# Homework 4

共 27 分。

5.2
We can not determine the size of MAR. (1')
MDR should be 64 bits. (1')

5.4
a. 8 bits (1')
b. 6 bits. Since for $n$ bit offset, we can represent the range $-2^{n-1}+1$ to $2^{n-1}$ (PC has be incremented).
（共 2'。如果答案正确，直接给满分。如果错误，但解释合理，可以给 1'。）
c. 6. Since when we calculate PC+offset, the PC has been incremented, which means PC points to the instruction after the control instruction, so here $PC=3+1=4$.
（共 2'。如果答案正确，直接给满分。如果错误，但解释合理，可以给 1'。）

5.9
a. `ADD R1, R1, #0`. It cannot be used for NOP since it changes CC.
b. `BRnzp #1` It cannot be used for NOP since it will unconditionally jump to the next address of PC.
c. It is ok since branch will never be taken since we will not check CC and it not affects CC.
（每问 2' 如果答案正确，直接给满分。如果错误，但指令翻译正确或者解释合理，可以给 1'。）

ADD instruction will set CC while other instructions(BR) don't do it. （如果前面三问回答正确，这里不算分。否则如果前面没有得满分，这一问答对可以给 1'。）

5.15
The program is as follows:

```
x3100:  LEA R1, x3121   ; offset=x20
x3101:  LD  R2, x3122   ; offset=x20
x3102:  LDI R3, x3123   ; offset=x20
x3103:  LDR R4, R2, x1  ; offset=x1
x3104:  HALT            ; TRAP x25
```

The data that we may store or load in the memory:

```
x3122:  x4566
x3123:  x4567
...
x4567:  xABCD
x4568:  xFED3
```

So the result: `R1=x3121, R2=x4566, R3=xABCD, R4=xABCD`
（每个寄存器的值 2'，共 8'。答案正确直接给满分，部分寄存器对则给部分分。如果有对程序的翻译，指令翻译正确但对应寄存器值计算出错可以给 1'。）

5.16
a. PC-relative mode. Since the range of loading values by PC-relative mode is $[-2^8+1, 2^8]$, which can meet the requirements of the problem, and such method is more efficient than indirect mode.
b. Indirect mode. Since the range is beyond the range of PC-relative mode. (Base+offset is also ok.)
c. Base+offset mode. Since the range may be beyond the range of PC-relative mode, and for sequential cases, it is more efficient than indirect mode since we can only changes offset to obtain the next data.

（每问 2'，答案 1' 解释 1'。对于第一问答案只能为 PC-relative mode，对于第三问答案只能为 Base+offset mode。第二问的答案可以是 Indirect 也可以是 Base+offset。）