CS2323 - Computer Architecture

Q1

a) x8 = x5 - 5

addi x8, x5, -5

Adding an immediate value of -5 to the value at x5 and storing the result in x8.

b) x5 = x3 * 8

slli x5, x3, 3

Shifting the bits stored in x3 to the left ~~right~~ by 3 (i.e equivalent to multiplying by 8) and storing the result in x5

c) x19 += 10

addi x19, x19, 10

Adding an immediate value of 10 to the value at x19 and storing the result in x19.

d) ++x15

addi x15, x15, 1

Adding an immediate value of 1 to the value at x15 and storing the result in x15.

e) x9 = x15/4

srai x9, x15, 2

Shifting the bits stored in x15 bits to the right by 2 (i.e equivalent to dividing by 4) and storing the result in x9.

f) x12 = 24

addi x12, x0, 24

Adding an immediate value of 24 to the value at x0 (hardwired to be 0) and storing the result in x12

3.

Q2 Given: Array M of 8 byte integers.
Base Address stored in x5.

a) M[12] = M[20] + 100

```
ld   x1, 160(x5)
addi x1, x1, 100
sd   x1, 96(x5)
```

b) M[20]++

```
ld   x1, 160(x5)
addi x1, x1, 1
sd   x1, 160(x5)
```

c) Swap M[5] & M[12]

```
ld   x1, 40(x5)
ld   x2, 96(x5)
sd   x2, 40(x5)
sd   x1, 96(x5)
```

d) Make first 32 bits of M[4] as 0

```
ld   x1, 32(x5)
addi x2, x0, -1
srli x2, x2, 32
and  x1, x1, x2
sd   x1, 32(x5)
```

e) Swap the most significant 32 bits of M[2] with it's least significant 32 bits

```
ld   x1, 16(x5)
srli x2, x1, 32
slli x3, x1, 32
or   x1, x2, x3
sd   x1, 16(x5)
```

Q3.

a) 23 - Positive number

1	23	2	$(23)_{10} = (10111)_2$
1	11	2	
1	5	2	In 8 bits
0	2	2	$(23)_{10} = (00010111)_2$
	1		

b) -1 - Negative, so we inverse and add 1 to the positive number's representation

$(1)_{10} = (00000001)_2$

$(-1)_{10} = (11111111)_2$

c) +255 - Not possible to represent in signed format using 8 bits.

Signed 8 bits range - [-128, 127]

If we ignore ~~2's~~ the signed format,

$(255)_{10} = (11111111)_2$

d) -128 - Negative number, so we inverse and add 1 to positive counterpart's binary representation

0	128	2
0	64	2
0	32	2
0	16	2
0	8	2
0	4	2
0	2	2
	1	

$(128)_{10} = (10000000)_2$

↓

$(01111111)_2$

↓ +1

$(-128)_{10} = (10000000)_2$

Q4

a) 11010100

→ $1 \times -2^7 + 1 \times 2^6 + 1 \times 2^4 + 1 \times 2^2$

→ $(-44)_{10}$

b) 00101011

→ $1 \times 2^5 + 1 \times 2^3 + 1 \times 2^1 + 1 \times 2^0$

→ $(43)_{10}$

c) 11111110

→ $1 \times 2^{-7} + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1$

→ $(-2)_{10}$