \text{ ciclo}}{1'3 \text{ Mops}} = \frac{7692308 \text{ ciclos}}{7000001 \text{ ins}} = \underline{1'0989 \text{ c/i}}$

d) $T_{exe} = (7 \cdot 10^6 + 1) \cdot 1'0989 \cdot \frac{1}{3 \cdot 10^9} = \underline{2'56 \text{ ms}}$

e) $T_{amany} \times 86 = 5 + \{5 + 5 + 2 + 1 + 2 \cdot 1 + 5 = \underline{32 \text{ B}}$

$T_{amany \text{ Mops}} = 11 \cdot 6 = \underline{66 \text{ B}}$

f) $32 \text{ B} \cdot 10^6 \text{ ins} = \underline{32 \text{ MB}}$ $\quad \frac{32 \text{ MB}}{2'56 \cdot 10^{-3}} = \underline{12'5 \text{ GB/s}}$

g) $66 \text{ B} \cdot 10^6 \text{ Mops} = 66 \text{ MB}$ El ancho de banda es el mismo

h) Sin cache $\Rightarrow 11 \cdot 10^{-9} \cdot 7 \cdot 10^6 = \underline{77 \text{ mJ}}$

Amb cache $\Rightarrow$ ~~11 · 8 + 1 · 10⁻⁹~~

$11 \cdot 10^{-9} \cdot 8 + 10^{-9} \cdot (7 \cdot 10^6 - 7) = \underline{7 \text{ mJ}}$

Ganancia $= \frac{77}{7} = \underline{11}$