1. $CPU\ time = \frac{Instruction\ Count \times CPI}{Clock\ Rate}$

for A: $CPU\ time = \frac{100000 \times 1.5}{500 \times 10^6} = 3 \times 10^{-4}$ s

for B: $3 \times 10^{-4} = \frac{I \times 2.3}{850 \times 10^6} \approx 110869.$

2. $CPU\ Clock\ cycle = 1100 \times 1 + 350 \times 7 + 120 \times 3 = 3910.$

$CPU\ Time = \frac{Clock\ cycle}{Clock\ Rate} = \frac{3910}{2 \times 10^9} = 1.955 \times 10^{-6}$ s

$CPI = \frac{Time \times Clock\ Rate}{Instruction\ Count} = \frac{3910}{1570} \approx 2.5$

3. one: $Time = \frac{2560 \cdot 1 + 1280 \cdot 4 + 256 \cdot 2}{3 \times 10^9} = 2.73 \times 10^{-6}$ s

two: $Time = \frac{1280 \cdot 1 + 640 \cdot 6 + 128 \cdot 2}{3 \times 10^9} = 1.79 \times 10^{-6}$ s

four: $Time = \frac{640 \cdot 1 + 320 \cdot 8 + 64 \cdot 2}{3 \times 10^9} = 1.11 \times 10^{-6}$ s

eight: $Time = \frac{320 \cdot 1 + 160 \cdot 10 + 32 \cdot 2}{3 \times 10^9} = 6.61 \times 10^{-7}$ s

4

```
sub  $t0, $s0, $s1
add  $t0, $t0, $s2
addi $s0, $t0, -72.
```

5.

```
sll  $t2, $t1, 2
add  $t2, $t2, $s5
lw   $t3, 0($t2).
add  $t3, $t0, $t3.
sw   $t3, 32($s6).
```

6. assume $s6 is address of A[], $s0 stores the answer B

```
i = A+4;
j = A+0;
A[2] = j;
i = A[1];
B = i+j;
```

Overall, C code is
```
A[2] = A;
B = A[1] + A;
```
✓

addi $t0, $s6, 4 ⇒ $t0 0x00000104

add $t1, $s6, $0 ⇒ $t1 0x00000100

sw $t1, 4($t0) ⇒ 0x00000108 → value 0x00001ff0

lw $t0, 0($t0) ⇒ $t0 0x0000F1a4

add $s0, $t0, $t1 ⇒ $s0 0x0000F2a4

thus, $s0 value is 0x0000F2a4 ✓

7. addi $s0, $0, 0x10000000 or $t0, $0, $0.

lb $s2, 2($s0) lui $t0, 0x1000

$(66)_{16} = (0110\ 0110)_2$ lbu $s2, 2($t0)

∴ content is 00000000 00000000 00000000 01100110

8. slt has sign, value of $t0 < value of $t1. thus $t2 = 1

since value of $t2 ≠ 0. do else,

addi $t2, $0, -2 ⇒ $t2 value is −2.

9. argument a in $a0, b in $a1
result in $v0.

originally sp at 0x7fff fffc

```
positive: addi  $sp, $sp, -12     ⇒ sp at 0x7fffffff0
          sw    $a0, 8($sp)       ⇒ 0x7fff fff8 : value of $a0, which is a
          sw    $a1, 4($sp)       ⇒ 0x7fff fff4 : value of $a1, which is b
          sw    $ra, 0($sp).      ⇒ 0x7fffffff0 : value of $ra
          jal   addit
          lw    $ra, 0($sp)
          lw    $a1, 4($sp)
          lw    $a0, 8($sp)
          addi  $sp, $sp, 12      ⇒ sp at 0x7fff fffc
          slt   $t1, $0 , $t0.
          addi  $v0, $t1, 0
          jr    $ra
addit :   add   $t0, $a0, $a1
          jr    $ra
```